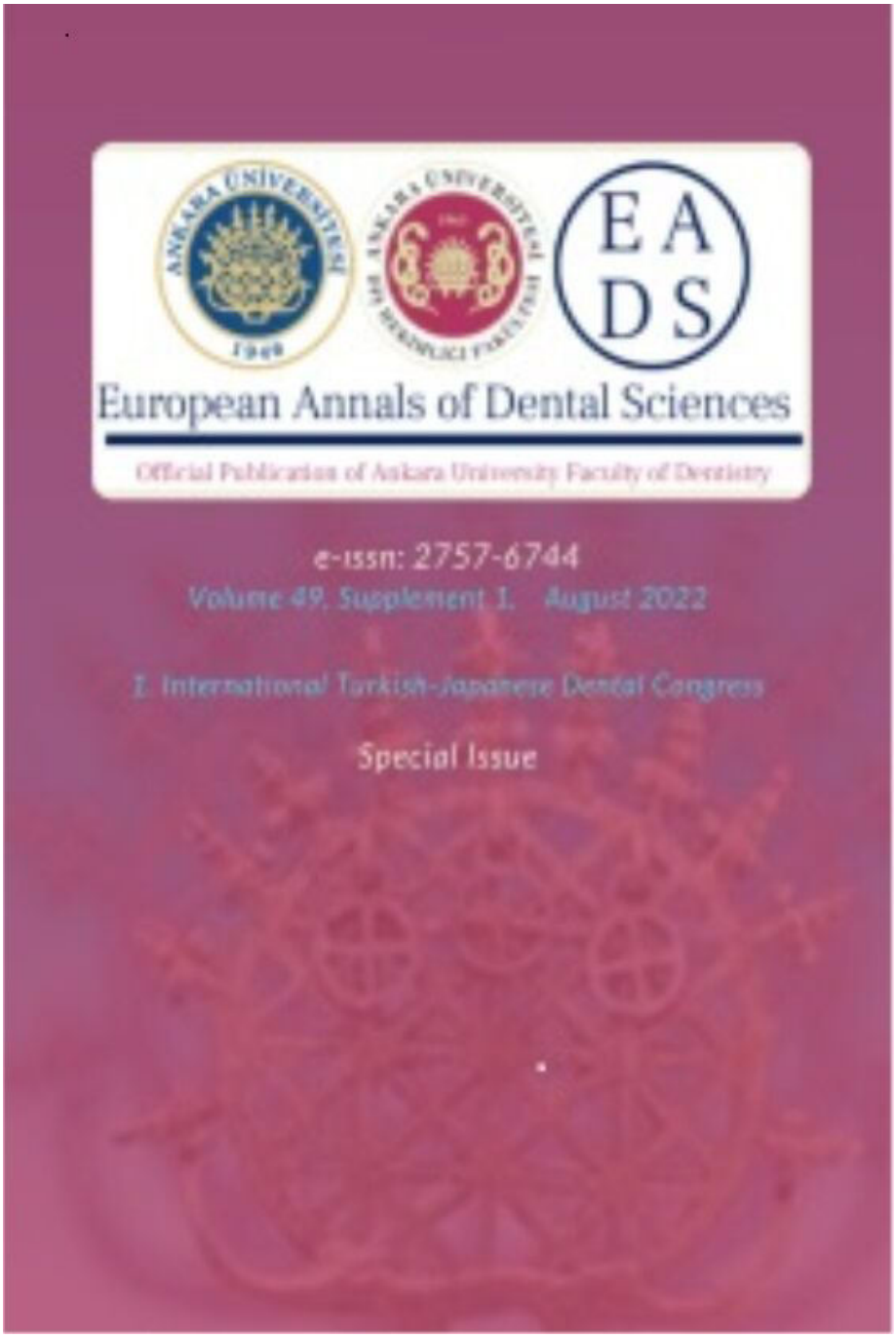

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CONGRESS PROCEEDING

Reactive Hyperplasias in the Oral Mucosa: Case Series

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Abstract

Purpose: Reactive hyperplasias are often encountered tumor-like exophytic lesions of the oral mucosa, but they are not a neoplasm. Local factors such as dental calculus, food residue stuck between teeth, incompatible prosthetic restoration, and systemic factors such as hormonal changes play a role in the etiology of these hyperplasia. The aim of this presentation is to evaluate the possible etiological factors, clinical, and radiological findings of 10 reactive hyperplasia cases seen in different regions of the mouth.
Case report: Ten patients (seven females and three males) with a mean age 40.2 applied to our clinic with complaints of swelling in the mouth. In the medical anamnesis, it was learned that three (30%) patients had recently given birth and the related swelling started to occur in the second trimester of pregnancy, three (30%) patients had different diseases such as heart, hypertension, diabetes, and cholesterol, and were under regular medication for systemic disease. There was no finding on extraoral examination. In intraoral examination, mass lesions which red and/or pink, lobular/nodular, painless, pedunculated and/or sessile, and smooth and/or ulcerated was seen on the maxilla of six patients, mandible of three patients, and lower lip mucosa of one patient. Poor oral hygiene in seven (70%) patients, prosthetic restoration in the lesion-related area in two (20%) patients, and attrition incisal tooth surface and diastema in one (10%) patient were found. Radiographic examination revealed that minimal resorption on the alveolar crest in the lesion-related area of only three (30%) patients was seen. All lesions were histopathologically examined after surgical excision. According to the clinic, radiographic and histopathological features, diagnosis of the lesions was made as pyogenic granuloma (four cases; 40%), peripheral ossifying fibroma (three cases; 30%), traumatic fibroma (two cases; 20%) and peripheral giant cell granuloma (one case; 10%).
Conclusion: It was concluded that the lesions examined in this case series were mostly caused by local factors. The clinical findings observed in the patients were red nodular mass, painless, soft, and smooth-surfaced. In the radiographic examination, no finding was detected in most of the lesions.

Key words: Reactive hyperplasia; Pyogenic granuloma; Peripheral ossifying fibroma; Traumatic fibroma; Peripheral giant cell granuloma

Introduction

Reactive hyperplasia lesions (RHL) are tumor-like, exophytic, and originated from fibrous connective tissue, but they are not neoplasm.[1] The lesions generally occur in the oral mucosa as response to any injuries.[2] Among the etiological factors of RHL are local factors such as dental calculus, food residue stuck between teeth, incompatible prosthetic restoration, and systemic factors such as hormonal changes.[3] RHL can be clinically painless, sessile, or pedunculated masses with ulcerated or smooth surfaces. The colour of the lesions may vary from pale pink to dense red or purple. During palpation, the consistency of the lesion may be soft, rubbery, or hard, depending on the amount of collagen it contains. In addition, some lesions can easily bleed with mild irritation, depending on the amount of vascularity it contains. The localization frequency of RHL is usually gingiva, tongue, buccal mucosa, and floor of the mouth.[4]

In literature, different classifications are accepted for RHL. Buchner et al. have classified RHLas focal fibrous hyperplasia, pyogenic granuloma, peripheral ossifying fibroma, and peripheral giant-cell granuloma.[5] Zarei et al. have classified RHL as traumatic fibroma, pyogenic granuloma, peripheral ossifying fibroma, hyperplasia caused by dentures, and peripheral giant-cell granuloma.[3] The aim of this presentation is to evaluate the possible etiological factors, clinical, and radiological findings of ten reactive hyperplasia cases seen in different localizations of the mouth.

Case Reports

Ten patients (seven females and three males) applied to the Department of Maxillofacial Radiology, Faculty of Dentistry, Gazi University with the complaining of swelling in the mouth are presented

Figure 1. Intraoral and radiography images of reactive hyperplasia lesions (a1 and a2: Case 1, b: Case 2, c: Case 3, d1 and d2: Case 4, e: Case 5, f1 and f2: Case 6, g: Case 7, h: Case 8, k: Case 9, l: Case 10)

Table 1. A mean age of the patients was 40.2 years old (minimum: 21, maximum: 70). In medical anamnesis, it was learned that Case 1, 2, and 3 having a childbirth one month ago and swelling started at the second trimester of pregnancy. It was learned that Case 5 smokes four/five cigarettes a day. Case 6, 7 and 9 were using 'antihypertensive medication', 'antihypertensive, antidiabetic, and anticoagulant medications', and 'antidiabetic, and anticoagulant medications', respectively. Medical histories of other patients were unremarkable. There are no findings all patients during extraoral examination. Intraoral examination revealed pinkish red lobular mass, in Case 1, 3 and 10 and pink nodular mass, in other cases Figure 1. Only one of the lesions was pedunculated (Case 1) and the others were sessile. Only one of the lesions was ulcerate-surfaced (Case 2) and the others were smooth-surfaced. All of the lesions were soft and painless. The lesions in Case 1, 2, 3, 4, 6 and 10 were on the maxilla, the lesions in Case 5, 7 and 8 were on the mandible, and the lesion in Case 9 was on the lower lip. Poor oral hygiene, calculus, dental plaque, and gingivitis were observed in Case 1, 2, 3, 4, 5, 8, and 10. Prosthetic restoration was not compatible, and gingiva had edema, in Case 6 and 7. Attrition at incisal tooth surface and diastema were seen in Case 9. Radiographically, minimal resorption was observed on alveolar crest in the lesion region in Case 1, 4, and 6 Figure 1. Other cases were no visible abnormalities on alveolar crest in the lesion region. The lesions were surgically excised and histopathological examinations were performed. The lesions were diagnosed as pyogenic granuloma in Case 1, 2, 3, and 4, as peripheral ossifying fibroma in Case 5, 6 and 7 as traumatic fibroma in Case 8 and 9 and as peripheral giant cell granuloma in Case 10.

Discussion

In this case series, ten reactive hyperplasias were evaluated according to their clinic, radiographic, and histopathologic features. Ramirez et al. have reported fibrous hyperplasia as the most percentage of RHL.[2] Ababneh et al. and Zarei et al. have reported pyogenic granuloma as the most prevalent of RHL.[3,6] The present case series has been found that pyogenic granuloma have a higher frequency. The most frequent RHL may vary depending on the study methodology, the difference in classification used, and the patient population. Local and systemic irritation factors such as hormonal changes caused by pregnancy, poor oral hygiene, periodontal diseases, dental calculus, and incompatible prosthetic restoration lead to RHL.[3,7] In this case series, hormonal changes in three patients, calculus in three patients, incompatible prosthetic restoration in two patients, and local trauma in two patients were considered as etiological factors. Were detected in the patients in accordance with previous studies.[3,7] It is known that the elimination of the etiological factor is very important in the treatment of the lesions and in the prevention of their recurrence.[7] Ramirez et al., Zarei et al., and Salum et al. have reported a higher RHL frequency in females than in males.[2,3,8] In the case series, RHL was more common in females than in males. According to localization, it is reported that pyogenic granuloma lesions are mostly observed in the anterior maxilla and peripheral ossifying fibroma lesions are mostly observed in the mandible.[3,9] In the present case series, the localizations of pyogenic granuloma and peripheral ossifying fibroma lesions were consistent with the literature

Conclusion

In this case series, according to the clinic, radiologic and histopathological features, diagnosis of the lesions was carried out as pyogenic granuloma (four cases; 40%), peripheral ossifying fibroma (three cases; 30%), traumatic fibroma (two cases; 20%) and peripheral giant cell granuloma (one case; 10%). It was concluded that the lesions examined were mostly caused by local factors. The most common clinical findings were painless red mass, smooth-surfaced, soft consistency and no finding was observed in the radiographic examination.

Author Contributions

N.B conceived the ideas, collected and analyzed the data of cases, scanned literature, and wrote the manuscript. İ.P and Ö.Ü conceived the ideas, made the necessary corrections, scanned literature, and final edits.

Table 1. Clinic and radiographical characteristics of reactive hyperplasia lesions

Case No	Age/ Gender	Complaint	Localiza-tion	Lesion feature	Radiography findings	Diagnosis	Etiological factors
1	28/Female	Swelling at second trimester of pregnancy	Palatal gingiva, maxilla	Large pinkish red lobular mass, pedunculated, soft, painless, smooth-surfaced	Minimal resorption on alveolar crest	Pyogenic granuloma	Hormonal changes
2	24/Female	Swelling at second trimester of pregnancy	Palatal gingiva, maxilla	Soft red, ulcerated mass, sessile, painless,	None	Pyogenic granuloma	Hormonal changes
3	28/Female	Swelling at second trimester of pregnancy	Buccal gingiva, maxilla	Soft pinkish red lobular mass, smooth-surfaced, sessile, painless	None	Pyogenic granuloma	Hormonal changes
4	35/Male	Swelling after tooth extraction	Buccal gingiva, maxilla	Pinkish red nodule, smooth-surfaced	Minimal resorption on alveolar crest	Pyogenic granuloma	Tooth extraction-related trauma
5	21/Male	Two months swelling	Labial gingiva, mandible	Soft red nodular mass, smooth-surfaced	None	Peripheral ossifying fibroma	Calculus
6	55/Female	Two weeks swelling	Labial gingiva, maxilla	Soft pink nodular mass, smooth-surfaced, painless	Minimal resorption on alveolar crest	Peripheral ossifying fibroma	Incompatible prosthetic restoration
7	70/Female	Two months swelling	Labial gingiva, mandible	Soft pink nodular mass, smooth-surfaced, painless	None	Peripheral ossifying fibroma	Incompatible prosthetic restoration
8	21/Female	Two weeks swelling	Labial gingiva, mandible	Soft pink nodular mass, smooth-surfaced, painless	None	Traumatic fibroma	Calculus-related trauma
9	55/Male	Two weeks swelling	Labial mucosa, lower lip	Small white and pink masses, smooth-surfaced, painless	None	Traumatic fibroma	Local trauma
10	60/Female	Four months swelling	Labial and palatal gingiva, maxilla	Pink lobular mass, smooth-surfaced, painless	None	Peripheral giant cell granuloma	Calculus

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CONGRESS PROCEEDING

Clinic and Radiographic Evaluation of Cemento-osseous Dysplasia: Case Series

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Abstract

Purpose: This paper aimed to present the clinical and radiographic findings of six cemento-osseous dysplasia (COD) cases.
Case Report: Six female patients with a mean age of 38 who applied to our clinic were evaluated. The patients did not have any systemic disorders or medication usage, in their medical anamnesis. There were no extraoral or intraoral findings. All the cases were detected in the mandible during routine radiological examinations and were asymptomatic. Cone-beam computed tomography examination revealed local thinning and resorption of the buccal and lingual cortical bone in the relevant region. Based on clinical, radiographic, and histopathological examinations, two (33.3%) of the lesions were diagnosed as periapical COD, one (16.6%) were diagnosed as focal COD, and three (50%) were diagnosed as florid COD.
Conclusion: The findings of this case series showed that all lesions examined were clinically asymptomatic. Dentists should be follow the COD periodically.

Key words: Cemento-osseous dysplasia; Mixed lesion; Radiographic examination

Introduction

Cemento-osseous dysplasia (COD) is the most common and benign fibro-osseous lesions in which histologically healthy bone is replaced by fibrous tissue with mineralizing substance consisting of osteoid, bone, and cementum-like material.[1,2] The lesions are mostly diagnosed in the third and fourth decade of life and African Americans also Asian descent females.[3] The etiology of COD are not exactly understood.[4] However, in some literature, parafunctional activities, such as bruxism and hormonal changes are accepted as etiological factors.[5,6] The terminology 'cemento-osseous dysplasia' was adopted instead of 'osseous dysplasia' because it accurately reflects the relationship of lesions with teeth and its origin from the periodontal tissues by the World Health Organization in the fourth edition of Head and Neck Tumors, in 2017.[7] COD lesions are usually asymptomatic and discovered on routine dental radiographic examination, and the teeth related to lesion are vital.[8] COD lesions are classified into three clinic-radiologic patterns: periapical COD, focal COD, and florid COD.[7] Generally, periapical COD presents in periapical region of the anterior mandibular teeth, focal COD occurs in the posterior jaws, and florid COD affects bilaterally the mandible but all four quadrants may be affected.[2] On radiographic image, COD lesions appear three different features according to its maturation stage. In the first or osteolytic stage, the lesion is shown circular or elliptical radiolucent areas. In the second or mixed stage, the lesion presents radiolucent-radiopaque appearance. The final or mature stage, the lesion is radiopaque and diffuse sclerosis.[7,9] When COD lesions secondarily infected by contacting with oral flora, the lesions can cause clinical symptoms.[4] Sclerotic lesions are more vulnerable to infection than radiolucent and mixed lesions. Treatment do not require for asymptomatic COD lesions, because these lesions have self-limited growth potential. But periodical follow-up is very important.[8] The aim of this presentation is to evaluate the clinical and radiographic findings of six COD cases that were detected incidentally during radiographic examination.

Case Reports

Six female patients with a mean age of 38 (minimum: 24, maximum: 60) who four (66.6 %) of them with prosthetic restoration complaints (Case 1, Case 2, Case 3, and Case 4) and two (33.3 %) of them for routine control examination of the previously diagnosed COD lesions (Case 5 and Case 6) applied to Department of Maxillofacial Radiology, Faculty of Dentistry, Gazi University Table 1. It was learned that the patients did not have any systemic disorders in their medical anamnesis. There is no finding on extraoral examination. In intraoral examination, teeth associated with COD lesions were vital as a result of the electric pulp test, and there is no other finding, such as pain, stiffness, or mucosal change related to the lesion.

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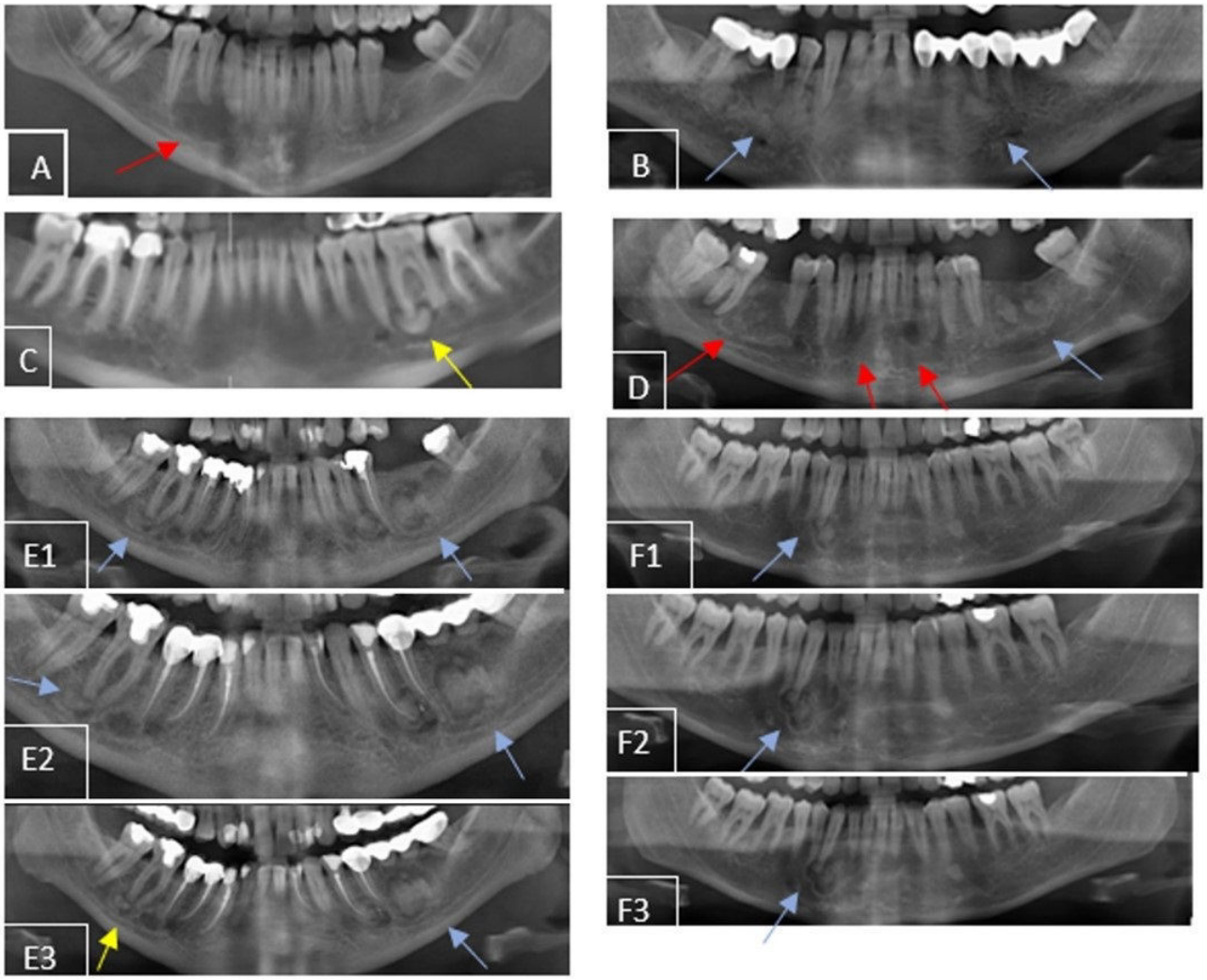

Figure 1. Panoramic radiographic images of the cases with COD lesions (A: Case 1, B: Case 2, C: Case 3, D: Case 4, E1: Case 5-2015, E2: Case 5-2017, E3: Case 5-2019, F1: Case 6-2014, F2: Case 6-2019, F3: Case 6-2020; red arrow: radiolucent lesion, blue arrow: mixed lesion, yellow arrow: radiopaque lesion)

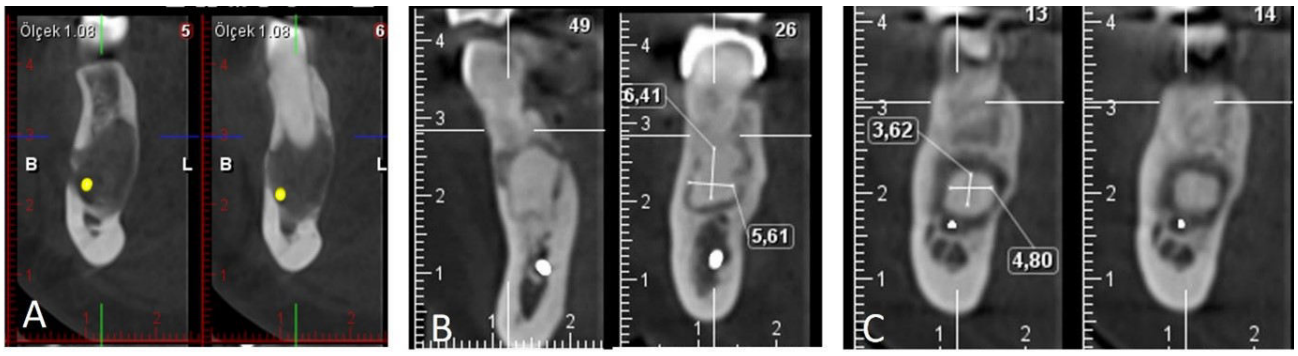

Figure 2. Cone-beam computed tomography images of the Case 1 (A), Case 2 (B), and Case 3 (C)

Panoramic radiographs (Sirona-Orthophos XG; Sirona; 60-90 kVp; 8 mA; 14 second) and cone-beam computed tomography (CBCT) (Planmeca Promax 3D Mid (Planmeca, Helsinki, Finland) were taken for the radiological examination. A different sizes radiolucent, mixed, and radiopaque lesions were detected in the mandible on control panoramic radiography images Figure 1. Uncertain border a radiolucent lesion was revealed in the right premolar region, in Case 1. Mostly dense mixed lesions were observed in bilateral posterior mandible, in Case 2. A radiopaque lesion which delimited by a radiolucent halo was seen in the left posterior mandible, in Case 3. Mixed and radiolucent lesions were revealed in bilateral posterior and anterior mandible, in Case 4. Radiolucent, mixed, and radiopaque lesions were observed in bilateral posterior mandible, in Case 5. In the right posterior mandible, while the lesion was mixed in 2015, the lesion was radiopaque in 2019. A mixed lesion was seen in anterior mandible, in Case 6. An enlargement of lesion size was detected within six years (2014-2020). In 2014, the lesion was only associated with the apex of the right canine, whereas in 2020 it was associated with the apex of both canine and lateral tooth roots. After, the lesions were examined in more detail with CBCT.

Table 1. Clinical and radiographical features of cases with cemento-osseous dysplasia lesions

Case Number	1	2	3	4	5	6
Age	24 years old	60 years old	53 years old	41 years old	38 years old	34 years old
Sex	Female	Female	Female	Female	Female	Female
Complaint of the patients	Routine examination	Prosthetic restoration	Dental restoration	Prosthetic restoration	Control examination of the previously diagnosed COD	Control examination of the previously diagnosed COD
Medical anamnesis	Not finding	Not finding	Not finding	Not finding	Not finding	Not finding
Findings of extraoral examination	None	None	None	None	None	None
Findings of intraoral examination	Lesion-related teeth are vital	Lesion-related teeth are vital	Lesion-related teeth are vital	Lesion-related teeth are vital	Not finding	Lesion-related teeth are vital
Imaging techniques	Panoramic radiography and CBCT	Panoramic radiography and CBCT	Panoramic radiography and CBCT	Panoramic radiography	Panoramic radiography	Panoramic radiography
Location of the lesion	Right premolar area mandible	Bilateral posterior mandible	Left posterior mandible	Bilateral posterior and anterior mandible	Bilateral posterior mandible	Anterior mandible
Internal structure of the lesion	Osteolytic	Mixed	Mature	Osteolytic and Mixed	Mixed and mature	Mixed
Effects on surrounding structures of the lesion	Perforation of the buccal and lingual cortical bone, associated with the mandibulary alveolar canal	Perforation and thinning of the buccal and lingual cortical bone	Thinning of the lingual cortical bone	No	No	No
Presence of concomitant lesion (cyst/ infection)	No	No	No	No	No	No
Definitive diagnosis	Periapical COD	Florid COD	Focal COD	Florid COD	Florid COD	Periapical COD

Perforation of the buccal and lingual cortical bone were observed in Case 1 and Case 2 Figure 2. Thinning of the lingual cortical bone was observed in Case 3 Figure 2. All evaluations were performed by a single dentomaxillofacial radiologists, with at least three years of experience. Based on clinical, radiographic, and histopathological examinations, Case 1, Case 6 were diagnosed as periapical COD (33.3 %), Case 3 was diagnosed as focal COD (16.6 %) and Case 2, Case 4, and Case 5 were evaluated as florid COD (50 %). All patients were followed up periodically for six months. Written and verbal consent was obtained from all patients that the data would be used in scientific studies.

Discussion

In this case series, six COD cases, two (50 %) of which were periapical, one (16.6%) of which was focal, and three (50 %) of which were florid were presented. The lesions were clinically asymptomatic. COD lesions are more common in female according to male. It is usually diagnosed between the third and / or forth decades of life.4,5 All patients were female, and their mean age was in the third decade of life. These findings were consistent with the previous published articles.4,5 Periapical COD is usually observed in the apical region of anterior mandibular teeth, while focal and florid COD are mostly observed in the posterior mandible.[1,2] In the case series, all three cases of florid COD were in the posterior mandible and only one of the three cases of periapical COD was in the anterior mandible relatively accordance with previous studies.[1,2] In early stage, the radiographic findings of COD lesions should differentiate from periapical inflammatory lesions. Because the radiographic features of these lesions are similar. This condition can result in unnecessary treatment of the related teeth.[10] The pulp vitality test is crucial for the differential diagnosis of COD lesions.[9] In the case series, lesions-related teeth were vital according to electrical pulp test. Usually, COD lesions is clinically asymptomatic.[9] If the lesion becomes secondarily infected, pain may develop.[11] Procedures such as endodontic treatment, tooth extraction, and biopsy may cause secondary infection of the lesion. In addition, pulp-related infection, periodontitis, and exposure of the lesion to oral cavity flora may cause several complications in the lesions.[7] Due to insufficient vascular support of the bone, there is a risk of infection and osteomyelitis may occur in cases.[12] If any symptoms occur, treatment is required. Periodical control examination is preferred for control of periodontal disease and prevent tooth loss in treatment of asymptomatic COD lesions.[11] All patients in this case series were clinically asymptomatic. They were followed up periodically.

Conclusion

• The lesions were observed in middle-aged women.
• All of the cases were clinically asymptomatic. • Lesions were radiographically observed as local or diffuse radiolucent, mixed, or radiopaque • In clinical practice, dentists should be aware the clinic and radiographic features of the lesions and patients should be followed-up periodically. The imaging evaluation and its correlation with clinical and demographic data is critical for their diagnosis.

None

Author Contributions

N.B conceived the ideas, collected and analyzed the data of cases, scanned literature, and wrote the manuscript: I.P and O.U. conceived the ideas, made the necessary corrections, scanned literature, and final edits.

Conflict of Interest

Authors declare that they have no conflict of interest.

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CONGRESS PROCEEDING

Clinical And Radiographic Evaluation Of Biomaterials Used In Different Endodontic Procedures-Case Report

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Abstract

Introduction: Endodontic treatment may be required for the permanent teeth due to different reasons in childhood. Biological materials such as MTA and tricalcium silicate-based (Biodentine®, Septodont, France) bioceramic repair material have started to be used nowadays in different endodontic treatment. Studies have shown that these materials stimulated the formation of new vascularized tissue in the apical of mature teeth with necrotic pulp and with periapical lesions. In addition, MTA and tricalcium silicate-based (Biodentine®, Septodont, France) bioceramic repair material are preferred in direct and indirect pulp capping due to their properties such as biocompatibility and impermeability.
Purpose: The aim of this study is to examine the teeth clinically and radiologically after the use of tricalcium silicate-based (Biodentine®, Septodont, France) bioceramic repair material and MTA as a barrier on the pulp capping, Cvek pulpotomy and regenerative endodontic treatment. Case Description: Different endodontic procedures using MTA and Biodentine in pediatric patients with different endodontic treatment needs are shown with 4 cases.
Conclusion: Today, the success rate is high in vital pulp treatments with newly developed materials such as MTA and tricalcium silicate-based (Biodentine®, Septodont, France) bioceramic repair material In addition, root development continues after regenerative endodontic treatments with Mineral Trioxide Aggregate (MTA) or tricalcium silicate-based (Biodentine®, Septodont, France) bioceramic repair material in non-vital and open-apex teeth.

Key words: Biodentine; MTA; Pulp capping; Pulpotomy; Regenerative endodontics

Introduction

In the childhood, need for endodontic treatment arise due to dental caries or traumatic injuries to permanent teeth. Especially, as a result of the loss of pulp vitality in immature permanent teeth associated with a poor crown-to-root ratio, thin dentin walls, a fragile tooth structure, and cessation of root development, a wide apical opening may occur, which complicates the endodontic treatment applications.[1] In order to prevent such adverse situations, it is important to maintain the vitality or ensure revascularization of the pulp in the immature permanent teeth.[2] Vital pulp treatments that may be applied in the immature permanent teeth can be listed as; pulp capping, shallow pulpotomy or partial pulpotomy.[1,2] Immature permanent teeth have a very high healing potential through their high cellular activity.[2] Mineral Trioxide Aggregate (MTA) and tricalcium silicate-based (Biodentine®, Septodont, France) bioceramic repair material, increase the recovery rate in vital pulp treatments with their antibacterial effects, regenerative properties, biocompatibility, bioactivity, and excellent hermetic sealing properties. MTA's longer curing time, difficult clinical manipulation, high cost and tooth discoloration problem make tricalcium silicate-based (Biodentine®, Septodont, France) bioceramic repair material a new calcium silicate-based material with improved properties, more advantageous.[3] When pulpal necrosis occurs in immature permanent teeth, root development stops, tooth becomes prone to fracture as the roots remain short and weak, and treatment prognosis decreases due to the more difficult application of endodontic procedures.[1] Calcium hydroxide apexification had previously been applied in order to maintain root development, but due to the disadvantages of this treatment, apical barrier have started to be formed with MTA and endodontic treatments were completed in a single session, and thus MTA apexification has currently become clinically preferred.[1,4] Plugging the area where root development has stopped with MTA does not allow root development to continue, causing insufficient crown-to-root ratio and crown fractures. Therefore, regenerative applications in immature permanent teeth are focused on.[1] Regenerative endodontic applications are a new, biologically based approach that provides the replace-

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Figure 1

Figure 2

ment of damaged structures in the dentin and root structure together with pulp and dentin cells. In particular, open-apical teeth with ongoing root development can show successful results even in cases of pulp necrosis, apical periodontitis or abscess, due to their rich pulpal blood supply and apical stem cells with high regeneration ability.[5,6] The aim of this case report is to clinically and radiographically demonstrate the success of MTA and tricalcium silicate-based (Biodentine®, Septodont, France) bioceramic repair material in pulp capping, shallow pulpotomy and regenerative endodontic treatment in immature permanent teeth.

Case Description

Case 1

A 12-year-old girl, who applied to our clinic with the complaints of the intermittent pain and hot-cold sensitivity in her tooth 26, was diagnosed with reversible pulpitis after clinical and radiographic examination and we decided to perform pulp capping. After the local anesthesia, a rubber dam (Royal Shield Dental Dams, MALAYSIA) was inserted to provide isolation and the caries was removed. The caries was excavated carefully so that the pulp would not be exposed, but due to the depth of the caries, the pulpal tissue was opened about 1.5-2 mm, and direct pulp capping treatment option was chosen. After the cavity was wiped with a sterile cotton pellet saturated with 2,5% NaOCl, MTA (Dentsply Sirona Pro Root MTA White, America) was placed in. Then, a moist cotton pellet was placed on it and it was closed temporarily, and an appointment was scheduled for the patient 2 days later for permanent filling. In her second visit, a rubber dam (Royal Shield Dental Dams, MALAYSIA) was placed again to ensure isolation and the temporary filling was removed. Then the tooth was etched with 37% ortho-phosphoric acid (3M ESPE, USA). After the dentin bonding system (Clearfil SE Primer and Bond Kuraray, Tokyo, Japan) was applied, direct composite (3M ESPE Filtek Ultimate, USA) restoration was performed. The patient was followed up at 6-month intervals. In the radiograph taken 1 year later, it was observed that the tooth was clinically asymptomatic, there was no radiographical pathology, and we also noted that a dentinal bridge was formed in the form of a thin line in the area where the pulp was opened.
(Figure 1, Figure 2)

Case 2

A 7-year-old boy, with a complicated crown fracture in his tooth 11 due to a bike accident, was admitted to our clinic 18 hours after the first emergency room intervention. Clinical examination showed no sensitivity to percussion and palpation, and the tooth responded positively to a cold test. Periapical and occlusal radiographs were taken for the evaluation of tooth and bone tissue. No pathology was found on radiographs. We decided to apply shallow pulpotomy (Cvek pulpotomy) to the open-apex tooth. After applying local anesthesia, a rubber dam (Royal Shield Dental Dams, MALAYSIA) was inserted to provide isolation. Afterwards, approximately 2 mm of the coronal part of the exposed pulp was removed and bleeding stopped within 2-5 minutes with the help of 2.5% NaOCl. After bleeding control was achieved, Biodentine® (Septodont, France) was placed on the exposed area since it did not cause discoloration and did not require a two-stage procedure, and it was covered with glass ionomer cement (Ketac Molar Easymix, 3M ESPE, Germany). After the application of the adhesive system (Clearfil SE Primer and Bond Kuraray, Tokyo, Japan), the previously selected composite resin (3M ESPE Filtek Ultimate, USA) was polymerized in layers and necessary corrections were made. The patient was followed up at 6-month intervals. In the follow-up after 1.5 years, we observed that the tooth was clinically asymptomatic and in the radiographs we noted that root development had continued. In addition, no discoloration was observed in the anterior tooth.
(Figure 3, Figure 4)

Case 3

An 8-year-old girl with an enamel-dentin fracture in her tooth 11 caused by a fall in school was admitted to our clinic 2 months after the accident. We learned that the broken tooth was restored in another clinic immediately after the trauma. In the clinical examination, pain and swelling were observed. Necessary periapical and occlusal radiographs were taken. Since the tooth was predicted to have necrosis, the access cavity was opened without anesthesia after the application of a rubber dam (Royal Shield Dental Dams, MALAYSIA) in order to provide drainage. Subsequently, the working length was determined with an apex locator (Dentsply Propex Pixi Apex Locator, Israel) and the root was first washed with 20 ml of 2.5% NaOCl with an injector needle adjusted to approximately 1-2 mm shorter than the apical root, and then with 20 ml of saline solution. After the root was dried, it was filled with calcium hydroxide and the patient was given an appointment 2 weeks later. In the second visit, the needle length was adjusted in the same length and the root was washed using 20 ml of 5% EDTA followed by 20 ml of saline solution. After the application of local anesthesia

Figure 3

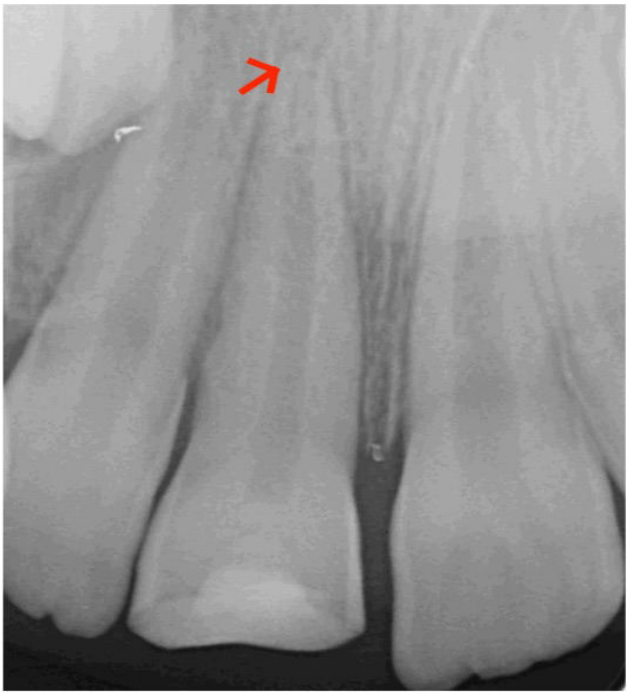

Figure 4

without vasoconstrictor, bleeding was managed with an H file sized 20 (Mani Inc. Utsomia, Japan) by rotating 2-3 mm beyond the root tip. After making sure that the canal space was filled with blood up to cementoenamel junction and a blood clot occurred and approximately 3-4 mm of the coronal part of the canal was filled with Biodentine® and then covered with glass ionomer cement (Ketac Molar Easymix, 3M Espe, Germany. 37% phosphoric acid (Actino Gel, Prevest DenPro, India) was applied to the enamel surfaces for 15 seconds and then washed and dried. Universal adhesive resin (Uni SE Bond, Cavex, Germany) was applied to the enamel surfaces and cured with a 20 sec LED light device (3M ESPE Elipar S10, The

Figure 5

Figure 6

Netherlands). Then, the tooth was restored with resin composite (Valux Plus, 3M ESPE Dental Products, St. Paul, USA) and necessary corrections were made. In the radiograph taken 1.5 years later, a remarkable thickening was observed in the root dentin. Additionally, we observed radiographically that root development had continued and the root was almost closed.
(Figure 5 , Figure 6)

Figure 7

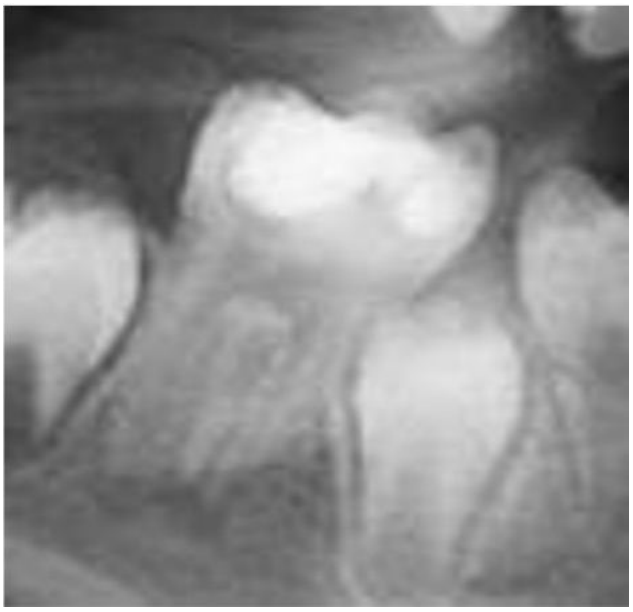

Figure 8

Case 4

A 7-year-old boy, admitted to our clinic with the complaints of the intermittent pain and hot-cold sensitivity in his tooth 46. After clinical and radiographic evaluation, we determined that the tooth was vital and with open apex, and pulp capping was decided. After applying local anesthesia, a rubber dam (Royal Shield Dental Dams, MALAYSIA) was inserted for isolation and the caries was carefully removed. A thin layer of dentin was observed at the cavity floor, the cavity was wiped with 2.5% NaOCl and covered with MTA (Dentsply Sirona Pro Root MTA White, America). MTA (Dentsply Sirona Pro Root MTA White, America) was temporarily closed by placing a moist cotton on it. Next day, the patient was called and the temporary filling material was removed after the rubber dam (Royal Shield Dental Dams, MALAYSIA) was placed for providing isolation. Subsequently, the tooth was etched with 37% ortho-phosphoric acid (3M ESPE, USA), an adhesive system (Clearfil SE Primer and Bond Kuraray, Tokyo, Japan) was applied to the cavity surfaces. The previously selected composite resin (3M ESPE Filtek Ultimate, USA) was applied in layers and each layer was light cured for 20 seconds. Necessary shape and form arrangements were made and its permanent restoration was completed. In the examination performed 1 year later, no clinical or radiological pathology was observed. Root development was also within the normal limits.
(Figure 7, Figure 8)

Discussion

Correct assessment of the inflammation level of the pulp and the selection of the appropriate materials are the primary success criteria in vital pulp treatment. The presence of pain that is not spontaneous but triggered by a stimulus, mild cold sensitivity, no percussion and palpation sensitivity, normal response to cold pulp tests, and absence of any radiographic pathology in the tooth indicate reversible pulpitis. On the contrary, the presence of spontaneous and nocturnal pain, hypersensitivity to cold and heat, pain on percussion and palpation, excessive response to pulpal tests, and gaping of the periodontal ligament on radiographs indicate irreversible pulpitis. In reversible pulpitis, when the irritant is removed, the pulp can return to its healthy structure, whereas in irreversible pulpitis, the inflamed pulp tissue should be removed partially or completely.[7] Unlike mature tooth, immature permanent tooth has a highly cellular pulp and a rich vascular nutrition system, and shows a high healing potential. However, the prognosis of pulp necrosis in an immature permanent tooth is risky and may potentially result in premature tooth loss.[1] Therefore, vital treatment applications such as pulp coatings, partial or coronal pulpotomy are gaining importance in immature teeth.[2] It has been claimed that pulp coatings can be the most effective treatments for maintaining pulpal health, and revealed that application of MTA and tricalcium silicate-based (Biodentine®, Septodont, France) bioceramic repair material in the treatment supported the sustainability of the pulpal defense ability by stimulating tertiary dentin formation and achieved high clinical success rates.[8]

In our study, the radiographs taken 1 year after the cases in which pulp coatings were performed with MTA and tricalcium silicate-based (Biodentine®, Septodont, France) bioceramic repair material showed that a thin tertiary dentin bridge was formed and root development continued in the case where we performed direct pulp coating. Pulpotomy is another vital pulp treatment approach that aims to maintain root development by removing the infected part of the pulp due to a number of factors such as caries or trauma.[1] Cvek et al. reported that the exposed pulp as a result of trauma in immature permanent teeth could maintain its vitality for 7 days and that the remaining pulp tissue could preserve its vitality by removal of the infected part about 2 mm from the coronal pulp.[9] The success of bioceramic materials in pulpotomy applications in asymptomatic immature permanent teeth is quite high, studies in symptomatic teeth are promising and more studies are reported to be needed.[1] Because the roots of necrotic immature permanent teeth are weaker, shorter and prone to fracture, performing chemomechanical debridement and creating an effective apical plug are difficult, lowering the success rate of endodontic applications.[1] Multi-session calcium hydroxide apexification has been successfully applied for many years in order to maintain root development and facilitate endodontic applications. However, due to the disadvantages such as long-term treatment, recurrent infections, and increased risk of root fracture caused by the long-term presence of calcium hydroxide in the root canal cavity, studies have focused on the creation of a single-session apical barrier and the application of regenerative methods.[1,4] In single-visit apexifications, MTA; has become the preferred material because of its low solubility, biocompatibility, hardening in the presence of moisture and inducing hard tissue formation.[3] Although apexification in a single session is a successful method, its disadvantages such as

cessation in root development, insufficient crown-to-root ratio and the tooth's propensity to fracture have brought regenerative treatment to the fore in necrotic immature teeth.[5] The aim of regenerative endodontic treatment is to ensure the proliferation of progenitor stem cells, which are resistant to infection and necrosis occurred in the apical papilla, in the root canal space, regeneration of pulp tissue and continuation of root development.[6] In the studies, MTA or tricalcium silicate-based (Biodentine®, Septodont, France) bioceramic repair material was recommended to be placed on the bleeding area that was controlled after the regenerative endodontic treatment and the success rate of both materials was found to be equal.[10] After the regenerative endodontic treatment applied to a patient presented at our clinic with an acute apical abscess in the tooth 21 with incomplete root development, we determined that the tooth was asymptomatic and also noted a remarkable root development and dentin thickening after 1.5 years. These results will contribute to supporting the new studies in the literature.

Conclusion

Using the proper materials for the cases encountered in vital pulp treatments, which are simple and effective applications is one of the most important factors for the success of the treatment. Thanks to their superior physicochemical and biological properties, the application and popularity of bioceramic materials in the pediatric dentistry is increasing day by day. Regenerative approaches used together with biomaterials in both mature and immature teeth should be preferred to more radical approaches, giving the tooth a chance to renew itself. Further research and clinical trials are needed in order to develop strong scientific evidence regarding the regenerative endodontic therapies in which biomaterials are used.

None

Author Contributions

A.B, P.C. conceived the ideas, collected and analyzed the data of cases, scanned literature, and wrote the manuscript: S.S.D. conceived the ideas, made the necessary corrections, scanned literature, and final edits.

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CONGRESS PROCEEDING

Endocrown Restoration Of The Endodontically Treated Teeth By Using Cad/Cam: Case Series

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Abstract

Purpose: As a result of large coronal destruction in endodontically treated teeth, significant losses occur in the dentin tissue around the pulp, and the need for prosthetic treatment occurs. In this case series, endocrown applications produced in a single session with CAD/CAM system are presented as an alternative to crown restoration traditionally applied to premolar and molar teeth with excessive crown destruction.
Case Series: In the first case, 38-years-old male patient number 25, 46-years-old female patient number 36 in the second case, 21-years-old female patient number 46 in the third case, 26-years-old male patient number 46 in our fourth case, and in the last case 52-years-old male patient tooth number 15 has been applied to root canal treatment. According to the clinical/radiological examinations of the patients, it was observed that there were no systemic diseases. Endocrown restoration was considered appropriate and recommended to patients with less dentin tissue. Firstly, teeth are prepared for endocrown restoration. Afterward, the impressions were digitalized by scanning the jaws with an intraoral optical scanner (Cerec Omnicam, Dentsply Sirona, USA). The restorations were designed with the help of the CEREC 4.3 software (Dentsply Sirona, USA) and the milling process was carried out with feldspathic ceramic block (Vita Mark II, Vita Zahnfabrik, Germany) in the same session by CEREC inLab MC XL (Dentsply Sirona, USA). Later, the glazing process was applied and cemented with dual polymerized resin cement (RelyX Ultimate, 3M ESPE, USA).
Conclusion: Endocrown is a minimally invasive, conservative treatment approach that provides mechanical adhesion to the pulp chamber and cavity walls with adhesive resin cement and allows the preservation of the remaining tooth structure. For this reason, it is a treatment option that can be preferred instead of post-core and crown application in teeth with root canal treatment.

Key words: Endocrown; CAD/CAM; Adhesive Dentistry; Digital Dentistry

Introduction

Prosthetic restoration should be applied to posterior teeth with endodontic treatment and excessive crown destruction, for reasons such as reducing tooth breakage and bacterial contamination.[1] In these cases, post-core and crown restoration, which is a traditional treatment method, is generally applied. However, this treatment may reduce the fracture resistance of the tooth, cause root perforations and elongation of the chairside.[2] With the development of adhesive dentistry, endocrown restorations is preferable option for teeth that have been treated with endodontic treatment and lost a large part of the coronal tissue. Endocrown is a monolithic restoration that is supported by the cavity margins, including the pulp chamber and is adhesively bonded to the tooth tissue. The part for extending into the pulp chamber provides macromechanical retention, while adhesive cementation provides micromechanical retention.[3] Endocrowns are indicated for teeth with short crown length, deficient interocclusal space, and considerable dental tissue damage that is not enough ferrule.[4] Lander and Dietchi stated in their study that endocrown restorations can be applied in cases where vertical height and ferrule effect are minimal.[5] Endocrown restorations are more conservative than traditional post-core restorations. The preparations made in the root and coronal tissue are eliminated and the tissues are protected.[6] Endocrown preparation should have 2-3 mm interocclusal reduction, 90° margin edges, smoothed internal angle, 6° pulp chamber angle, and a flat pulp chamber floor with a closed canal entrance.[2] After the endocrown preparation, there are two options for the production technique. As the first option, the pressed ceramic technique can be applied by taking conventional impressions, while computer-aided design/computer-aided manufacturing (CAD/CAM) technique can be applied by taking digital impressions in a single session as the second option.[7] Today,

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with the developing technology, endocrown restorations produced with CAD/CAM reduce the time spent in the clinic and allow the treatment to done in single session. Many different materials such as feldspathic ceramic, lithium disilicate glass-ceramic, hybrid ceramic, resin nanoceramic can be used for restorations to be applied with CAD/CAM.[8] In this case series, endocrown restorations produced by CAD/CAM with a feldspathic ceramic block were applied to premolars and molars with excessive crown destruction after root canal treatment.

Case Series

In this case series, endocrown restorations were applied to five patients at İzmir Katip Çelebi University Faculty of Dentistry, Department of Prosthetic Dentistry with the need for prosthetic treatment as a result of root canal treatment and excessive crown destruction applied to their premolar or molar teeth. According to clinical/radiological examinations, it was seen that the patients did not have any systemic disease and prosthetic treatment was needed due to excessive crown destruction. Endocrown restoration was recommended for patients with less remaining dentin tissue as an alternative for causing more material damage with traditional crown application. Endocrown restorations were applied to the premolar teeth of two of the five patients and the molars of the remaining three patients. While two of the patients did not have only the distal wall, two had losses in the mesial, distal, and palatal wall, and one patient had losses in the distal and palatal wall. In the first case, a 38-year-old male patient applied because of the need for prosthetic treatment of his upper left second premolar tooth. Firstly, the temporary restoration applied to the patient was removed. Then endocrown preparation was performed and gingival retraction was applied. The impression of the area of restoration, opposing jaw, and bite was taken with an intraoral optical scanner (Cerec Omnicam, Dentsply Sirona, USA) and the impression was transferred to the digital environment. Restoration design was made on the transferred digital impression with the help of CEREC 4.3 software (Dentsply Sirona, USA). Then, the milling process was carried out using a feldspathic ceramic block (Vita Mark II, Vita Zahnfabrik, Germany) with a CEREC inLab MC XL (Dentsply Sirona, USA). The prepared restoration was glazed and fired with a Programat 300 (Ivoclar Vivadent, Switzerland) device. The marginal edge compatibility of the restoration was checked before cementation. Then, hydrofluoric acid and silane were applied to the inner surface of the restoration. Finally, the restoration was cemented using dual polymerized resin cement (RelyX Ultimate, 3M ESPE, USA) following the manufacturer's instructions. During the control sessions, no complication was observed. In the second case, a 46-year-old female patient in her tooth number of 36 with root canal treatment. The temporary restoration material on the tooth was removed and endocrown preparation was performed. The impression was transferred to the digital environment by scanning the jaws. Then the restoration was designed and milled using a feldspathic ceramic block. Glazing was performed and the intraoral compatibility of the restoration was checked. Then, the cementation process was completed using dual polymerized resin cement. In the third case, 21-year-old female patient applied with the need for prosthetic treatment in her tooth number 46. As a result of the intraoral examination, it was observed that only the distal and vestibule walls of the tooth were present. After preparation and retraction for endocrown restoration, the jaws were scanned and the impression was transferred to the digital environment. Then the restoration was designed and milled with a feldspathic ceramic block. After the glazing process, the cementation process was completed using dual polymerized resin cement. In the fourth case, 26-year-old male patient applied with the need for prosthetic treatment in tooth number 46. As a result of the examination, it was seen that only the distal wall of the tooth was absent. Preparation was made for endocrown restoration. The impressions of the jaws were taken digitally with the intraoral optical scanner. After the design, milling, and glazing processes, the cementation process was completed using dual polymerized resin cement. In the fifth and last case, 52-year-old male patient applied with the need for prosthetic treatment in his tooth number of 15. As a result of the examination, it was seen that only the vestibule wall of the tooth was present. Gingivectomy was performed because the gingival level was higher in the palatal and mesial regions. Then, similar to the other cases, the preparation procedures were completed first. The upper, lower jaw, and bite impressions were scanned and transferred to the digital environment with an intraoral optical scanner. The restoration design was completed and the milling process was carried out. After the glazing process of the restoration, the cementation process was completed using dual polymerized resin cement. It wasn't observed that any complications occurred in the applied restoration at the control session.

Discussion

Restoration of root canal treated teeth is a challenging issue in reconstructive dentistry. Treatment options for teeth with root canal treatment and extensive coronal destruction are post-core crown restorations and endocrown restorations.[3] In this case series, endocrown restorations were applied to premolar and molar teeth. In some studies, it has been stated that the performance of endocrown restorations applied to premolar teeth is not the same as molar teeth.[9,10] It has been stated that the surface area bonded with the adhesive agent may be reduced due to the smaller premolar teeth.[9] However, Thomas et al. reported that similar success rates were observed between endocrown restorations applied to premolar and molar teeth in their systematic review and meta-analysis study.[11] Endocrown preparation is a more minimally invasive approach that preserves tooth structure. Thus, risks such as vertical root fracture and root perforation are eliminated by making preparations in the root canals.[11] Preparation is an important factor for the success of endocrowns. The restorative material used affects the reduction in the occlusal surface. If monoblock ceramic material is to be used, 2 mm reduction is required, while 1-1.5 mm reduction will be sufficient when hybrid materials containing composite are used.[8] According to Einhorn et al., endocrown preparations with a ferrule design may increase failure load.[2] It was noted that all endocrown restorations, with or without a ferrule design, were subject to a high rate of catastrophic failures against forces greater than normal masticatory function.[2] In other words, it was stated that the preparation of the endocrown with or without ferrule design did not make a difference in the fracture resistance.[2] Dental care should be taken during the preparation of the endocrown preparation. In cases such as ferrule addition, because of the increase in cavity depth, and intraradicular enlargement, inconsistencies may increase in the prepared cavity and this may cause a decrease in the adaptation of the restoration.[8] All endocrown restorations were designed and fabricated with CAD/CAM in this case series. Today, the widespread use of digital technology has resulted in reduced treatment time and better marginal adaptation of restorations, and also the restoration can be produced faster and easier in a single session.[6] Many different material options are available for the fabrication of endocrowns. Firstly, alumina or spinell reinforced non silica-based ceramics and feldspathic ceramics were used. Then, leucite and lithium disilicate reinforced ceramics and hybrid materials have been used in endocrown production.[8] In this case series, all endocrowns were fabricated from a feldspathic ceramic block. In a study using three different CAD/CAM materials; feldspathic ceramic, lithium disilicate glass-ceramic, and resin nano-ceramic, no significant difference was observed between feldspathic ceramics and lithium disilicate glass ceramics in terms of fracture strength.[4] In another study, fracture strengths of restorations made of lithium

Figure 1. Restoration stages of premolar tooth with Cad/Cam

Figure 2. Restoration stages of molar tooth with Cad/Cam

disilicate glass-ceramic, leucite glass-ceramic and feldspathic ceramic were investigated after adhesive and conventional cementation. It was observed that feldspathic and lithium disilicate glass-ceramic restorations applied with adhesive cementation performed

similar results in terms of fracture strength.[12]

Conclusion

Endocrown restoration can be applied as an alternative treatment to post-core and crown restorations in premolar and molar teeth that have root canal treatment and excessive crown destruction. Endocrown restorations produced with the CAD/CAM method can be applied in a single session and this provides a significant advantage by reducing the time spent in the clinic and laboratory. It was not observed any complications in the follow-ups of the endocrown restorations applied in this case series.

None

Author Contributions

Author B.U.K and E.A. contributed to the manuscript equally.

Conflict of Interest

Authors declare that they have no conflict of interest.

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Assessment Of Juxta-Apical Radiolucency With Cone Beam CT

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Abstract

Purpose: This study aimed to investigate the association of Juxta-Apical Radiolucency (JAR) with third molar status and mandibular canal and also describe its radiologic features through cone beam computed tomography (CBCT).
Methods: CBCT images of 100 individuals (153 mandibular third molars) were evaluated for the presence of JAR. Than, the CBCT images were analysed to evaluate the position of the JAR and its relationship to the impacted teeth, mandibular canal and buccal-lingual cortical plates. Descriptive statistical analyses were used.
Results: JAR was identified in 70 individuals and 95 mandibular third molars (48 right side, 47 left side). 22 of the individuals with JAR were male and 48 were female. It was found that 26 (27,4%) of the 95 third molars were erupted, 10 (10,5%) were partially erupted, 59 (62,1%) were impacted. 74,7 % were on the apical third of the root and the rest was located along the mesial or distal surfaces of root. Close proximity to the buccal cortical plate was seen in 25,35 % of JAR located apically, whereas it was seen only 25% of JAR located along the root surface. Only 23.4 % were associated with the mandibular canal.
Conclusion: The present study gives an insight into the relationship of JAR with mandibular canal and cortical plates using CBCT. However, future studies are warranted that use a larger sample size to validate the above findings.

Key words: Mandible; Radiolucency; Third Molar Teeth

Introduction

Surgical extraction of mandibular third molars is a common procedure in dental practice. To minimize the post-operative complications, the surgeon should have relevant information about the third molars, such as the inclination of the tooth root/s to the buccal or lingual cortical plate and the course of the mandibular canal in relation to the root.[1] Pre-operative image evaluation of third molars is essential to clarify the relationship between these teeth and adjacent anatomical structures. The Juxta-Apical Radiolucency (JAR) is a well-defined radiolucent area located laterally and in continuity with the root apexes of healthy third molars and it has been considered an image created by cancellous bony architecture instead of pathology.[2–4] JAR, that has been described recently, has been pointed out as possible predictor of inferior alveolar nerve (IAN) injury during tooth removal.[3] JAR can also cause thinning of the cortical layer when positioned lingually resulting in lingual nerve damage. Lingual cortical plate thinning is an important feature in causing lingual nerve damage during third molar removal.[1] Cone beam computed tomography (CBCT) which is excellent in detecting such anatomical variations provides accurate 3-dimensional (3-D) images of hard tissue and their relations with surrounding anatomical structures.[5] Knowledge of the JAR's radiographic feature, such as gender predisposition, location of the root as mesial/distal, close proximity of buccal/lingual cortical plates, relationship between presence of JAR and status of mandibular third molars as errupted or impacted, the radiographic relationship with the mandibular canal, might help oral surgeons and dental practitioners, distinguishing pathological or anatomical variation, enlightening the surgical planning and enabling good communication with patients.[2] The aim of this study was to assess presence of JAR and its radiological features, the status of related tooth in alveolar bone and its relationship between adjacent teeth and anatomical structures on CBCT images.

Methods

TThe approval from the Ethical Committee of Lokman Hekim University, Ankara, Turkey, was obtained for this study (Protocol No: 2021-008). A retrospective study was carried out to analyse the JAR presence on CBCT for initial sample of 100 patients (153 mandibular third molars). 70 individuals of them had JAR and composed the final sample. 22 of the individuals with JAR were male and 48 were

female and mean (SD) age 36 (14) years, range (17–79). JAR was examined in a total of 95 mandibular third molars (48 right side, 47 left side), which were included in the study regardless of their eruption status. Images with artifacts that would degrade image quality of the relevant region and the third molars with caries, restoration and any other conditions such as cysts or tumours, were excluded from this study. CBCT images were acquired with Planmeca Promax 3D (Planmeca) cone-beam CT unit device with a voxel size of 0.20 mm with a special mode field of view of 16 x 4-12 cm. The slice thickness of the multiplanar reconstruction images was 1 mm. JAR was identified as a well-circumscribed radiolucent area in the multiplanar sections, lateral to the root of the mandibular third molars, and separated from the surrounding structures by the cortical border. CBCT scans were analysed to assess the presence, site of the JAR and its relations to the mandibular canal, buccal or lingual cortical plates, tooth position, and condition of apex of the root in the axial, coronal, sagittal, cross-sectional planes and in reformatted panoramic views. Radiological evaluations were made by one dentomaxillofacial radiologist, one with 2-year experience (SC). The observer examined whether the presence or absence of JAR and the defined JAR position was related to the position of the roots. These positions were described as mesial, distal, buccal, lingual, apical and lateral surface of the roots. The relation between the mandibular canal and JAR was examined as in contact or separate. The positional close proximity of the JAR to the mandibular cortical bone was detected as buccal, lingual or between roots. In addition, we recorded whether or not there was a cortical perforation. The status of third molars was examined as errupted, partially impacted or impacted Figure 1. After two weeks, 20% of the images were reassessed for consistency by the observer.

For descriptive statistics, mean and standard deviation are given for numerical variables, and number and percentage values are given for categorical variables. Whether there was a difference between the groups was examined with the significance test of the difference between the two averages in numerical variables. The relationship between categorical variables was analyzed using the chi-square test. The significance level was taken as $p<0.05$. Statistics were made with IBM SPSS v.22.

Results

JAR presence was seen in 70 individuals of initial sample. JAR was most frequently found female than male (68,6%). No statistically significant difference was observed in the right-left side distribution of the mandibular third molar teeth in JAR presence. (p=0.889) JAR significantly associated with apical positioning of the mandibular third molar root (p = 0.003), which occurred in 74,7% of cases of the JAR group. Just one case (1,05%) positioned in mesial surface of the root in relation to third molar and the rest was located along the distal surfaces of root (24,2%). The anatomic relationship between JAR and the mandibular canal revealed that in most cases the JAR was separated with the canal, 76,6 % of cases of the JAR group and also there was no cortical perforation found in this study. JAR presence was significantly associated with status of teeth (p= 0.035), 62,1% of cases of the JAR group was impacted, 27,4% of them was erupted, 10,5% of them was partially erupted. JAR showed a statistically significant association in positional relation to mandibular cortical plate as buccal, lingual or between roots. (p=0.021) Close proximity to the buccal cortical plate was seen in 25,3 % of JAR located apically, whereas it was seen only 25% of JAR located along the root surface. Table 1 describes patients' demographic features and summarizes the association of third molar status and radiographic signs of proximity with JAR.

Table 1. Descriptive analysis of juxta-apical radiolucency (JAR) and its association with surrounding anatomical structures

Variables	Number (%)	p Value
JAR presence/absence:	100	
Present	70(70)	
Absent	30(30)	
Distribution of gender with JAR	70	
Male	22(31,4)	
Female	48(68,6)	
Distribution of teeth with JAR	95 (100)	
Right mandibular third molar	48(50,5)	0.889
Left mandibular third molar	47(49,5)	
Position in relation to third molar		
Apical	71 (74,7)	0.003
Mesial Surface of the Root	1 (1,05)	
Distal Surface of the Root	23 (24,2)	
Relation of JAR to mandibular canal		
Contacting	22(23.4)	
Separated	73(76,6)	
Status of Third Molar Teeth		
Erupted	26 (27,4)	0.035
İmpacted	59 (62,1)	
Partially erupted	10 (10,5)	
Positional relation of JAR to mandibular cortical plate		
Buccal	26 (27,4)	0.02
Lingual	44(46,3)	
Between Roots	25 (26,3)	

Discussion

Preoperative identification of potential risk factors for nerve damage is essential for safe surgical treatment of the mandibular third molars. Owing that JAR presence is pointed out as a predictor of injuries, its pre-operative detection is important to estimate the possible outcome related to third molar surgery.[3] In this context, the CBCT stands out as a valuable imaging choice since it produces three-dimensional information of the radiographic signs of proximity to the anatomical structures.[5] It was first described by Renton et al.[3] who conducted a controlled clinical trial and found a significant association between the presence of JAR and the occurrence of nerve injuries during third molar surgery. Since then, studies have been performed using CBCT.[2,4,6] Published JAR-related studies are limited. In the present study, the presence of JAR and its relation with anatomical structures were evaluated on CBCT images in a small group of Turkish patients. JAR was detected 70% of 100 individuals, 22 of them was male, 48 of them was female. There was no statistically significant difference between right and left side. Unlike the present study, Nascimento et al had stated that JAR was present in 15.9% of 252 patients with CBCT.[2]Yalçın and Artaş A detected JAR in 33% of patients and 20% of third molars on CBCT images.[7] In previous studies, no significant relations were found between the location of the JAR and the dental surfaces.[2,8] Nascimento et al.[8] was reported that it was distal or mesial to the third molar in 72.9% and in another study, Nascimento et al.[9] distal to the third molar in 66%. The findings of this study showed a significant difference for the position in relation to third molar statistically. JAR significantly associated with apical positioning of the mandibular third molar root (74,7%). Unlike to this study, Yalçın and Artaş[7] found a significant relation between the site of the JAR and dental surfaces, which was mostly mesial (43.4%) to the third molar. The present study showed a relation between the location of the JAR and mesial root surface just for one case (1,05%). The anatomic relationship between JAR and the mandibular canal revealed that in most cases the JAR was separated with the mandibular canal in the present study. Nascimento et al3 asserted that JAR is an image showing increased separation of the trabeculae in cancellous bone. Similar

Figure 1. Multiplanar views of CBCT (Panoramic, sagittal, axial, coronal) show a juxta-apical radiolucency image (arrow), which appears as a well-circumscribed radiolucent area located laterally to the roots and continuously with the root apex of the third molar on the right side.

to this study, Yalçın and Artaş found no significant relation detected between JAR and the mandibular canal in their study.[7] Both study declares JAR does not need to be associated with the mandibular canal. The association between JAR and the mandibular canal is still unclear. Further studies are needed to clarify this issue. The status of the teeth was associated with presence of JAR in the present study, there was a significant difference for depth of impaction statistically. JAR was related to impacted mandibular molar teeth mostly (62,1%). Nascimento et al.[2] evaluated the depth of impaction for the mandibular third molar teeth. Similar to the present study, they found that JAR was detected in partially erupted or unerupted teeth in most cases (77%), however, this association was not statistically significant. The findings for unerupted, partially erupted and erupted mandibular molar teeth were 10%, 67,7%, 22,3% of the 130 cases of the JAR group, respectively. JAR can cause lingual nerve damage when positioned lingually as a result of lingual cortical plate thinning during third molar removal.[1] The current study showed that JAR was at lingual positional relation to mandibular cortical plate (46,3%). Similar to this study, Nascimento et al[9] examined the positional relation of JAR and the mandibular canal and concluded that JAR was significantly positioned lingual to the mandibular canal (59.6%). On the other hand, Kapila et al[6] and Yalçın and Artaş[7] reported that it was seen most often in buccal or superior positions to the mandibular canal. However, whether direct contact of the JAR with the nerve produces the same effect is unknown. It may be logical to consider that close proximity between the JAR and the mandibular canal, could produce a fragile area in the region of the mandibular canal that would leave the inferior alveolar nerve and lingual nerve more susceptible to injuries. However, to confirm this hypothesis, clinical trials should be planned containing CBCT imaging and postoperative follow-up. The limitations of this study were that the patients cannot be followed up because of the retrospective nature of the study and limited number of samples, so prospective CBCT studies will be planned with larger sample.

Conclusion

The results of the present study showed that JAR is not a rare imaging finding and third molars in female patients are more strongly associated with the presence of JAR. JAR has a stronger association with apical position of third molar. In most cases, JAR is detected along with impacted teeth and is separated from the mandibular canal. Additionally, cortical plates involvement related to JAR was associated with its identification on CBCT, in which lingual involvement increased its detection. Lingual position of JAR to mandibular cortical plate may increase the risk of nerve injury during removal of mandibular third molars when JAR is present. Three-dimensional evaluation allowed accurate JAR detection and comprehension of variables related to it, highlighting the value of the CBCT for this purpose. CBCT imaging for JAR assessment provides insights into the relationship of JAR with the mandibular canal and the mandibular cortical plates. Future studies that correlate the presence of JAR and its imaging characteristics with a higher incidence of postoperative complications are required.

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Author Contributions

S.C.: Designed the study; Reviewed the literature; Acquired, analysed, and interpreted the data; Statistical analyses; Wrote the manuscript; Approved the final manuscript

Authors declare that they have no conflict of interest.

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Potential Biomarkers For Early Detection Of Oral Cancer: Leptin And Adiponectin

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Abstract

Purpose: To determine adiponectin and leptin expression levels in samples from healthy, dysplastic and cancerous oral lesions and to investigate the potential role of these biomarkers in oral cancer development.
Methods: Tissue samples from the archives which were histologically diagnosed as oral squamous cell carcinoma (OSCC) (n=24), oral dysplasia (n=12) and healthy tissue (n=16) were included. The concentration and purity of samples were determined after total RNA extraction. Thereafter, cDNA synthesis was performed. The differences between expression levels were evaluated with qPCR. Expression levels related to OSCC were performed according to normalizing gene ACTB. $2 - \delta\delta CT$ method was used for comparison of expression levels. Student t-test was used to compare the differences in gene expression levels between groups, using $2 - \delta\delta CT$ value for each gene.
Results: Adiponectin and leptin expression levels were decreased by 1.09 (p = 0.49) and 10.3 (p = 0.22), respectively, in OSCC group, however differences were not statistically significant. The level of adiponectin expression decreased by 1.65 times (p = 0.62) and leptin expression increased by 3 times (p = 0.30) in the dysplasia group. When OSCC and dysplasia groups were compared, it was found that the level of adiponectin expression increased by 1.52 times (p = 0.99) and the level of leptin expression decreased by 30.94 times (p = 0.16) in the OSCC group. The samples were re-grouped as increased risk (OSCC+dysplasia) (n=36) and healthy (n=16) and a decrease by 16.5 (p= 0.3) in leptin expression and an increase by 1.14 (p= 0.6) in adiponectin expression was observed in the increased risk group compared to the healthy group.
Conclusion: In tissue samples diagnosed as healthy, dysplastic and OSCC, expression levels for leptin and adiponectin have not been compared before. The results revealed a decrease in leptin expression and an increase in adiponectin expression in increased risk group.

Key words: Adinoceptin; Leptin; Oral Cancer

Introduction

More than 90 per cent of all oral and oropharyngeal cancers are histologically diagnosed as squamous cell carcinomas (SCC).[1] Oral SCCs cause severe damage to the oral and facial anatomical structures before and after treatment. However, most SCC cases are diagnosed at advanced stages.[2] The 5-year survival rate for oral SCC after treatment is approximately 50%.[1,2] The delayed detection and recognition of these lesions by the patient or the dental practitioner and the prolongation of the diagnosis process reduce the survival rates of the disease. Studies have revealed that 30% of oral SCC patients had undergone oral cancer screening in the 3 years prior to receiving a diagnosis of oral SCC.[3] Management of advanced-stage tumors includes radical surgery involving neck dissection, radiotherapy, and chemotherapy. The surgical procedures, which result in significant loss of tissue from the head and neck area, lead to devastating psychological and sociological effects on patients. Therefore, early detection and diagnosis of oral SCC are essential to induce overall survival rates and to reduce treatment-related complications and treatment costs.[3] Molecular diagnosis/genetic studies have become more and more prominent in the prevention of oral cancer to identify risk groups before the disease presents.

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Tumor growth, invasion and metastasis is a multistep process that involves numerous genes and pathways. The molecular biology of oral SCC is rather complex. Dysfunction of any of the genetic mechanisms that have an influence on cancer development may cause oral SCC.[4] Therefore, researchers focus on verifying prognostic biomarkers that enable early diagnosis in high-risk patient groups. In genetic studies that using single nucleotide polymorphism as a biomarker, certain factors related to angiogenesis, immune response and thrombosis have been found to be effective in the development of oral cancer.[3–5] Among these factors, cytokines and adipokines that regulate inflammation attract considerable attention as potential biomarkers for their possible relationship with cancer risk.[4] Adipokines contribute to numerous physiological processes such as nutrition, appetite, energy balance, insulin, glucose and lipid metabolism, regulation of blood pressure, vascular remodeling, coagulation, and inflammation. TNF-alpha, IL-6, resistin, leptin, adiponectin, vaspin, visfatin, and omentin are the most well-known adipokines.[6,7] The relationship of adipokines with obesity and obesity-related diseases have been described clearly. Studies have been reported that obesity causes several disorders such as hypertension, type II diabetes (DM), cardiovascular diseases, osteoarthritis, and cancer. Recently, the roles of adipokines as mediators in different physiological mechanisms such as the immune system and inflammatory response, and pathological processes such as malignant tumors, have started to attract more attention.[6] Young et al. have reported that there was an inverse relationship between the levels of leptin, a proinflammatory mediator, and adiponectin, an anti-inflammatory mediator. Additionally, the serum level of leptin was shown to increase in patients with oral premalignant lesions.[8] Guo et al. have observed a significant decrease in circulating adiponectin levels in patients diagnosed with tongue cancer compared to healthy individuals. Furthermore, it has been reported that leptin or leptin receptors stimulate cell proliferation and have an influence on cancer development and metastasis.[9] Yapijakis et al. have analyzed DNA samples from tissues of 150 patients diagnosed with oral SCC and 152 healthy individuals by polymerase chain reaction and reported that leptin gene polymorphism increases the risk of oral SCC.[10] These studies suggest that leptin and adiponectin may be promising candidates as biomarkers that can be useful to determine the risk of oral cancer. Expression levels for leptin and adiponectin in tissue samples diagnosed as healthy, dysplastic and OSCC has not been compared before. The aim of this study is to determine adiponectin and leptin expression levels in samples from healthy, dysplastic, and cancerous oral lesions and to investigate the potential role of these biomarkers in oral cancer development.

Methods

Paraffine embedded tissue samples from the archives of Ege University, Faculty of Medicine, Department of Pathology which were histologically diagnosed as oral squamous cell carcinoma (OSCC) (n=24), oral dysplasia (n=12) and healthy tissue (n=16) were included in this retrospective study. The study protocol was approved by the Ethics Committee of Ege University (Approval no: 18-5/18). To determine the expression levels of leptin and adiponectin, total RNA extraction was performed using Invitrogen™ PureLink™ FFPE total RNA Isolation kit from a total of 52 tissue samples. Thereafter the concentration and purity of samples were determined with NanodropTM device (Thermo Scientific) by measuring their absorbance at 260/280 nm and 230/260 nm wavelengths. Total RNA's A260/A280 and A230/A260 absorbance ratio >2.0 and the amount of $10 \mu g/\mu l$ were included in the study. Complementary DNA synthesis from isolated RNA was performed using High-Capacity cDNA Reverse Transcription kit. The differences between expression levels of leptin and adiponectin in tissues was evaluated with qPCR. 2X TAQMAN UNIV Master MIX, TaqMan Gene Expression Assays ($Hs00226105_m1$), TaqMan Gene Expression Assays ($Hs00174497_m1$) and TaqMan Gene Expression Assays were used as control qPCR assay. Leptin and adiponectin expression levels related to OSCC was performed according to normalizing gene ACTB. $\delta\delta CT$ method was used for comparison of leptin and adiponectin expression levels. An increase in expression level was accepted in case the $2 - \delta\delta CT$ value was over 2, and a decrease in expression level was noted in case the $2 - \delta\delta CT$ value was under 1. Additionally, dysplastic and OSCC tissue samples were further analyzed together as 'increased risk' group and adiponectin and leptin levels were compared with healthy samples. Student t-test was used to compare the differences in gene expression levels between healthy, dysplastic, and cancerous groups using $2 - \delta\delta CT$ value for each gene ($p<0.05$).

Results

When compared to the healthy group, adiponectin and leptin expression levels were decreased by 1.09 (p=0.49) and by 10.3 (p=0.22) respectively in the OSCC group, however the differences were not statistically significant. The level of adiponectin expression decreased 1.65 times (p=0.62) and leptin expression increased by 3 times (p=0.30) in the dysplasia group when compared to the healthy group. When OSCC and dysplasia groups were compared, it was found that the level of adiponectin expression increased by 1.52 times (p=0.99) and the level of leptin expression decreased by 30.94 times (p=0.16) in OSCC group Figure 1. The samples were re-grouped as increased risk (OSCC+dysplasia) (n=36) and healthy (n=16) and a decrease by 16.5 (p=0.3) in leptin expression and an increase by 1.14 (p=0.6) in adiponectin expression was observed in increased risk group compared to the healthy group.

Discussion

Numerous studies have been conducted to investigate the effects of adipokines on obesity, metabolic diseases, inflammation, cardiovascular and malignant comorbidities. Leptin and adiponectin have antagonistic effects, therefore, in different types of cancer, while an increase in serum leptin concentration is observed, adiponectin level decreases.[6] It has been shown that the increase in the serum leptin level of oral SCC patients causes a decrease in apoptosis rate and accelerates cancer progression.[8] A study has reported a significant decrease in serum adiponectin levels in patients with tongue cancer compared to healthy individuals.[9] Yapijakis et al. have analyzed DNA samples obtained from tissues of 150 patients diagnosed with OSCC and 152 healthy individuals using polymerase chain reaction and reported that leptin gene polymorphism increases the risk of OSCC.[10] In our study, paraffine embedded tissue samples from the archives of Ege University, Faculty of Medicine, Department of Pathology which were histologically diagnosed as oral squamous cell carcinoma, oral dysplasia and healthy tissue were included. Adiponectin and leptin levels in identified tissue samples were determined by gene expression analysis. When compared to the healthy group, adiponectin and leptin expression levels were decreased by 1.09 (p=0.49) and 10.3 (p=0.22) respectively, in OSCC group, however the differences were not statistically significant. The level of adiponectin expression decreased by 1.65 times (p=0.62) and the leptin expression increased by 3 times (p=0.30) in dysplasia group when compared to the healthy group. When OSCC and dysplasia groups were compared, it was found that the level of adiponectin expression increased y 1.52 times (p=0.99) and the level of leptin expression decreased by 30.94 times (p=0.16) in OSCC group. When the samples were re-grouped as increased risk and healthy groups, a decrease by 16.5 (p=0.3) in leptin expression and an increase by 1.14 (p=0.6) in adiponectin expression was observed in increased risk group compared to the healthy group. Since expression levels for leptin and adiponectin in tissue samples diagnosed as healthy, dysplastic and OSCC has not been compared before, it is not pos-

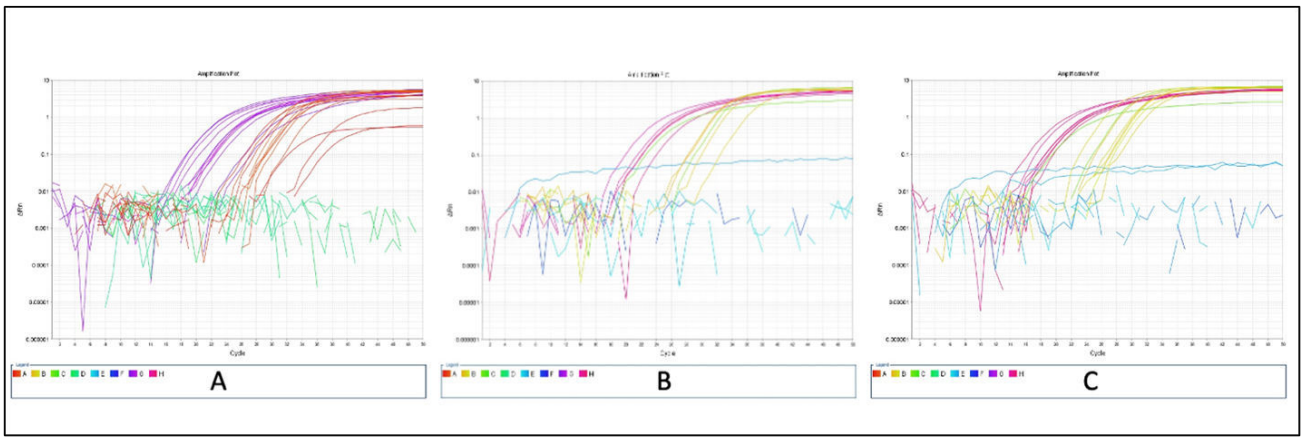

Figure 1. Expression of leptin and adiponectin in (A) OSCC, (B) dysplasia and (C) healthy tissue groups.

sible to compare our results with previous studies. The results of the present study revealed a significant decrease in leptin expression and an increase in adiponectin expression in samples from increased risk group which included dysplasia and OSCC tissue samples. These results conflict with previous studies which reported an increase in leptin expression and a decrease in adiponectin expression in serum levels of OSCC patients. The difference in the number of subjects included may account for this difference. Additionally, the type of tissue that has been investigated regarding the expression of leptin and adiponectin may have an influence on findings from different studies. It may be speculated that the presence of gene polymorphism, tissue levels and serum levels for these adipokines may differ depending on the type of sample collection and the method that have been used for analysis. It is known that the level of adipokines is closely related to several disorders such as obesity, diabetes mellitus etc. There for, it is obligatory to also consider the characteristics of the studied population when interpreting the results. Unfortunately, since this study was conducted in a retrospective manner and tissue samples were obtained from the archive, medical information for these patients were not available. Therefore, further studies with larger study samples in which demographic and medical data of subjects are included are needed to clarify the roles of leptin and adiponectin in oral cancer development. Additionally, it may be interesting to compare the level of these adipokines in both serum and oral tissue samples in the same study population.

Conclusion

The mechanisms between adipokines and oral cancer is still not fully understood. The results of the present study revealed a significant decrease in leptin expression and an increase in adiponectin expression in samples from increased risk group which included dysplasia and OSCC tissue samples. In contrast, an increase in leptin expression and a decrease in adiponectin expression in serum levels of OSCC patients have been reported in previous studies. The limited amount of tissue samples in the present study may account for this difference. Therefore, further studies with larger study samples are needed to clarify the roles of leptin and adiponectin in oral cancer development.

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Author Contributions

All authors made substantial contributions to the present study. BI and PG designed the study, AV and ATV contributed to data collection, PG, BI, ATV and NEÖ contributed to interpretation of data and editing of the manuscript. PG, BI and NEÖ wrote the manuscript. All authors read and approved the final manuscript.

Conflict of Interest

Authors declare that they have no conflict of interest.

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CONGRESS PROCEEDING

Micro-CT Analysis of the Root Canal Configuration of Maxillary Second Molars with Fusion

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Abstract

Purpose: The present study investigated the root canal configuration of maxillary second molars with root fusion using micro-computed tomography (micro-CT).
Materials & Methods: A total of 136 fused maxillary second molars were scanned with micro-computed tomography. Images were transferred to CTAn v.1.18.8 software (Bruker-microCT) to obtain three-dimensional models. The specimens were classified according to the fusion type. According to Vertucci, classification of the root canal configuration of fused roots was determined using CTVol v. 2.3.2.0 (Bruker-microCT) and DataViewer v.1.5.6 (Bruker-microCT) softwares. The specimens that could not be represented were also specified. The frequency of canal configuration according to the fusion type was calculated.
Results: For Type 1 fusion (n=40) and Type 2 fusion (n=22), the most common canal configuration for mesiobuccal (MB), distobuccal (DB) and palatal (P) canals was Type I. In type 3 fusion specimens (n = 21), DB and P canals were completely fused in 1 sample in accordance with Vertucci type IV, while in the remaining specimens, types II, I, V, VI and IV were observed in decreasing order in the MB canal. In type 4 fusion, MB and DB canals were completely fused in 4 of 21 specimens and showed Vertucci type VI, II, I and III configurations. In the remaining 17 samples, MB had Vertucci type I, II, IV, V, VI, VII configurations, while DB showed type I, V and III configurations. In 7 samples with type 5 fusion all canals displayed different configurations. In type 6 fusion, the canal configurations of 6 samples could not be classified. Type II, I, and V configurations were seen in 9 of the remaining 19 samples with a single canal.
Conclusion: Vertucci type I was the dominant canal configuration in the P and DB, however, MB showed much more diverse configurations either independently or when included in fusion. area and pulp volume to increase the accuracy of age estimation in adult Turkish individuals.

Key words: Canal configuration; root canal anatomy; Vertucci classification

Introduction

Root fusion, which occurs either by cement deposition between roots or an anomaly in the Hertwig root sheath development, could affect maxillary and mandibular molars.[1] Partial or total root fusion of maxillary molars has been reported in different forms from fusion of buccal roots to the complete fusion of all 3 roots presenting a conical-shaped single root.[1,2] The root fusions were initially investigated from periodontal or surgical perspectives, however with the development of cone beam computed tomography (CBCT) and micro-computed tomography (micro-CT) for the visualisation of root canal anatomy the subject has been much more relevant for endodontics.[2–7] Micro-CT has been utilised as the gold standard method for ex vivo evaluation of root canal anatomy with accurate and detailed information regarding fine anatomical elements of root canal system.[8] Classification of different fusion types into 6 groups was developed by means of this technology.[1] It was also revealed that fused roots commonly have complicated anatomy with apical deltas, isthmuses and C-shaped canal configurations by a recent micro-CT study.[2] Previous studies revealed different incidence of root fusion in different populations varying between 9% and 58% and also reported rare fusion types that did not fit the classification.[4–7] The present micro-CT study aimed to evaluate root canal configurations of fused maxillary second molars in terms of different types of fusion according to Vertucci and Gulabivala classifications.[9,10]

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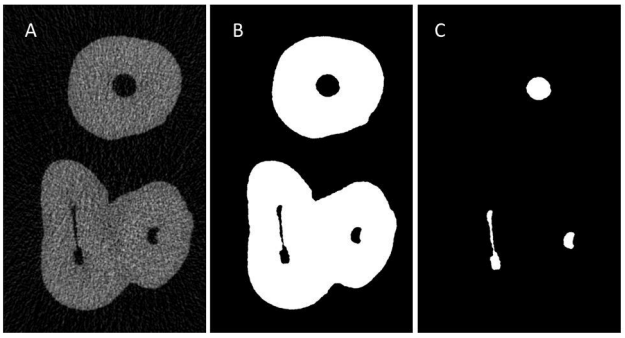

Figure 1. A: Axial cross-sections obtained by the reconstruction process after scanning **B:** Dentin with image processing **C:** Obtaining the root canal space with image processing.

Figure 2. Three-dimensional models of representative specimens with type 5 fusion **A:** showing an unusual connection between distobuccal and second mesiobuccal canals. **B:** A specimen with type 1 fusion showed Vertucci type III configuration with an abrupt apical curvature. **C:** This specimen has multiple orifices and very complex radicular anatomy.

Methods

The study protocol was reviewed by local university ethical board with the approval number KAEK-2017-234. A total of 136 extracted fused maxillary second molar teeth with mature roots free of fractures, or deep caries extending to root dentine, were selected from Turkish subpopulation and stored at 37°C with 100% humidity. Samples were selected and classified as showing root fusion according to the distance between cementoenamel junction (CEJ) and the most coronal point of root furcation (if there were any) being more than 70% of the distance between anatomical apex and CEJ. The measurements were performed with digital calliper. The gender and age information of the patients were unavailable. The specimens were classified according to the fusion types as described by Zhang et al. as follows.[1] Type 1: MB root fused with distobuccal (DB) root, Type 2: MB root fused with palatal (P) root, Type 3: DB root fused with P root, Type 4: MB root fused with DB and P root fused with MB or DB, Type 5: P root fused with MB and DB roots, Type 6: MB, DB and P roots fused into a conical-shaped root. The teeth were scanned on a micro-CT device (SkyScan 1172, Bruker-microCT, Kontich, Belgium) at 9 μm (pixel size), 100 kV, 100 μA, 180° rotation range and 0.6° step, camera exposure time of 2200 ms and frame average of 1 with aluminium copper filters.[11] Data reconstruction was performed by NRecon v.1.10.6. software (Bruker-microCT) with a beam hardening correction of 65% resulting the images of the dentin and canal system space Figure 1. After the reconstruction, approximately 1300 two-dimensional axial cross-sectional images of each sample were obtained at 0.01 mm intervals. Images were transferred to CTAn software in order to obtain three-dimensional models. In CTVol (Bruker-microCT) software, dentin was made translucent and after the root canals were coloured, root canal configuration was evaluated visually. Canal configurations were classified according to Vertucci and Gulabivala et al. classification systems[9,10], and specimens that could not be represented with these systems were also specified. The data was analysed with frequency analysis using Excel (Microsoft Corporation, Redmond, WA, USA).

Results

A total of 136 specimens were evaluated. The distribution of the root canal configuration according to the fusion type was presented in Table 1. For Type 1 fusion (n=40), the most common canal configuration for mesiobuccal (MB), distobuccal (DB) and palatal (P) canals was Type I. In 9 specimens buccal (B) canal was detected with Vertucci I, II, III and V anatomy Figure 2. In specimens with Type 2 fusion (n=22), 2 specimens had fused MB-P canals with Vertucci type II and V configurations. Remaining specimens had majority of Type I configuration in MB, DB, and P canals. In type 3 fusion specimens (n = 21), DB and P canals were completely fused in 1 sample in

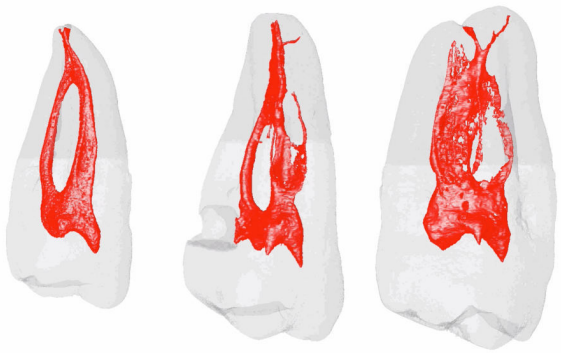

Figure 3. Representative three-dimensional models of specimens that could not be classified either Vertucci or Gulabivala classifications, show connections between roots, loop accessory canals, C-shaped cross sections and apical ramifications.

accordance with Vertucci type IV, while in the remaining specimens, types II, I, V, VI and IV were observed in decreasing order in the MB canal. One MB canal had Gulabivala type 9 configuration. DB and P canals all showed type I configuration. In type 4 fusion, MB and DB canals were completely fused in 4 of 21 specimens and showed Vertucci type VI, II, I and III configurations. In the remaining 17 samples, MB had Vertucci type I, II, IV, V, VI, VII configurations, while DB showed type I, V and III configurations. Type I was seen in all of the P canals. In 7 samples with type 5 fusion, one of the B canals formed as a result of fusion showed Type III and the other type VII configuration. Types I, II, IV, V and VII were seen in MB canals, all of which can be seen in a single specimen. In the DB canals, 4 specimens were type I, 1 specimen was type II, while type I was detected in all P canals. In type 6 fusion, the canal configurations of 6 samples could not be classified. Vertucci type II, I, and V configurations were seen in 9 of the remaining 19 samples with a single canal. Type II, V and VI were detected in MB; while Type I was seen in all of the DB and P canals. Types II, V, VI and I were seen in specimens with a B canal. Figure 3 displays the three-dimensional models of representative non-classified specimens.

Discussion

Comprehensive knowledge of root canal anatomy and associated anatomical variations is one of the most important factors for a successful root canal treatment.[10] For the Turkish population, several studies concerned with evaluating root canal morphology in different teeth have been carried out but only one study have evaluated molars with fusion using cone-beam computed tomography.[12] In

Table 1. Correlation between chronological age and the CBCT image measurement ratios according to Kvaal's method

Values	Maxillary central incisor tooth Correlation coefficient (r)	Maxillary canine tooth Correlation coefficient (r)
M	-0.173	-0.217*
W	-0.126	-0.342**
L	0.154	0.175
P	0.035	0.082
R	0.242*	0.250*
A	-0.209*	-0.119
B	-0.088	-0.292**
C	-0.253	-0.298**
W-L	-0.152	-0.397**

P: pulp/root length ratio; R: pulp/tooth length ratio; A: ratio between width of pulp and root at cementoenamel junction; B: ratio between width of pulp and root at midpoint between levels C and A; C: ratio between width of pulp and root at mid-root level; W: mean value of width ratios from levels B and C; L: mean value of the length ratios P and R; M: mean value of all ratios.
* Correlation is significant at the 0.05 level.
** Correlation is significant at the 0.01 level.

maxillary second molars incidence of root fusion has been reported as 23.% in a recent CBCT study.[12] Clinically, the presence of root fusion in almost 1 out of every 4 teeth has also attributed importance in terms of canal configuration of this anatomical variation. Root canal morphology reports have been considered to be influenced by the evaluation technique, sample size, patient age and the population groups. No study has investigated root canal configuration of fused molars using micro-CT therefore, this study has aimed to examine root canal configuration of different fusion types using micro-CT. This study evaluated a total of 136 maxillary second molars including each fusion type 1 (n=40), 2 (n=22), 3 (n=21), 4 (n=21), 5 (n=7), and 6 (n=25) with the given sample distribution. Unfortunately, no information was available regarding the age and gender of the patients. In the present study Type 1 and 2 fusions have dominance of Vertucci type I configuration in DB, P, and MB canals, although less than half of the MB canals showed a variety of configurations as type V, II, IV, VI, VII. In type 2 fusions, totally fused canals of MB and P results in type II and V configurations in 2 specimens. Similarly, in type 3 fusion, total fusion of DB and P canals result in a type IV configuration. MB canals in type 3 fusion, which are independent showed a variety of configurations as type I, II, V, VI and VI in decreasing order. One specimen showed a configuration that could not be classified, with three orifices merging and terminating with a single apical foramen. In all specimens DB and P canals showed Type I canal configuration. Type 4 fusion also showed a variable configuration in non-merging MB canals and MB-DB fused canals such as type I, V, IV, II, III, VII and non-classified types. Type 5 fusion had a small sample size but all specimens showed different configuration types from themselves, which all could be classified by Vertucci. Type 6 fusion had the highest number of unclassified specimens and buccal root canal system. The high number of Vertucci type I configuration demonstrates the consistency of this study with the recent CBCT study conducted in Turkish population also. However, the present study was able show a greater variety in canal configuration types in the remaining specimens. That recent CBCT study categorized fused roots as having merging or non-merging canals, which both groups had MB canals with mainly Type I fusion followed by Type II.[12] In the present study, micro-CT examination revealed that merging canals and MB canals showed a greater variability in terms of root canal configurations. This study revealed that the mesiobuccal root is the most versatile root in the types of canal configuration that exist, which adding to the complexity of the root canal system. The differences between the results of the studies can be attributed to differences in the technique used (CBCT vs. micro-CT) or number of sample size. CBCT has been reported to underdiagnose fine structures of root canal system as shown in a previous study comparing CBCT with micro-CT in terms of their ability to represent actual canal anatomy.[13] Vertucci type I is the dominant canal configuration of the canal in the palatal and distobuccal roots irrespective of the fusion type. In several specimens, distobuccal canal system showed two canals when the distobuccal root was included in fusion.

Conclusion

The findings of the study reflect the high probability of encountering multiple canals in mesiobuccal roots and between fused roots during root canal treatment of the of the maxillary second fused molars.

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Author Contributions

Concept: C.K., A.K., Design: C.K., A.K., O.S.O. Data Collection or Processing: C.K., A.K., O.S.O., Analysis or Interpretation: C.K., Literature Search: C.K., A.K., O.S.O., Writing: C.K., A.K., O.S.O.

Conflict of Interest

Authors declare that they have no conflict of interest.

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CONGRESS PROCEEDING

Investigation of the Effect of Different Content of Mouthwashes on Rezin CAD / CAM Blocks

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Abstract

Purpose: As a result of studies aimed at reducing the transmission of severe acute respiratory syndrome coronavirus-2 (SARS-CoV-2), mouthwash use has become more popular recently. The aim of this study is to examine the effect of mouthwashes with different ingredients on color changes.
Methods: Two different resin-based CAD/CAM materials (Vita Enamic and Brilliant Crios) were used in the study (n=32). Total of 64 samples were prepared by taking 2 × 7 × 12 mm sized sections from resin-based CAD/CAM blocks (n=32). After the samples were kept in artificial saliva at 37° C for 24 hours, a spectrophotometer was used to take initial color measurements (VITA Easy shade V, Germany). Then resin-based CAD/CAM samples were kept in 3 different mouthwashes containing Cetylpyridinium chloride (Oral-B), Povidone iodine (Batiqon) and Chlorhexidine (Kloroben) for 1 minute twice a day (n=8). Color measurement of the samples was repeated on the 7,14 and 30 days. Values of color differences (E_{00}) were assessed by one-way analysis of variance (ANOVA) and Tukey test ($p<0.05$).
Results: There was no statistically significant difference between the color changes at the end of 7, 14 and 30 days of Vita Enamic and Brilliant Crios CAD/CAM blocks kept in mouthwashes containing cetylpyridinium chloride, povidone iodine and chlorhexidine. ($p>0.05$). In the composite-reinforced CAD/CAM samples (Brilliant Crios), only Povidone-iodine-containing mouthwash produced color change above the noticeable threshold value ($\delta E_{00} > 0.8$).
Conclusion: It has been determined that, mouthwashes with different contents did not cause a significant color change in resin-based CAD/CAM samples, which are frequently used during the pandemic period.

Key words: CAD / CAM material; COVID-19; Discoloration; Mouthwash

Introduction

Today, different esthetic restorative materials are using by dentists to meet the expectations of patients who demand a whiter and more esthetic smile. Recently, new resin-based CAD/CAM materials have been produced, which combine the high durability and high color stability properties of ceramic materials, which are frequently used by manufacturers in esthetic applications, with the higher flexibility and lower abrasive properties of composite.[1]

In restorative dentistry, restoration materials are expected to retain their color and optical properties for a long time. The fact that restorations maintain their color stability against different physical and chemical effects that may cause coloration in the mouth affects their long-term success.[2–4]

Studies on the ways of transmission of the SARS-CoV-2 virus, which continues to spread rapidly and how it should be protected, continue today. Studies have reported that COVID-19 is transmitted through the mucous membranes of the mouth, nose and eyes through surfaces contaminated with SARS-CoV-2.[5] A large number of live viruses were detected on the epithelial surface of the oral mucosa and the dorsum of the tongue of SARS-CoV-2 positive patients and saliva is an important for transmission tool for the COVID-19 outbreak.[6] The time a person coughs, sneezes, breathes or chatters, they emit large drops of saliva containing microorganisms. Therefore, it is believed that the oral cavity very important in the pathogenicity and spread of SARS-CoV-2.[2] According to recent studies, it is stated that the use of antiseptic mouthwashes in order to prevent COVID-19 transmission can reduce the oral viral load of COVID-19 and thus the risk of transmission can be prevented or greatly reduced.[7] Mouthwashes and antiseptic solutions also help to improve oral and dental health. It accelerates healing of tissue after the periodontal treatment and shortens the recovery time. Chlorhexidine gluconate, benzydamine hydrochloride, cetylpyridinium chloride and alcohol-containing mouthwashes

and antiseptics are among the most frequently using for this purpose.[2] However, in addition to these advantages, mouthwash and antiseptics can cause external discoloration of dental tissues and dental restorations.[3] Mouthwashes available in the market and that are easily accessible are povidone-iodine, chlorhexidine, hydrogen peroxide, cyclodextrin, citrox, cetylpyridinium chloride and essential oils. Since SARS-CoV-2 is an enveloped virus, some act by targeting the reactive outer lipid membrane, while others act on the capsid by denaturing proteins.[2]Mouthwashes with 3 different ingredients were used in the study: Mouthwashes with povidone iodine (PVP-I): When degraded, it contains iodine and a water-soluble polyvinylpyrrolidone polymer that has antibacterial properties. It also denatures proteins and oxidizes nucleic acids with iodine release. By disrupting numerous metabolic pathways and destroying the cell membrane, PVP-I has antiviral effects against both enveloped and non-enveloped viruses, and this impact is stronger than the other antiseptics like CHX.[2] Mouthwashes with chlorhexidine (CHX): It's a cationic bisbiguanide that's frequently utilized in medicine as a broad-spectrum antiseptic. CHX has antiviral properties, although it is only known to work against lipid-enveloped viruses, not non-enveloped viruses. According to studies, it minimizes the probability of SARS-CoV-2 spreading via aerosols.[2] Mouthwashes with cetylpyridinium chloride (CPC): It's a nonoxidant or corrosive quaternary ammonium compound that's highly cationic at neutral pH and can be dissolved in water or aqueous solutions. It has a wide range of antimicrobials that have a quick bactericidal effect on gram-positive bacteria. CPC also has antiviral properties, which makes it useful in the treatment of viral diseases, particularly respiratory tract infections. CPC acts by destroying the virus capsid. Although it is often found in mouthwashes, it is recommended to be used to fight SARS-CoV-2.[2] The goal of our research is to see how increasing usage of mouthwashes and antiseptics affects the color stability of resin-based CAD/CAM blocks during the COVID-19 pandemic induced by SARS-CoV-2. The null hypothesis of the study is that mouthwashes will not have any effect on the color change of resin-based CAD/CAM blocks.

Methods

Two different resin-based CAD/CAM blocks (Vita Enamic, Brilliant Crios) were selected for the study Table 1. Samples of 2 x 7 x 12 mm were prepared from resin-based CAD/CAM blocks with a precision cutting device (Micracut 201; Bursa, Turkey). A total of 64 samples, 32 of each, were prepared from Vita Enamic and Brillant Crios CAD/CAM samples. The samples were polished with a spiral shaped polishing kit (Clearfil Twist Dia; Kuraray, Japan) and polishing paste (Dia Polisher, GC, Tokyo, Japan). During the polishing step, the spirals were used under water cooling at 10000 rpm for 20 seconds. Samples were kept in artificial saliva at 37 °C for 24 hours after the polishing.

The initial color values (L*, a*, b*) of the samples were recorded with the spectrophotometer device VITA Easy shade V (VITA Zahnfabrik, Bad Säckingen, Germany). Color measurements were made by placing the probe tip of the spectrophotometer perpendicular to the sample surface. In the color measurement process, 3 measurements were made from each sample, from the center point of the samples.

The samples were kept in mouthwashes of different contents (Oral-B, Procter&Gamble, cetylpyridinium chloride; Batiqon, Povidex Aqua, 0.2% polyvinylpyrrolidone iodine; Kloroben, Drogsan; 0.12% chlorhexidine gluconate, 0.15% benzydamine hydrochloride) after the initial color measurements were completed. To simulate the daily mouthwash use of individuals, the samples were kept in mouthwashes for 1 minute. After the samples were kept in mouthwash for 1 minute, they were re-incubated in artificial saliva at 37 °C. Control groups were kept only in artificial saliva for 30 days. The mouthwashes and artificial saliva in which the samples were kept were changed regularly every day. Color measurements of the samples, whose color measurements were recorded at the beginning, were recorded by repeating on the 7th, 14th and 30th days.

The CIEDE2000 formula (E_{00}) was used to calculate the color changes of resin-based CAD/CAM blocks over the L*, a* and b* parameters. SPSS 22.0 statistical program (SPSS Inc., Chicago, IL, USA) was used for the statistical evaluation of the color changes of CAD/CAM blocks. Color change values were evaluated by two-way analysis of variance (ANOVA) and Tukey test ($p<0.05$).

Results

When the study results were examined, no statistically significant difference was observed in the color changes of Vita Enamic and Brillant Crios resin-based CAD/CAM samples, which were kept in mouthwashes containing cetylpyridinium chloride, povidone iodine and chlorhexidine, on the 7th, 14th abd 30th days. The sample groups kept in mouthwashes showed similar color change with the artificial saliva, which was the control group, at all the time periods Table 2.

Although there was no significant difference in the coloration of the samples, the coloration of all samples was at the maximum level on the 30th day. When the coloration of the samples at the end of the 30th day is evaluated in terms of acceptable threshold value; mouthwashes caused discoloration of resin-based CAD/CAM blocks below the PT value (E_{00} : 0.8). Only povidone iodine-containing mouthwash showed color change above the PT value (E_{00} : 0.8) in the Brillant Crios composite reinforced block.

Discussion

Mouthwashes with different contents did not make a statistically significant difference in the color change of the resin-based CAD/CAM blocks. Therefore, the null hypothesis of the study was accepted.

New generation resin-based CAD/CAM blocks are widely preferred by clinicians benefit from the ease of preparation, polishing, and reparability. Despite the effective finishing and polishing processes in resin-containing restorative materials, the color changes that occur over time cause patient dissatisfaction, and this is considered as the esthetic inadequacy of the materials.

In recent years, spectrophotometer device is has been widely used to measure tooth colors.[5] CIELAB calculates color differences in materials with the δEab formula using L*, a*, b* values. In 2001, a new formula CIEDE2000 (E_{00}) was developed by the CIE.[8] In this study, the color change caused by mouthwashes in CAD/CAM blocks was measured with a spectrophotometer device. Color changes were also calculated with the CIEDE2000 formula. The color changes on the CAD/CAM materials of mouthwashes, which have an increased frequency of use in the pandemic and can stain teeth and restorations in long-term use, were investigated.[9]

According to studies, periodontal diseases begin as a result of plaque accumulating for 10-21 days.[10]As a result of 4 weeks of plaque accumulation, white spot lesions may start.[11] In order to avoid the side effects of mouthwashes, its use is limited to an average of 5 weeks.[12] Therefore, the samples in this study were kept in mouthwashes for 4 weeks. It is also recommended to use mouthwashes for 1 minute twice a day in accordance with the manufacturer's instructions. Considering this situation, daily use was simulated by keeping our samples in a mouthwash twice a day for 1 minute every day. The solutions were replaced with new ones after each use, ensuring that the effectiveness of the solutions continued for 4 weeks. Generally, mouthwash and antiseptic solutions contain antimicrobial agents, herbal extracts that provide a refreshing taste and smell, and solvents such as alcohol, sorbitol or water. These

Table 1. Resin-based CAD/CAM blocks used in the study

Materials, Manufacturer	Type of material	Composition by weight		Lot Number
		Filler	Polymer	
Vita Enamic, VITA Zahnfabrik, Germany	Hybrid ceramic block	86% feldspatic ceramic	Methacrylate Polymer, UDMA, TEGDMA	81060
Brilliant Crios, Coltene/Whaledent, Switzerland	Composite resin block	70% of glass, amorphous silica	Cross-linked methacrylates Bis-GMA, Bis-EMA, TEGDMA	I89523

Table 2. Color change created by mouthwashes on resin-based CAD/CAM blocks

CAD/CAM Material	Mouthwash	7th day	14th day	30th day
Vita Enamic	Oral-B	0.6±0.1	0.6±0.1	0.7±0.1
	Batiqon	0.6±0.1	0.6±0.1	0.8±0.1
	Kloroben	0.6±0.1	0.6±0.1	0.7±0.1
	Artificial saliva	0.5±0.1	0.6±0.1	0.6±0.1
Brilliant Crios	Oral-B	0.6±0.1	0.7±0.1	0.8±0.1
	Batiqon	0.7±0.1	0.8±0.1	0.9±0.2
	Kloroben	0.6±0.1	0.7±0.1	0.8±0.1
	Artificial saliva	0.6±0.1	0.7±0.1	0.8±0.1
P		0.246	0.387	0.214

active ingredients and flavoring agents often contain coloring pigments.[13] In mouthwash and antiseptic solutions, pigment density, fluidity property of the solution, adhesion to the surface of composite resin materials and wettability are important factors affecting coloration.[14]

In the current study, although the povidone iodine-containing antiseptic solution caused more color changes on CAD/CAM blocks than cetylpyridinium chloride and chlorhexidine-containing mouthwashes, this difference was not statistically significant. In addition, while the Povidone-iodine-containing mouthwash showed a color change above the detectable threshold value PT (E_{00} : 0.8) in the composite reinforced block, it created a color change below the detectability threshold value in the hybrid ceramic block. Hybrid ceramic CAD/CAM blocks are thought to exhibit less discoloration due to the high filler ratio and polymer infiltrated mesh structure.

This study has some limitations. After daily use of mouthwash and antiseptic solution, the washing effect of saliva, the effect of oral fluids, the effect of food and different beverages may change the color change caused by these solutions, but these factors could not be simulated in vitro in this study. More research is needed to investigate the effect of mouthwashes on the coloration of CAD/CAM materials.

Conclusion

At the day 30, mouthwashes produced similar color differences on resin-based CAD/CAM blocks with artificial saliva. The color alterations did not differ in a statistically meaningful in the color differences within the CAD/CAM blocks.

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Author Contributions

B.E. and N.A. participated in designing the study. S.K. and N.A. participated in generating the data for the study. N.A. and B.E. participated in gathering the data for the study. N.A. participated in the analysis of the data. B.E. and N.A. wrote the majority of the original draft of the paper. S.K. and N.A. participated in writing the paper. All authors approved the final version of this paper.

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CONGRESS PROCEEDING

Investigation of Frequency of Heterotopic Teeth: A Cone Beam CT Study

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Abstract

Purpose: Teeth that are encountered in distant places from the alveolar arch (maxillary sinus, orbit, infratemporal fossa, condylar region, etc.) because of various local or systemic factors are named heterotopic teeth. The heterotopic tooth is a rare phenomenon. Although the etiology is still unknown, it is known that it may be seen because of pathologies caused by cystic lesions, cleft lip-palate, trauma history, and infectious conditions. They are usually asymptomatic, so they are detected by chance in routine clinical and radiological examinations. This study aims to determine the frequency of heterotopic permanent teeth and their anatomical localization with the help of cone-beam computed tomography (CBCT).
Methods: This study was retrospectively performed with CBCT slices. CBCT sections of 2590 individuals (1432 females, 1158 males) between the ages of 10-89 (mean: 44 ± 17 years) were evaluated in the study. Heterotopic teeth were investigated using coronal, axial, sagittal CBCT sections in regions distant from the maxillary-mandibular arch. SPSS V.21 software (IBM Corp., Armonk, NY, USA) was used for data analysis.
Results: Heterotopic teeth were found in 10 of 2590 individuals (0.4%). All the heterotopic teeth detected were molar teeth; 4 were mandibular third molar teeth, 5 were maxillary third molar teeth and 1 was maxillary second molar tooth. The frequency of heterotopic teeth according to gender did not show a statistically significant difference (4 females, 6 males, p> 0.05). The average age of individuals with heterotopic teeth was 35.3 (17-65 years). 4 of the heterotopic impacted teeth were located in the ramus and 6 in the maxillary sinus.
Conclusions: The prevalence of heterotopic teeth was very rare (0.4%). The teeth with the highest frequency of heterotopia were the third molars. Heterotopic teeth did not have an anatomical location and gender that they preferred predominantly.

Key words: Heterotopia; Ectopia; Impacted tooth; CBCT

Introduction

Heterotopic tooth is a term used when a tooth is not on the jaws due to various local or systemic factors and is encountered in another organ. The heterotopic teeth are rare phenomena, so the etiology is still not clear.[1] Various factors may cause heterotopic teeth like cleft lip-palate, traumas, cystic lesions, and maxillary infections.[2] When a heterotopic tooth is detected, teeth are generally located in the orbit, nasal cavity, maxillary sinuses, infratemporal fossa, condylar process, and mandibular ramus.[3,4] The most common heterotopic teeth are maxillary and mandibular third molars.[2] In the literature, very few cases have been reported; therefore, the knowledge about its prevalence, tendency of anatomical location, or gender is limited. This study aims to investigate data of the frequency of heterotopic teeth, their gender tendency, and preferred anatomical localization using cone-beam computed tomography (CBCT) slices.

Methods

This study was retrospectively performed in Necmettin Erbakan University Faculty of Dentistry, Department of Oral and Maxillo-facial Radiology, with CBCT slices obtained between 2018-2021 years. The study protocol was approved by the Research Ethics Committee of Necmettin Erbakan University, Faculty of Dentistry (no. 2021/04-53) and was done under with the principles defined in the Declaration of Helsinki, including all revisions. CBCT sections of 2590 individuals (1432 females, 1158 males) between the ages of 10-89 (mean: 44 ± 17 years) were evaluated in the study. CBCT records of heterotopic tooth-related jaw pathologies, heterotopic deciduous teeth, mesiodens, supernumerary, and supplementary teeth were excluded from the study.

Heterotopic teeth were investigated using coronal, axial and, sagittal CBCT (J Morita MFG Corp., Kyoto, Japan) sections in regions

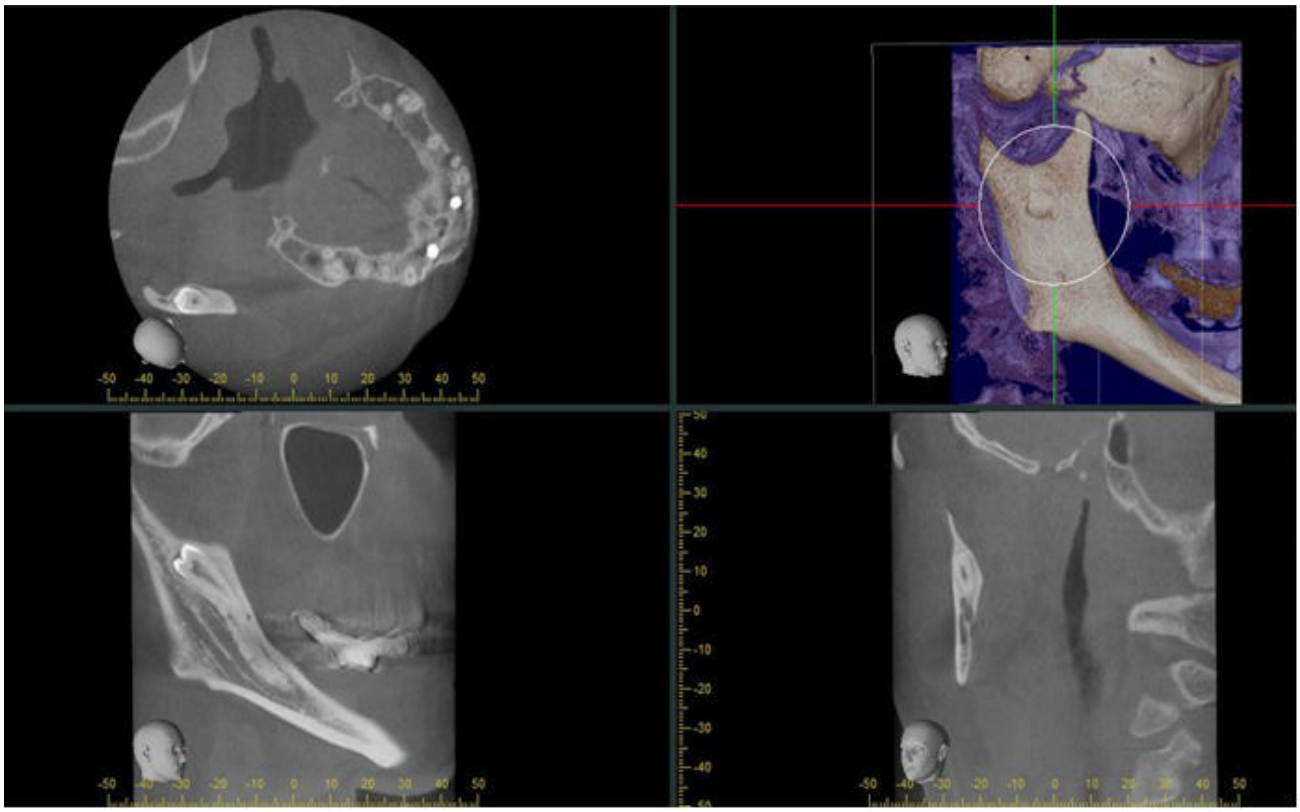

Figure 1. A heterotopic right mandibular third molar tooth in the mandibular ramus on coronal, axial and sagittal CBCT sections. White arrows show the heterotopic teeth.

distant from the maxillary-mandibular arch (e.g. ramus, maxillary sinus, condylar region, orbital region) Figure 1, Figure 2. Observations were done by large FOV images (100x100 mm, 140x100 mm, 170x120). Images were taken using 250 μm voxel size, 17.5 seconds exposure time, 5 mA, and 90 kVp parameters. All scans and parameters were determined according to the manufacturer's recommended protocol. 2.66 GHz Intel Xeon computer with 3.25 GB RAM and Windows XPTM Professional operating system processor and 27" Dell U2711HTM monitor with 2560×1600-pixel resolution (U2711HTM; Dell, Round Rock, TX, USA). All assessments were done by using i-Dixel software (J Morita MFG Corp., Kyoto, Japan) on a flat-screen monitor by the same examiner.

SPSS V.21 software (IBM Corp., Armonk, NY, USA) was used for data analysis. Descriptive statistics (mean, standard deviation) were calculated for all parameters in this study. Mann-Whitney U test was applied to test the relationship between age and heterotopic tooth. The chi-square test was used to determine the relationships between categorical variables, and significance level was $p < 0.05$.

Figure 2. A heterotopic right maxillary third molar tooth in the maxillary sinus on coronal CBCT sections and white arrow shows the heterotopic teeth.

Results

Heterotopic teeth were found in 10 of 2590 individuals (0.4%). All the heterotopic teeth detected were molar teeth; 4 of them were mandibular third molar teeth, 5 of them were maxillary third molar teeth and 1 of them was maxillary second molar tooth. 4 of the heterotopic impacted teeth were located in the ramus, and 6 in the maxillary sinus. The distribution of heterotopic teeth according to the region is given in Table 1. The frequency of heterotopic teeth according to gender did not show a statistically significant difference (4 females, 6 males, $p > 0.05$). The average age of individuals with heterotopic teeth was 35.3 (17-65 years). There was no statistically significant relationship between age and heterotopic teeth. The distribution of heterotopic teeth according to age and gender was given in Table 2.

All experience indicates that distance education will be more than a necessity in the coming period. Especially, ensuring the continuity of service and education is very important in maxillofacial radiology, which is an indispensable branch for the scientific continuity of dentistry. Data obtained as a result of studies showed that distance education still has shortcomings in radiology practical training. Despite some drawbacks, the integration of online learning into radiology education should be utilized rapidly. It is inevitable to change hygiene habits after the pandemic and to make necessary changes in maxillofacial radiology education.

Table 1. The distribution of heterotopic teeth according to region

Tooth Number	Frequency	Region
18	3	Maxillary Sinus
27	1	Maxillary Sinus
28	2	Maxillary Sinus
38	2	Mandibular Ramus
48	2	Mandibular Ramus
Total	10	

Discussion

The occurrence of heterotopic teeth, which is a dental position anomaly, is a very rare condition. They are usually asymptomatic so do not cause patient complaints. Therefore, clinicians usually notice it by chance during the clinical examination. The location where they are found, relationship with anatomical structures, the age of the patient are factors that determine the prognosis of the heterotopic tooth. The purpose of this study was to investigate the frequency of heterotopic teeth, their gender tendency, and preferred anatomical localization using CBCT. The terms heterotopia and ectopia are two terms that are often used and confused interchangeably. Both conditions are very rare and etiologically similar factors cause them. In the literature, the term ectopia was used more frequently in the presence of an abnormal eruption pattern with the teeth on the dental arch.[5] Therefore, it would be more appropriate to use the term heterotopia for teeth detected in regions distant from the dental arch. The first case report on heterotopic teeth published in the literature is by Keros et al.[4] in 1997. Prior to the case reported by Keros et al.[4], there were some reports of impacted teeth in the maxillary sinus or mandibular condyle under the term ectopic teeth.[6] Although there are many case reports published from then to now, a systematic review or epidemiological study is not available due to very rare occurrence of heterotopic teeth. The study, which is conducted by Elsayed et al.[7] with 9000 dental panoramic radiographies, has found the frequency of ectopic teeth to be 0.7%. Similarly, in this study, which was performed with 2590 CBCT slices, the frequency of heterotopic teeth was found to be 0.4Heterotopic teeth may be permanent, deciduous or supernumerary. Although usually heterotopic teeth are supernumerary teeth or mesiodens, they were excluded in this study. This study is only focused on permanent teeth. Of the 10 heterotopic teeth detected in this study, 9 were third molars. Third molars are the last to take place in the dental arch and are the last to develop embryologically, and the teeth that are most affected by developmental conditions and traumas. Therefore, third molars are the most frequently encountered heterotopic teeth.[1,4] In the literature review of Iglesias et al.[8] covering the years 1980-2011, they collected 14 well-documented clinical cases about ectopically located molar teeth. Of the detected teeth, 11 were reported as mandibular third molars, of which 5 were in the mandibular ramus and 6 were in the coronoid process. Thus, it may be said lower ectopic third molars prefer the subcondylar or condylar region. In the maxillary region, ectopically located teeth may be found in many various anatomical locations as infratemporal fossa, intranasal region, maxillary sinus, etc. In the study of Baykul et al.,[9] in which they only evaluated teeth located in the maxillary sinus, the most common teeth in the maxillary sinus were molars, with a rate of 66.6%. Half of the molars were formed by the third molars. It is also supported by the results of the present study that the maxillary sinus is the place where molar teeth are often encountered ectopically. According to the results of the present study, gender was not effective in the appearance of heterotopic teeth. However, no gender tendency was observed in studies on ectopic teeth.[7] In contrast, some studies have reported a slight gender tendency.[10] Since some of these studies have a female tendency and some have a male tendency, it is not possible to talk about the existence of a specific dominant gender. Considering the age of individuals with heterotopic teeth, there were case reports presented at very different ages in the literature.[1,8] Since heterotopic teeth are usually asymptomatic, they can be detected incidentally in different age groups. It is likely to be detected at an earlier age in syndromic individuals and symptomatic patients. Nevertheless, for heterotopic teeth, more epidemiological studies are needed. Panoramic radiography is the standard diagnostic imaging method for dentistry. However, the third dimension may be needed to overcome the disadvantages of panoramic radiography.[8] Generally, the first examination of impacted teeth is done by panoramic radiographs and CBCT could be taken before surgical procedures, to determine the exact relationship with anatomical structures or to differentiate them from tooth-like calcifications.[3] This study was performed with axial, coronal, and sagittal CBCT slices so that heterotopic calcifications with tooth-like appearance could be exactly identified. When heterotopic teeth are detected, they are appropriate to be regular, followed by most clinicians or surgeons due to their surgically difficult-to-access location. Although they usually tend to be asymptomatic, there were cases with symptoms such as pain, limitation of mouth opening, swelling, facial asymmetry, nasal obstruction, speech problem or chronic rhinorrhea.[8,9] In cases where a surgical approach will be performed, the experience and preference of the surgeons are the main determinants.[9] Conservative treatment that will create minimal trauma should be determined according to the position of the tooth. Although the intraoral approach is generally preferred in the operation, the extraoral approach may also be preferred in cases where the field of view will be limited. On the other hand, the aesthetic disadvantage of the extraoral approach should be considered as an additional complication.

Conclusion

The prevalence of heterotopic teeth was very rare (0.4%). The teeth with the highest frequency of heterotopia were the third molars. Heterotopic teeth did not have an anatomical location and gender that they preferred predominantly. More epidemiological studies are needed regarding the distribution of heterotopic of teeth with larger samples.

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Author Contributions

Conception / design of the work: M.T. Acquisition, analysis and interpretation of the data: M.T., F.Y. Drafting the work: M.T.,F.Y. Final approval of the version to be published: M.T. Investigation of accuracy and integrity of any part of work: M.T.

Conflict of Interest

Authors declare that they have no conflict of interest.

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Table 2. The distribution of heterotopic teeth according to age and gender of the patient

Tooth number	Region	Age of patient	Gender of patient
18	Maxillary sinus	21	Female
18	Maxillary sinus	24	Female
18	Maxillary sinus	33	Male
27	Maxillary sinus	49	Male
28	Maxillary sinus	17	Male
28	Maxillary sinus	19	Female
38	Mandibular ramus	60	Female
38	Mandibular ramus	65	Male
48	Mandibular ramus	32	Male
48	Mandibular ramus	33	Male

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CONGRESS PROCEEDING

In Vitro Comparison of Indirect Bonding Methods Using Different Isolation and Adhesive Systems with Each Other

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Abstract

Purpose of this study is to compare the shear bond strength and adhesive remnant index of a new indirect bonding isolation method for different adhesive systems with the direct bonding technique. 100 premolars and 10 incisors extracted human teeth were bonded with one direct and four indirect bonding methods, and then subjected to 1000 thermal cycles between 5°C and 55°C. Adhesive Remnant Index (ARI) was analyzed by the chi-square test. The Shear Bond strength was analyzed by the analysis of variance (ANOVA) and the Tukey multiple comparison (HSD) test. The bracket-enamel interface area of two teeth from each group was examined under scanning electron microscope (SEM). All groups provided clinically acceptable bond strengths. In the traditional isolation + light-cured bonding group with the highest bonding values identified, the scores for all failures were recorded as 3 and this group differs from all other groups in respect of ARI scores ($p<0.05$). In addition, it was identified from SEM images that there were air bubbles in the adhesive layer in the groups where chemical adhesives were used. When a tape is used as the isolation material, the laboratory process stage is shortened and simplified. Therefore, if the custom base indirect bonding technique is to be used, this new method can be used with light-cured bonding agent for isolation.

Key words: chemically cured; indirect bonding; light-cured

Introduction

The "indirect bonding technique" was firstly introduced in 1972 by Silverman et al.[1] for more accurate and effective placement of brackets on teeth. Later, Thomas[2] introduced a new method creating a custom base made of composite resin under the bracket. This method has not only allowed for an extension of the working time as desired, but also reduced the composite resin flash problems. However, the most disputed issue in this method is the possibility of the weak bonding between the adhesive and the bracket base made of composite resin customized for the patient and the possible reasons for this weakness.[3] Following their manufacture, composite custom bases are usually sanded with 50 μm aluminum oxide particles and cleaned with alcohol to get rid of oil residues and separating medium residues on the composite base.[4] Despite the known fact that any cleaning applied onto the composite resin base reduces the bonding strength of the bracket to the enamel; there has been no isolation method developed to prevent the contamination of composite resin base with undesirable substances. In addition, while there are many adhesive systems produced for use with the direct bonding technique today, the adhesive systems produced for the indirect bonding technique are limited.

The objective of this study was to identify the most suitable adhesive system that can be used with the custom base indirect bonding technique and the most appropriate isolation system by comparing two different isolation methods.

Methods

One hundreed maxillary and mandibular premolar and 10 incisor teeth without any cracks, fractures, white spot lesions, or filling on their enamel surfaces were cleaned and then stored in a 5% chloramine-T solution at 4°C for a week and subsequently in distilled water at 4 °C. The teeth were mounted in acrylic blocks in groups of 10 each with the teeth coming into contact with each other at their contact points. After taking measurements in the indirect bonding groups, 38% phosphoric acid (Gel Etching Agent,

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Reliance Orthodontic Products, Inc., Itasca, USA) was applied onto the enamel surfaces of all teeth. After waiting for 30 seconds, the surface of each tooth was washed with pressurized water for 10 seconds and then dried for 10 seconds. It was observed that an opaque white area formed on the enamel after this treatment.

In the direct bonding control group, Transbond TM XT Light Cure Adhesive Primer (3M Unitek, Monrovia, CA, USA) was applied as a thin coat onto the enamel surface and bracket base, followed by the placement of Transbond XT onto the composite resin base, filling up to the half of the bracket base area; and then, the bracket was placed on the tooth surface. The composite resin was polymerized by applying plasma arc light (Apollo 95 E Denmark Technologies, Inc., USA) for 3 seconds per bracket.

In the indirect bonding group named TT (Tape + Transbond), after waiting one day for the hard plaster models to dry, stationery-type plastic clear adhesive tape was attached to the buccal surfaces of the teeth only in the plaster model for isolation purposes. After applying Transbond XT bond and Transbond XT composite resin onto the bases of the brackets, the brackets were placed on the tape-covered plaster model by applying constant pressure for 5 seconds. Following the application of plasma arc light for 3 seconds, all brackets were coated with Emiluma (Ortho Kinetics, USA) and a tray was formed with 0.40-inch-thick Essix (Raintree Essix, Inc., USA) plate. After removing the tray from the model together with the brackets, no treatment was applied except for slightly spraying air against the composite surface. After applying Transbond XT bond onto the teeth prepared as described above, the tray was positioned, and the brackets were bonded to the teeth by applying plasma arc light for 3 seconds.

In the indirect bonding group named TS (Tape + Sondhi), the steps explained above were exactly followed; but instead of Transbond XT, Sondhi Rapid set was applied according to the user company's recommendation.

In the indirect bonding group named IT (Isolant + Transbond), the steps described for the group named TT were repeated exactly; but Isolant was used for isolation of the models, and then, the composite surfaces of the tray were carefully sandblasted with 50 μm aluminum oxide particles, cleaned with alcohol, and then dried with air. In the IS (Isolant + Sondhi) group, the steps described for the group named IT were repeated exactly; but; but instead of Transbond XT, Sondhi Rapid set was applied according to the user company's recommendation.

After undergoing 1000 cycles in the thermocycling device at a temperature set between 5°C and 55°C with a dwell time of 30 seconds in each bath, the samples were stored in distilled water at 37°C for 72 hours. The speed of the upper movable table of the Instron testing machine (Hounsfield, United Kingdom) was set as 0.5 mm/minute and the measurements were made with 1N precision. Variable forces generated in response to movement at a constant speed of 0.5 mm/minute were monitored from the electronic display and the highest value of the force generated at the time of failure was recorded (Table 1). The surfaces of the teeth were examined at 30X magnification. Adhesive Remnant Index (ARI) defined by Artun and Bergland was used to define the failure sites.[5] (Table 2) The bracket-enamel interface area of two teeth from each group was examined under scanning electron microscope (SEM). The thickness of the adhesive remaining between the composite resin and enamel layers on each tooth was measured in three separate sites. A total of 30 measurements, including 6 measurements per group, were performed at 1000X magnification and the photographs of the sites of such measurements were taken. In addition, the bracket-enamel interface area was also examined at 40X magnification to examine the presence of air bubbles. All statistical evaluations were performed using SPSS (Statistical Package for Social Sciences, SPSS for Windows 10.0.1, SPSS Inc, Chicago) package program. The descriptive statistical data including mean, standard deviation, minimum and maximum values of the shear testing results in MPa were calculated for the Control, TT, TS, IT, and IS groups. The comparison of the groups was performed using the analysis of variance (ANOVA) and the Tukey multiple comparison (HSD) test. Chi-square (X^2) analysis was performed to compare the ratios of ARI scores. Kruskal-Wallis analysis of variance was used to compare the medians of three measurements made for two teeth per each of Control, TT, TS, IT, and IS groups against five groups.

Table 1. Statistical comparison of tensile test (MPa) results.

Groups	N	Mean	SD	Min	Max	Tukey Test*
Control	20	8.2	3.3	3.9	16.6	AB
TT	20	8.6	4	3.1	13.8	AB
TS	20	8.0	3.4	4.1	17.6	AB
IT	20	10.3	3.4	5.5	1.8	A
IS	20	7.1	2.7	4.0	13.8	B
		F=2.68		p=0.048		

N: Number of sampels, SD: standard deviation, Min: Minumum value, Max: Maximum value *Groups shown with different letters differ statistically significantly.

Table 2. Distribution of ARI scores and results of x^2-square test

Groups	N	1	2	3	4	5
Control	20	0	8	11	1	0
TT	20	1	3	11	3	2
TS	20	0	3	12	5	0
IT	20	0	0	20	0	0
IS	20	0	1	14	5	0
		x^2 = 36.301		p=0.003		

Results

The data were evaluated using ANOVA and in the comparison of the stress measurements of the groups, the difference between the groups was found to be significant ($p<0.05$). As a result of the Tukey test, the difference between the IT group and the IS group was found significant ($p<0.05$). When the adhesive remaining on the enamel surface was evaluated under a stereo light microscope, it was determined that there were statistically significant differences between the groups (X^2=36.301, p=0.003). The difference between the IT group and all other groups was found to be statistically significant ($p<0.05$). In addition, there was a significant difference identified between the control group and the IS group ($p<0.05$). While all of the failures observed in the IT group occurred at Score 3, i.e. on the composite resin; the failures in the other groups varied with different scores.

In the comparison of the findings obtained from the analysis of adhesive thicknesses under SEM, there were significant differences between the direct bonding group and all other groups ($p<0.05$). In addition, the difference between the TT group and the TS group and IT group and the difference between the TS group and the IS group were found to be significant ($p<0.05$). However, the difference between the TT group and the IS group was found to be insignificant ($p<0.05$). In addition, it was identified based on the SEM images that there were air bubbles in the adhesive layer in the TS and IS groups.

Discussion

While custom base technique offers the advantage of easy removal of adhesive remnants after bonding of the brackets, it also has a disadvantage caused by the formation of an interface layer between the old composite resin and the new adhesive.[3] The adhesive systems

other than thermosetting adhesive systems are basically systems produced for use with the direct bonding technique. Besides the advantages of chemically-cured adhesives such as ease of use, easy learning of the system, and quick working capability, it is stated that they also have some disadvantages such as limited working time, excessive polymerization shrinkage occurring due to the internal stresses caused by sudden onset of polymerization, and reduced bond strength due to the entrapment of air bubbles in them during mixing in dual-cure systems.[6] While the biggest advantage of light-cured adhesives is the ability to control their polymerization times, it has been reported that the length of exposure times of these adhesive systems might pose a disadvantage in a clinical setting.[7]

In this study, Transbond XT primer adhesive was preferred in the control group (direct bonding) and the two indirect bonding groups due to its compatibility with Transbond XT composite resin to make a comparison with Sondhi Rapid-Set adhesive system. A clear full arch tray was used since this primer has a light-cured structure to better represent the mouth environment. Silicone-based Emiluma, a transparent material produced to form trays in the indirect bonding technique only, was used as the tray material. Since this material has a light body consistency, the stability was assured by forming a second tray using thermoplastic material.

The new isolation method that we used in our study was the isolation of the plaster model directly with clear tape. The advantage of this isolation method is that there is no waste of time for cleaning after the removal of the tray from the model, thus eliminating the risk of damage to the composite resin custom base likely to be caused by cleaning. In this isolation method that we apply, the composite resin that will form the custom base is polymerized by remaining between the clean tape and the bracket base. The bonding strength of the composite resin to the tape is high enough to keep the brackets fixed on the model during the formation of the tray. In contrast, a slight mechanical force is sufficient to remove the tray from the model when desired. As a result of this study, only the 3rd indirect bonding group for which Transbond XT primer adhesive was used was found to have a higher bond strength compared to the 4th indirect bonding group for which Sondhi Rapid Set was used as the adhesive system. No statistically significant differences were identified in the other comparisons between groups. The 4th indirect bonding group was the group with the lowest average bond strength of 7.1 MPa. The lower values required for clinical success in the literature vary in the range between 5.9 and 7.8 MPa. Even the 4th indirect bonding group has satisfied these clinically acceptable bond strengths.

No statistically significant differences were identified between all the other indirect bonding groups and the direct bonding group. However, in both indirect bonding groups in which Transbond XT was used as adhesive, the bonding values were found to be higher than the direct bonding group for which the same material was used. Although these high values were not found statistically significant, we can say that the indirect bonding method is at least as reliable as the direct bonding material since the same adhesive materials were used in all of the three groups. This finding is also consistent with many other studies. There is no statistically significant difference between the direct bonding group and the 2nd indirect bonding group for which Sondhi Rapid Set was used as adhesive, either. When the values obtained are reviewed regardless of the isolation method, it is observed that the average bond strengths in the groups using Sondhi Rapid Set as adhesive are lower than the groups for which Transbond XT adhesive primer was used. We think that this was caused by the air bubbles that we have identified in the groups for which Sondhi Rapid Set was used, as shown by the SEM examinations.

Considering ARI score values that we have obtained in our study, failures are mostly of cohesive nature. In the IT group with the highest bonding values identified, all failures were found to be at score 3 and this group differs from all other groups in terms of ARI scores ($p<0.05$). The IT group is also the group found to have the thickest interlayer in SEM. Based on these data, it can be concluded that the thick interlayer identified in SEM in the indirect bonding groups is not a weak zone. The score 5 recorded for these teeth reveals that the adhesive has neither efficiently bonded to the enamel surface, nor adhered to the enamel surface at all. However, we think that this has resulted from the fact that the tape surface of the composite resin base has weakened the bond strength with the adhesive primer due to its smooth surface structure. In the shear test results that we have obtained, lower values were recorded in the group TT compared to the IT group, which also supports our opinion. We think that this problem can be solved by using a tape with a rough surface for isolation purposes, thus further increasing the bonding values in the groups in which tape is used. Since the failure is of cohesive nature in all the other teeth, it is seen that there is no difference between the techniques in terms of the ease of cleaning of the composite residues remaining after debonding, either.

Conclusion

Because of the air bubbles in Sondhi adhesive groups, it is recommended to use Transbond XT as the adhesive system. However, in cases where light-cured adhesive systems cannot be used, Sondhi adhesive can be used on the condition that tape is preferred as the isolation method.

Author Contributions

B.K. and C.D. planned the study design. B.K. prepared the samples and performed the laboratuary tests. C.D. evaluated the results. B.K. wrote the text and C.D. made the necessary corrections.

Conflict of Interest

Authors declare that they have no conflict of interest.

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CONGRESS PROCEEDING

In Vitro Comparison of Indirect Bonding Methods Using Different Isolation and Adhesive Systems with Each Other

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Abstract

Purpose of this study is to compare the shear bond strength and adhesive remnant index of a new indirect bonding isolation method for different adhesive systems with the direct bonding technique. 100 premolars and 10 incisors extracted human teeth were bonded with one direct and four indirect bonding methods, and then subjected to 1000 thermal cycles between 5°C and 55°C. Adhesive Remnant Index (ARI) was analyzed by the chi-square test. The Shear Bond strength was analyzed by the analysis of variance (ANOVA) and the Tukey multiple comparison (HSD) test. The bracket-enamel interface area of two teeth from each group was examined under scanning electron microscope (SEM). All groups provided clinically acceptable bond strengths. In the traditional isolation + light-cured bonding group with the highest bonding values identified, the scores for all failures were recorded as 3 and this group differs from all other groups in respect of ARI scores ($p<0.05$). In addition, it was identified from SEM images that there were air bubbles in the adhesive layer in the groups where chemical adhesives were used. When a tape is used as the isolation material, the laboratory process stage is shortened and simplified. Therefore, if the custom base indirect bonding technique is to be used, this new method can be used with light-cured bonding agent for isolation.

Key words: chemically cured; indirect bonding; light-cured

Introduction

The "indirect bonding technique" was firstly introduced in 1972 by Silverman et al.[1] for more accurate and effective placement of brackets on teeth. Later, Thomas[2] introduced a new method creating a custom base made of composite resin under the bracket. This method has not only allowed for an extension of the working time as desired, but also reduced the composite resin flash problems. However, the most disputed issue in this method is the possibility of the weak bonding between the adhesive and the bracket base made of composite resin customized for the patient and the possible reasons for this weakness.[3] Following their manufacture, composite custom bases are usually sanded with 50 μm aluminum oxide particles and cleaned with alcohol to get rid of oil residues and separating medium residues on the composite base.[4] Despite the known fact that any cleaning applied onto the composite resin base reduces the bonding strength of the bracket to the enamel; there has been no isolation method developed to prevent the contamination of composite resin base with undesirable substances. In addition, while there are many adhesive systems produced for use with the direct bonding technique today, the adhesive systems produced for the indirect bonding technique are limited.

The objective of this study was to identify the most suitable adhesive system that can be used with the custom base indirect bonding technique and the most appropriate isolation system by comparing two different isolation methods.

Methods

One hundreed maxillary and mandibular premolar and 10 incisor teeth without any cracks, fractures, white spot lesions, or filling on their enamel surfaces were cleaned and then stored in a 5% chloramine-T solution at 4°C for a week and subsequently in distilled water at 4 °C. The teeth were mounted in acrylic blocks in groups of 10 each with the teeth coming into contact with each other at their contact points. After taking measurements in the indirect bonding groups, 38% phosphoric acid (Gel Etching Agent,

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Reliance Orthodontic Products, Inc., Itasca, USA) was applied onto the enamel surfaces of all teeth. After waiting for 30 seconds, the surface of each tooth was washed with pressurized water for 10 seconds and then dried for 10 seconds. It was observed that an opaque white area formed on the enamel after this treatment.

In the direct bonding control group, Transbond TM XT Light Cure Adhesive Primer (3M Unitek, Monrovia, CA, USA) was applied as a thin coat onto the enamel surface and bracket base, followed by the placement of Transbond XT onto the composite resin base, filling up to the half of the bracket base area; and then, the bracket was placed on the tooth surface. The composite resin was polymerized by applying plasma arc light (Apollo 95 E Denmark Technologies, Inc., USA) for 3 seconds per bracket.

In the indirect bonding group named TT (Tape + Transbond), after waiting one day for the hard plaster models to dry, stationery-type plastic clear adhesive tape was attached to the buccal surfaces of the teeth only in the plaster model for isolation purposes. After applying Transbond XT bond and Transbond XT composite resin onto the bases of the brackets, the brackets were placed on the tape-covered plaster model by applying constant pressure for 5 seconds. Following the application of plasma arc light for 3 seconds, all brackets were coated with Emiluma (Ortho Kinetics, USA) and a tray was formed with 0.40-inch-thick Essix (Raintree Essix, Inc., USA) plate. After removing the tray from the model together with the brackets, no treatment was applied except for slightly spraying air against the composite surface. After applying Transbond XT bond onto the teeth prepared as described above, the tray was positioned, and the brackets were bonded to the teeth by applying plasma arc light for 3 seconds.

In the indirect bonding group named TS (Tape + Sondhi), the steps explained above were exactly followed; but instead of Transbond XT, Sondhi Rapid set was applied according to the user company's recommendation.

In the indirect bonding group named IT (Isolant + Transbond), the steps described for the group named TT were repeated exactly; but Isolant was used for isolation of the models, and then, the composite surfaces of the tray were carefully sandblasted with 50 μm aluminum oxide particles, cleaned with alcohol, and then dried with air. In the IS (Isolant + Sondhi) group, the steps described for the group named IT were repeated exactly; but; but instead of Transbond XT, Sondhi Rapid set was applied according to the user company's recommendation.

After undergoing 1000 cycles in the thermocycling device at a temperature set between 5°C and 55°C with a dwell time of 30 seconds in each bath, the samples were stored in distilled water at 37°C for 72 hours. The speed of the upper movable table of the Instron testing machine (Hounsfield, United Kingdom) was set as 0.5 mm/minute and the measurements were made with 1N precision. Variable forces generated in response to movement at a constant speed of 0.5 mm/minute were monitored from the electronic display and the highest value of the force generated at the time of failure was recorded (Table 1). The surfaces of the teeth were examined at 30X magnification. Adhesive Remnant Index (ARI) defined by Artun and Bergland was used to define the failure sites.[5] (Table 2) The bracket-enamel interface area of two teeth from each group was examined under scanning electron microscope (SEM). The thickness of the adhesive remaining between the composite resin and enamel layers on each tooth was measured in three separate sites. A total of 30 measurements, including 6 measurements per group, were performed at 1000X magnification and the photographs of the sites of such measurements were taken. In addition, the bracket-enamel interface area was also examined at 40X magnification to examine the presence of air bubbles. All statistical evaluations were performed using SPSS (Statistical Package for Social Sciences, SPSS for Windows 10.0.1, SPSS Inc, Chicago) package program. The descriptive statistical data including mean, standard deviation, minimum and maximum values of the shear testing results in MPa were calculated for the Control, TT, TS, IT, and IS groups. The comparison of the groups was performed using the analysis of variance (ANOVA) and the Tukey multiple comparison (HSD) test. Chi-square (X^2) analysis was performed to compare the ratios of ARI scores. Kruskal-Wallis analysis of variance was used to compare the medians of three measurements made for two teeth per each of Control, TT, TS, IT, and IS groups against five groups.

Table 1. Statistical comparison of tensile test (MPa) results.

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		F=2.68		p=0.048		

N: Number of sampels, SD: standard deviation, Min: Minumum value, Max: Maximum value *Groups shown with different letters differ statistically significantly.

Table 2. Distribution of ARI scores and results of x^2-square test

Groups	N	1	2	3	4	5
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IT	20	0	0	20	0	0
IS	20	0	1	14	5	0
		x^2 = 36.301		p=0.003		

Results

The data were evaluated using ANOVA and in the comparison of the stress measurements of the groups, the difference between the groups was found to be significant ($p<0.05$). As a result of the Tukey test, the difference between the IT group and the IS group was found significant ($p<0.05$). When the adhesive remaining on the enamel surface was evaluated under a stereo light microscope, it was determined that there were statistically significant differences between the groups (X^2=36.301, p=0.003). The difference between the IT group and all other groups was found to be statistically significant ($p<0.05$). In addition, there was a significant difference identified between the control group and the IS group ($p<0.05$). While all of the failures observed in the IT group occurred at Score 3, i.e. on the composite resin; the failures in the other groups varied with different scores.

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Conclusion

Because of the air bubbles in Sondhi adhesive groups, it is recommended to use Transbond XT as the adhesive system. However, in cases where light-cured adhesive systems cannot be used, Sondhi adhesive can be used on the condition that tape is preferred as the isolation method.

Author Contributions

B.K. and C.D. planned the study design. B.K. prepared the samples and performed the laboratuary tests. C.D. evaluated the results. B.K. wrote the text and C.D. made the necessary corrections.

Conflict of Interest

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CONGRESS PROCEEDING

Knowledge Skills and Attitudes of Dentistry and Dental Clinic Assistant Students Related to Online Pedodontics Lecture During the Covid-19 Pandemic

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Abstract

Purpose: In Turkey, with Covid-19 pandemic, online education system has been introduced, as is the case all over the world. Since March 2020, dentistry(D) and dental clinic assistant(DCA) students have taken pedodontics lessons online. This research; Necmettin Erbakan University Faculty of Dentistry and dental clinic assistant students aim to evaluate efficiency of education given in online pedodontics course, the satisfaction of students and online course system.
Methods: In questionnaire, there are multiple-choice questions about methods of accessing online education system and access knowledge and skills of students. In addition, various propositions about pedodontics classes were presented to students to be answered with Likert scale consisting of 1-5, strongly disagree, disagree, undecided, agree and strongly agree options. This questionnaire was conducted over internet, with anonymity for identity of students. IBM SPSS Statistics25 program was used for statistical evaluations.
Results: Survey participated by 88D and 59DCA students; 40.1% of students reported that they connected to lessons via their mobile phones and tablets. Statistically significant difference was not found between two groups in terms of difficulty and effort levels in their connection to classes(p=0.622,p=0.348). In contribution of pedodontics to students' knowledge levels was found that knowledge levels of students with easy access to internet at the beginning and end of lessons were significantly different from those with difficult access(p=0.002). Lecturers' skill level and their competence do not differ significantly according to groups. Statement that watching webinars is more beneficial than online education has been the proposition with lowest mean score.
Conclusions: Dentistry and dental clinic assistant students faced various difficulties adapting to online education system. Internet and technology-based system caused inequalities in education levels of students, tried to be balanced lecturers. While pandemic process continues in an unpredictable way, lecturers have great responsibility to make pedodontics lesson reach their goals fairly.

Key words: Covid-19 Pandemic; Online Lectures; Pedodontics

Introduction

In our country; within the scope of oral and dental health services, there is an associate degree program that provides training to train "oral and dental health technicians" or "dental clinical assistants" in order to meet the dentist's need for assistant personnel before and after treatment. With the Covid-19 pandemic, all courses of dentistry and dental clinical assistant students started to be given online in the process.[1–3] Online courses are a new system for lecturers as well as students. Basic factors such as system requirements, the necessity of using internet-based programs, the quality of the material to be used as a program tool, internet connection speed, economic requirements, home-office working style affected the quality of the courses. Lecturers are aware of the adaptation process with these factors and are responsible for providing the necessary understanding, as well as maintaining the quality of the course.[4] Our study aims to evaluate the effectiveness of the education given in the online pedodontics course of Necmettin Erbakan University Faculty of Dentistry and dental clinic assistant students, student satisfaction and the online course system through a questionnaire.

Methods

The first part of the prepared questionnaire consists of 10 questions aiming to measure the students' age, gender and the level of their

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education, and the theoretical knowledge level. This questionnaire was administered on the internet in a way that the identity of the students was confidential. In the second part where the clinical attitudes of the students are evaluated; 11 questions were asked in which multiple-choice answers were sought (always, often, sometimes, never). Chi-square test was used for statistical analysis between groups and Man-Whitney-U tests were used for analysis within groups. IBM SPSS Statistics 25 (IBM Corporation, Armonk, NY, USA) program was used for statistical evaluations.

Results

The students' means of connecting to the lesson were 40.1% via mobile phones and laptop computers. 125 out of 147 students reported that they used their mobile phones to attend lectures. In the question in which the belonging of the students' tools for connecting to the courses were evaluated, 72.1% reported that the tools belonged to themselves. No statistically significant difference was found according to the Chi-square test performed in the evaluation of the ease of access to the Internet by the students of dentistry and dental clinic assistants ($p=0.622$). In the question in which the level of effort of the students to receive distance education was evaluated, there was no statistically significant difference between the levels of effort ($p=0.348$). According to the Mann-Whitney-U test results, students who reported that accessing the internet were easy compared to those who said it was difficult, the level of skill-knowledge at the beginning of the lessons $p=0.002$; level at the end of the lessons $p=0$; level of knowledge required to complete courses $p=0$; The contribution of the courses to the skill/knowledge level was reported as $p=0$. In the section of the contribution of online courses to your knowledge, the option of "connecting to courses" and the section read did not significantly affect the answers ($p>0.05$). The answers given to the questions of the skill level of the trainers and their proficiency in responding did not differ significantly according to the section read ($p>0.05$). In the answers given to the questions about the skill level of the trainers; A statistically significant difference was found for students who attended classes with facilities such as internet cafe or library compared to other students ($p<0.05$). Students reported that watching webinars is not more beneficial than theoretical training. The answer given by the students to the proposition "I can download and upload a file" in the system requirements section was found to be the proposition with the highest score. Hybrid education was preferred more by dental clinical assistant students.

Discussion

During the COVID 19 pandemic process, a rapid crisis management and online distance education process was implemented in order not to interrupt the education-training process. Identifying some of the difficulties and deficiencies that occurred during the sudden transformation of a planned model for formal education into online distance education and receiving direct feedback from students may enable the crisis to be turned into an opportunity by developing and improving this education method. For this purpose, in this study was aimed to evaluate the effectiveness of the education given in the online pedodontics course for dentistry and dental clinic assistant students, student satisfaction and the online course system through a questionnaire. In a study conducted on Physiotherapy and Rehabilitation Department students, it was suggested that the additional use of online learning in clinical learning could help bridge the theory-practice gap and support advanced clinical skill learning.[5] In this study, it has been seen that the contribution of online distance education to the theoretical knowledge level of the students is more than its contribution to the application skill. One-to-one practice by students after listening to the course content can contribute more to the both student's professional practice skills. It has been reported that the integration of online learning with the virtual community can encourage student engagement that can improve learning outcomes.[6] The study of Cheng and Chau (2016) focused on the important role of social interaction in online education.[7] On the other hand, it has been reported that the lack of social bonding and low solidarity among students in online education can reduce students' social interactions and they may have low performance and high attrition rate. It is seen that online distance education is advantageous in that it allows students to learn information at their own pace and to receive information at the specified time. However, the fact that students do not receive sufficient feedback, think that they cannot express themselves adequately, and forget the topics they have listened to quickly shows that this education model has disadvantages within the disabilities by connection models. A meta-analysis reported that planning for online learning should not only cover content, but also carefully consider how to support different interactions that are important for the learning process.[8] Learning processes usually take place in groups and through social interaction, even in online education.[9] It has been reported that students in an online learning community perform better with higher interaction, learning achievement, and student engagement.[10] Similarly, student-trainer interactions have been recognized as other important interactions that occur in an online education.[11] Although a study conducted with medical school students showed that direct and open communication with classmates, teachers and education team increased the level of trust and cooperation, another study on dentistry students, online education, it promotes self-learning independence among students and demonstrates that it improves their ability to use online resources.[12,13] Both the dentistry and dental clinic assistant students need to be more encouraged by the lecturers to support theoretical knowledge after lessons. Besides lecturers should support students considering their difficulties in accessing the lessons.

Conclusion

Dentistry and dental clinic assistant students faced various difficulties adapting to online education system. Internet and technology-based system caused inequalities in education levels of students, tried to be balanced lecturers. While pandemic process continues in an unpredictable way, lecturers have great responsibility to make pedodontics lesson reach their goals fairly.

None

Author Contributions

Conceived and designed the analysis; H. O., M.A.I Collecting of the data; Y.D.F. Contributing data or analysing tools; H.O. Performed the analysis; M.A.I. Writing of the paper H.O., M.A.I., Y.D.F.

Conflict of Interest

Authors declare that they have no conflict of interest.

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CONGRESS PROCEEDING

Effects of Different Beverages on Color Stability of Bulk-Fill Restorative Materials

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Abstract

Purpose: The aim of the study is to evaluate the color stability of a conventional composite resin and bulk-fill composite resins.
Material Methods: A total of 120 samples of 10 mm diameter and 2 mm thickness were prepared from three bulk-fill (Beautifil Bulk-Fill, Filtek One Bulk-Fill, Tetric N-Ceram Bulk-Fill) and one conventional composite (Z250) and light cured. Initial color measurements were made with a spectrophotometer. Samples for each composite were randomly divided into 3 groups (black, kombucha and matcha tea) (n = 10). The samples were kept in the solutions for 12 days, and the color measurement was repeated. The values of δL, δa, δb and $\delta E00$ were calculated. SEM images were taken from a randomly selected sample from each group. Two-way analysis of variance (ANOVA) with Bonferroni correction was used to evaluate the color parameters.
Results: Beautifil composite showed the greatest change in all values of E00, δL, δa, and δb., Filtek One and Tetric N-Ceram had the highest $\delta E00$ values values after Beautifil, respectively, and there was no difference between Z250 and Tetric N-Ceram. The lowest δL value belonged to Z250 composite, there was no difference between Tetric N-Ceram and Filtek One. Tetric N-Ceram had the highest δa value after Beautifil and, there was no difference between the Z250 and Filtek One. Filtek One had the highest δb value after Beautifil, there was no difference between the Tetric N-Ceram and Z250.
Conclusion: Beverages can negatively affect the surface properties of bulk-fill composite resins in terms of color stability.

Key words: bulk-fill; color stability; tea; spectrophotometer

Introduction

Resin-based composite materials (RBCs) are preferred for the direct restoration of posterior teeth because of their ability to adhere to the dental hard tissue, superior esthetics, and conservative tooth preparation, and their cost-effectiveness.[1] In dental treatments, the requirement for good esthetic and mechanical properties has led to the production of several new resin-based restorative materials. The disadvantages of the layering technique in the clinical application of conventional composites, which include a gap or contamination between the composite layers, the failure of interlayer bonding, and time-consuming clinical application, have led to the development of bulk-fill RBCs.[2] Bulk-fill RBC materials have become widely used for posterior teeth restoration due to their ability to fill a single increment up to 4–6 mm. In addition, the translucency of bulk-fill RBCs has been improved for deeper polymerization. Bulk-fill RBCs also contain a lower filler amount and an enlarged filler size, shrinkage stress relievers, polymer isolator modulators, and additional light-reactive photoinitiator systems.[1]

It has been claimed that bulk-fill RBCs have a higher polymerization depth and lower polymerization shrinkage than conventional RBCs. Bulk-fill composites are categorized into different types according to their viscosity, filler content, and indication, etc.[1,3] The long-term durability of RBC restoration depends on the restorative material (e.g., the monomer structure, filler size, type and loading, and monomer conversion rate) and the oral conditions.[4] Oral environment variables such as thermal changes, masticatory stresses, and chemicals from food and beverages, etc., have a significant impact on the restoration. Exposure to saliva, food components, and beverages in the oral environment can degrade the restoration and adversely affect esthetic and physical properties such as surface roughness, microhardness, color stability, and translucency.[5] Recently, people have become more interested in healthy food and healthy drinks. Kambocha tea is a popular fermented beverage that has been reported to have antioxidant and anti-inflammatory properties[6]. Matcha tea has also been proven to increase antioxidant properties and cognitive functions, and its consumption is rapidly increasing[7]. However, to our knowledge, no previous dentistry

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studies have investigated the effects of Kombucha and matcha tea on dental restorations. Although bulk-fill composite resin materials are widely used in dentistry practice, the literature contains limited studies evaluating the surface roughness of bulk-fill composite resins after beverage immersion.[1,3] Investigation of the physical and mechanical properties of composite resin materials depending on oral environment variables has substantial importance for clinicians in choosing the right restorative material.[1] Also, no previous study has evaluated the surface properties of giomer-based bulk-fill composite resins after beverage immersion. The aim of this study was to evaluate the effect of different teas on the surface roughness and surface morphology of conventional and three-fluoride-containing bulk-fill composite resins. The null hypothesis was that exposure to different teas does not affect the surface roughness of the tested composite resins.

Materials and Methods

A total of 120 samples, 10 mm in diameter and 2 mm thick, were prepared for three bulk-fill (Beautifil Bulk-Fill, Filtek One Bulk-Fill, and Tetric N-Ceram Bulk-Fill) and one conventional composite (Filtek Z250) using polytetrafluoroethylene molds. The detailed information about the materials was given at Table 1. The samples were polimerized for 20 sec with a light-curing device and left in an incubator in 37° distilled water for 24 hr to complete the polymerization. The upper surfaces of the samples were polished with polishing discs ranging from coarse to fine-grained. Initial color measurements were made with a spectrophotometer according to the CIELab. Four measurements were taken from each sample, and the average values were recorded. Samples of each composite were randomly divided into three groups (black tea, kombucha tea, and matcha tea) (n = 10). The samples were immersed in the tea solutions for 12 days[4], after which the color measurements were repeated. The values of δL, δa, δb, and $\delta E00$ were calculated. Scanning electron microscopy (SEM) images were taken of a randomly selected sample from each group. In the statistical analysis of the data, compliance with normal distribution was examined using the Shapiro–Wilk test. Two-way analysis of variance (ANOVA) with Bonferroni correction was used to evaluate the color parameters.

Results

The results were shown at Table 2 and 3. All differences were statistically highly significant. The Beautifil composite showed the greatest change in all values of E00 (8.93 ± 3.17), δL (-5.56 ± 1.58), δa (1.41 ± 0.98), and δb (12.07 ± 6.68) ($p < 0.01$). The matcha tea solution had a different effect on the different composites ($p < 0.01$) in all composites E00 (4.03 ± 5.10), δL (-1.21 ± 2.17), δa (0.05 ± 0.43), and δb (6.53 ± 8.71) values. When the $\delta E00$ values were compared, the greatest color change after the Beautifil composite was in the Filtek One composite (2.91 ± 0.99) and the Tetric N-Ceram composite (1.30 ± 0.74), and there was no difference between Filtek Z250 (0.82 ± 0.32) and Tetric N-Ceram (respectively, $p < 0.01$, $p < 0.01$, $p = 0.322$). The lowest δL value belonged to the Filtek Z250 composite (0.05 ± 0.74), and there was no difference between Tetric N-Ceram (-0.89 ± 0.86) and Filtek One (-1.00 ± 0.71) ($p < 0.01$, $p > 0.05$). When the δa values were compared, the highest value after Beautifil was in Tetric N-Ceram (0.62 ± 0.28). There was no difference between the Filtek Z250 (-0.17±0.22) and Filtek One (-0.05 ± 0.38) samples, which had a lower δa value than Beautifil and Tetric (respectively, $p < 0.01$, $p > 0.05$, $p < 0.01$). When the δb data were evaluated, it was found that there was no difference between the Tetric N-Ceram (0.78 ± 1.36) and Filtek Z250 (1.16 ± 0.77) with the lower δb value, Beautifil (12.07± 6.68) had the highest value and it was followed by Filtek One (5.53 ± 2.10) (respectively $p>0.05$, $p<0.01$, $p<0.01$,). SEM images were shown at Figure 1. Beautifil groups in all solutions had the most non-homogenous surface.

All experience indicates that distance education will be more than a necessity in the coming period. Especially, ensuring the continuity of service and education is very important in maxillofacial radiology, which is an indispensable branch for the scientific continuity of dentistry. Data obtained as a result of studies showed that distance education still has shortcomings in radiology practical training. Despite some drawbacks, the integration of online learning into radiology education should be utilized rapidly. It is inevitable to change hygiene habits after the pandemic and to make necessary changes in maxillofacial radiology education.

Discussion

Beautifil is a hybrid restorative material known as giomer. It has pre-reacted glass ionomer fillers within a resin matrix. Giomer composites release fluoride ions based on their water sorption characteristics. The pre-reacted zones of the giomer structure could cause osmotic pressure, which may increase the water sorption of the material. Water sorption enables water-soluble colorants to stain the composite material. In the present study, compared with other composite materials immersed in staining solutions, Beautifil had the highest color change values, which is similar to the findings of a previous study[2]. $\delta E00 > 1.8$ values were considered clinically unacceptable[8]. In the present study, Beautifil and Filtek One showed a clinically unacceptable color change. Bis-EMA is a highly hydrophobic resin monomer. It has been reported that better mechanical properties with lower water solubility in aqueous solutions might be obtained with Bis-EMA monomer[5]. When composite groups are examined in terms of color change, the conventional composite and the Tetric N-Ceram composite had the statistically lowest $\delta E00$ value. This may be related to the Bis-EMA content in their organic matrix. Because the resin matrix of a dental composite absorbs water, a lower filler ratio generall, leads to greater water sorption[2]. In the present study, Filtek One had the second highest $\delta E00$ value, after Beautifil, perhaps because Filtek One has a lower filler ratio than the conventional composite. In addition, Tetric N-Ceram and the conventional composite's hydrophobic bis-EMA content could be the reason of their color stability. Most resin-based materials contain camphorquinone (CQ) as a photoinitiator, which has been connected with discoloration. In Tetric N-Ceram, there are two additions to CQ: Ivocerin and Lucirin TPO. It has been reported that composite resins containing Lucirin TPO had a higher color resistance than composites with CQ[9]. The Bis-EMA and Lucirin TPO content could be the reason that Tetric N-Ceram had a lower $\delta E00$ value than Filtek One despite the similar filler ratio. Also, its glass filler particles may have enabled it to be more resistant to color change[10]. The highest δb (change of yellowness/blueness) values were observed for Beautifil, Filtek One, and the conventional composite while the lowest value was observed for Tetric N-Ceram. This may be related to the camphorquinone photoinitiator, which has shown a yellow color change over time.[9] There was a statistically significant difference between the means of the $\delta E00$ values of the different solutions ($p < 0.001$). Matcha had the highest staining capacity, which may be explained by the fact that its tannin content is higher than that of black tea[7]. This study did not investigate oral conditions since it was conducted entirely in vitro. Saliva has a pH neutralizing effect in the oral environment. Also, with oral hygiene routines, the extrinsic discoloration caused by beverages could be decreased or even inhibited. It would be appropriate to consider the effect of brushing in discoloration studies. Further in situ and in vivo studies are necessary to confirm the long-term effects of these teas on restorative materials. In future studies, these limitations should be considered.

Table 1. Details of the materials used in the study

Composite Resin Materials	Manufacturer	Type	Composition	Photoinitiator
Tetric N-Ceram Bulk Fill	Ivoclar Vivadent, Liechtenstein	Nano-hybrid	Monomers: Bis-GMA, UDMA, Bis-EMA Fillers: Barium aluminosilicate glass, prepolymer filler, ytterbium fluoride, spherical mixed oxide In total: 75-77 wt%, 53-55 vol% 0,4-0,7 μm	Camphorquinone Lucirin TPO Ivocerin
Filtek One Bulk Fill Posterior	3M Espe, St. Paul, MN, USA	Nano-hybrid	Monomers: AUDMA, AFM, DDMA, UMA Fillers: Ytterbium trifluoride (YbF3), zirconia filler, silica filler In total: 76 wt%, 58 vol% 0,004- 0,01 μm	Camphorquinone
Beautifil Bulk Fill	Shofu, Tokyo, Japan	Giomer	Monomers: Bis-GMA, UDMA, Bis-MPEPP, TEGDMA Filllers: S-PRG filler based on fluoroboroalumino silicate glass In total: 87 wt%, 74 vol%	Camphorquinone
Fitek Z250	3M Espe, St. Paul, MN, USA	Micro-hybrid	Monomers: Bis-GMA, UDMA, Bis-EMA, PEGDMA, TEGDMA Fillers: Modified zirconia/silica In total: 82 wt%, 68 vol% 0,01 μm to 3,5 μm with an average particle size of 0,6 μm	Camphorquinone

Table 2. Mean ± SD values of the $\delta E00$, δL, δa and δb of the composite resin groups.

	$\delta E00$	δL	δa	δb
	Mean ± SD	**Mean ± SD**	**Mean ± SD**	**Mean ± SD**
Beautifil	8.93 ± 3.17^{a}	-5.56 ± 1.58^{d}	1.41 ± 0.98^{g}	12.07 ± 6.68^{j}
Tetric	1.30 ± 0.74^{b}	-0.89 ± 0.86^{e}	0.62 ± 0.28^{h}	0.78 ± 1.36^{l}
Filtek One	2.91 ± 0.99^{c}	-1.00 ± 0.71^{e}	-0.05 ± 0.38^{i}	5.53 ± 2.10^{k}
Z250	0.82 ± 0.32^{b}	0.05 ± 0.74^{f}	-0.17 ± 0.22^{i}	1.16 ± 0.77^{l}

Two way ANOVA test *p<0.05
** Superscripts indicate statistical differences in the same column

Table 3. Mean ± SD values of the $\delta E00$, δL, δa and δb of the immersion solution groups.

	$\delta E00$	δL	δa	δb
	Mean ± SD	**Mean ± SD**	**Mean ± SD**	**Mean ± SD**
Tea	3.33 ± 3.12^{a}	-2.01 ± 1.85^{c}	0.46 ± 0.94^{e}	4.71 ± 2.94^{h}
Kombucha	3.11 ± 3.12^{a}	-2.32 ± 3.00^{c}	0.84 ± 0.86^{f}	3.41 ± 3.52^{i}
Matcha	4.03 ± 5.10^{b}	-1.21 ± 2.17^{d}	0.05 ± 0.43^{g}	6.53 ± 8.71^{j}

Two way ANOVA test *p<0.05
** Superscripts indicate statistical differences in the same column

Conclusion

Beverages can negatively affect the surface properties of bulk-fill composite resins in terms of color stability. Beautifil bulk-fill composite resin containing previously reacted glass ionomer particles was found to have lower color stability than other bulk-fill composites.

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Author Contributions

E.Ö. and A.K. have contributed to; conception and design of the study, data collection. A.K. analyzed the data. E.Ö. wrote the manuscript and revised the final version of the manuscript.

Conflict of Interest

Authors declare that they have no conflict of interest.

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CONGRESS PROCEEDING

Evaluation Of Oral Health Literacy Of Pregnant Women

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Abstract

Oral health literacy is the capacity of individuals to receive and understand the health information and services necessary to make appropriate oral health decisions. Low oral health literacy is associated with insufficient oral health knowledge and behaviors. The aim of our study was to assess the level of oral health literacy of pregnant women and their ability to recognize words on the Turkish version of Rapid Estimate of Adult Literacy in Dentistry (TREALD-30) scale, as well as their knowledge of the meaning of words. 300 pregnant women between the ages of 18-45 who were admitted to the Obstetrics and Gynecology outpatient clinic of Ataturk University Faculty of Medicine participated in our study. The TREALD-30 scale, consisting of 30 words, determines the ability to read dental words. Participants received 1 point for each correctly read word in TREALD 30. A total of 0-30 points were scored. In addition, the word scores that participants knew the meaning of were evaluated under the heading TREALD-30-M. Analysis of the collected data was carried out in SPSS v26 program. The average age of the participants was 31.2 years and the average educational status was 13 years. It was found that 31% of participants had their first pregnancy. 66.7% of respondents were housewives and 9.7% were health workers. The number of words that can only be read was determined as 29±2, the number of those that can be read by knowing their meaning was 17±4, and the number of those that cannot be read was determined as 3±6 words. As the level of education increased, oral health literacy increased ($p<0.001$). Health workers showed higher TREALD-30 and TREALD-30-M scores compared to housewives ($p<0.001$). In order to increase the level of oral health literacy of expectant mothers, health improvement programs are required.

Key words: Oral health literacy; pregnant women; TREALD-30

Introduction

Health literacy is the degree to which people have the capacity to acquire and understand the health information and services necessary to make appropriate health decisions.[1] Pregnant women with high levels of health literacy are reported to have better behaviors and views on iron and folic acid use, weight gain during pregnancy, and breastfeeding.[2] Therefore, the high level of health literacy of pregnant women is important for the health of both their own and their babies, as it makes it easier to access and interpret accurate health-related information in the prenatal period. Oral health literacy is defined as "The capacity of individuals to receive and understand the health information and services necessary to make appropriate oral health decisions".[3] It is noted that low oral health literacy is associated with negative consequences such as poor oral health, insufficient oral health knowledge and behavior.[4] The fact that health literacy affects the ability to understand and use health information may suggest that oral health literacy also affects the ability to understand and use oral health-related information. In order to measure oral health literacy, various tests have been developed in the form of word recognition, conceptual knowledge and reading comprehension.[5] The aim of our study is to determine the level of oral health literacy of pregnant women and to evaluate both the pronunciation and knowledge of the meaning of words on the Rapid Estimate of Adult Literacy in Dentistry (REALD-30) scale.

Methods

300 pregnant women between the ages of 18-45 who were admitted to the Obstetrics and Gynecology outpatient clinic of Ataturk University Faculty of Medicine participated in our study. The ethics committee approval of our study was obtained from the Clinical Research Ethics Committee of the Ataturk University Faculty of Medicine with the letter "Meeting Number: 02 / Decision No: 10". REALD-30 quickly and easily assesses the ability to read common dental words correctly. The validity and reliability of the Turkish version of the REALD-30 was studied by Peker et al. in 2017 under the name TREALD-30.[6] This word recognition test contains commonly used 30 dental words. Participants were given a copy of the TREALD-30 and told to read each word aloud. When participants were unable to read a word, they were asked to say "pass"

and move on to the next word. After 1 point was given for each correctly pronounced word, a total of 0-30 points were scored. It was also questioned whether participants knew the meaning of the words. On the oral health literacy scale, word scores known for meaning were also evaluated with the same scoring under the heading TREALD-30-M. The data obtained were analyzed in SPSS v26 program. Descriptive statistics are presented as percentage, average and standard deviation. The suitability of numerical variables for normal distribution was investigated by the Kolmogorov Smirnov test. One-way analysis of variance was used in cross-group comparisons of normal distributed numerical variables. The level of statistical significance was accepted as $p<0.05$.

Conclusion

A total of 300 pregnant women were evaluated. The average age of the participants was 31.2± 5.1 years and the average educational status was 13±4 years. 66.7% of respondents were housewives and 9.7% were health workers. The majority of respondents (79.3%) stated that they had a middle income. 31% of participants had their first pregnancy and 38.7% had at least 2 children. The distribution of reading and knowing the meaning of the words used in the TREALD-30 scale is given in Figure 1. Of the 30 words on the TREALD-30 scale, the number of words that participants could only read was 29±2, while the number of words that they could read by knowing the meaning was 17±4 and the number that they could not read was 3±6 words. While the words sugar, smoking, brush, and caries could be read correctly by all, participants were found to have difficulty reading temporomandibular, malocclusion, halitosis, analgesia, bruxism, and periodontal. Less than 15% of participants were able to read the words halitosis, apical resection, malocclusion, temporomandibular, bruxism, hypoplasia, pulp and hyperemia knowing their meaning. When evaluated according to age groups, TREALD-30 and TREALD-30-M scores of participants older than 35 years were found to be higher than those of other age groups ($p<0.001$). It was found that participants who graduated from primary and secondary school had the lowest TREALD-30 scores ($p<0.001$). In terms of the TREALD-30-M score, a statistically significant difference was found between all education levels ($p<0.001$). While the TREALD-30 scores of housewife participants showed a statistically significantly lower score ($p=0.001$), the TREALD-30-M scores were different in all occupational groups ($p<0.001$). High-income participants had higher TREALD-30 and TREALD-30-M scores ($p<0.001$).

Discussion

Women often use health services and are open to learning health-related information during pregnancy period. An attempt to increase the level of health literacy, which indicates the ability to understand and use health information, in pregnant women, plays an important role in protecting both the mother's own health and the health of family members.[7] In order to give their children oral hygiene habits, mothers must have good knowledge of oral health and have sufficient level of oral health literacy to understand and use this information.[8] Although the TREALD-30 scale, which we use to measure oral health literacy, is short and easy to implement, it only measures pronunciation and does not evaluate meaning. Since word pronunciation can be performed by most people with a certain level of literacy skills, it was thought that knowing the meaning of words on the scale would give more detailed information about the level of oral and dental health information. For this reason, in addition to the word pronunciation test in our study, whether participants knew the meaning of the words they read was also questioned under the heading TREALD-30-M. In our study, the average reading of words on the TREALD-30 scale by participants was 29±2 words, while the number of words read by knowing the meaning was 17±4. In a study conducted in the United States, the average reading of words was 23±5.1 and the average knowing of their meaning was 16±4.3.[9] Similar to the participants of this study, all participants in our study had difficulty reading the word temporomandibular while being able to read the words sugar, cigarette, brush and caries correctly. Again, similar to this study, most participants did not know the meaning of the "bruxism, hypoplasia, temporomandibular and apical resection". When the words were examined, it was found that most of the words that were difficult to read passed from a foreign language to our language, so they did not follow the rules of Turkish grammar. Furthermore, it is thought that the words whose meaning is unknown do not have any connotations to the participants, as they are not of Turkish origin. Participants' high level of knowledge about the meaning of the words "fluoride, plaque and enamel" may have been due to the impact of toothpaste ads. In order to increase the level of oral health literacy, instead of Latin words, the use of words that can be easily understood and adopted by the community recommended by the Turkish language institution can be popularized. When the scale results were evaluated although the reading rate of most words was very high, the level of knowledge of their meaning was quite low. This has been interpreted as the TREALD-30 scale being not selective in measuring oral health literacy compared to TREALD-30-M. It was determined that the longer the participants received training, the higher their oral health literacy scores. Similarly, the results from different studies conducted in the United States and Brazil support our findings.[8–10] It is believed that the high TREALD-30 and TREALD-30-M scores of health workers compared to housewife participants are due to the fact that health workers know the meaning of dental words on the scale thanks to their profession. Studies have shown that low-income individuals exhibit a lower REALD-30 score.[8,10] Similarly, in our study, it was found that TREALD-30 and TREALD-30-M scores increased as income levels increased. No significant association was found between the number of children and TREALD-30 scores of participants. People's knowledge, motivation and competence in accessing, understanding, evaluating and applying health information to maintain or improve their quality of life is also effective in making appropriate oral health decisions. Oral health in pregnant women is important, as it can affect not only the expectant mother, but also the future of the child. In order to increase the level of oral health literacy of mothers and expectant mothers, it is important that the education and health system work in cooperation and implement health protection and development programs. In this way, mothers' awareness of both themselves and their children's oral and dental health will increase and positive results will be seen on children.

Conclusion

It is important to conduct different trainings to increase oral health literacy and knowledge before, during and after pregnancy by determining women's health literacy levels. It is believed that studies conducted in the wider population on both oral health literacy and oral and dental health knowledge levels of pregnant women are needed.

Author Contributions

G.Y.: Data collection, article writing, English translation
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Figure 1. The distribution of reading and knowing the meaning of the words used in the TREALD-30 scale is given

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CONGRESS PROCEEDING

Impact of Non-Surgical Periodontal Therapy on Quality of Life of Periodontitis Patients

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Abstract

Purpose: Oral Health Impact Profile (OHIP-49) and a shorter version of that (OHIP-14) are the most comprehensive, accessible, and common scales to measure the impact of the treatment on quality of patient's life. Our aim was to evaluate the effect of non-surgical periodontal therapy on quality of generalized chronic periodontitis patients' life by using the Turkish version of the OHIP-14 scale (OHIP-14-TR).
Method: 58 patients (21 women and 37 men) diagnosed with generalized chronic periodontitis and requiring non-surgical periodontal therapy were recruited in this study. All patients were asked to fill in a form containing demographic, socio-economic information, reason of dental visit and oral hygiene habits. Clinical periodontal parameters (Plaque index (PI), gingival index (GI), probing pocket depth (PPD), clinical attachment loss (CAL), and bleeding on probing (BOP)) were recorded at baseline, and 1 month after treatment. Non-surgical periodontal therapy, including scaling and root planing, was completed in two appointments over the course of one week. OHIP-14-TR questionnaires have been filled out before and after treatment.
Results: There were significant decreases in all periodontal parameters and OHIP-14-TR one month after non-surgical periodontal treatment ($p<0.001$). There were significant positive correlations with OHIP-14-TR, PI, and GI (respectively; $p=0.024$. $p=0.026$). On the contrary there were no correlations between OHIP-14-TR, and BOP, PPD, and CAL ($p>0.05$). Significant positive correlation was found between physical pain, and BOP and PPD. After periodontal treatment, BOP, PPD, and physical pain decreased.
Conclusion: Non-surgical periodontal treatment was found to be successful in improving patients' quality of life, according to the findings of this study.

Key words: Chronic periodontitis; Quality of life; Oral Health Impact Profile; Periodontal treatment.

Introduction

World Health Organization defined 'Health' as 'A state of complete physical, mental and social well-being and not merely the absence of disease or infirmity' in 1948. In the same year, WHO defined 'quality of life' as an individual's sense of their position in life in relation to their objectives, expectations, standards, and concerns in the context of the culture and value systems in which they live. Oral health has been proven to have a major impact on appearance, breath, comfort, sleep, social life, and quality of life. Oral health is a default standard for contributing to physical, psychological, and social health, enabling individuals to take part in selected social roles, eating, communicating, and socializing without discomfort and intraoral tissues.[1] Oral health-related quality of life is the individual's personal perception of how oral health affects their quality of life and general health. Factors affecting quality of life and oral health-related quality of life are personal characteristics, psychological state, socio-demographic factors, factors affecting lifestyle, and judgements of the social environment. The health standard-based assessment is essential to indicate health. Therefore, nowadays for determining evaluating the impact of intraoral problems on health and quality of life, some surveys are being used. Although there were no scales measuring the relationship between oral health and quality of life twenty years ago, today there are several surveys evaluating the impact of oral problems on health and quality of life.[1,2] Among the scales the most comprehensive, accessible, and most

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common are the Oral Health Impact Profile OHIP-49 and OHIP-14. It is a scale that is personally perceived by individuals, measures the social impact of oral diseases on general health, and is used all over the world. The main benefit of this scale is that the questions are presented by patients rather than researchers or dentists.[2] OHIP-49, which had 49 questions was shortened to include 2 questions from each of the 7 titles. Shorten version OHIP-14 was created and approved by Slade, which includes 14 questions and had the same validity and reliability.[1,2] These scales include selection of treatment needs and type of treatment which can provide valuable information for evaluating treatment outcomes and monitoring the patient's condition. On this point, studies have been conducted to evaluate the effect of periodontal disease and its treatment on quality of life.[3–6] In a study by Balcı et al. the Turkish version of the OHIP-14 scale (OHIP-14-TR) was created and implemented.[7] The aim of this study was to evaluate the effect of periodontal status on quality of life of individuals with periodontal disease at baseline and 1 month after non-surgical periodontal treatment using the OHIP-14-TR.

Methods

The study consisted of fifty-eight patients who referred to Ankara University Faculty of Dentistry Department of Periodontology for periodontal treatment. Being over 25 years old, having at least 15 teeth (excluding third molars), and being diagnosed with generalized chronic periodontitis were prerequisites for inclusion. (Affected areas more than 30%, PPD ≥5mm (at least 8 areas), CAL ≥5mm (At least 4 areas), and BOP ≥30%). Patients with systemic disease requiring antibiotic prophylaxis for periodontal treatment, patients with any systemic disease associated with periodontal therapy and/or medication, patients who had received periodontal treatment in the previous 6 months, and female patients who were pregnant or potentially pregnant during the study were all excluded. Clinical periodontal parameters as PI, GI, PPD, BOP, and CAL were recorded. The study was reviewed and approved by the Ethics Committee for the use of human subjects in research, Ankara University Faculty of Dentistry (No:35/2, on 14.05.2012). Participants were asked to complete a questionnaire that included demographic information (age, gender), socioeconomic status (education, marital status, income), the reason for applying to faculty, oral hygiene habits (brushing, interdental cleaning, use of oral rinse), the frequency of dental examinations, and the use of removable dentures. Oral health-related quality of life was assessed using the OHIP-14-TR scale. All periodontal measures (PI, GI, PPD, BOP, and CAL) as well as OHIP-14-TR scores were recorded again in the control session, one month after periodontal treatment.

Descriptive analyses were performed by using SPSS for Windows 15. Data were expressed as mean ± SD and median (IQR). Mann Whitney U and Wilcoxon test were used for statistical analyses. Correlation between OHIP-14 and periodontal clinical parameters was performed using Spearman's correlation.

Results

A total of 58 patients, 21 women (36.2%) and 37 men, with a mean age of 45.07±7.28 were included in the study. 49 of the participants were married and 9 of them were single. 3 patients were uneducated, 14 patients had completed primary school, 22 patients had completed high school, 13 patients had completed university, and 6 patients had completed higher graduate education. While 17 patients had a monthly income of less than 1000 TL, just three patients had a monthly income of 4000-5000 TL. 36 patients (62.1%) applied to faculty for gingival problems, 15 patients (25.9%) for dental problems, 4 patients (6.9%) for a prosthesis requirement, and 3 patients (5.2%) for control. Gingival bleeding was reported in 54 of 58 individuals, with 39 patients having no teeth mobility and 19 having teeth mobility Table 1. After non-surgical periodontal treatment, all periodontal parameters (PI, GI, PPD, CAL and BOP) were decreased significantly when compared to pre-treatment values ($p<0.001$). Post-treatment OHIP-14-TR values were also significantly decreased ($p<0.001$). Functional limitation, physical pain, psychological discomfort, physical disability, psychological disability, social disability, and handicap values were decreased significantly after treatment compared to baseline. ($p<0.001$) Table 2. While statistically significant correlations were found between PI, GI, and OHIP-14-TR ($p<0.05$); no significant correlations were found between BOP, PPD, CAL and OHIP-14-TR ($p>0.05$). Statistically significant positive correlations were found between physical pain and BOP, also between physical pain and PPD ($p<0.05$). No statistically significant relationship was found between gender, educational status, income level and OHIP-14-TR ($p>0.05$). While the decrease in OHIP-14-TR was 61.54% in patients without gingival bleeding; the decrease in OHIP-14-TR was found to be 75% in those with gingival bleeding. The decrease in OHIP-14-TR was statistically significantly higher in patients with gingival bleeding than in those without bleeding ($p<0.05$). While the decrease in OHIP-14-TR was 85.71% in patients who did not have any complaints of mobility; the decrease in OHIP-14-TR was found to be 69.23% in those with bleeding complaints. The decrease in OHIP-14-TR after treatment in patients with mobility was statistically significantly higher than in patients without mobility ($p<0.05$). The decrease in OHIP-14-TR was significantly higher in patients who did not use removable prosthesis ($p<0.05$). In smokers, the decrease in OHIP-14-TR was 73.68%, and in non-smokers it was 78.46%. The decrease in OHIP-14-TR was greater in non-smokers, but this difference was not statistically significant ($p>0.05$).

Table 1. Demographic and socio-economic status of patients

		N	%
Gender	Female	21	36.2
	Male	37	63.8
Marital status	Married	49	84.5
	Single	9	15.5
Education	Uneducated	3	5.2
	Primary school	14	24.1
	High school	22	37.9
	University	13	22.4
	Higher education	6	10.3
Income	Less than 1000 TL	17	29.3
	1001-1999 TL	17	29.3
	2000-2999 TL	17	29.3
	3000-3999 TL	4	6.9
	4000-4999 TL	3	5.2
	More than 5000 TL	-	
Reason for applying faculty	Gingival problems	36	62.1
	Dental problems	15	25.9
	Prosthesis	4	6.9
	Control	3	5.2

Discussion

In this study, the relationship of non-surgical periodontal treatment with quality of life and oral health was evaluated over a 1-month period using the OHIP-14-TR scale. The findings of this study reveal that there is a statistically significant relationship between periodontal disease clinical symptoms and quality of life. According to our results, it can be said that periodontal treatment provides

Table 2. Clinical Periodontal Parameters, and OHIP-14-TR Questionnaire Before and After Non-surgical Periodontal Treatment

	Before Treatment Median (min-max)	After Treatment Median (min-max)	p
PI*	1.83 (1.28-2.68)	0.48 (0.29-0.91)	**<0.001**
GI*	1.61 (1.01-2.84)	0.47 (0.25-0.81)	**<0.001**
PPD*	4.37 (3.34-5.11)	3.34 (2.51-4.01)	**<0.001**
CAL*	4.65 (3.51-5.75)	4.04 (3.13-4.77)	**<0.001**
	Before Treatment **Mean ± Sd**	**After Treatment** **Mean ± Sd**	**p**
BOP**	69.4±6.7	26.1±7.4	**<0.001**
	Before Treatment **Median (min-max)**	**After Treatment** **Median (min-max)**	**p**
OHIP-14-TR*	12 (1-32)	3 (0-16)	**<0.001**
Functional Limitation*	0 (0-4)	0 (0-2)	**<0.001**
Physical Pain*	2 (0-7)	0 (0-3)	**<0.001**
Psychological Discomfort*	1.5 (0-4)	0 (0-2)	**<0.001**
Physical Disability*	1.5 (0-4)	0 (0-2)	**<0.001**
Psychological Disability*	2.5 (0-6)	1 (0-3)	**<0.001**
Social Disability*	2 (0-5)	0 (0-3)	**<0.001**
Handicap*	0 (0-6)	0 (0-3)	**<0.001**

Abbreviations: PI, plaque index; GI, gingival index; PPD, probing pocket depth; CAL, clinical attachment loss; BOP, bleeding on probing. *Data were expressed as medians and IQRs. ** Data were expressed as mean ± SD. Statistically significant ($p<0.05$).

a significant improvement in individuals' perception of quality of life.[1,2] Periodontal disease is a common oral health problem of varying severity and prevalence in the community. It causes destruction of the tooth support tissues including the periodontal attachment and alveolar bone, also may cause tooth loss in severe cases. Due to inflammation and periodontal tissue destruction, periodontal disease causes clinical symptoms such as bleeding, tooth mobility and halitosis, therefore have an impact on daily life.[1,2] The reliability of the Turkish version of OHIP-14 (OHIP-14-TR) was observed to be close to the golden standard and perfect. OHIP-14-TR correlates with different clinical conditions and has excellent internal consistency (Cronbach Alpha=0.91). These physio metric features are important for health scales and these features make the OHIP-14-TR suitable for evaluating oral health-related quality of life in Turkish population.[7] It is reported that the evaluation of the effects of non-surgical treatment on quality of life of generalized periodontitis patients with OHIP-14 scale in early period after periodontal treatment is important for understanding the effect of periodontal treatment on patients and thus for motivating patients to maintain their oral hygiene. Özçelik et al. emphasized that conditions such as pain, anxiety and reluctance that can be seen in the maintenance phase can be avoided with early post-treatment patient follow-up.[8] In our study, all periodontal parameters and OHIP-14-TR scale were repeated at first month after the non-surgical periodontal treatment to evaluate the short-term effects of the therapy. The possibility of lack of motivation occurring in the long-term evaluation, which could have an unfavorable effect on OHIP-14-TR, was eliminated by selecting a one-month short-term evaluation period. While Gürgan et al.[9] evaluated PI and GI scores on the 7th day after non-surgical periodontal treatment; Zambon et al. evaluated PI on the 5th day.[10] Zambon et al. (1989) also evaluated PPD and CAL on the 28th day after bilateral flap surgery.[10] In the literature the relationship between bleeding and mobility and quality of life has not been studied separately. However, it has been accepted as a remarkable fact that periodontal treatment reduces gingival bleeding and mobility complaints caused by periodontal disease, and thus improves quality of life.[4] In various studies, it was shown an improvement in tooth function after non-surgical periodontal treatment.[3,5] Psychological improvement[3,6] and reduction in physical pain[5,6] has been also reported after non-surgical treatment. A decrease in these values indicates a decrease in the OHIP-14 value, which may be attributed to an improvement in quality of life. We can also conclude that while BOP and PPD decreased after treatment, physical pain also decreased. So, the relationship between these parameters was found to be statistically significant. As a result, the relationship between these variables was found to be statistically significant. Clinical periodontal parameters were not correlated with OHIP-14-TR scores in our study. This may be because people may only become aware of a problem as the disease progresses. From this point of view, it is possible to conclude that patients are not sufficiently aware of their oral health. Both periodontal status and periodontal treatment have a remarkable impact on daily life and quality of life. Periodontal status has been shown to have an impact on patients' quality of life, with individuals who do not have severe periodontal disease having a better quality of life.[4] To have idea about patients' expectations about oral health, it is important to understand the concept of periodontal disease and the impact of periodontal treatment. Furthermore, it is critical to assess the impact of periodontal disease on patients' lives in order to provide periodontal treatment based on the patient's needs and to raise awareness of the importance of periodontal care in society.[4]

Conclusion

Several studies show that, clinical periodontal status is closely related to quality of life. Evaluation of the impact of non-surgical periodontal treatment on patients' quality of life is necessary to draw public attention to the importance of periodontal health. We can conclude that non-surgical periodontal treatment improves quality of life and provides significant recovery.

Author Contributions

HB recorded the clinical data. CO contributed to study design, helped to record clinical data, analyzed the clinical data and helped interpret the results. SK contributed to study design, analyzed the clinical data and helped interpret the results. MA contributed to study design, recorded the clinical data, and wrote the manuscript with input from other authors. CG contributed to study design and helped interpret the results. MG contributed to study design, directed the implementation of the research, helped interpret the results and was the study coordinator. All authors reviewed and approved the submitted final manuscript.

Conflict of Interest

Authors declare that they have no conflict of interest.

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ORIGINAL RESEARCH ARTICLE

Evaluation of Different Beverages' Effect on Microhardness and Surface Roughness of Different Artificial Teeth

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Abstract

Purpose: This study evaluated the microhardness and surface roughness of four artificial teeth type against various beverages.
Materials & Methods: Conventional acrylic resin, reinforced acrylic resin, microfiller composite resin, and nanofiller composite resin teeth were used. From each group, 10 maxillary first and second molars were immersed in 5 beverages (tea, filtered coffee, cola, cherry juice, and distilled water. The test period of 24 hours appears comparable to approximately 1 month of normal beverage consumption. The test periods used in this study were arranged according to this protocol and 1 week, 1 month, 3 months and 6 months of normal beverage consumptions were simulated. Vickers microhardness and surface roughness of denture teeth were measured for each test period.
Results: The microhardness values significantly decreased in all beverages especially in 6th month. The surface roughness values significantly increased in all beverages especially in 3th month. There were no statistically significant differences between the beverages. Microfiller composite resin denture teeth had the highest microhardness values and the lowest surface roughness values.
Conclusion: Different types of beverages consumed daily negatively affect the microhardness and surface roughness of artificial teeth. Microfiller composite resin teeth could have the ideal surface properties.

Key words: beverages; denture teeth; microhardness; nano-composite; surface roughness

Introduction

Rapid progress and new technologies in the dental materials industry offer dentists many different artificial tooth options. These developments allow the creation of a wide range from acrylic teeth to reinforced acrylic and composite resin teeth with different filler sizes.[1,2] Nanotechnology is literally translated as 'the science of the little'.[3] Nanotechnology in dentistry was first used in 1997 to improve the physical properties of restorative materials.[4] The most recent development is the application of nanoparticle technology to composite resins.[5] It has been possible to produce nano-sized filler particles and so a larger amount of filler could be added to the composite resin matrix.[6,7]

Artificial teeth are important components of removable partial and complete dentures in terms of aesthetics, function and phonation.[1,8,9] Preservation of occlusion, continuity of chewing activity and aesthetic requirements are the most sought features of artificial teeth. Materials used in artificial teeth production are expected to have good mechanical and physical properties such as color stability, smooth surface and wear resistance.[10,11] Acrylic resin and porcelain are the most commonly used materials. However, none of them fully meet the characteristics required for an ideal artificial tooth. Porcelain teeth were preferred due to the rapid erosion of acrylic resin teeth.[9] However, with the tendency of porcelain to break, acrylic teeth have gained popularity. Reinforced acrylic resin and new composite resin teeth have higher wear resistance and have replaced porcelain in the last years.[1,7,10] Recently, composite materials have attracted attention as artificial teeth materials and have been introduced as modified, abrasion resistant dental materials.[12] There is not enough information about the clinical performance of these new artificial teeth. Therefore, there is a need for studies evaluating the properties of artificial teeth.[13] Composite resin artificial teeth available on the market differ in many properties. These features are filler shape, filler amount, polymer type and degree of crosslinking.[1,14,15] With the effect of nanotechnology on dental materials, artificial teeth were also produced from

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Table 1. Artificial teeth used in the study

Denture tooth	Manufacturer	Structure	Filler type	Matrix
Major Dent	Major Prodotti Dentari S.p.A., Moncalieri, Italy	Conventional acrylic resin	-	Polymethyl methacrylate
Integral	Merz Dental GmbH, Lütjenburg, Germany	Reinforced acrylic resin	-	Cross-linked polymer network (IPN)
SR Orthosit PE	Ivoclar Vivadent, Schaan, Lichtenstein	Microfiller composite resin	Inorganic microfiller	Urethane dimethacrylate
Veracia	Shofu Inc., Kyoto, Japan	Nanofiller composite resin	Nano composite filler	Urethane dimethacrylate

nano-filled composite.[16] In these artificial teeth, nano-sized inorganic fillers are homogeneously distributed in the matrix without agglomeration.[9] In this way, the smoothness of the surface was preserved even when the teeth were worn. As a result of the tests, it has been observed that nanocomposite artificial teeth are more durable and wear resistance than acrylic teeth and microfiller resin composite teeth.[13,17,18]

Hardness is one of the most studied mechanical properties for artificial tooth materials[13] and is important in terms of protecting the formed occlusion and the continuity of the function. In addition to provide an aesthetic appearance, a smooth surface prevents the formation of a colored layer and plaque retention.[4,19] Plaque accumulation occurs on rough surfaces following the attachment of microorganisms. For the oral usability of dental restorative materials, the average surface roughness should be below 0.2 μm.[20]

Chemical structure of the material, oral hygiene, denture cleaning habit, prosthesis usage time and nutrition habits effect the artificial teeth. Some beverages such as coffee, tea, red wine and even water can affect the mechanical and physical properties of composite materials. Chemicals in the formulations of beverages can cause erosion and surface degradation.[21] These effects may vary depending on the amount and frequency of intake.[22,23] The amount of liquid remaining in the mouth after swallowing is less than 1 ml. This limits the amount of beverage that comes into contact with teeth and restorations.[24]

In our study, it was aimed to compare surface hardness and surface roughness properties of four different artificial teeth when they exposed to frequently consumed beverages at different time periods. The null hypothesis was the chemical structure of artificial tooth doesn't affect the hardness and surface roughness.

Materials and Methods

The artificial teeth used in the study are shown in Table 1. They were grouped according to their chemical structures as conventional acrylic resin, reinforced acrylic resin, micro-filled composite resin and nano-filled composite resin teeth. Beverages used in the study are tea, filtered coffee, coke, cherry juice and distilled water as a control. 10 samples from each tooth group were randomly selected for each fluid medium. In total 200 upper 1st and 2nd molar artificial teeth were used for microhardness and surface roughness measurements from each tooth group. Each artificial tooth was embedded in 1 cm high and 1 cm diameter cylinder molds of acrylic resin with the buccal surfaces above and parallel to the floor. All specimens were kept in an oven (Köttermann GmbH & Co.) in distilled water at 37°C for 24 hours before the test. Initial measurements were made before the specimens were immersed in solutions.

Beverages were prepared according to manufacturers' instructions (tea and filtered coffee). Solutions were prepared freshly every day during the test period. While the control group was kept in distilled water during the experiment, the other specimens were kept in four different solutions (tea, filtered coffee, cola, cherry juice). Each specimen was stored individually in 5 ml plastic capped tubes. During the experiment, all specimens were kept in a dark environment at 37°C to mimic the mouth environment.

Table 2. Immersion times in beverages and simulated time of denture usage equivalent to these times

Test period (Immersion time in beverages)	Simulated time of denture usage
336 minutes (5,6 hours)	1 week
24 hours	1 month
72 hours (3 days)	3 months
144 hours (6 days)	6 months

We used the solutions without adding artificial saliva. In order to be able to carry out our in vitro study in accordance with in vivo conditions, we considered some criteria while determining the storage times in liquids; average daily drink consumption (average 3 glasses / 300ml), average drinking time of a drink (15 minutes for 1 glass / 200ml), the amount of beverage left in the mouth after the swallowing process (less than 1ml), the amount of contact of drinks with tissue and restorations in the mouth before saliva reaches (20 seconds). We aimed to evaluate the changes in 6 months usage of prostheses, we determined a soaking period in a beverage that we can simulate this 6-month period, considering the material we use. Although there is no definite protocol on this subject in previous studies, Fraunhofer & Rogers,[25] in their study investigating the dissolution rate of enamel, accepted the 14-day soaking time as equivalent to the tooth-beverage contact that will occur as a result of 13 years of beverage intake. In the study of Güler et al[26] for composite resin materials used in temporary restorations, it was stated that the 24-hour beverage storage period simulated 1-month beverage intake. Considering the acrylic and composite resin materials used in our study, the immersion times of the samples in beverages and the simulated time processes are as shown in the Table 2. Measurements were made after each test period. Specimens taken from the solutions at the end of their immersiom time in beverages were washed under tap water and dried with a towel napkin before each measurement.

In the evaluation of surface roughness, a profilometer (Perthometer M2, Mahr GmbH, Göttingen, Germany) was used. The measurement length was set as 1.75 mm, the cut-off value was taken as 0.25 and n was taken as 5. Measurements were made from the flattest surface in the middle triple region of the buccal surfaces of the artificial tooth specimens. Three repeated measurements were recorded for each specimen and average roughness (Ra) values were calculated. For microhardness values, a Vickers microhardness device (HVS 1000 Microhardness Tester Bulut Makine, Istanbul, Turkey) was used. 300 g load for 15 seconds was applied and three measurements were performed from each sample surfaceand the averages were calculated. The analysis of all data obtained from the measurements and the calculated values were made using IBM SPSS Statistics 19 statistical analysis program (SPSS for Windows, Version 19.0; IBM Corporation, New York).

Table 3. Microhardness values (kg/mm²) and standart deviations of specimens stored in different beverages over time

	Baseline	1. Week	1. Month	3. Month	6. Month	p
Distilled water	31.02 ±6.70a	26.69 ±3.72b	25.63 ±4.52bc	25.71 ±4.36bc	23.33 ±2.51c	0.000*
Tea	30.76 ±5.91a	25.39 ±4.34b	25.79 ±4.63bc	25.34 ±5.64bc	22.64 ±3.35c	0.000*
Filtered Coffee	28.48 ±4.37a	26.38 ±4.20a	25.81 ±5.31a	25.82 ±4.71a	22.65 ±3.53b	0.000*
Cola	28.92 ±4.43a	26.17 ±4.02ab	25.79 ±5.34b	24.75 ±5.36b	24.05 ±5.98b	0.000*
Cherry Juice	29.64 ±3.95a	25.08 ±3.82b	25.08 ±4.87b	24.27 ±4.83b	23.92 ±5.13b	0.000*

* p <0.01 (Statistically different.)
For each analysis of variance, Tukey HSD results are indicated by the lettering method next to the mean ± standard deviation results. For each line; same letters show that there is no difference between groups, and different letters show that the difference between groups is important.

Table 4. Microhardness values (kg/mm²) and standart deviations of different artificial teeth over time

	Baseline	1. Week	1. Month	3. Month	6. Month	p
Integral	25.54 ±2.43a	23.22 ±1.51b	21.76 ±1.00c	21.18 ±1.62c	20.18 ±1.71d	0.000*
Major	25.55 ±1.95a	22.37 ±1.76b	22.31 ±1.20b	21.97 ±1.36b	20.19 ±2.00c	0.000*
Veracia	32.56 ±3.80a	26.45 ±1.69b	24.93 ±1.43c	24.64 ±1.40c	23.96 ±1.79c	0.000*
Orthosit	35.41 ±3.14a	31.73 ±1.66b	33.49 ±1.77c	32.93 ±2.45bc	28.93 ±3.47d	0.000*

* p <0.01 (Statistically different.)
For each analysis of variance, Tukey HSD results are indicated by the lettering method next to the mean ± standard deviation results. For each line; same letters show that there is no difference between groups, and different letters show that the difference between groups is important.

Table 5. Microhardness values (kg/mm²) and standart deviations of different artificial teeth according to beverages

	Distilled Water	Tea	Filtered Coffee	Cola	Cherry Juice	p
Integral	23.01 ±1.33	22.22 ±2.72	22.59 ±2.26	22.04 ±2.42	22.01 ±3.40	0.225
Major	23.01 ±2.39	22.13 ±2.27	22.25 ±2.43	21.98 ±2.58	23.00 ±2.24	0.074
Veracia	27.97 ±5.34a	26.95 ±4.01a	26.38 ±2.83ab	26.37 ±2.90ab	24.87 ±2.90b	0.002*
Orthosit	31.91 ±4.05	32.64 ±4.24	32.08 ±3.25	33.35 ±2.26	32.50 ±2.43	0.226

* p <0.01 (Statistically different.)
For each analysis of variance, Tukey HSD results are indicated by the lettering method next to the mean ± standard deviation results. For each line; same letters show that there is no difference between groups, and different letters show that the difference between groups is important.

Results

For microhardness and surface roughness measurement results, one-way analysis of variance (ANOVA) was used to determine the differences between artificial teeth and beverages. The nonparametric Friedman Test was used to determine the differences between repeated measurements. When the difference between the groups was found to be significant in one-way analysis of variance and Friedman Test, a comparison was made with Tukey HSD, one of the multiple comparison tests, in pairs. According to the initial values, all groups created with artificial tooth specimens are homogeneous. Beverage and time, artificial tooth and time, artificial tooth and beverage interactions were evaluated for each test method.

There was a significant decrease from the baseline to the 6th month in all beverages for the microhardness values of all artificial tooth groups (Tukey HSD test, p<0.01). However, at the end of the 6th month, no significant difference was observed between the beverages in terms of microhardness in the overall specimens (Friedman test, p>0.01) (Table 3). When the baseline microhardness values of different artificial teeth were compared, Veracia (32.55 kg/mm²) and Orthosit (35.41 kg/mm²) teeth were significantly higher than Integral (25.76 kg/mm²) and Major (25.54 kg/mm²) teeth (Tukey HSD test, p<0.01) (Table 4). The highest microhardness values for each artificial tooth group were for the specimens waiting in distilled water (control group) while the difference wasn't statistically significant (Tukey HSD test, p>0.01). However, Veracia teeth waiting in distilled water had higher microhardness values compared to other beverage (Table 5).

It has been stated that the amount of surface roughness of dental materials should be less than 0.2 μm. Considering this situation, the average surface roughness values revealed in our study increased above 0.2 μm from the 1st month in all beverages for all artificial tooth groups. While the surface roughness values increased over time during the test period, the most significant increase was observed in the 3rd and 6th month measurements (Tukey HSD test, p<0.01). Although the highest roughness values were found in the specimens stored in cola and cherry juice in the 3rd month and 6th month measurements, this difference was not significant (Friedman test, p>0.01) (Table 6).

When the initial surface roughness values of different artificial tooth specimens are compared, Orthosit (0.16 μm) teeth have lower values than Integral (0.19 μm), Major (0.18 μm) and Veracia (0.18 μm) teeth, but this difference is statistically was not significant (Tukey HSD test, p> 0.05). At the end of the 6th month, the lowest surface roughness values belonged to Orthosit teeth (Tukey HSD test, p<0.01) (Table 7). Specimens in distilled water had the lowest roughness values at all times, but this result was also not significant (Tukey HSD test, p> 0.05) (Table 8).

Discussion

In our study, which we planned considering that it will assist the dentist's choice of artificial teeth, we chose four different types of artificial tooth materials to see how the chemical composition of artificial teeth affects the mechanical and physical properties. The null hypothesis as 'Chemical structure of artificial tooth doesn't affect the hardness and surface roughness.' is rejected.

The most important feature of nanocomposite artificial teeth is that they have a homogeneous structure because this material is not very cross-linked but contains nano-sized inorganic fillers that are evenly distributed without agglomeration in the matrix resin. These properties can provide smooth surfaces against wear

Table 6. Surface roughness values (μm) and standart deviations of specimens stored in different beverages over time

	Baseline	1. Week	1. Month	3. Month	6. Month	p
Distilled water	0.19 ±0.07a	0.20 ±0.05ab	0.20 ±0.05a	0.23 ±0.06bc	0.26 ±0.07c	0.000*
Tea	0.18 ±0.05a	0.21 ±0.06ab	0.21 ±0.06ab	0.24 ±0.07bc	0.26 ±0.07c	0.000*
Filtered Coffee	0.19 ±0.05a	0.20 ±0.04a	0.20 ±0.04a	0.25 ±0.05b	0.26 ±0.05b	0.000*
Cola	0.19 ±0.04a	0.20 ±0.05a	0.21 ±0.05a	0.26 ±0.06b	0.26 ±0.06b	0.000*
Cherry Juice	0.19 ±0.06a	0.21 ±0.06a	0.21 ±0.06a	0.25 ±0.07b	0.28 ±0.08b	0.000*

* p <0.01 (Statistically different.)
For each analysis of variance, Tukey HSD results are indicated by the lettering method next to the mean ± standard deviation results. For each line; same letters show that there is no difference between groups, and different letters show that the difference between groups is important.

Table 7. . Surface roughness values (μm) and standart deviations of different artificial teeth over time

	Baseline	1. Week	1. Month	3. Month	6. Month	p
Integral	0.19 ±0.05a	0.21 ±0.04ab	0.22 ±0.04b	0.26 ±0.06c	0.28 ±0.06c	0.000*
Major	0.19 ±0.07a	0.20 ±0.06a	0.20 ±0.06a	0.25 ±0.07b	0.25 ±0.08b	0.000*
Veracia	0.19 ±0.06a	0.20 ±0.05a	0.20 ±0.06a	0.24 ±0.06b	0.28 ±0.07c	0.000*
Orthosit	0.17 ±0.05a	0.20 ±0.05a	0.20 ±0.05a	0.24 ±0.06b	0.25 ±0.06b	0.000*

* p <0.01 (Statistically different.)
For each analysis of variance, Tukey HSD results are indicated by the lettering method next to the mean ± standard deviation results. For each line; same letters show that there is no difference between groups, and different letters show that the difference between groups is important.

Table 8. Surface roughness values of (μm) and standart deviations of different artificial teeth according to beverages

	Distilled Water	Tea	Filtered Coffee	Cola	Cherry Juice	p
Integral	0.22 ±0.06	0.24 ±0,08	0.23 ±0,05	0.22 ±0,05	0.25 ±0,06	0,138
Major	0.22 ±0.08a	0.20 ±0,07a	0.25 ±0,07b	0.21 ±0,05a	0.22 ±0,09a	0,015**
Veracia	0.22 ±0.07ab	0.21 ±0,05c	0.20 ±0,05b	0.24 ±0,08a	0.23 ±0,08ab	0,034**
Orthosit	0.20 ±0.05a	0.23 ±0,07b	0.20 ±0,05a	0.23 ±0,06a	0.21 ±0,06a	0,008*

* p <0.01 **p <0.05 (Statistically different.)
For each analysis of variance, Tukey HSD results are indicated by the lettering method next to the mean ± standard deviation results. For each line; same letters show that there is no difference between groups, and different letters show that the difference between groups is important.

in nanocomposite teeth. However, it can be thought that it will have a limited abrasion resistance due to its polymethylmethacrylate content.[1,18] Studies have shown that this material has wear and microhardness properties similar to micro-filled and cross-linked acrylic resin teeth.[18,27] The initial microhardness values of the artificial teeth were 36.18 kg/mm^2 for Orthosit, 32.55 kg/mm^2 for Veracia, 25.76 kg/mm^2 for Integral, 25.54 kg/mm^2 for Major. The differences in the microhardness values of the specimens that have not been processed yet are due to the differences in the chemical structure. It is seen that the material used for Veracia and Orthosit teeth is composite, giving them an initial advantage compared to other teeth with an acrylic structure. When the initial surface roughness values of different artificial tooth specimens were compared, Orthosit (0.16 μm) teeth had lower values than Integral (0.19 μm), Major (0.18 μm) and Veracia (0.18 μm) teeth.

Hardness appears to be associated with wear resistance and harder materials are expected to wear less.[13] There are various opinions about the correlation between the hardness and wear resistance of composite resin-based restorative materials. A group of researchers stated that it is difficult to obtain healthy results by only measuring surface hardness in determining wear resistance and emphasized that surface hardness value is only one of the important parameters in determining the amount of wear.[28]

The different behavior of composite materials depends on the differences in composition and filler distribution of the matrix. Factors affecting the properties of composites are monomers, fillers and binding agents.[1,29] Filler content is also related to color stability, hardness and compression strength. Increased filler ratio reduces water absorption, which results in less degradation on the surface.[1,30,31] However, changes may occur as a result of the continuous and natural decomposition of the material surface in the liquid medium.[32] Filler and matrix connection breaks with water absorption. This linkage can also be weakened by chemical solvents. The increase in the surface roughness of the Veracia teeth in the 6th month may have occurred as a result of the weakening of the bond between the filler and the matrix.

The main differences between restorative composite resins and composite resins used for artificial teeth are the filler amount and size. The amount of filler is higher in restorative composite resins. In this way, the coefficients of thermal expansion become similar to the natural tooth structure and polymerization shrinkage is also reduced. However, composite resin artificial teeth consist of at least two layers, and after the enamel layer comes a layer without fillers. This multi-layer structure enhances the aesthetic appearance. If the filler amounts of these two layers are very different, the thermal stress between them increases and this prevents them from being tightly bonded to each other. Also, there is no problem of polymerization shrinkage for composite resin teeth.[13]

Acrylic resin teeth contain a negligible amount of filler. There is a positive linear relationship between hardness and filler amount.[13] Larger fillers provide greater stiffness and bending strength. However, smaller fillers also allow smoother surfaces to be obtained. Loyaga-Rendon et al13 attributed the different hardness values of two different composite resin teeth containing the same amount of filler to the filler sizes. The macro-filled composite resin tooth gave greater microhardness values than the micro-filled one. In our study, Orthosit teeth, which are composite resin teeth with micro-fillers, had higher microhardness values than Veracia teeth, which are composite resin teeth with nano-fillers. Orthosit and Veracia composite resin teeth we used in our study contain 42.9% and 5.9% inorganic filler content, respectively.[13] In the study by Loyaga-Rendon et al[13] investigating the structural properties of artificial teeth, it was observed that the filling distribution of Orthosit teeth was more homogeneous. Less filler amount of Veracia

teeth may cause an increase in roughness values.

In general, the enamel layer of artificial teeth should have properties such as cracking, deterioration in solvents and resistance to abrasion. In our study, we did not apply any abrasion and polishing process to artificial teeth. We have used as flat surfaces as possible by measuring from the buccal middle triple regions of the specimens. Kawano et al[11] did not perform any abrasion and polishing process while measuring the microhardness of artificial teeth. We ensured that the enamel layers preserve their properties without abrasion of the artificial tooth specimens we use.

The effect of beverages can be strong depending on the structural properties of artificial teeth such as chemical composition or external properties such as finishing and polishing.[27] Moreover, the effect of drinks on the characteristics of artificial teeth may be directly related to the frequency and amount of intake.[22] Previous studies[23,33] demonstrated that storage in water, the pH of the stored medium and the ionic composition of organic acids, foods and beverages affect the mechanical properties of dental materials. However, it has been observed that the temperature and pH values of the beverages are mostly effective in studies evaluating the erosive effects on enamel.[34] In our study, in parallel with the researches, liquid environments containing artificial tooth specimens were kept in the oven at 37°C. Sarı et al[35] concluded that foods and beverages with low pH cause lower microhardness value and more surface roughness on enamel and composite samples. Aliping-Mckenzie et al[36] suggested that the surface hardness of glass ionomer and compomer samples is affected not only by low pH values but also by the chemical composition of acidic beverages. Badra et al[22] attributed the increase in surface roughness of composite resins with different fillers kept in coffee at 60 ° C to the high temperature of the solution. In our study, there was a significant decrease from the beginning to the 6th month in all beverages for the microhardness values of all artificial tooth groups. However, at the end of the 6th month, there was no significant difference between the solutions in terms of microhardness in general. There was no significant difference between beverages for all the time of measurement of surface roughness. The fact that cola and cherry juice has a lower pH compared to other beverages increases the surface roughness, while it is not thought to have a significant effect on microhardness.

Microhardness and roughness varied depending on the storage time of the specimens in beverages. Therefore, it is important to determine test times and measurement times in a way that reflects denture use. It is thought that the 6-day test period we determined can reflect the clinical conditions by simulating 6-month denture use.[22,25,26] Teeth and denture surfaces come into contact with food or drink taken for a very short time before being washed by saliva. In studies where specimens were kept in solutions for a long time, this role of saliva was not taken into account.[31,36] Therefore, while planning our study, we determined our test period by considering the possible contact time of intraoral tissues and restorations before being washed by saliva. The effects of saliva such as the buffering capacity, formation of a pellet layer and contribution to remineralization are difficult to imitate in vitro. These properties are more important for studies on enamel.

In studies, the differences in the surface hardness of artificial teeth have been attributed to the presence of cross-links for acrylic resin teeth, and to the difference in filling particles and composition for composite resin teeth.[11,13,37–39] In the Vickers hardness measurement technique, it is possible to calculate the average and obtain information about the hardness of the entire structure, since the tip coincides with inorganic and organic structure. In composite resins, one of the heterogeneous measuring materials, the tip can correspond to the soft or hard area. For this reason, 3 measurements were made from each surface in our study.

Although hardness is a surface property, it is affected by water absorption decrease in the amount of filler leads to increased water absorption.[30] In order for the surface hardness of the composite resin to decrease, the liquid in the environment must penetrate the resin matrix and cause filler release by weakening the filler silane bond. Studies[11,13,18,28,38] have shown that microfilled composite resin artificial teeth have higher microhardness values. These studies support the result of our research. The addition of inorganic filler particles to the highly cross-linked polymer structures of microfilled composite resin teeth provided them higher hardness values.

Surface roughness is the 2-dimensional parameter of the material surface. As the surface free energy decreases on rough surfaces, the accumulation of food residues becomes easier. This results in an accumulation of stains, plaque and calculus.[9,40] The softening of the resin matrix causes the filler particles to separate from the surface, resulting in a rough surface.[22] Suzuki[18] compared the surface roughness properties of four different artificial teeth (nano-composite, micro-filled composite, cross-linked acrylic resin, conventional acrylic resin). According to the results, the surface roughness of all artificial teeth showed lower values than conventional acrylic teeth. There was no significant difference between the roughness values of the nanocomposite artificial teeth and the micro-filled teeth and cross-linked acrylic teeth. These results are in line with our study. Bollen et al[20] argued that the amount of surface roughness of the oral hard tissues should be less than 0.2 μm in order to prevent the accumulation of plaque and thus to provide biocompatible restorations. Considering this situation, the average surface roughness values revealed in our study increased above 0.2 μm from the 1st month in all solutions for all artificial tooth groups. While the surface roughness values increased with time during the test period, the most significant increase was observed in the 3rd and 6th month measurements.

Conclusion

The daily consumption of regular beverages can alter the surface characteristics and the microhardness of artificial teeth. To improve these mechanical and physical properties, new artificial teeth have been developed by controlling the filler particles and the polymer matrix. Based on the results of this study, microfiller composite resin teeth were recommended for their best mechanical properties.

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Author Contributions

P.O. and S.T.D. planned the study design. S.T.D. prepared the samples and performed the laboratuary tests. P.O. evaluated the results. S.T.D. wrote the text and P.O. made the necessary corrections.

Conflict of Interest

The authors declare that there is no conflicts of interest.

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CONGRESS PROCEEDING

Periodontal Treatment Of Gingival Overgrowth Due To Amlodipine Use: Case Series

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Abstract

Purpose: In this case series, clinical properties of gingival overgrowths deriving from the usage of amlodipine, which is a type of calcium channel blockers and its treatment protocols are explained.
Methods: Three male patients aged 15, 60 and 45 applied to our clinic with the complaints of gingival overgrowth and bleeding. In the anamnesis, it was learned that they were using antihypertensive medication containing amlodipine. In the first session, scaling and root planning applications were performed. Then, the patients who were given detailed oral hygiene instructions including tooth brushing and interface cleaning, consulted with the relevant physicians. It was deemed appropriate to replace the drug the patients were using with another antihypertensive drug, which is an alternative that does not lead to gingival overgrowth. After the controls performed at certain time intervals and oral hygiene evaluations, it was observed that a perfect recovery was achieved. In addition to these, gingivectomy was performed using classic surgical method under local anesthesia in one case.
Results: All three patients showed uneventful healing without any complications. During periodic controls, it was observed that patients' complaints disappeared, the gingiva regained their natural physiological form, aesthetically pleasing results were achieved, no recurrences were observed in the 6th month and periodontal health could be maintained.
Conclusion: Gingival overgrowth can make oral hygiene practices difficult, increasing plaque retention which causes aesthetic problems, therefore it needs to be treated. The treatment protocol for gingival overgrowth due to drug use includes the replacement or discontinuation of the current drug with an alternative drug with the physician's consultation, after the initial periodontal treatment and oral hygiene practices, periodontal surgical procedures and regular controls in severe cases. Treatment not always start with surgery, at times it can be treated simply by controlling bacterial plaque and discontinuing or changing the medication. Nevertheless, physicians should consider alternative treatments such as additional periodontal surgical procedures when necessary.

Key words: Gingival overgrowth; Amlodipine, Hypertension, Calcium channel blockers

Introduction

Gingival overgrowth is a common type of gingival disease. Both medication-related gingival lesions, formerly known as "gingival hyperplasia" or "gingival hypertrophy," are now referred as "gingival enlargement" or "gingival overgrowth", because the histologic composition of the pharmacologically changed gingiva was not reflected correctly in the earlier names. There are a growing variety of drugs that can cause gingival overgrowth, but gingival overgrowth can also be caused by a wide range of pathological and idiopathic reactions. Drug-induced gingival growths generally begin in the papillary and marginal gingiva regions, and their frequency and severity are most common on the labial surfaces of the maxillary and mandibular anterior teeth.[1,2] It is an important periodontal issue, not only because of aesthetic appearance, but also because of the development of the ideal environment for microbial dental plaque. It can cause tooth decay, infections and periodontal diseases, which may lead to undesirable results in terms of speech, chewing and aesthetic appearance, and therefore needs to be treated.[3] Anticonvulsants, immunosuppressants and calcium channel blockers are the three main classes of drugs associated with gingival overgrowth, based on their therapeutic actions.[2] Calcium channel blocker or calcium antagonists, antihypertensive medications are widely used in patients with angina or peripheral vascular disease.[2,4] They act by blocking the flow of calcium ions through the membranes of cardiac and smooth muscle cells and blocking intracellular mobilization of calcium4. Calcium channel blockers are known as benzothiazepine derivatives (diltiazem), phenylalkylamine derivatives (verapamil),

or substituted dihydropyridines based on their chemical composition (amlopidine, felodipine, isradipine, nicardipine, nifedipine, nitrendipine, oxodipine, nimodipine and nisoldipine).[4,5] Amlodipine, a calcium channel blocker, has been identified as one of the possible etiological causes of gingival overgrowth.[2,4,6] In this context, the aim of the study is to offer suggestions to physicians that the treatment of drug-induced gingival overgrowth should not be started with surgery at first, but that in some cases additional periodontal surgical procedures may be required in addition to non-surgical methods. In this case series, intraoral clinical features and treatment protocols of gingival overgrowths due to amlodipine use are presented.

Methods

Case 1

A 15-year-old male patient applied to the periodontology clinic with complaints of excessive gingival overgrowth and bleeding. In the clinical examination it was observed that the patient had apparent overgrowth, redness, pseudopockets, excessive plaque and calculus. In the anamnesis, it was learned that the patient had been using an antihypertensive drug containing amlodipine for 8 months due to the nephrotic syndrome disease. In the first session, scaling and root planning applications were performed with ultrasonic devices and periodontal hand instruments. Then, the patient who was given detailed oral hygiene instructions including tooth brushing and interface cleaning, consulted with the relevant physician. It was deemed appropriate to replace the drug of the patient with an antihypertensive drug containing captopril. In the controls, the necessary periodontal procedures were performed and the patient was provided motivation on maintaining oral hygiene practices.

Case 2

A 60-year-old male patient with complaints of excessive gingival overgrowth and bleeding applied to the periodontology clinic. In the clinical examination, apparent overgrowths, redness, dental caries, deep periodontal pockets, excessive plaque and calculus were observed. In the anamnesis, it was learned that the patient had been using an antihypertensive drug with amlodipine content for 5 years. The patient who was performed initial periodontal treatment in the first session and given detailed oral hygiene instruction, consulted with the relevant physician. It was deemed suitable to replace the patient's medicine with an antihypertensive drug containing enalapril. The needed periodontal procedures were performed and the patient was provided motivation on maintaining oral hygiene practices in the controls.

Case 3

A 45-year-old male patient with excessive gingival overgrowth, bleeding and pain applied to our periodontology clinic due to these complaints. A large amount of plaque and calculus was detected in the patient due to the insufficient oral hygiene practices. Deep periodontal pockets and pseudopockets were also present on probing. Overgrown gingival tissues were soft, red or bluish-red on initial periodontal examination, also extremely fragile and was bleeding easily on probing. According to the anamnesis obtained from the patient, it was learned that the patient had hypertension and had been using an antihypertensive drug containing amlodipine due to his condition for 3 years. The patient said that he noticed gingival overgrowth within a few months after starting to use the drug containing amlodipine. In the first session, the patient who was performed initial periodontal treatment and given detailed oral hygiene instruction, consulted with the relevant physician. It was deemed appropriate to replace the drug of the patient with an antihypertensive drug containing captopril. As a result of the controls performed at certain time intervals and oral hygiene evaluations, it was observed that a great improvement was achieved, and gingivectomy procedure was planned, as the shape of the gingiva did not recuperate as desired, despite the fibrotic and firm consistency. Then, with the gingivectomy procedure applied with classical surgical method under local anesthesia, no.15 scalpel was used with the classical surgical method. Later, periodontal dressing (Coe-Pack, GC America Inc., USA) was applied. The gingiva was shaped, recuperated to its natural physiological form, and the patient became able to access all the areas in his mouth with ease.

All patients showed uneventful healing without any complications. They were recalled to controls and evaluated regularly on the 3rd, 7th, 14th days and in the 1st, 3rd and 6th months. The needed periodontal procedures were performed and the patients were provided motivation on maintaining oral hygiene practices in the controls. After Phase 1 periodontal therapy, it was determined that the bleeding and inflammation in the gingiva were reduced to a great extent in all the cases, also the gingiva became pink and firm. In the first and second cases, aesthetically and functionally satisfying results were achieved, additional surgical procedures were not needed Figure 1, Figure 2. In the third case however, especially in the papillary areas, it was observed that the presence of retention areas had not completely gained their natural physiological form. For this reason, the gingivectomy procedure was performed using the traditional surgical procedure under adrenaline including articaine local anesthesia and the gingiva was shaped, restored to its natural physiological form and the patient could reach the formerly inaccessible areas more easily. Following that, postoperative treatment included twice-daily use of a mouthwash containing chlorhexidine (Andorex, Pharmaceuticals Ind. and Trade Co. Ltd., Turkey) and analgesic (Apranax Fort 550mg, Abdi İbrahim Pharmaceuticals Ind. and Trade Co. Ltd., Turkey). The patient's symptoms vanished, the gingiva returned to its natural physiological state of pink colored, knife-edge papillae, and an aesthetically appealing outcome was obtained in the periodic controls. The patient became able to maintain good oral hygiene. In none of the cases any recurrence was observed in the 6th month and periodontal health could be maintained Figure 3.

Discussion

Gingival overgrowth is a major concern both for the patients and physicians, since it is found unaesthetic and leads to the disposition of microbial dental plaque. It is still unknown how drugs may trigger a connective tissue reaction in the gingiva.[1] Based on their clinical actions, anticonvulsants, immunosuppressants, and calcium channel blockers are the three key groups of drugs linked to gingival overgrowth.[2] Antihypertensive drugs such as calcium channel blockers or calcium antagonists are often used in patients with angina or peripheral vascular disease.[2,4] Amlodipine, a calcium channel blocker, has been identified as one of the possible etiological causes of gingival overgrowth.[2,4,6] Three patients with poor oral hygiene experienced gingival enlargement as a result of chronic amlodipine use, according to Seymour et al (at least 3 months).[6] In a study of 911 patients conducted by Ellis et al., 63 percent of those taking nifedipine had gingival enlargement, which was substantially higher than the amlodipine and diltiazem classes.[7] Increased connective tissue matrix is a typical histopathological symptom of all drug-induced gingival overgrowth.[5] Although the connection between gingival inflammation and drug-induced overgrowth is still debated, evidence suggests that local factors and associated inflammation play a role in gingival overgrowth formation.[6,8,9] Bacterial plaque has been related to gingival and periodontal disease, making it a natural target for attempts to avoid or control gingival overgrowth. Not being able to maintain oral hygiene is a problem of the patient, that might require professional help from the dentist.[9] The severity of gingival overgrowth in patients taking these drugs is linked to impaired plaque control and is proportional to plaque-induced inflammation.[7] In our study, regarding the first and second cases, after giving oral hygiene instruction to the patient and applying initial periodontal treatment including regular con-

Figure 1. Case 1- clinical situation at the first visit and 6 months follow-up.

Figure 2. Case 2- clinical situation at the first visit and 6 months follow-up.

Figure 3. Case 3- clinical situation at the first visit and 6 months follow-up.

trols, the current drug was replaced with an alternative drug with physician consultation, and improvement was achieved without additional periodontal surgical procedures. The direct and indirect effects of these drugs on gingival fibroblast metabolism are the subject of current research on the pathogenetic mechanism of drug-associated overgrowth. Treatment focuses on medication replacement and successful regulation of local inflammatory factors like plaque and calculus, if possible.[1] With nonsurgical periodontal treatment and good plaque control, Hancock and Swan were able to achieve a very effective regression in gingival overgrowth.[8] Despite the fact that non-surgical care is effective in the majority of cases, many patients must have their overgrown areas surgically removed for cosmetic and functional purposes. When gingival overgrowth interferes with speech, function, aesthetics, or oral hygiene, it should be surgically removed.[10] External bevel gingivectomy, followed by scaling and root planning, is the traditional surgical procedure for gingival overgrowth care.[8] A complete or partial internal gingivectomy solution, on the other hand, has been suggested as an alternative. By eliminating bare connective tissue damage caused by external gingivectomy, this technically more difficult procedure has the advantage of limiting postoperative discomfort and bleeding.[3,8] Plaque prevention has also been stated to be successful when using chlorhexidine mouthwash and gel.[4] A treatment protocol was applies in the 3rd case, including initial

periodontal treatment and replacement of the current drug with an alternative drug, as mentioned in the first and second cases, and the recovery was achieved to a great extent. However, it was observed that the presence of retention areas had not completely gained their natural physiological form and the patient could reach the formerly inaccessible areas more easily. For this reason, the gingivectomy procedure was applied and the gingiva was shaped, restored to its natural physiological form and the patient could reach the formerly inaccessible areas more easily. The results of our study are compatible with many studies published in the literature that include similar treatment protocols.[2–4,7,11] The limitations of this study are the low number of our cases, the need for additional periodontal surgical procedures for only one patient, and the follow-up period of the patients for 6 months.

Conclusion

One of the common causes of gingival overgrowth is the use of drugs containing amlodipine, which is one of the calcium channel blockers. Gingival overgrowth can make oral hygiene practices difficult, increase bacterial biofilm retention and cause aesthetic problems, therefore needs to be treated. The treatment protocol is followed by a careful patient history and determination of the cause. If the condition is due to drug use, the treatment includes the replacement or discontinuation of the current drug with an alternative drug with the physician's consultation; besides, after the initial periodontal treatment, oral hygiene practices including effective bacterial biofilm controls and regular visits should be done, and in severe cases, periodontal surgical procedures should be made. In this case series, the treatment of gingival overgrowth induced by the combination of amlodipine and bacterial biofilm retention has been demonstrated, based on the clinical results. Treatment not always start with surgery, at times it can be treated simply by controlling bacterial plaque and discontinuing or changing the medication. Nevertheless, physicians should consider alternative treatments such as additional periodontal surgical procedures when necessary.

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Conflict of Interest

Authors declare that they have no conflict of interest.

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CONGRESS PROCEEDING

Assessment of Knowledge and Awareness Levels of Healthcare Professionals and Candidates on Dentoalveolar Injuries

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Abstract

Purpose: To evaluate the level of knowledge and awareness of healthcare professionals and candidates about traumatic dental injuries.
Material and Methods: A total of 160 people, consisting of 3rd, 4th, 5th year students (47) studying at Faculty of Medicine, 3rd and 4th year students (91) studying at School of Nursing, and emergency physicians, emergency and traumatology nurses, and otorhinolaryngologist and specialist nurses (22) attended. Participants were asked to answer the questionnaire forms sent in digital environment.
Results: 82.3% of the participants stated the percentage of teeth and jaws affected by trauma to the head and facial area as 40-60% or more. When asked about what to do when you encounter an avulsed tooth case, 50.9% of them stated that they will refer the patient to the dentist and 48.4% should be in the first half hour, 11.3% of them reimplanting the avulsed tooth. While 23.9% of the participants preferred sterile saline solution during the transportation of the avulsed tooth, 33.3% stated that they did not have any knowledge. 87.4% of the participants stated that it is important to participate in an educational program related to dental trauma and 85.5% of them want to participate in an educational program.
Conclusion: Within the limits of the study, it was concluded that training programs are necessary to improve the knowledge and awareness levels of non-dentist healthcare professionals and candidates about dentoalveolar traumas.

Key words: Dentoalveolar trauma; Healthcare Professionals; Knowledge Level

Introduction

Dental traumatic injuries, especially in children, are one of the most common problems after tooth decay. The prognosis in dental traumas may change according to the time spent after the trauma, where and how the trauma occurred, the type of trauma, the degree of displacement or mobility of the tooth, the fracture area, the condition of the root development and the age of patient.[1] It has been reported that most of the children are taken to the dentist between 1-6 months after trauma and there are very few children who are taken to the dentist within the first 24 hours. In addition, it was determined that only 15% of children had first intervention after oral-dental injury.[2–4] Since traumas are usually among the situations that require urgent intervention, the first treatment with the patients is performed by medical doctors in the emergency services.[5,6] The priority in the emergency services is the treatment of conditions that threaten the general health of the patients, so the treatment of injuries of teeth and surrounding tissues can be ignored. Early treatment is of great importance in terms of prognosis in oral-tooth injuries.[7,8] Dentofacial trauma is encountered more frequently in emergency departments of public hospitals, university hospitals and private hospitals. Emergency services, trauma knowledge and awareness for this group are important as full-time dentists are rarely available.[9] Nurses play an important role in emergency preparedness. In the treatment of dentofacial trauma where timing is important, nurses who have functions such as preparing the patient, helping the physician, calling the emergency service are also important in coping with dentofacial trauma.[10] After re-

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viewing the literature, it is seen that the gap in the literature is the lack of information about dental trauma, where medical faculty, emergency physicians, and nurses are evaluated together. For this reason, the present study was conducted with emergency medicine physicians and candidates, nurses and candidates. The aim of this study is to evaluate the level of knowledge about the management of traumatic dental injuries of both emergency medicine doctors and nurses, including specialist health professionals in the traumatology department, and health worker candidates studying at the Faculty of Medicine, Faculty of Nursing. The null hypothesis of the study is that there is no difference between the groups when the questionnaire questions in dental trauma assessment are compared.

Methods

A total of 160 people, consisting of 3rd, 4th, 5th grade students (47) studying at Faculty of Medicine, 3rd and 4th grade students (91) studying at School of Nursing, and emergency physicians, emergency and traumatology nurses, and otorhinolaryngologist and specialist nurses (22) were included. Data collection forms were sent to the participants who accepted to participate in the study via digital platform called Google Forms. The data collection form was composed of 16 questions used in a similar study published previously[5,9] in the literature which questioned the participants in terms of their level of knowledge and awareness in the emergency treatment of dental injuries Table 1. Each participant answered the questionnaire separately. The data obtained as a result of the answers given to the questionnaires were evaluated statistically by using the Chi-Square Test in the SPSS 24.0 package program. The sample size was determined as a minimum of 158 with a significance level of 0.05 and a power of 0.94 percent. Ethics approval was obtained through University A Research Ethics Committee (reference no.8057635405099/214).

Table 1. Questions in the questionnare form

Question 1	What do you think is the percentage of teeth and jaws affected in traumas on the head and face area?
Question 2	What will you do with the "avulsed tooth"?
Question 3	What do you do if a dislocated tooth is broken?
Question 4	Do you know what to do if a permanent tooth is dislocated as a result of an accident?
Question 5	Do you think it is important to have a training program regarding management of dental trauma?
Question 6	Do you think your level of knowledge about oral and dental injuries is sufficient?
Question 7	Would you like to attend a training program on management of dental trauma?
Question 8	Have you ever encountered an accident that caused a tooth to come out of place?
Question 9	Would you replace an avulsed permanent tooth?
Question 10	What is the material used to clean the "knocked out tooth"?
Question 11	Which part of the tooth should be kept while placing an avulsed tooth?
Question 12	What is the medium used to transfer the "knocked out tooth"?
Question 13	Would you replace an avulsed decidious tooth?
Question 14	Do you think breaking a tooth is an emergency problem?
Question 15	What is the importance of finding the broken piece when the tooth is broken?
Question 16	What is the average time taken to seek the doctor in case of a "knocked out tooth"?

Results

Demographic data, basic level of knowledge and education about dentofacial trauma as well as knowledge levels of crown fractures and emergency management of avulsion in primary and permanent teeth are shown in Table 2 and Table 3. When asked the question, "What do you think is the percentage of teeth and jaws affected in traumas to the head and face area?", 42.4% of the participants responded with a percentage of 62-80 (p=0.301). The question was ,"Have you ever encountered an accident that caused a tooth to come out?". According to the result, 120 (75.5%) of the participants had not encountered a situation that caused the tooth to come out before. Following that, they were asked, "What will you do with the avulsed tooth?", about 11.3 %reported that they answered in the following way: "I replace the tooth and immediately apply to the dentist". The 4th year students of the Faculty of Medicine gave the correct answer at the highest rate, 30.4%. There was a significant difference between answers (p=0.048). When they were asked the question, "What is the average time taken to seek the doctor in case of a "knocked out tooth? ", approximately 48.4% answered "within the first 30 minutes"; 15.7% answered "I don't know". There is a significant difference between the answers (p=0.002). Another question asked to the participants was, "What do you do if a dislocated tooth is broken?", 17.6% of the participants answered "I don't know"; about 3.8% answered "I will still replace the tooth" p= 0,767 and 66% of the participants said that it was important to find the broken part when the tooth was broken. No significant difference between the answers (p=0.077). When asked about the transport media for the avulsed tooth, 23.9% of the participants were realized to show a tendency to use distilled water, 8.8 % preferred oral cavity and saliva while 33.3 % showed preference in terms of milk. There were significant differences between the answers given (p=0.000). More than 81.1% of the participants responded that they were not satisfied with their knowledge regarding traumatic dental injuries, and they felt that attending a dental education program would be of much benefit when they handle patients.

Table 2. Responses of the participants to the questions, their percentages and statistical comparison

	3rd year students at Faculty of Medicine		3rd year students at School of Nursing		4rd year students at Faculty of Medicine		4rd year students at School of Nursing		5rd year students at Faculty of Medicine		Emergency Medicine Nurses		Otorhinolaryngology Nurses		Otorhinolaryngology specialist physician		traumatology department nurse		p
	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	
Male	5	22,7	1	25,0	11	47,8	25	28,7	2	100,0	3	20,0	0	0,0	1	100,0	0	0,0	0,083
Female	17	77,3	3	75,0	12	52,2	62	71,3	0	0,0	12	80,0	1	100,0	0	0,0	4	100,0	
Question 1																			
1-20	1	4,5	0	0,0	0	0,0	4	4,6	0	0,0	2	13,3	0	0,0	0	0,0	0	0,0	
21-40	3	13,6	0	0,0	3	13,0	9	10,3	2	100,0	2	13,3	0	0,0	1	100,0	2	50,0	
41-60	5	22,7	1	25,0	5	21,7	19	21,8	0	0,0	2	13,3	0	0,0	0	0,0	0	0,0	0,301
61-80	11	50,0	2	50,0	10	43,5	37	42,5	0	0,0	4	26,7	1	100,0	0	0,0	2	50,0	
81-100	2	9,1	1	25,0	5	21,7	18	20,7	0	0,0	5	33,3	0	0,0	0	0,0	0	0,0	
Question 2																			
I immediately consulted the dentist.	14	63,6	3	75,0	4	17,4	49	56,3	0	0,0	7	46,7	1	100,0	1	100,0	2	50,0	
I wash the child's mouth with tap water and put the tooth in a damp cloth.	7	31,8	1	25,0	12	52,2	29	33,3	2	100,0	8	53,3	0	0,0	0	0,0	1	25,0	0,048
I replace the tooth and immediately apply to the dentist.	1	4,5	0	0,0	7	30,4	9	10,3	0	0,0	0	0,0	0	0,0	0	0,0	1	25,0	
Question 3																			
I don't know.	3	13,6	0	0,0	3	13,0	18	20,7	0	0,0	3	20,0	0	0,0	0	0,0	1	25,0	
Other (specify)	2	9,1	0	0,0	0	0,0	0	0,0	0	0,0	1	6,7	0	0,0	0	0,0	0	0,0	
I go to the dentist with broken tooth.	16	72,7	4	100,0	18	78,3	56	64,4	2	100,0	8	53,3	1	100,0	1	100,0	3	75,0	0,767
I don't care about the broken piece.	0	0,0	0	0,0	0	0,0	10	11,5	0	0,0	3	20,0	0	0,0	0	0,0	0	0,0	
I replace the tooth	1	4,5	0	0,0	2	8,7	3	3,4	0	0,0	0	0,0	0	0,0	0	0,0	0	0,0	
Question 4																			
Yes	4	18,2	1	25,0	6	26,1	17	19,5	0	0,0	3	20,0	0	0,0	0	0,0	0	0,0	
I don't have an idea	5	22,7	2	50,0	6	26,1	28	32,2	0	0,0	5	33,3	0	0,0	0	0,0	4	100,0	0,478
No	13	59,1	1	25,0	11	47,8	42	48,3	2	100,0	7	46,7	1	100,0	1	100,0	0	0,0	
Question 5																			
I don't know	0	0,0	0	0,0	1	4,3	8	9,2	0	0,0	2	13,3	0	0,0	0	0,0	0	0,0	
Yes	21	95,5	4	100,0	19	82,6	75	86,2	1	50,0	13	86,7	1	100,0	1	100,0	4	100,0	0,477
No	1	4,5	0	0,0	3	13,0	4	4,6	1	50,0	0	0,0	0	0,0	0	0,0	0	0,0	
Question 6																			
Yes	0	0,0	1	25,0	3	13,0	11	12,6	0	0,0	2	13,3	0	0,0	0	0,0	0	0,0	
I don't have an idea	0	0,0	1	25,0	2	8,7	9	10,3	0	0,0	1	6,7	0	0,0	0	0,0	0	0,0	0,816
No	22	100,0	2	50,0	18	78,3	67	77,0	2	100,0	12	80,0	1	100,0	1	100,0	4	100,0	
Question 7																			
Yes	18	81,8	4	100,0	17	73,9	77	88,5	1	50,0	13	86,7	1	100,0	1	100,0	4	100,0	
I don't have an idea	4	18,2	0	0,0	0	0,0	4	4,6	0	0,0	2	13,3	0	0,0	0	0,0	0	0,0	0,041
No	0	0,0	0	0,0	6	26,1	6	6,9	1	50,0	0	0,0	0	0,0	0	0,0	0	0,0	
Question 8																			
Yes	8	36,4	0	0,0	5	21,7	17	19,5	0	0,0	6	40,0	1	100,0	1	100,0	1	25,0	0,113
No	14	63,6	4	100,0	18	78,3	70	80,5	2	100,0	9	60,0	0	0,0	0	0,0	3	75,0	

Table 3. Responses of the participants to the questions, their percentages and statistical comparison

	3rd year students at Faculty of Medicine		3rd year students at School of Nursing		4rd year students at Faculty of Medicine		4rd year students at School of Nursing		5rd year students at Faculty of Medicine		Emergency Medicine Nurses		Otorhinolaryngology Nurses		Otorhinolaryngology specialist physician		traumatology department nurse		p
	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	
Question 9																			
Yes	4	18,2	2	50,0	13	56,5	25	28,7	0	0,0	2	13,3	0	0,0	0	0,0	1	25,0	0,086
No	18	81,8	2	50,0	10	43,5	62	71,3	2	100,0	13	86,7	1	100,0	1	100,0	3	75,0	
Question 10																			
I don't know.	10	45,5	1	25,0	1	4,3	20	23,0	0	0,0	2	13,3	0	0,0	0	0,0	2	50,0	
I brush the teeth.	1	4,5	0	0,0	0	0,0	7	8,0	0	0,0	0	0,0	0	0,0	0	0,0	0	0,0	
I wash in tap water.	4	18,2	0	0,0	4	17,4	0	0,0	0	0,0	0	0,0	0	0,0	0	0,0	0	0,0	0,040
I wash it under running water under the tap.	0	0,0	0	0,0	0	0,0	13	14,9	0	0,0	5	33,3	0	0,0	0	0,0	0	0,0	
I wash with physiological saline.	7	31,8	3	75,0	17	73,9	45	51,7	2	100,0	8	53,3	1	100,0	1	100,0	2	50,0	
I replace it without cleaning it.	0	0,0	0	0,0	1	4,3	2	2,3	0	0,0	0	0,0	0	0,0	0	0,0	0	0,0	
Question 11																			
it does not matter	3	13,6	1	25,0	0	0,0	10	11,5	1	50,0	1	6,7	0	0,0	0	0,0	1	25,0	
from the root	2	9,1	1	25,0	2	8,7	17	19,5	0	0,0	2	13,3	0	0,0	1	100,0	0	0,0	0,310
from the crown	17	77,3	2	50,0	21	91,3	60	69,0	1	50,0	12	80,0	1	100,0	0	0,0	3	75,0	
Question 12																			
inside the mouth	0	0,0	0	0,0	3	13,0	1	1,1	0	0,0	0	0,0	1	100,0	0	0,0	2	50,0	
Alcohol	0	0,0	1	25,0	1	4,3	0	0,0	0	0,0	0	0,0	0	0,0	0	0,0	0	0,0	
I do not know	4	18,2	0	0,0	4	17,4	36	41,4	0	0,0	8	53,3	0	0,0	0	0,0	1	25,0	
Ice	1	4,5	0	0,0	3	13,0	8	9,2	0	0,0	0	0,0	0	0,0	0	0,0	0	0,0	0,000
Dry environment (napkin etc.)	11	50,0	1	25,0	2	8,7	11	12,6	2	100,0	1	6,7	0	0,0	0	0,0	0	0,0	
sterile saline	3	13,6	1	25,0	6	26,1	25	28,7	0	0,0	2	13,3	0	0,0	1	100,0	0	0,0	
Milk	2	9,1	1	25,0	1	4,3	4	4,6	0	0,0	3	20,0	0	0,0	0	0,0	1	25,0	
Saliva	1	4,5	0	0,0	3	13,0	2	2,3	0	0,0	1	6,7	0	0,0	0	0,0	0	0,0	
Question 13																			
Yes	1	4,5	1	25,0	3	13,0	20	23,0	0	0,0	1	6,7	0	0,0	0	0,0	0	0,0	0,430
No	21	95,5	3	75,0	20	87,0	67	77,0	2	100,0	14	93,3	1	100,0	1	100,0	4	100,0	
Question 14																			
Yes	13	59,1	4	100,0	17	73,9	55	63,2	0	0,0	10	66,7	1	100,0	0	0,0	4	100,0	0,163
No	9	40,9	0	0,0	6	26,1	32	36,8	2	100,0	5	33,3	0	0,0	1	100,0	0	0,0	
Question 15																			
I think finding the part is not important.	2	9,1	1	25,0	5	21,7	37	42,5	0	0,0	7	46,7	0	0,0	0	0,0	2	50,0	0,077
I'm trying to find the part.	20	90,9	3	75,0	18	78,3	50	57,5	2	100,0	8	53,3	1	100,0	1	100,0	2	50,0	
Question 16																			
1-2 hours	3	13,6	0	0,0	1	4,3	5	5,7	0	0,0	0	0,0	0	0,0	1	100,0	2	50,0	
between 30-60 minutes	2	9,1	0	0,0	9	39,1	11	12,6	1	50,0	3	20,0	0	0,0	0	0,0	1	25,0	0,002
I do not know	7	31,8	0	0,0	2	8,7	15	17,2	0	0,0	1	6,7	0	0,0	0	0,0	0	0,0	
first 30 minutes	7	31,8	4	100,0	9	39,1	47	54,0	0	0,0	9	60,0	0	0,0	0	0,0	1	25,0	
You should go after you feel good.	3	13,6	0	0,0	2	8,7	9	10,3	1	50,0	2	13,3	1	100,0	0	0,0	0	0,0	

Discussion

Traumatic dental injuries, in addition to psychosocial problems, which can cause pain and anxiety and result in negative results if mistakes are made in the emergency intervention and guidance stage continue to be one of the important oral-dental health problems where problems can develop.[10] In recent years, the knowledge and awareness levels of dentists, dental hygienists and primary school teachers about dental trauma have been investigated in various countries.[3,8] There is not enough information about the knowledge and awareness level of healthcare professionals and candidates in the management of dental traumas, especially in the treatment of avulsed teeth.[1,3] In this study, the awareness of healthcare professionals and candidates who may encounter trauma cases about dental injuries was evaluated and their knowledge level about trauma was investigated by asking questions related to treatment protocols. According to the International Association of Dental Traumatology (IADT) guidelines, immediate replantation at the accident site is the best treatment for permanent teeth. The condition of the cells, storage conditions and the time spent outside the mouth affect the vitality of the tooth. Especially dry time is critical for the survival of periodontal ligament cells.[2] In the study conducted by Coskun et al.[9], 11.2% of the physicians and 10.2% of the nurses reported that the avulsed tooth was placed immediately within 15-30 minutes, and most of the participants expressed the opinion that an avulsed tooth should be retained from the crown. In the current study, the students of the 4th grade Nursing Faculty reported that the dentist should be reached in the first 30 minutes with the highest percentage (54%) among the candidate groups, and 60% of the emergency nurses gave this answer. In the current study, most of the participants expressed their opinion that an avulsed tooth should be held from the crown. However, the correct response rates were low regarding in which media the tooth is to be stored. 8% of candidates of nurses, 30.3% of candidates of physicians and %26.7 emergency nurses preferred saliva, milk or inside the mouth which is the most suitable storage mediums. Sterile saline solution, which is an alternative storage medium, was preferred by the nurse candidates at the highest rate, with a rate of 28.7%. Similar to the results of our study, it was determined that there was a lack of knowledge in studies evaluating the knowledge of medical and nursing students and emergency health workers on dentofacial trauma.[4,5,10] According to the IADT directive, replantation is not recommended for avulsed primary teeth.[2] From this point of view, one of the most important questions of our survey study was "What will you do with the "avulsed tooth"?. In the study by Çiftçi et al.[7], this question was replied "I will replace 58.6 teeth and immediately apply to the dentist". In our study, 83.6% of them stated that they would not replace the primary teeth and 70.4% stated similarly for permanent tooth, that is, giving the answer that I would replace 11.3% teeth and apply to the dentist immediately. In the study of Yunus et al.[6], similar to our study, it was reported that there was a lack of knowledge about the storage environment and time management for avulsed teeth in nursing students. It leads to undesirable applications in the management of traumatic dental injuries. Incorporating dental trauma management into medical and nursing school curricula will provide students with a better understanding of the importance of early treatment for better patient outcomes. Medical doctors and nurses competent in managing emergency dental trauma procedures will be able to provide a higher standard of care for the patient that can prevent potentially lifelong negative repercussions. It is obvious that adding the trainings on dental trauma management to the emergency aid training will contribute. Our study also included nurses, doctors, emergency service workers and health worker candidates, and their level of knowledge was found to be less than expected. There were differences between the answers given in the study, and the null hypothesis was rejected.

Conclusion

The present study revealed that the level of knowledge and awareness of health staff was not as high as expected. Considering the results, it is important for health staff working in emergency departments to know the treatment protocols for traumatic dental injuries, especially avulsion injuries, in order to minimize complications. Taking the data of this study into consideration, another multi-centre study with a larger number of participants can be planned. Lecture notes on traumatic dental injuries can be added to the training curriculum, and educational and attractive brochures can be posted in the emergency services. Up-to-date training programs on the subject can be organized for other health care workers, especially emergency service workers, in order to improve their knowledge and awareness levels.

None

Author Contributions

T.A. and S.O. planned the study design.
S.O and F.O.C. prepared and performed survey form.
All authors evaluated the results, wrote the text and made the necessary corrections.

Conflict of Interest

Authors declare that they have no conflict of interest.

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CONGRESS PROCEEDING

Frequency of Pericoronal Radiolucency in Impacted Teeth: A Panoramic Radiography Study

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Abstract

Purpose: All permanent teeth may remain impacted. Impacted teeth may exist in the jaw for a long time without any pathology; however, they may cause some complaints on the temporomandibular joint, infections, neuralgiform pain, root resorption in neighboring teeth, and other pathologies. Pericoronal radiolucency observed over 2.5 mm in radiographic imaging is suspicious. The aim of this study was to investigate the frequency of pericoronal radiolucency in impacted teeth examined on panoramic radiographs. Methods: The study was conducted retrospectively by examining panoramic radiographs of 1128 adult patients (>18 age) (633 females, 495 males). Permanent impacted teeth with complete root development were included in the study, and primary teeth, mesiodens, supernumerary and supplemental impacted teeth were excluded from the study. Pericoronal radiolucency was recorded as 'present' in case of pericoronal radiolucency (>3 mm) associated with impacted permanent tooth on panoramic radiographs. The SPSS v.21 (IBM Corp., Armonk, NY, USA) program was used to analyze the data. Results: The age average of the individuals included in the study was 31±11 years (18-85). A total of 2247 impacted teeth from 1128 individuals were evaluated. Pericoronal radiolucency was detected in 208 impacted teeth (9.3%). There was a statistically significant association between the gender and frequency of pericoronal radiolucency ($p<0.05$). The frequency of pericoronal radiolucency is lower in females and individuals over 60 years of age. Conclusion: The frequency of pericoronal radiolucency associated with impacted teeth is 9.3%. This condition is more likely to be observed on radiographic examinations in males and individuals under 60 years of age. It is recommended that erupted teeth that are not located in the arch in clinical examination should be carefully examined radiologically in order to detect at an earlier pathological stage and carry out an appropriate treatment.

Key words: Pericoronal Radiolucency; Impacted Tooth; Panoramic Radiography

Introduction

All permanent teeth may remain impacted and their distribution differs mandible and maxilla. The most impacted teeth are third molars, maxillary canines, maxillary-mandibular premolars, and maxillary central incisors.[1] The causes for impacting the last erupted third molars in all races include differences in development of the face, sizes of the jaw and teeth, nutrition, space in the jaw arch, heredity, rickets, anemia, congenital syphilis, tuberculosis, endocrine disorders, and certain syndromes.[2] Impacted teeth may remain in the jaw for a long time without causing any pathology, as well as cause neuralgiform pain, infection, temporomandibular joint complaints, root resorptions in neighboring teeth, pathologies such as dentigerous cyst and ameloblastic fibroma. It is stated that embryonic residues found in dental follicles around impacted teeth have the potential to proliferate and transform into odontogenic lesions. It is stated that impaction is most commonly associated with dentigerous cyst, unicystic ameloblastoma, ameloblastic fibro-odontoma, adenomatoid odontogenic tumor and odontoma.[3] Radiographs continue to be the primary method to diagnose jaw lesions, and panoramic radiography is the first technique that comes to mind as an initial imaging technique in the evaluation of impacted teeth and associated lesions.[4] The radiographic appearance around the impacted tooth may not be a reliable indicator of dental follicle-related disease, and diagnosis based on radiographic findings alone may be highly misleading. However, pericoronal radiolucency exceeding 2.5 mm should be suspected in panoramic or intraoral radiographies, and it should not be forgotten that it may have the potential for various pathological transformations, especially dentigerous cysts.[5] The problem may be resolved earlier through a careful radiographic evaluation. The aim of this study was to investigate the frequency of pericoronal radiolucency in impacted teeth examined on panoramic radiographs.

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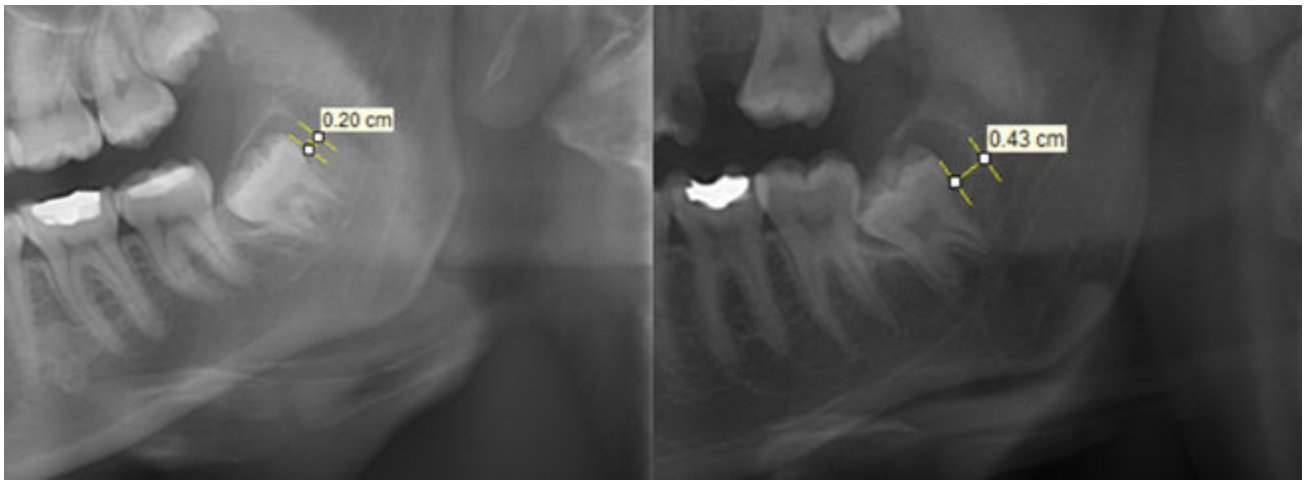

Figure 1. Pericoronal radiolucency was recorded as 'present' in case of pericoronal radiolucency (>3 mm, right side) 'absent' in case of pericoronal radiolucency (<3 mm, left side) associated with impacted permanent tooth on panoramic radiographs.

Methods

Study design The study protocol was approved by the Research Ethics Committee of Dentistry Faculty of Necmettin Erbakan University (no. 2021/04-54). The patients who have referred to the Department of Oral, Dental and Maxillofacial Radiology at Faculty of Dentistry of Necmettin Erbakan University between the years 2020-2021 were reviewed retrospectively. Permanent impacted teeth of individuals over the age of 18 who have completed their root development were included in the study. The primary teeth, mesiodenses, supernumerary and supplemental impacted teeth were excluded from the study. Radiological examination Pericoronal radiolucency was recorded as 'present' in case of pericoronal radiolucency (>3 mm) associated with impacted permanent tooth on panoramic radiographs Figure 1.[5] The panoramic radiographs were obtained (Morita Veraviewepocs 3D R100-P, J Morita MFG Corp., Kyoto, Japan) at 70 kVp, 10mA, and 10 s, according to the manufacturer's recommended protocol. All assessments were performedthrough i-Dixel software (J Morita MFG Corp., Kyoto, Japan) on a flat-screen monitor by the same examiner. Statistical analysis SPSS v.21 (IBM Corp., Armonk, NY, USA) program was used in order to analyze the data. Descriptive statistics (mean, standard deviation) were calculated for all parameters in the study. Chi-square test was used to determine the relationships between categorical variables; and any p value below 0.05 ($p<0.05$) was considered to be significant .

Results

The mean age of the individuals included in the study was 31±11 years (18-85). A total of 2247 impacted teeth from 1128 individuals were evaluated. The most common impacted teeth groups were lower third molars, upper third molars, upper canines, lower canines, upper premolars, and lower premolars Table 1. Pericoronal radiolucency was detected in 208 (9.3%) of 2247 impacted teeth examined in the present study. The frequency of pericoronal radiolucency in different tooth groups showed a statistically significant difference ($p<0.01$). Although the rate of pericoronal radiolucency is high because the number of teeth examined in some groups is lower, third molars are in the first place in terms of pericoronal radiolucency Table 1. The mean age of 633 women included in the study was 30.62±10.96 (18-85) years, and the mean age of 495 men was 31.86±11.98 (18-78) years. There was a statistically significant association between gender and the frequency of pericoronal radiolucency ($p<0.01$). The frequency of pericoronal radiolucency in women is lower than in men. The frequency of pericoronal radiolucency according to age groups did not show a statistically significant difference ($p>0.05$). However, the frequency of pericoronal radiolucency is lower in individuals over 60 years of age Table 2.

Discussion

The appearance of the follicle space surrounding the crown in impacted teeth is called pericoronal radiolucency. It is decided that it is normal or pathological depending on the width, and radiolucency larger than 3mm is considered abnormal.[5] The aim of this study was to investigate the frequency of pericoronal radiolucency in impacted teeth examined on panoramic radiographs. A total of 2247 impacted teeth from 1128 individuals were evaluated in the study. The most common impacted teeth groups are lower third molars, upper third molars, upper canines, lower canines, upper premolars, and lower premolars, respectively. In the Greek population, 940 teeth were examined including 406 teeth (43.2%) on the maxilla and 534 (56.8%) teeth on the mandible. According to this study, 91.6% of third molars, 5.3% of canines, 1.6% of premolars, 1.4% of molars and 0.1% of incisors were impacted.[6] The difference between the results of various studies is due to racial and genetic differences between populations. Our study concluded that third molars showed more pericoronal radiolucency than other teeth. It may be considered that the reason for this higher impaction rate of third molars than other teeth. Pericoronal radiolucency was detected in 208 of 2247 impacted teeth examined in our study (9.3%). In the literature, there is limited number of studies on the prevalence of pericoronal radiolucency radiologically, and it is observed that the majority of such studies included histological analysis. In a histological analysis study conducted by Kotrashetti et al.[7], cystic changes were observed in 21 (51.2%) of 41 follicles. Two of these were odontogenic keratocysts, one was calcified epithelial odontogenic cysts, and 18 were dentigerous cysts. Edamatsu et al.[8] examined mandibular third molars in 80 patients (39 males and 41 females). They found that the width of the pericoronal space was less than 3 mm (76.3%) in 61 cases and between 3mm and10 mm in 19 cases (23.7%). However, they showed that the width of the pericoronal space was more than 3 mm in 27 teeth that developed dentigerous cysts. It was detected in the study of Villalba et al.[5] on 140 patients that the width of pericoronal space was less than 2.5 mm in 127 patients and between 2.6 and 5 mm (hyperplastic) in 13 patients. Cystic changes were detected in 18 of these patients, and pericoronal width was normal in 15 of the patients with cystic changes and hyperplastic in three of them. In our study, pericoronal radiolucency was recorded as 'present' in case of radiolucency more than 3 mm in width, and it should be kept in mind that cystic

Table 1. The distribution of impacted tooth

Tooth number	Frequency, n	Percentage	Pericoronal radiolucency		Percentage	p
			Absence	Presence		
14	1	,0	1	0	0	
15	1	,0	1	0	0	
17	1	,0	1	0	0	
18	412	18,3	386	26	6	
22	1	,0	1	0	0	
23	54	2,4	51	3	5	
25	5	,2	5	0	0	
28	436	19,4	410	26	6	
33	6	,3	6	0	0	
34	1	,0	0	1	100	0.005*
35	3	,1	3	0	0	
37	2	,1	2	0	0	
38	685	30,5	604	81	13	
43	4	,2	3	1	25	
44	1	,0	1	0	0	
45	1	,0	1	1	1	
47	2	,1	1	1	50	
48	602	26,8	534	68	13	
Total	**2247**	**100,0**	**2039**	**208**	**9,3**	

*The significance level is p<0.01

Table 2. The distribution of pericoronal radiolucensies according to age and gender groups

Age and Gender Groups	Pericoronal radiolucency			Total	p
	Absence,n	Presence, n	Percentage (%)		
18-40	1756	180	9.2	1936	0.367
41-60	233	26	10.0	259	
61-85	50	2	3.8	52	
Total	**2039**	**208**	**9.3**	**2247**	
Female	1202	86	6.6	1288	0.000*
Male	837	122	12.7	959	
Total	**2039**	**208**	**9.3**	**2247**	

*The significance level is p<0.01

transformation may occur in cases below this value (3 mm). The incidence of cystic epithelium and squamous metaplasia is more common in hyperplastic follicles.[5] The limitation of our study is the lack of histological confirmation. The normal pericoronal width does not confirm that there is no pathology. In the study conducted by Glosser and Campbell[9], dentigerous cystic changes were found in approximately 37% of the mandibular third molars and 27% of the maxillary third molars by the histological examination of impacted third molars with normal follicle widths radiographically. In the literature, the incidence of hyperplastic follicles is reported to be higher in males and younger individuals.[10] The reason of gender difference is not known exactly. Similarly, in this study, the frequency of pericoronal radiolucency was found to be lower in women. There was not any statistically significant difference between the frequency of pericoronal radiolucency according to age groups. However, the frequency of pericoronal radiolucency is lower in individuals over 60 years of age. This may be explained with the fact that the incidence of impacted teeth decreases as age increases.

Conclusion

The frequency of pericoronal radiolucency associated with impacted teeth is 9.3%. This condition is more likely to be seen on radiographic examinations in males and individuals below 60 years of age. It is recommended that erupted teeth that are not located in the arch in clinical examination should be carefully examined radiologically in order to detect at an earlier pathological stage and to carry out an adequate treatment. In addition, since cystic changes may occur in impacted teeth without pericoronal radiolucency, histopathological examination of teeth which are planned to be extracted is recommended.

None

Author Contributions

Conception / design of the work: M.T. Acquisition, analysis and interpretation of the data: M.T. , M.A. Drafting the work: M.T. , M.A. Final approval of the version to be published: M.T. Investigation of accuracy and integrity of any part of work: M.T.

Conflict of Interest

Authors declare that they have no conflict of interest.

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