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PULL-OUT STRENGTH OF FIBER POSTS LUTED WITH DIFFERENT SELF-ADHESIVES

Cem ŞAHİN[1], Simel AYYILDIZ[2]*

ABSTRACT

Introduction: Dislodging from the root canals is the most common failure of bonded fiber restorations. Self-adhesive system has the advantage of reduced cementation procedure. The aim of this study was to evaluate the bond strengths of fiber posts with three different self-adhesive/resin systems to coronal and apical thirds of the post space dentine

Materials and methods: Thirty freshly extracted single-root human teeth were selected for this study. The specimens were then randomly divided into 3 subgroups each containing 10 samples. Fiber posts (RelyX, 3M, ESPE, UK) were inserted into canals using RelyX Unicem 3M ESPE, St. Paul, MN, USA), G-Cem (GC Corporation, Tokyo, Japan) and Maxcem Elite (Kerr Hawe Neos Orange,CA, USA) adhesives. Two disc shaped sections perpendicular to the long axis of each root sample were obtained for push-out tests. Failure load value was recorded. Statistical analysis was performed using One-way ANOVA and Kruskall-Wallis tests.

Results: RelyX Unicem exhibited the highest mean push-out bond strength values at the coronal section of all samples. G-Cem exhibited higher push-out bond strength values at apical section The overall bonding data of RelyX Unicem was also observed to be the highest among groups.

Conclusion: Self-adhesive systems are of practical ways of intra-canal cementation. It does not require multiple steps for success. All the systems offered acceptable retention ability. Keywords: Self-adhesive systems, root-canal cementation, post-core

Keywords: *Self-adhesive systems, root-canal cementation, post-core*

ÖZET

Giriş: Bağlantı sonrası fiber restorasyonların kök kanallarından ayrılması en sık karşılaşılan başarısızlıktır. Self adeziv sistemler azaltılmış simantasyon prosedür avantajına sahiptir. Üç farklı self-adeziv rezin sistemin kullanıldığı bu çalışmanın amacı fiber postların koronal ve apikal üçlülerdeki bağlanma dayanımını değerlendirmektir.

Materyal ve metod: Bu çalışma için 30 adet yeni çekilmiş tek köklü insan dişi seçildi. Örnekler 10!arlı rasgele gruplandı. Fiber postlar (RelyX, 3M, ESPE, UK) RelyX Unicem (3M ESPE, St. Paul, MN, USA), G-Cem (GC Corporation, Tokyo, Japan) ve Maxcem Elite (Kerr Hawe Neos Orange,CA, USA) adezivler kullanılarak kanallara yerleştirildi. İtme testleri için örneklerden diş uzun eksenine dik ve birbirine paralel 2 disk şeklinde kesit alındı. İstatistiksel analizler için tek yönlü varyans analizi ve Kruskall-Wallis testleri kullanıldı.

Sonuçlar: RelyX Unicem tüm örneklerde koronal bölgede en yüksek itme değerleri ortaya çıkardı. G-Cem ise apikal bölgede en yüksek değerlere ulaştı. Tüm veriler değerlendirildiğinde RelyX-Unicem yine en yüksek değerleri verdi.

Karar: Kanal içi simantasyonunda self-adeziv sistemler pratik çözüm yoludur. Çoklu aşama gerektirmezler. Çalışmada kullanılan bütün sistemler kabul edilebilir bağlanma değerleri sunmaktadır.

Anahtar Kelimeler: *Self-adeziv sistemler, Kök-Kanal Simantasyonu, Post-Kor*

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INTRODUCTION

Root filled teeth with excessive loss of coronal tooth structure are frequently reconstructed with posts and cores[1]. Most clinical failures with endodontic post systems are related with the decementation of the post and/or root fractures[2, 3]. Conventional metal post restorations may result an unaesthetic gray discoloration when used with all-ceramic restorations. Besides, fiber posts have better vision and generally offer advantages about application over conventional cast posts or prefabricated metallic posts[4-6]. The most common failure of restorations bonded with fiber posts is dislodging of the posts from the root canals[7, 8]. Various luting agents and adhesive systems have been proposed for luting fiber posts to root canal dentine[9]. Contemporary resin cements, frequently used to lute fiber posts, may be divided into three subgroups according to the adhesive approach; etch-and-rinse adhesive systems, self-etching primers, self-adhesive cements[10]. The self-adhesive systems eliminate the need for separate etching, priming, and bonding steps in an attempt to simplify the cementation procedure[11]. However, information on fiber post cementation technique is still confusing and inadequate in the literature[10, 12]. Besides, as the number of dentine tubules decreases from coronal to the apical direction, the success of bonding to dentine may vary at these different regions of even the same root canal[9].

Therefore, the aim of this study was to evaluate the bond strengths of fiber posts with three different adhesive/resin systems to coronal and apical thirds of the post space dentine.

MATERIALS AND METHODS

Thirty freshly extracted single-root human teeth were selected for this study. Soft tissue and remnants were cleaned gently from the root surfaces. The crown of each tooth was removed with a diamond disc 1 mm apical from the cemento-enamel junction. After gently removing the pulpal residuals working length was determined as 1 mm shorter than the canal length. The canals were instrumented using a crown-down technique with rotary ProTaper instruments (Dentsply, Maillefer, Ballaigues, Switzerland) to size of finishing F3. The canals were irrigated with 2% sodium hypochlorite (NaOCl) among each file size and then the root canals were dried with #30 sterile paper points (Spident, Incheon, Korea). All root canals were obturated with lateral compaction technique. Single cone ProTaper Gutta-percha (#30) (F3) (Dentsply, Maillefer, Ballaigues, Switzerland) with AH-26 sealer was used as a master cone. The samples were then stored at 100 % humidity for 7 days at 37 ºC to allow complete setting of the sealers.

To prepare 8-mm-deep fiber post spaces ISO size-90 preparation instrument (Dentsply, Maillefer, Ballaigues, Switzerland) was used. Spaces were irrigated with 2% sodium hypochlorite solution and were dried with paper points. The specimens were then randomly divided into 3 subgroups each containing 10 samples. Fiber posts (RelyX, 3M, ESPE, UK) were inserted into canals using RelyX Unicem 3M ESPE, St. Paul, MN, USA), G-Cem (GC Corporation, Tokyo, Japan) and Maxcem Elite (Kerr Hawe Neos Orange,CA, USA) adhesives. All materials were used according to the manufacturers' recommendations. All the posts were then seated to full depth in the prepared spaces using finger pressure. The excess luting agent

material was immediately removed with a small cotton brush. After initial setting, the resin luting cements were polymerized with a light cure for 40 s. Thirty minutes after the cementation procedures, all samples were stored in distilled water for 24 h. Two disc shaped sections perpendicular to the long axis of each root sample were obtained for push-out tests as shown in the figure 1. Using a low-speed saw (Micromet M; Remet S.p.A., Casalecchio di Reno, Italy).

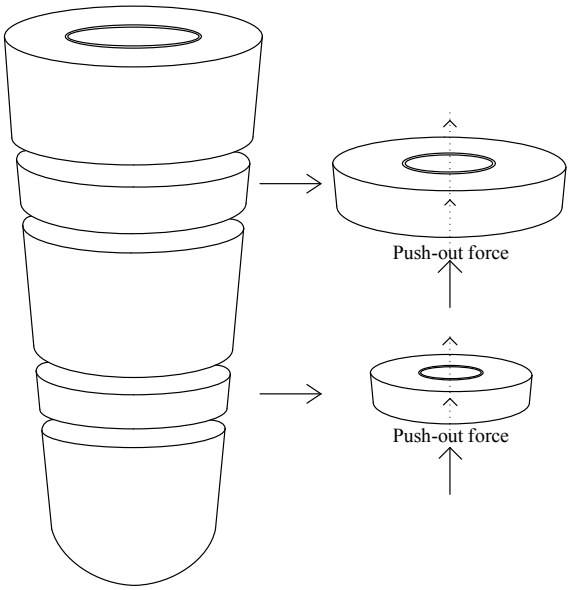

Figure 1: Schematic view of obtaining coronal and apical sections

The thickness of each specimen was measured and recorded by a digital caliper (Insize, Insize Co., LTD, USA) having the accuracy of 0.001 mm. Apical side of each slice (1.0 ± 0.1 mm) was marked with an indelible marker.

Push-out tests were performed by applying a compressive load at a crosshead speed of 0.5 mm/min to the apical aspect of each slice via a cylindrical plunger mounted on a Universal Testing Machine (Lloyd LR 30K; Lloyd Instruments Ltd, UK). Load was performed until the breakdown occur. Maximum failure load value was recorded.

Statistical analysis

The statistical difference between the push-out bond strength values of the groups were analyzed using One-way ANOVA. Then Kruskall-Wallis tests were performed to assess the significance among groups

RESULTS

Push-out test results are shown in Table 1. RelyX Unicem exhibited the highest mean push-out bond strength values at the coronal section of the samples. On the other hand Maxcem Elite exhibited the least mean push-out bond strength values at the apical section of the samples.

G-Cem exhibited higher push-out bond strength values at apical section than both RelyX unicem and Maxcem Elite adhesives, however this was not statistically significant at 0,05 confidence level, conversely the push-out values at the coronal third obtained with RelyX Unicem adhesive was significantly higher than other groups. ($p<0.05$).

The overall bonding data of RelyX Unicem was also observed to be the highest among groups. However the differences among all groups were not statistically significant ($p>0.05$).

DISCUSSION

Dual-cure adhesive systems need multi-clinical steps and do require pretreatment at dentin/enamel surface however, self-adhesive systems do not require any pretreatment. Self-adhesive systems have methacrylate monomer formulation with phosphoric acid

esters, which produces polymerization in an acidic environment[13]. Methacrylate monomers infiltrate into dentin while the acidic esters demineralize the surface. To balance the acidic activity of the esters during and after the process glass-ionomer formulations are added into many of the self-adhesive systems. The interaction between the hydroxyapatite crystal of dentin and the methacrylate monomers are altered by such compositional changes. In addition, it should be reminded that the retentive data may vary depending on the composition of the adhesive system itself. As the particle size of the filler ingredient increase (for cohesive strength) the flowing ability will degrease which is essential for self-adhesive systems to move through the retentive areas. Therefore, the activity of the material should be evaluated carefully for a detailed discovery of functional ability.

Several studies reported controversial results regarding bond strengths of different luting agents in the root canals[7, 14-16]. Kerstin and

Table 1: Mean push-out bond strengths for experimental groups

	RelyX Unicem	G-Cem	Maxcem Elite
Coronal third	17.53 ± 3.01 N	15.43 ± 4.17 N	14.91 ± 3.46 N
Apical third	14.77 ± 2.72 N	15.07 ± 3.23 N	14.22 ± 3.82 N
Overall	16.15 ± 2.94 N	15.25 ± 3.76 N	14.56 ± 3.22 N

Sebastian[17] found that RelyX self-adhesive cement pointed out significantly higher push-out bond strength values than Panavia and Variolink II dual cure adhesive systems. They speculated that the moisture tolerance of these systems may explain the favorable adhesion of RelyX[1]. This result is also compatible with ours, that RelyX Unicem showed significantly higher bonding values in the coronal section ($p<0.05$). The degree of moisture is known to be difficult to control inside the root canal. However, etch-and-rinse based adhesives need to be applied on the restrained moist dentin. Moreover, this is essential for the use of dual cure materials inside the root canal.
The success of RelyX Unicem in our study may also be attributed to the optimum film thickness of this material[18]. Because of the ingredients and composition of adhesive materials, it may be very difficult to produce thinner film thickness which is essential to avoid cohesive failures. Cohesive failures in adhesive materials induce failure of the restoration even the penetration into dentin or restoration is quite acceptable. On the other hand, degree of conversion rates of this adhesive system is claimed to be very high[19]. It is known that for the completion of the polymerization (adequate bond strengths and mechanical properties) 24 hours is requisite at the areas without energy of light[20]. In our study all the samples were stored in water for sufficient polymerization for 24 hours.

On the contrary, Maxcem Elite represented significantly lower bond strength values than G-Cem and RelyX Unicem in both apical and coronal sections in our study ($p<0.05$). The 37% phosphoric acid activity of this system may not be enough to decalcify and remove dentin from the surface. The excess smear-like substrate is un-favored situation for adhesive activity.

The acidic activity of the material is a very effective factor which is the first step of

penetration of the resin into dentinal canals or irregular surfaces. It is known that irregular surfaces and/or dentinal canals are necessary for retention of the resin material. Higher pH concentration may completely deform the dentinal canal formation which is never desired. On the other hand, lower pH values may not be enough for required decalcification. Therefore, optimum acidic concentration is essential. Self-adhesive systems have a self-etch process that provide rough dentin surface which is essential for adhesive penetration as mentioned. The self-etch process of these systems cannot be inspected visually and may sometimes be inadequate. According to our results Maxcem Elite represented the lowest test values at both sections with respect to RelyX Unicem and G-Cem.

Investigations about the composition and structure of apical and coronal parts of root canal dentine also depicted conflict results. While some of the investigators reported higher bond strengths to root canal dentin in the apical one-third[21, 22], others claimed that higher values were obtained at the coronal one-third[23, 24]. In our study we obtained higher bond strength values at coronal sections of each sample than apical sections. The difference was statistically significant for Relyx Unicem samples ($p<0.05$) but not for Maxcem Elite and G-cem samples.

Dual cure adhesive systems polymerize both with light and chemical activation. It is clear that during a root canal cementation because of non-light areas, chemical curing specialty should be assumed as more important than the light curing. However, the process starts with the light activity. Within the limitations of this study the samples for push-out tests were obtained from apical and coronal sections which are impossible to be light activated. The lower bonding values at each sample may be attributed to this issue as mentioned. Polymerization shrinkage is one of the most important issue for light activated or dual cured resin systems. Researchers claimed that[25, 26] chemical cured systems produces higher bonding strength than dual cured systems. Therefore, push-out data of samples that are chemically cured may be different from dual cured.

CONCLUSIONS

Self-adhesive systems are of practical ways of intra-canal cementation. It does not require multiple steps for success. All the systems offered acceptable retention ability.

Conflict of Interest

We the authors declare that we do not have any conflict of interest

REFERENCES

[1] Bitter K, Meyer-Lueckel H, Priehn K, Kanjuparambil JP, Neumann K, Kielbassa AM. Effects of luting agent and thermocycling on bond strengths to root canal dentine. Int Endod J. 2006;39:809-18.

[2] Bergman B, Lundquist P, Sjogren U, Sundquist G. Restorative and endodontic results after treatment with cast posts and cores. J Prosthet Dent. 1989;61:10-5.

[3] Bitter K, Priehn K, Martus P, Kielbassa AM. In vitro evaluation of push-out bond strengths of various luting agents to tooth-colored posts. J Prosthet Dent. 2006;95:302-10.

[4] Fokkinga WA, Kreulen CM, Vallittu PK, Creugers NH. A structured analysis of in vitro failure loads and failure modes of fiber, metal, and ceramic post-and-core systems.

Int J Prosthodont. 2004;17:476-82.

[5] Cormier CJ, Burns DR, Moon P. In vitro comparison of the fracture resistance and failure mode of fiber, ceramic, and conventional post systems at various stages of restoration. J Prosthodont. 2001;10:26-36.

[6] Newman MP, Yaman P, Dennison J, Rafter M, Billy E. Fracture resistance of endodontically treated teeth restored with composite posts. J Prosthet Dent. 2003;89:360-7.

[7] Ohlmann B, Fickenscher F, Dreyhaupt J, Rammelsberg P, Gabbert O, Schmitter M. The effect of two luting agents, pretreatment of the post, and pretreatment of the canal dentin on the retention of fiber-reinforced composite posts. J Dent. 2008;36:87-92.

[8] Victorino KR, Kuga MC, Duarte MA, Cavenago BC, So MV, Pereira JR. The effects of chlorhexidine and ethanol on push-out bond strength of fiber posts. J Conserv Dent. 2016;19:96-100.

[9] D'Arcangelo C, Zazzeroni S, D'Amario M, Vadini M, De Angelis F, Trubiani O, et al. Bond strengths of three types of fibre-reinforced post systems in various regions of root canals. Int Endod J. 2008;41:322-8.

[10] Radovic I, Mazzitelli C, Chieffi N, Ferrari M. Evaluation of the adhesion of fiber posts cemented using different adhesive approaches. Eur J Oral Sci. 2008;116:557-63.

[11] Saskalauskaite E, Tam LE, McComb D. Flexural strength, elastic modulus, and pH profile of self-etch resin luting cements. J Prosthodont. 2008;17:262-8.

[12] Rezende EC, Gomes GM, Szesz AL, Bueno CE, Reis A, Loguercio AD. Effects of Dentin Moisture on Cementation of Fiber Posts to Root Canals. J Adhes Dent. 2016;18:29-34.

[13] Gerth HU, Dammaschke T, Zuchner H, Schafer E. Chemical analysis and bonding reaction of RelyX Unicem and Bifix composites--a comparative study. Dent Mater. 2006;22:934-41.

[14] Cury AH, Goracci C, de Lima Navarro MF, Carvalho RM, Sadek FT, Tay FR, et al. Effect of hygroscopic expansion on the push-out resistance of glass ionomer-based cements used for the luting of glass fiber posts. J Endod. 2006;32:537-40.

[15] Sadek FT, Goracci C, Monticelli F, Grandini S, Cury AH, Tay F, et al. Immediate and 24-hour evaluation of the interfacial strengths of fiber posts. J Endod. 2006;32:1174-7.

[16] Kremeier K, Fasen L, Klaiber B, Hofmann N. Influence of endodontic post type (glass fiber, quartz fiber or gold) and luting material on push-out bond strength to dentin in vitro. Dent Mater. 2008;24:660-6.

[17] Bitter K, Paris S, Pfuertner C, Neumann K, Kielbassa AM. Morphological and bond strength evaluation of different resin cements to root dentin. Eur J Oral Sci. 2009;117:326-33.

[18] Kious AR, Roberts HW, Brackett WW. Film thicknesses of recently introduced luting cements. J Prosthet Dent. 2009;101:189-92.

[19] Arrais CA, Giannini M, Rueggeberg FA. Kinetic analysis of monomer conversion in auto- and dual-polymerizing modes of commercial resin luting cements. J Prosthet Dent. 2009;101:128-36.

[20] Al-Assaf K, Chakmakchi M, Palaghias G, Karanika-Kouma A, Eliades G. Interfacial characteristics of adhesive luting resins and composites with dentine. Dent Mater. 2007;23:829-39.

[21] Gaston BA, West LA, Liewehr FR, Fernandes C, Pashley DH. Evaluation of regional bond strength of resin cement to endodontic surfaces. J Endod. 2001;27:321-4.

[22] Muniz L, Mathias P. The influence of sodium hypochlorite and root canal sealers on post retention in different dentin regions. Oper Dent. 2005;30:533-9.

[23] Yoshiyama M, Matsuo T, Ebisu S, Pashley D. Regional bond strengths of self-etching/ self-priming adhesive systems. J Dent. 1998;26:609-16.

[24] Bouillaguet S, Troesch S, Wataha JC, Krejci I, Meyer JM, Pashley DH. Microtensile bond strength between adhesive cements and root canal dentin. Dent Mater. 2003;19:199-205.

[25] Vaz RR, Hipolito VD, D'Alpino PH, Goes MF. Bond strength and interfacial micromorphology of etch-and-rinse and self-adhesive resin cements to dentin. J Prosthodont. 2012;21:101-11.

[26] D'Arcangelo C, De Angelis F, D'Amario M, Zazzeroni S, Ciampoli C, Caputi S. The influence of luting systems on the microtensile bond strength of dentin to indirect resin-based composite and ceramic restorations. Oper Dent. 2009;34:328-36.

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MUTAGENIC POTENTIAL OF A SELF-ADHESIVE FLOWABLE COMPOSITE

Tuğba TOZ[1], Zeliha AYDOĞAN[2], Duygu TUNCER[3], Emel KARAMAN[4]*

ABSTRACT

Objective: The aim of this study was to assess the potential mutagenic effects associated to extracts from current self-adhesive flowable resin composite (Vertise Flow,Kerr Corp, Orange, CA, USA) that allows skipping the time-consuming adhesive processes.

Study design: The materials were eluted in dimethyl sulphoxide and the extracts were tested either after 1 day or 7 day incubation period at 370C. Mutagenic effects of the materials were tested on Salmonella typhipmurium strain TA 100 using the standard plate incorporation assay in the absence of S9 fraction from rat liver. The data were statistically analyzed using two-way variance analysis ($p<0.05$).

Results: The dose of the material and incubation as well as the interactions between these factors exhibited varying degrees of influences on the Salmonella typhipmurium colony number. However no mutagenic effect was detected for the self-adhesive restorative material.

Conclusion: It can be concluded that the adhesive restorative material tested in this study has no mutagenic potential.

Keywords: *mutagenicity, AMES test, Salmonella tphymiruim, self-adhesive composite, bulk fill flowables, adhesive resin*

ÖZET

Amaç: Bu çalışmanın amacı, zaman alıcı adeziv prosedürleri kısaltan self-adeziv akışkan rezin kompozit (Vertise Flow,Kerr Corp, Orange, CA, ABD) ekstrelerinin potansiyel mutajenik etkisinin değerlendirilmesidir.

Çalışma dizaynı: Materyal örnekleri dimetil sülfoksit içerisinde bekletilmişler ve 370C' deki inkübasyon sürelerinin 1. ve 7. günlerinde test edilmişlerdir. Bu materyallerin mutajenik etkileri, Salmonella typhipmurium TA 100 suşunda, standart plak korporasyon yöntemi ile S9 fraksiyonu eksikliğinde değerlendirilmiştir. Veriler iki yönlü varyans analizi yardımı ile istatistiksel olarak analiz edilmiştir ($p<0.05$).

Bulgular: Materyal dozu ve inkübasyon süresi ve birbirleri ile ilişkileri Salmonel-la typhipmurium koloni sayıları üzerinde farklı etkiler göstermiştir. Bununla birlikte self-adeziv restoratif materyal için mutajenik etki gözlenmemiştir.

Sonuç: Bu çalışmada test edilen adeziv restoratif materyalin mutajenik etkisi bulunmamıştır.

Anahtar Kelimeler: *mutajenisite, AMES testi, Salmonella tphymiruim, self-adeziv kompozit, bulk fill akışkanlar, adeziv rezin*

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INTRODUCTION

The introduction of adhesion to dentistry around the mid of the last century can be accepted as a big revolution.This revolution and patients attitude due to their esthetic demands has been contributed to the development of new adhesive restoratives. With adhesive technology, the dental clinicians have met with total etching concept and adhesive systems. After the Buonocore attitude about adhesion,various researchers developed new procedures to enhance handling and quality of adhesive restorative materials.The earlier adhesives include three steps in order to achieve bonding to tooth tissue named as the 3-step etch and rinse systems. The aim was later turned into 2-step etch and rinse and the adhesive systems were classified into two general categories such as two step etch and rinse systems that combine primer and bond together applied after etching; and two step self-etch systems, that etch and prime tooth tissue with primer before the application of bond. These materials were accepted as user-friendly and less technique sensitive. With further laboratory efforts 1step self-etch systems were introduced with dental technology that has the possibility to achieve all the steps. These materials are more effective in minimizing technique sensitivity, showed simultaneous demineralization and resin infiltration and reduce postoperative sensitivity however they still requires the polymerization step[1].

Current dental technology goal is combining the benefits of adhesive and composite materials into a self-adhesive restorative. However, it is the biggest question to overcome the hydrophobic–hydrophilic mismatch between restorative material and especially dentin tissue [2].

The latest developments in self-adhesive restorative materials are promoted as materials require neither etching nor a bonding agent[3]. Special phosphate dimethacrylate monomers, like glycerol phosphate dimethacrylate (GPDM), allows chemical interaction of the phosphonate groups with calcium ions of tooth tissue can be accepted as a way to reproduce self-adhesive restorative material [4]. Firstly introduced self-adhesive flowable composites were introduced mainly for cavity sealing and restoration. They include monomers mediating adhesion with tooth tissue thus they do not require any adhesive pretreatment[5]. These materials did not improve the bond strength to enamel when compared to etch-and-rinse adhesives[6] however they have similar shear bond strength with self-etch and etch and rinse adhesive systems on superficial and deep dentin[4]. Vertise Flow (VF; Kerr, Orange, CA, USA)was a self-adhesive flowable composite that includes the monomer glycerol phosphate dimethacrylate (GPDM) designed to bond to tooth tissue without a separate adhesive and etching step according to these contributions [2].

The continuous advancements in dental technology have raised questions about the biological safety of new materials and techniques. There are several investigations on the biocompatibility of dental materials generally focused on the characterization of cytotoxic effects in vitro [7].However, until recently the efforts to obtain information on the key events leading to cell damage have been scarce. One of the well-known major consequences of dental monomers on living tissue is their induction of DNA mutations, which, if not repaired, could lead to birth defects or malignant transformation of the

tissue as indicated by the induction of genotoxic effects. The *Salmonella typhimurium*/ microsome assay (Salmonella test; Ames test) is a widely accepted short-term bacterial assay for identifying substances that can produce genetic damage that leads to gene mutations. Also its low cost, simplicity, and speed make the Ames test an important and widespread part of biological examinations of dental materials and of standardization protocols[8]. The objective of this study was to determine the mutagenic potential of this self-adhesive flowable composite Vertise Flow related to its monomer ingredients.

MATERIALS AND METHODS

Chemicals, positive mutagens and tester strains

D-glucose, d-biotin, crystal violet, and sodium chloride were purchased from Sigma Chemicals (Sigma Aldrich, Deisenhofen, Germany), ampicillin trihydrate and dimethyl sulphoxide (DMSO) was from Fluca (Sigma Aldrich, Deisenhofen, Germany), Oxoid agar, Oxoid nutrient broth no. 2 from Oxoid Ltd. (Oxoid Ltd. , Hampshire, England), and citric acid monohydrate,sodium ammonium phosphate, sodium hydrogen phosphate were obtained from Merck (Merck, Darmstadt, Germany). The positive mutagens sodium azide (NaN3) was purchased from Sigma Chemicals (Sigma Chemicals, Deisenhofen, Germany), and Daunomicina was purchased from Deva Holding (Deva Holding, Istanbul, Turkey). Sodium azide was used on S. typhimurium TA 100 and Daunomicina was used on S. typhimurium strains in the absence of a metabolically active microsomal fraction from rat liver (S9). S. typhimurium TA 100 was kindly provided by Dr. Bruce N Ames (University of California, Berkeley, CA, USA).

Preparation of test substances

Five disc shaped specimens (Table 1) were prepared by placing Vertise Flow into teflon molds according to the manufacturers' instructions in laminar flow (Bioair, Siziano, Italy) to obtain sterile conditions . The dimensions of the discs were 5 mm in diameter and 2 mm and applied as bulk fill; than the surfaces were covered with transparent strip to prevent the formation of air-inhibited surface layer and light cured with LED (Elipar Free Light, 3 M ESPE, AG, Germany, 1007 mW/ cm^2) 40 s.

Table 1: Chemical composition and application procedure of Vertise Flow

Material	Manufacturer	Composition	Application procedure
Vertise Flow	Kerr, Orange, CA, USA	Resin: GPDMA, HEMA, Bis-GMA, catalysts Fillers: prepolymers, silanated Ba-glass, SiO2, YF3	Dispense a thin layer (<0.5 mm) on a forcefully dried surface; use a provided applicator with a brushing motion for 15–20 s; light cure for 20 s; syringe additional material in increments of less than 2 mm and light cure each increment for 20 s.
HEMA hydroxyethyl methacrylate, Bis-GMA bisphenol glycidyl dimethacrylate, GPDMA glycerolprosphoric acid dimethacrylate, SiO2 silicium oxide, YF3 ytterbium tri-fluoride			

Extract Preparation

The specimens were eluted in 10 mL dimethyl sulphoxide (DMSO) and the extracts were tested after an incubation period of 24 h at 37^0C and 168 h at 37^0C in a fully humidified air atmosphere incubator containing 5% CO2 (n=15). The ratio of sample surface area to the volume of the culture medium was adjusted to approximately $3cm^2$/mL as recommended by ISO.

Cytotoxicity testing

Prior to mutagenicity testing, cytotoxic amounts of the adhesive material extracts were evaluated. The rationale behind this test was to determine whether the test concentrations of the materials would have any cytotoxic effect 0.1 ml of a diluted of an overnight bacterial culture (TA 100 strain) was added to 2.5 ml top agar along with different concentrations of the tested chemicals. The top agar was poured onto nutrient agar plates and assessment of cytotoxicity was performed after 24 h incubation at 37^0C[9].

Mutagenicity tests

Mutagenicity tests were conducted by the standard plate incorporation test as previously described by Maron and Ames[10]. Two test strains of *Salmonella typhimurium* and TA 100 were used to detect frame-shift and base-pair mutation, respectively. Dimethyl sulfoxide samples of 25, 50, 75, 100 µL were plated into minimal agar plates with 2.5 ml of top agar previously supplemented with 0.05 mM histidine-biotin solution had been previously added. Overnight culture of TA 100 (0.1 ml) and the contents were mixed and poured on agar plates. Oxoid nutrient broth no. 2 was used for overnight culture. For plate incorporation assays, 0.1 ml of bacterial tester strain, and different concentrations of test extracts from different adhesive materials were added separately to 2.5 ml of molten top agar. For this assay, Daunomicina and Sodium azide (N_aN_3) (known mutagens) without S9 were used as positive control of the TA 100 strains, respectively in the absence of S9 fraction. The negative control was DMSO that we used as solvent. Three plates were conducted for each dose group and each experiment repeated independently two or three times. The strains were checked routinely for ampicillin resistance, ultraviolet-light sensitivity, crystal-violet sensitivity, histidine requirement and spontaneous reversion rate. After 72 h of incubation, revertant colonies were counted. The mutagenicity was expressed as the number of revertants per plate.

Statistical analysis

The data were analyzed by one way ANOVA. Doses higher than the mean of the control group and consequent mutagenic condition were defined as ‘‘mutagenic’’, whereas an increase in dose approaching to, but not reaching a two-fold increase was defined as ‘‘weak mutagenic’’.

RESULTS

For a substance to be considered mutagenic in the Ames Test, the number of revertant colonies per plate containing the test material must be at least two fold higher than the revertant colony number of the vehicle control or there must be an increase in the revertant colony number in a dose dependent manner in plates containing test substance in compare to the vehicle control plates. As a sequel of cytotoxicity tests, it was found that none of the test doses of the materials exhibited cytotoxic effects, even for increased doses. The number of revertants in the positive control group was significantly increased in comparison with the negative control (solvent) which

verified the conducted assay.The mutagenic effects of the materials had correlations with applied dose, and the incubation procedure as well as the combination of these parameters for some materials. Considering the bacterial colonization on the test plates of the materials with different doses and incubation periods it was seen that neither the incubation period nor the applied doses have significant effect on Vertise Flow's mutagenicity ($p > 0.05$) (Table 2).

Table 2 : Mutagenicity of Vertise Flow

Applied Doses (mL)	Incubation Period	
	24 h	168 h
25	123± 2.8	150± 12
50	120± 3.2	143± 8.3
75	134± 1	138± 7
100	137± 4	138± 7
Vehicle Control	140± 1.5	146± 6
Positive Control	800± 24 [a]	

[a] The correlation between dose, and incubation period is significant in comparison with the control group ($p<0.05$)
*DMSO was used as the vehicle control.
*NaN3 was used as positive control.

DISCUSSION

Since the question whether biomaterials have adverse effects on the body is of major concern. Incomplete polymerization of dental resin composites and resin-based bonding agents under clinical conditions result in unreacted resin monomers that may be released from the resin matrix into the aqueous environment of oral cavity. An immediate question is whether the released monomers can reach sufficient concentration to induce a significant cellular effect.There have been several evidences showing genotoxicity of resin monomers. Direct interaction between nucleotides and resin monomers, production of DNA damaging intermediates, or inhibition of DNA repair systems might be responsible for the mutagenicity of resin monomers [11]. Released monomers can reach sufficient concentration to induce a significant cellular effect. It has been estimated that the concentrations of some monomers released from the dentinal adhesives can be in the millimolar range after diffusion through the dentin layer. For instance, HEMA leaching from dentin adhesives may reach concentrations as high as 1.5–8 mmol/l [12]. Therefore, the concentration of dental monomers in the pulp may be in the millimolar range, high enough to be considered as potentially harmful for pulp cells. Ames test used in this study has been recommended as the mutagenesis screening test for chemicals and environmental samples because of its extensive database and good correlation with carcinogenicity. This assay which was specifically developed to detect chemically induced mutagenesis developed by Bruce Ames[13] is generally preferred as an initial screen to determine the mutagenic potential of new chemical technology as the most rapid, simple, sensitive and economical screening method. Ames test has also a good correlation with carcinogenicity[14] thus this method generally used to detect the possible mutagenic and genotoxic effects of dental materials. An Ames test with *Salmonella typhimurium* revealed that a monomer ingredients of resin composites glycidyl methacrylate (GMA) could cause mutagenicity through base-pair substitution and frame shift mutation in the genetic code[15]. None of the article was assessed the mutagenic effects of Vertise Flow, only in one literature it was mentioned that Vertise Flow may cause cellular damage in gingival

and pulp fibroblasts in vitro[16]. This material has been generally used for cavity lining and restorative treatments applied directly to tooth tissues without any adhesive procedure [5]. It is already seriously mentioned in the literature that chemical activity of adhesive restorative materials is important for the restored tooth prognosis [17]. Like all adhesive materials, Vertise Flow may release components with possible harmful effects to dental structures especially pulp tissue and cause a wide spectrum of pulpa dentinal reactions. Thus biological safety and monomer release of this self-adhesive material remains in close contact with living dental tissue over a long period of time are very important. Vertise Flow includes GPDMA, HEMA and BisGMA as monomer component. In the literature no assay was evaluated the biocompatibility of GPDMA, however it was observed that HEMA and Bis-GMA could induce the enhancement of DNA migration in human lymphocytes[18] and they have genotoxic effects at chromosome level in V79 cells[19]. These monomers' genotoxic effect was also showed in the in vitro Mammalian Cell Gene Mutation Test (HPRT Test) in CHO (Chinese hamster ovary) cells[20]. Nevertheless, hydroxylated metabolites of Bis-GMA monomer were not found to be mutagenic in L929 cells or *Salmonella typhimurium* [21]. However we could not observed any mutagenic effect of Vertise Flow including HEMA and BisGMA in our study. The Ames Salmonella/microsome test generally detects 83% of the carcinogens as mutagenic with completed protocol. This ratio pointed out that Ames' test is not able to state all carcinogens[10]. Mutagenicity tests may exhibit false-positive results, andit is not possible to draw a conclusive statement based solely on a single study[22]. In addition to this the mutagenic potential of Vertis Flow was tested in the absence of S9 fraction.Within this limitation this material did not lead to mutagenicity, but also a possible mutagenic effect could be detected in the presence of S9. Thus this test must be repeated in the presence of S9.

CONCLUSIONS

In the light of the results of this study, Vertise Flow can be considered safe in terms of mutagenicity within these parameters. However all clinicians must consider the possible mutagenic potential of all dental restorative materials in their clinical practice.

REFERENCES

[1] Peumans M, De Munck J, Van Landuyt K, Lambrechts P, Van Meerbeek B. Five-year clinical effectiveness of a two-step self-etching adhesive. The journal of adhesive dentistry. 2007;9(1):7-10.

[2] Poitevin A, De Munck J, Van Ende A, Suyama Y, Mine A, Peumans M, et al. Bonding effectiveness of self-adhesive composites to dentin and enamel. Dental materials : official publication of the Academy of Dental Materials. 2013;29(2):221-30.

[3] Fu J, Kakuda S, Pan F, Hoshika S, Ting S, Fukuoka A, et al. Bonding performance of a newly developed step-less all-in-one system on dentin. Dental materials journal. 2013;32(2):203-11.

[4] Czasch P, Ilie N. In vitro comparison of mechanical properties and degree of cure of a self-adhesive and four novel flowable composites. The journal of adhesive dentistry. 2013;15(3):229-36.

[5] Eliades A, Birpou E, Eliades T, Eliades G. Self-adhesive restoratives as pit and fissure sealants: a comparative laboratory study. Dental materials : official publication of the Academy of Dental Materials. 2013;29(7):752-62.

[6] Frankenberger R, Lohbauer U, Roggendorf MJ, Naumann M, Taschner M. Selective enamel etching reconsidered: better than etch-and-rinse and self-etch? The journal of adhesive dentistry. 2008;10(5):339-44.

[7] Malkoc S, Corekci B, Ulker HE, Yalcin M, Sengun A. Cytotoxic effects of orthodontic composites. The Angle orthodontist. 2010;80(4):571-6.

[8] Mortelmans K, Zeiger E. The Ames Salmonella/microsome mutagenicity assay. Mutation research. 2000;455(1-2):29-60.

[9] Dean BJ, Brooks TM, Hodson-Walker G, Hutson DH. Genetic toxicology testing of 41 industrial chemicals. Mutation research. 1985;153(1-2):57-77.

[10] Maron DM, Ames BN. Revised methods for the Salmonella mutagenicity test. Mutation research. 1983;113(3-4):173-215.

[11] Schweikl H, Spagnuolo G, Schmalz G. Genetic and cellular toxicology of dental resin monomers. Journal of dental research. 2006;85(10):870-7.

[12] Bouillaguet S, Wataha JC, Hanks CT, Ciucchi B, Holz J. In vitro cytotoxicity and dentin permeability of HEMA. Journal of endodontics. 1996;22(5):244-8.

[13] Ames BN, McCann J, Yamasaki E. Methods for detecting carcinogens and mutagens with the Salmonella/mammalian-microsome mutagenicity test. Mutation research. 1975;31(6):347-64.

[14] Jukic S, Miletic I, Anic I, Britvic S, Osmak M, Sistig S. The mutagenic potential of AH+ and AH26 by Salmonella/microsome assay. Journal of endodontics. 2000;26(6):321-4.

[15] Schweikl H, Schmalz G, Rackebrandt K. The mutagenic activity of unpolymerized resin monomers in Salmonella typhimurium and V79 cells. Mutation research. 1998;415(1-2):119-30.

[16] Tadin A, Marovic D, Galic N, Kovacic I, Zeljezic D. Composite-induced toxicity in human gingival and pulp fibroblast cells. Acta odontologica Scandinavica. 2014;72(4):304-11.

[17] Costa CA, Vaerten MA, Edwards CA, Hanks CT. Cytotoxic effects of current dental adhesive systems on immortalized odontoblast cell line MDPC-23. Dental materials : official publication of the Academy of Dental Materials. 1999;15(6):434-41.

[18] Kleinsasser NH, Wallner BC, Harreus UA, Kleinjung T, Folwaczny M, Hickel R, et al. Genotoxicity and cytotoxicity of dental materials in human lymphocytes as assessed by the single cell microgel electrophoresis (comet) assay. Journal of dentistry. 2004;32(3):229-34.

[19] Schweikl H, Schmalz G, Spruss T. The induction of micronuclei in vitro by unpolymerized resin monomers. Journal of dental research. 2001;80(7):1615-20.

[20] Muller BP, Eisentrager A, Jahnen-Dechent W, Dott W, Hollender J. Effect of sample preparation on the in vitro genotoxicity of a light curable glass ionomer cement. Biomaterials. 2003;24(4):611-7.

[21] Kostoryz EL, Eick JD, Glaros AG, Judy BM, Welshons WV, Burmaster S, et al. Biocompatibility of hydroxylated metabolites of BISGMA and BFDGE. Journal of dental research. 2003;82(5):367-71.

[22] Kaplan C, Diril N, Sahin S, Cehreli MC. Mutagenic potentials of dental cements as detected by the Salmonella/microsome test. Biomaterials. 2004;25(18):4019-27.

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AESTHETIC MANAGEMENT OF ANTERIOR TEETH WITH DIRECT COMPOSITE VENEERS AND BLEACHING AFTER FIXED ORTHODONTIC TREATMENT

Engin Fırat ÇAKAN[1], Fatma YILDIRIM[2], Ahu TOPKARA[2]

ABSTRACT

In present time people consider more about appearance and facial aesthetics according to the past. Person in social communication is perceived by the expression on his/her face. The middle and the lower section of the face where the eyes, the maxilla and the mandible are located, are the primary attention spots and have an undisputed important place in social life. Smile of individuals, reveals the anterior teeth and disrupts or improves the harmony of the face. Therefore, dental aesthetics, which creates an important part of the facial appearance, is a prominent feature of overall aesthetic.

As a result of the development of the adhesive dentistry, aesthetic expectations of the patients are possible to provide by the physicians. The main purpose of the aesthetic treatments in dentistry is to establish the design of a beautiful smile in addition to provide a good function. After dental procedures, especially the appearance of the upper anterior teeth is great importance in terms of patient satisfaction. Although, there are many types of treatment options available for functional and aesthetic problems in the upper anterior region, multidisciplinary treatment approaches are recommended for an optimal treatment.

The aim of this study was to demonstrate anterior aesthetic rehabilitation of a patient who had Angle Class I malocclusion with crowding. Discoloration of anterior teeth due to previous treatments, managed with direct composite veneer following vital and non-vital in-office bleaching after orthodontic treatment.

Keywords: *anterior crowding, direct composite veneers, laminate veneers, tooth bleaching*

ÖZET

Günümüzde bireyler dış görünüşlerine ve yüz estetiklerine geçmiş zamanlara oranla daha fazla önem vermektedir. Sosyal iletişimde kişi, yüzündeki ifade ile algılanır. Gözlerin bulunduğu yüzün orta bölümü ve maksilla ve mandibulanın bulunduğu alt bölümü, ilk dikkat çeken noktalardır ve kişinin sosyal yaşamı içinde tartışmasız önemli bir yer tutmaktadır. Bireylerin gülümsemeleri ön dişleri göz önüne çıkarır ve bu gülümseme yüzün harmonisini bozar ya da geliştirir. Bu nedenle yüz görünümünün önemli bir parçasını oluşturan diş estetiği, ön planda yer almaktadır.

Adeziv diş hekimliğinin gelişimi ve varış noktası sonucunda estetik beklentilerin hekim tarafından sağlanması mümkün hale gelmiştir. Diş hekimliğinde estetik amaçlı yapılan tedavilerde esas amaç, fonksiyonun kazandırılmasının yanı sıra, güzel bir gülüş dizaynının da ortaya konmasıdır. Dental girişimler sonrasında, özellikle üst ön bölge dişlerinin görünümü hasta memnuniyeti açısından büyük önem taşımaktadır. Üst çene anterior bölgedeki fonksiyonel ve estetik problemler için birçok tedavi seçeneği bulunmaktadır; fakat ideal bir tedavi için multidisipliner tedavi yaklaşımları önerilmektedir.

Bu olgu sunumunda, Angle Sınıf I maloklüzyon ve çapraşıklığa sahip olan hastanın, üst çene ortodontik tedavisini takiben, tedavi öncesinde mevcut olan restorasyonlar sonucunda meydana gelen renklenme ve form bozukluklarının, devital ve ofis tipi beyazlatma uygulamaları kombine edilerek, direkt kompozit veneer uygulaması ile estetik rehabilitasyonu sunulacaktır.

Anahtar Kelimeler: *diş beyazlatma, direkt kompozit veneer, laminate veneer, ön çapraşıklık*

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INTRODUCTION

In present time people consider more about appearance and facial aesthetics according to the past. The social media determines the desirable appearance, for this reason patients quest to beautify their smiles. The first step in any type of dental therapy is to establish treatment objectives. If the appropriate goals or objectives have not been identified before treatment, it is impossible to achieve the ideal results.[1] So, multidisciplinary treatment approaches are recommended for optimal treatment. Due to the increasing importance of the smile aesthetic which provides confidence-boosting process in social and professional experience, many adult patients prefer orthodontic treatment. Particularly in adult patients, aesthetic solutions should be planned with interdisciplinary strategies as the case requires.[2] In fact, the primary goal of modern orthodontics is to establish the proper occlusal relationship between the maxillary and mandibular arches while maintaining facial esthetics.[3] In order to achieve it, the physician will often have to rely on restorative procedures to reach the optimal esthetic result.[4]

With advances and interest in adhesive dentistry, bleaching of discolored teeth has become popular. Tooth discoloration is a multifactorial event that can be internal or external origin and classified as intrinsic, extrinsic or both according to the etiology and localization of staining.[5,6] Extrinsic discoloration is caused by chromogenous intake through dietary sources such as tea, coffee, fizzy drinks, wine, tobacco or poor oral hygiene.[7] Intrinsic discoloration largely results of genetic or metabolic causes such as amelogenesis imperfecta, dentinogenesis imperfecta, dentinal dysplasia, fluorosis and tetracycline intake during tooth development process. Local reasons such as pulp necrosis, pulp tissue remnants after root canal treatment and endodontic filling materials also may occur intrinsic discoloration.[5]

Intrinsic discoloration involves on enamel, dentin or both of them, while extrinsic discoloration occurs on enamel.[8] Therefore, extrinsic discoloration can be partly removed with mechanical cleaning and/or brushing with toothpaste; internal discoloration can be eliminated only with bleaching.[9,10] For non-vital bleaching, 30% sodium perborate and 35% hydrogen peroxide solution used either in combination or separately. There are two basic bleaching techniques for internal discolored teeth: walking and thermocatalytic bleaching.[11] In-office bleaching, different concentrations of hydrogen peroxide are applied approximately 45 minutes for each practice 2 to 6 times.[8] Both of these treatments are used on non-vital teeth for adapting same color harmony.

Lots of people, consider that the best solution is porcelain crowns for highly discolored teeth. Crowns that made by high aesthetic ceramic materials, have potential to provide long-term aesthetics. On the other hand, the number of physicians who accept the applications of adhesive dentistry are increasing. Composite laminate veneer applications, with a conservative approach to protect the natural tooth structure, are an alternative treatment to porcelain crowns.[12] Direct composite veneers indicated as a complementary treatment option to the bleaching, to ensure aesthetic compliance for old restorations, to replace missing tooth tissue or to mask discolored teeth. The aim of this case-report was to demonstrate an anterior aesthetic rehabilitation of a patient who had Angle Class I malocclusion with crowding.

Discoloration of anterior teeth due to previous root canal treatments and restorations, treated with direct composite veneers following non-vital walking and in-office bleaching after orthodontic treatment.

CASE REPORT

A 22-year-old female patient who had Angle Class I malocclusion, crowding and 4 mm midline shift in the maxillary anterior region (Fig 1), was referred to Department of Orthodontics, for existing orthodontic treatment. Patient had started her orthodontic treatment in another clinic and her upper left second premolar teeth was extracted in order to correct upper jaw midline discrepancy. The orthodontist had bonded the ceramic braces just only in the upper teeth (Fig 2). After treatment had started, she had wanted to continue her treatment in Istanbul Aydin University, Faculty of Dentistry.

Initial case procedures were started when the patient came for the first appointment in faculty clinics. For the assessment of this case; radiographs, photographs and the study cast models were taken. The transverse positions of the maxillary and mandibular midlines were evaluated in postero-anterior cephalogram. There was no skeletal discrepancy between the jaws and it was found that the midline shift was caused from dental asymmetry. Thus, we thought that her previous orthodontist had reached the same conclusion and had chosen the tooth extraction treatment. Before the orthodontic treatment, solving other dental problems is important for oral hygiene recovery. Because it will become so difficult for patient to maintain oral hygiene during the

Figure 1 OPG Before Orthodontic Treatment

Figure 2 Case Photos (Before)

orthodontic treatment. In this case the physician whom started the orthodontic treatment, was began without taking into account procedures. Patient had periodontal problems and gingival index scores were measured close to 2 because of poor oral hygiene at first arrival. Furthermore, she had discoloration both as existing root canal treatments and as deformed previous restorations. All under these terms, the treatment plan was determined by a multidisciplinary approach.

As a result of treatment planning, periodontal improvement was defined as to be done first. After periodontal treatment was completed, oral health care education and motivation were given and correction of poor oral hygiene was provided. It was decided to continue treatment with existing braces not to prolong the duration of treatment. Therefore, after consultation with Department of Restorative Dentistry, the renewal of restorative treatments and aesthetic improvement were left to the end

of the orthodontic treatment. Depending on the patient's demand, orthodontic treatment has begun only in upper jaw after informed consent form received. To achieve good Class II occlusion at the left side, the extraction space was used to slide and correct the midline.

Over a period of 15 months, orthodontic treatment was completed. On the right side Class I molar occlusion and on the left side full cusp Class II molar occlusion with a Class I canine relationship and 2 mm overjet and overbite for both sides were obtained (Fig 3).

Figure 3 OPG After Orthodontic Treatment

For the treatment of the patient's aesthetic expectations, the patient was referred to the Department of Restorative Dentistry following the end of the orthodontic treatment. During this process, Essix retainers were prepared in order to maintain the treatment outcomes. First of all, when the patient visited to the restorative dentistry clinic, discoloration and color mismatch of the teeth had been focused on. In order to remove tooth discoloration due to pre-made root canal treatment, non-vital walking bleaching was planned. Discolored upper left central and both upper lateral incisors were included to the treatment. Residual supplies in the pulp chamber were cleaned and root canal orifices were closed with glass ionomer cement in hermetic manner. Opalesence Endo (Ultradent Productions Inc, UT, USA), 35% hydrogen peroxide was applied at first practice and was changed for 3 times in every 4 days. 4 days after the last appointment, the teeth were bleached substantially. To reach the final colors of the root canal treated teeth, Opalesence Endo was cleaned with physiological saline and has been waited for one week. At the beginning of the following week, the pulp chamber was sealed by calcium hydroxide (Sultan Healthcare, PA, USA) for one week to allow elimination of residual oxygen. During this two-week period, in-office bleaching (Philips Zoom WhiteSpeed, Philips, Holland) was done for 2 times, one week apart in 15-minute sessions, to adapt all the teeth. After reaching the final colors of the teeth in the anterior region, the teeth which has degraded aesthetic features, edge harmony, colors and forms, were restored with Composite Laminate Veneers due to extensive borders of restoration (Fig 4). Existent caries and old restorations has been removed in accordance with minimally invasive treatment procedures. A three-step etch-and-rinse bonding agent (Adper Single Bond 2, 3M/ESPE, St. Paul, MN, USA) and a nanofil composite (Filtek Ultimate, 3M/ESPE, St. Paul, MN, USA) were used. The composite increments were placed between the tooth and matrix strip by using hand instruments. Subsequent to polymerization, contouring and finishing were performed with microfine finishing diamonds and restorations were polished using abrasive disks (Sof-Lex, 3M/ESPE, St. Paul, MN, USA) ranging from medium to superfine. At the end of all restorative procedures, fixed lingual retainers were bonded to prevent relapse (Fig 4).

Figure 4 Case Photos (After)

DISCUSSION

Before the beginning of the orthodontic treatment, required process for oral hygiene maintain should be completed. Substantially when the proper teeth positions and optimal occlusion is achieved, orthodontic treatment can be terminated without the need to any other treatment. Depending on the aesthetic expectations, if there is a requirement for the renewal of previous restorations to rearrange the remaining tooth shapes or colors, restorative dentistry should play a part in the finishing phase of the orthodontic treatment.[13] Physician should determine the treatment objectives, as should meet the requirements of the patient. To meet the treatment needs of patients properly, it is necessary to evaluate all aspects of the case. Constant interaction and communication among the team members and the patient at all level of treatment are the keys to the success of the interdisciplinary treatment.[14]

In dental and facial aesthetics, dental midlines relative to each arches and to the face are very important.[15] In diagnosing dental asymmetries, a through clinical examination and radiographic evaluation are necessary. Each dental arches should be evaluated separately both clinically and by using dental cast models, to accurately determine the bilateral symmetry of the molar and canine positions. In addition to the clinical and dental model evaluation, differentiation between various types of asymmetries can be aided by the use of postero-anterior cephalograms.[16] In this case by using clinical examination, dental cast model evaluation and postero-anterior cephalometric analyses, it was determined that the 4 mm of midline shift to the right side was dentoalveolar.

Through dental asymmetries are often treated asymmetric extraction sequences and asymmetric mechanics.[16] In this case; for to propose of the treatment of the 4 mm of dentoalveolar midline discrepancy, upper left premolar tooth was extracted and upper left canine was distalized 4 mm to correct the midline and the remaining extraction space was closed by anterior mesialization of molar teeth to provide full Class II molar relationship in the left side.

In order to plan aesthetic rehabilitation of discolored teeth, both porcelain and composite laminate veneers may be preferred. Between both treatment options, technical precision and cost should also be considered as well as aesthetic results to be obtained. Porcelain veneers are more resistant to adhesive and cohesive forces. Therefore, when requested to increase the inciso-gingival sizes of the teeth, porcelain laminate veneers should be preferred.[17,18] Although the composite veneers are aesthetic, they don't provide exactly all the aesthetic properties of dental structures as much as porcelain. In addition to aesthetic properties, good results are obtained with porcelain veneers in terms of satisfaction of patients.[18,19] However, porcelain veneers require more technical precision and higher costs compared to composite veneers. Due

to providing the aesthetic results in the same appointment, quick application period and comparative low costs, direct composite veneers may be preferred.[20] In this case composite laminate veneers were preferred due to aesthetic expectations of the patient, her age and treatment cost in addition to obtain desired level of the patient's tooth color and shapes without changing inciso-gingival sizes of the teeth.

CONCLUSIONS

Smile design should be in full compliance with the facial aesthetic features that were performed in accordance with different perspectives and the combination of different disciplines.

Before and during the orthodontic process, adhesive dentistry and orthodontics collaboration are necessary to facilitate the formation of foresight in the creation of a new smile harmony following orthodontic treatment.

REFERENCES

[1] Kokich VG. Create realistic objectives. Am J Orthod Dentofacial Orthop. 2011; 139(6):713.

[2] Rodriguez Flores JM. Multidisciplinary orthodontic treatment in adult patients: the future of orthodontics. Int J Orthod Milwaukee. 2010; 21(3):11-21.

[3] Wylie WL. The mandibular incisor-its role in facial esthetics. Angle Orthod. 1955; 25:32-41.

[4] Senty EL. The maxillary cuspid and missing lateral incisor: esthetics and occlusion. Angle Orthod. 1976; 46:365-371.

[5] Nathoo SA. The chemistry and mechanisms of extrinsic and intrinsic discoloration. J Am Dent Assoc. 1997; 128 Suppl:6S-10S.

[6] Hattab FN, Qudeimat MA, al-Rimawi HS. Dental discoloration: an overview. J Esthet Dent. 1999; 11(6):291-310.

[7] Watts A, Addy M. Tooth discolouration and staining: a review of the literature. Br Dent J. 2001; 190(6):309-16.

[8] Ozel Y, Ozel E, Attar N, Aksoy G. Bleaching in dentistry. EÜ Dişhek Fak Derg 2007; 28: 33-40.

[9] Zantner C, Derdilopoulou F, Martus P, Kielbassa AM. Randomized clinical trial on the efficacy of 2 over-the-counter whitening systems. Quintessence Int. 2006; 37(9):695-706.

[10] Yap AU, Wattanapayungkul P. Effects of in-office tooth whiteners on hardness of tooth-colored restoratives. Oper Dent. 2002; 27(2):137-41.

[11] Attin T, Paqué F, Ajam F, Lennon AM. Review of the current status of tooth whitening with the walking bleach technique. Int Endod J. 2003; 36(5):313-29.

[12] Roberson TM, Heymann HO, Swift Jr EJ. Sturdevant's Art and Science of Operative Dentistry. 5th ed. Mosby Inc, Missouri. 2006; p:637-648.

[13] Kokich VG, Spear FM. Guidelines for managing the orthodontic-restorative patient. Semin Orthod. 1997; 3(1):3-20.

[14] Savana K, Ansari A, Hamsa R, Kumar M, Jain A, Singh A. Interdisciplinary therapy in orthodontics: an overview. Int J Advanced Health Sci. 2014; 1(5):23-31.

[15] Burstone CJ. Diagnosis and treatment planning of patients with asymmetries. Semin Orthod. 1998; 4(3):153-64.

[16] Bishara SE, Burkey PS, Kharouf JG. Dental and facial asymmetries: a review. Angle Orthod. 1994; 64(2):89-98.

[17] Jordan RE. Esthetic Composite Bonding Techniques and Materials. St. Louis, Mosby-Year Book, Inc. 2nd ed. 1993; p:84-86,132-134,140,150.

[18] Peumans M, Van Meerbeek B, Lambrechts P, Vanherle G. Porcelain veneers: a review of the literature. J Dent. 2000; 28(3):163-77.

[19] Meijering AC, Roeters FJ, Mulder J, Creugers NH. patients' satisfaction with different types of veneer restorations. J Dent. 1997; 25(6):493-7.

[20] Chiche GJ, Pinault A. Esthetics of anterior fixed prosthodontics. Chicago, Quintessence. 1994; p:42-46.

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ENDODONTIC TREATMENT OF MANDIBULAR PREMOLAR WITH THREE CANALS USING CBCT

Seda AYDEMİR[1], Alper SİNANOĞLU[2], Işıl Kaya BÜYÜKBAYRAM[3], Göze ARUKASLAN[1]

ABSTRACT

Background
Mandibular premolars generally have single root and single root canal. The frequency of mandibular premolars with two roots and three canals is extremely rare.

Objective
To present the management of a mandibular second premolar with two roots and three canals which was identified by cone-beam computed tomography (CBCT)

Case Description
13 years old male patient having pain in the right mandibular second premolar was referred for the endodontic treatment. The preoperative periapical radiograph showed the presence of two roots. After identification of three canals by CBCT two in the distal root and one in the mesial root, the endodontic treatment was performed. Radiographic follow-up of the case revealed no signs of periapical inflamation after one year.

Conclusion
Dental anatomical variations are important and must be identified preoperatively for a successful treatment outcome in endodontics. CBCT can be used for the preoperative diagnosis of complex root canal anatomy.

Keywords: *anatomical variations, CBCT, endodontic treatment, mandibular second premolar*

ÖZET

Giriş
Alt çene küçük azı dişleri genellikle tek kök tek kanala sahiptir. Alt çene küçük azı dişlerinde çok nadir iki kök üç kanal gözlenmektedir.

Amaç
Konik ışınlı bilgisayarlı tomografi (KIBT) kullanılarak iki kök üç kanallı olduğu tespit edilen alt çene ikinci küçük azı dişine yapılan kök kanal tedavisinin sunulmasıdır.

Olgu sunumu
13 yaşındaki erkek hasta sağ alt ikinci küçük azı dişinde ağrı şikayeti ile kliniğimize başvurmuştur. İşlem öncesi alınan periapikal radyografide dişin iki köklü olduğu gözlenmiştir. KIBT yardımıyla ikisi distal kökte bir tanesi de mezial kökte olmak üzere toplam üç kanal varlığı tespit edilmiş ve sonrasında endodontik tedavi gerçekleştirilmiştir.1 yıl sonra alınan kontrol radyografisinde periapikal bölgenin sağlıklı olduğu görülmüştür.

Sonuç
Endodontik tedavinin başarılı olabilmesi için dişteki anatomik varyasyonların işlem öncesinde tespit edilmesi önemlidir. KIBT işlem öncesinde karmaşık kök kanal anatomisine sahip dişlerdeki varyasyonların tespitinde kullanılabilir.

Anahtar Kelimeler: *Alt çene ikinci küçük azı dişi, anatomik varyasyonlar, endodontik tedavi, KIBT*

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INTRODUCTION

Missed root canals are the common reason for the failure of endodontic treatment. Root canals are often left untreated because of clinician's lack of recognize about their presence, especially in teeth that has complex root canal morphology.[1] For this reason, the clinician should be informed about the possible variations in canal anatomy.

Mandibular second premolars generally have single root and single root canal.[2]Although extra canals in mandibular second premolars with multiple roots have been posted in literature these cases are extremely rare.[3] Slowey[4] stated that endodontic treatment of mandibular second premolar was the most complicated one due to the variations in canal anatomy

CBCT can be used for the preoperative diagnosis of complex root canal anatomy. The conventional intraoral radiograph gives two-dimensional (2D) image of the root canal system. However, CBCT images provide three-dimensional imaging. CBCT images can also allow the clinician to modify endodontic access cavity design in order to find extra canals.

CBCT is not specified as a standard method in endodontics for showing of root canal anatomy. Using CBCT may be indicated where conventional intraoral radiographs show equivocal or inadequate information for planning treatment. Therefore, uses of this advanced imaging facilitate management of complex cases such as a premolar with three root canals. [5]

In this case report, successful endodontic treatment of the uncommon anatomy of a mandibular right second premolar with two roots and three canals which were identified via CBCT and one- year follow-up findings was presented.

CASE REPORT

A 13 years old male patient was applied to Kocaeli University, Faculty of Dentistry with pain in the right mandibular posterior region. An intraoral clinical examination and preoperative periapical radiograph showed the deep aproximal caries lesion in the right mandibular second premolar. The pain was spontaneous and ceased only with analgesics. The probable diagnosis was an acute pulpitis and the endodontic treatment was indicated. Treatment plan was explained to the patient and consent obtained.

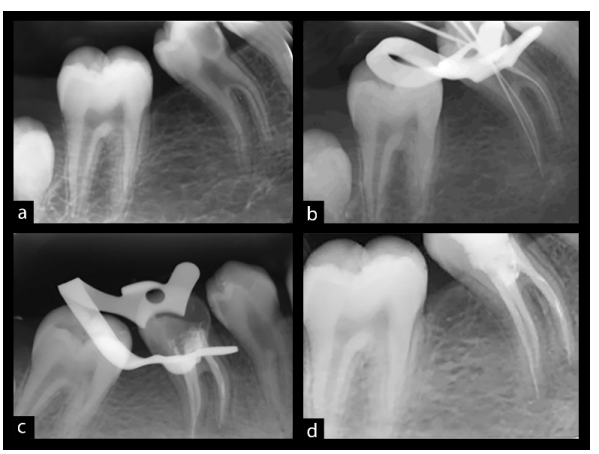

Figure 1. A: Pre-operative radiograph of right mandibular second premolar. B: Working length-determination radiograph demonstrating three root canals. C: Post-operative radiograph. Note three obturated root canals. D: Follow-up radiograph taken after one year.

The preoperative periapical radiograph [Figure 1a] showed the presence of two roots. Then cone-beam computed tomography scan was performed at 0.1 mm^3 voxel in order to investigate the cross-sectional morphology (Promax 3D Max, Planmeca Oy, Helsinki, Finland). The smallest field of view (FOV) was chosen as 5 x 5 cm. From orifice to apex, cross sectional morphology revealed the presence of three canals with two in the distal root and one in the mesial root [Figure 2].

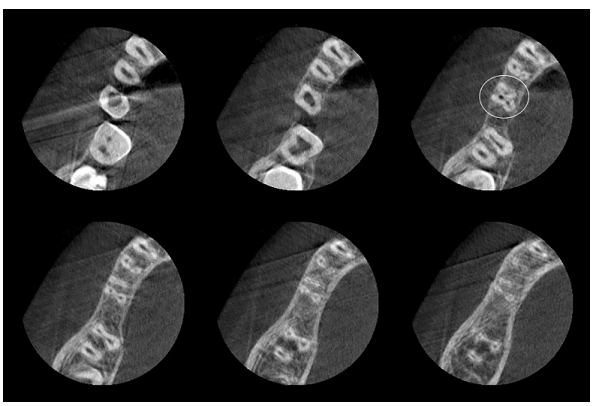

Figure 2 CBCT axial scan of mandibular second premolar with three canals.

Local anesthesia was applied (3% lidocaine with 1:100000 adrenaline) and a rubber dam was placed. The access cavity was prepared with a high-speed handpiece. After removing all coronal interference, the root canals were located and patency was obtained using a size #10 K-file (Mani Inc. Japan). The working lengths were established using an apex locator (Raypex 6, VDW, Germany) and a periapical radiograph [Figure1b].

The endodontic treatment was performed with Protaper rotary instruments (Dentsply, Maillefer; Switzerland). The root canals were irrigated with 2.5 % sodium hypochlorite. After drying the canals with paper points, the canals dressed with calcium hydroxide paste (Sultan Chemists Inc. Englewood, NJ, USA) and the access cavity was sealed with Cavit (3M ESPE, Seefeld, Germany). Ten days later, no clinical and radiographic symptoms were observed. Radiograph was taken with master cones in all canals. The root canals were obturated with gutta-percha and AH Plus (Dentsply, Maillefer; Switzerland) resin based sealer using cold lateral condensation technique. A final radiograph was taken to confirm obturation [Figure 1c]. And post endodontic restoration was performed with composite resin (Filtek Z250, 3M ESPE Seefeld, Germany) Radiographic follow-up of the case revealed no signs of periapical inflammation after one year [Figure 1d]

DISCUSSION

Before initiating endodontic treatment, the actual number of root canals cannot be correctly identified.[6] The optimum expansion of the access cavity is necessary for identification of the orifices. [5] Examination of the pulp chamber floor by using small K-file tip was also proposed to detect the location of orifices.[6] In the present case the access cavity could not be prepared as proposed due to the narrow alignment of the orifices and Also the use of loop was insufficient.

Several diagnostic steps are essential for the definition of extra canals in mandibular second premolars. As a basic principle, Slowey[4] suggested good quality preoperative radiographs for discovering the additional root canals. Fischer & Evans[7] stated that the shape, position and relative outline of the suspected root and the periodontal ligament space should be evaluated carefully for identification of such anomalies like an extra root or root canal. Alberuerque et al.[8] recommended correct explanation of angled

radiographs, accessing suitable cavity, and a comprehensive exploration of tooth. Use of apex-locater combined with periapical radiograph for accurate working length determination was also suggested by Kim et al.[9] We performed the same approach Working length was successfully determined and the intraoperative radiograph was able to show two root canals confined in the distal root. Nevertheless, due its 2D limitation, it was not possible to investigate the mesial root canal morphology.

CBCT imaging has been used in endodontics to study root canal morphology which reveals teeth's actual canal number. The potent dose of CBCT scanners can be changed and the radiation dose can be reduced using a smaller FOV. It was reported that choice of FOV has a significant influence on root canal visibility.[10] In this case, the smallest FOV setting was used for CBCT scan in order to investigate the number of root canals.

CONCLUSIONS

Successful endodontic treatment needs detailed knowledge of variations of root canal anatomy. The presence of extra root canals should be investigated for each tooth treated endodontically. CBCT can be used as a useful tool in the accurate diagnosis of complex root canal anatomy.

REFERENCES

[1] Cohen AS, Brown DC. Pathways of the Pulp. In: Cohen S, Burns RC. Orofacial dental pain emergencies: endodontic diagnoses and management. 8th ed. Boston: Mosby, 2002: 31-75.

[2] Zillich R, Dowson J. Root canal morphology of mandibular first and second premolars. Oral Surg 1973;36:738-44.

[3] Prakash R, Nandini S, Ballal, S, Kumar SN, Kandaswamy D. Two-rooted mandibular second premolars: Case report and survey. Indian J Dent Res 2008;19:70-3.

[4] Slowey RR. Root canal anatomy- Road map to successful endodontics. Dent Clin North Am 1979;23:555-73.

[5] Patel S, Dawood A, Ford TP, Whaites E. The potential applications of cone beam computed tomography in the management of endodontic problems. Int Endod J 2007; 10:818-30.

[6] Poorni S, Karumaran C, Indira R. Mandibular first premolar with two roots and three canals. Aust Endod J 2010;36:32–4.

[7] Fischer GM, Evans CE. A three-rooted mandibular second premolar. Gen Dent 1992; 40:139-40.

[8] Alberquerque D, Kottoor J, Hammo M. Endodontic and clinical considerations in the management of variable anatomy in mandibular premolars: a literature review. BioMed Res Int 2014; 512574.

[9] Kim E, Marmo M, Lee CY, Oh NS, Kim IK. An in vivo comparison of working length determination by only Root-ZX apex locator versus combining Root-ZX apex locator with radiographs using a new impression technique. Oral Surg Oral Med Oral Pathol Oral Radiol Endod 2008;105:79-83.

[10] VenskutonisT, Plotino G, Juodzbalys G, Mickevičienė L. The importance of cone-beam computed tomography in the management of endodontic problems: a review of the literature. J Endod 2014; 40:1895-901.

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SINGLE NO-PREP PORCELAIN LAMINATE VENEER RESTORATIONS; 2 CASE REPORTS

Volkan TURP[1], Simel AYYILDIZ[2], Deniz ŞEN[1], Gülcan BAHARDIRLI[1]

ABSTRACT

Porcelain laminate veneers provide an esthetic and conservative option in the anterior region for dentists and patients. In these applications, the selection of right indication and material affects the success directly. No-prep techniques for laminate veneers are being considered again in the current literature. In this article, 2 cases with single no-prep porcelain laminate veneers in the anterior region are presented.

Keywords: *Porcelain laminate veneer, prepless, resin cement*

ÖZET

Porselen laminate veneer restorasyonları ön dişlerin rehabilitasyonunda diş hekimi ve hastaya konservatif bir estetik çözüm sunan uygulamalardır. Bu tür restorasyonlarda uygun endikasyon ve uygun malzeme seçimi başarıyı doğrudan etkilemektedir. Diş hazırlığı yapılmadan restorasyonun uygulanması literatürde güncel olarak yeniden tartışılan bir konu olmuştur. Bu olgu sunumunda, 2 hastada ön bölgede tek dişe hazırlık yapılmadan uygulanan porselen laminate veneer restorasyonlar ele alınmıştır.

Anahtar Kelimeler: *Porselen laminate veneer, prepless, reçine siman*

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INTRODUCTION

Restoration of anterior teeth using a conservative approach allows clinicians to provide porcelain laminate veneers with excellent esthetics without extensive tooth structure removal. Tooth preparation for porcelain veneers requires less tooth reduction compared to other restorative treatment options due to higher fracture strength when resin cement is bonded to enamel. Application of laminate veneers without making any preparations on the tooth has become a possibility with the improvements in the adhesive materials. Teeth with microdontia, abrasions, malpositions and diastemas can be restored successfully with "prepless" laminate veneers with the right treatment planning.[1,2]

Ceramic laminate veneer restorations have advantages of bond strength to dental tissues, periodontal health, mechanical resistance and esthetics. On the other side they have disadvantages of requiring technical precision, not being repairable, having long chairside application time, not being able to mask underlying color when required, being brittle prior to cementation and not being economic.[3]

In these two case presentations, two patients were rehabilitated by 'minimally invasive' approach by their request. Lingually malpositioned teeth were restored with laminate veneer restorations.

CASE PRESENTATIONS

CASE-1

34-year-old female patient was concerned about her lingually malpositioned upper left lateral incisor and requested an esthetic restoration (Figure 1).

Figure 1: Case-1, initial situation.

Following clinical and radiological examinations different treatment options were discussed with the patient. Firstly, orthodontic treatment was recommended but the patient refused this option. As the patient was content with the appearance of other maxillary anterior teeth, it was decided to restore malpositioned lateral incisor with a laminate veneer without making any preparations. The introral factors of tooth like its position, occlusal relation, color, periodontal health and gingival biotype were evaluated. It was decided to apply no-prep laminate veneer procedure by using feldspathic blocks with a CAD/CAM system for the fabrication of the restoration.

After the selection of tooth color the impression was made using polyvinyl siloxane impression material (Express XT VPS, 3M ESPE, Seefeld, Germany). Laminate veneer restoration was fabricated in laboratory using CAD/CAM System (CEREC, Sirona Dental, Salzburg, Austria) from a feldspathic block (Vita Mark II, Vita Zahnfabrik, Bad Sackingen, Germany). Margins, occlusion and esthetic criteria were evaluated in the clinic and restoration was finished after characterization.

Due to good light transmission quality of feldspathic porcelain, a light curing resin cement (CHOICE 2, Bisco Inc., Schaumburg, IL, USA) was selected for luting the restoration.

Before cementation, a try-in paste was applied and translucent shade was found appropriate. 9.5 % Hydrofluoric acid was applied for 60 seconds onto the cementation surface of the restoration, rinsed with water and air-dried. Following the silane and bonding application the restoration was placed onto the tooth; the light curing was applied first on the lingual, then the labial side for 5 seconds. Excess cement was removed and completely cured by applying light for 20 seconds from all sides. (Figure 2)

Figure 2: Case-1, after cementation of prepless laminate veneer restoration on upper left lateral incisor.

Figure 3: Case-1, after 6 months.

The follow-up controls of the patient were carried out in 6 month (Figure 3) and 1 year (Figure 4) periods. No gingival problems were observed and the patient was satisfied with the esthetics and function.

Figure 4: Case-1, after 1 year.

CASE-2

26-year-old female patient applied to Istanbul University Faculty of Dentistry Prosthodontics Clinic for esthetic problems on her lingually malpositioned upper left canine. (Figure 5)

Figure 5: Case-2, initial situation.

Same with the other patient orthodontic treatment was recommended firstly, but the patient refused this option. As the patient was content with the appearance of her other maxillary anterior teeth, it was decided to restore malpositioned canine teeth with a laminate veneer without making preparation.

The same procedures with Case-1 were applied for the impression making and preparation of the restoration and the treatment was finished. (Figure 6)

Figure 6: Case-2, after cementation of prepless laminate veneer restoration on upper left canine.

The patient was called back at 6 month (Figure 7) and 1 year (Figure 8) periods. The restoration was observed as successful in terms of esthetics and function, and no gingival problems were observed.

Figure 7: Case-2, after 6 months.

Figure 8: Case-2, after 1 year.

DISCUSSION

The initial presentation of laminate veneer restorations suggested a no-prep approach and reported this as an advantage of the procedure. However, this technique was abandoned due to restored teeth being too bulky and unnatural, resulting in esthetic concerns. A minimal preparation approach was found more successful and clinicians preferred it for a long time. [4]

In the last decade, minimal invasive procedures gained popularity and improvements in the materials used that made very thin laminate veneers a possibility. This resulted in no-prep laminate veneers to be considered as treatment options once again.[5]

However, applying laminate veneers without any preparations on the tooth is still a debated subject.[6] Even though clinicians would like to restore teeth with minimal invasive techniques, especially when the reason is purely cosmetic, the survival and success of no-prep laminate veneers in long term, and health of soft tissues around these restorations are subjects of discussion in literature.[7]

Recent studies report good results in no-prep laminate veneer restorations if several conditions are met.[8] Wells stated the following conditions for the success of no-prep laminate veneers:

1- Microdontia, for example tiny lateral incisors, irregularities in the width of the teeth and arch form,

2- Occlusal material loss due to abrasion, erosion or a combination of both,

3- Narrow dental arch and lingually malpositioned teeth in orthodontic premolar extraction cases,

4- Big lips and a wide smile, generally cases where there is enough space for the enlargement of the teeth.

In the current study no-prep laminate veneer restorations are planned and applied by taking

these points into consideration and selecting the right patients. CAD/CAM technique was preferred for a better marginal and internal fit compared to conventional fabrication procedures and homogeneity and mechanical stability advantages of ceramic blocks.[9] Several different materials can be used in the CAD/CAM systems. In these cases, feldspathic ceramic blocks were used. These materials have 150 MPa fracture strength after adhesive cementation, their abrasion resistance similar to natural enamel, have good polishing properties and can be polished intraorally.[10] Matsumura et al. reported several advantages of feldspathic ceramic; it can be successfully used in very thin layers, cost less than several other dental ceramic materials in the market, high mechanical resistance after etching with hydrofluoric acid and exceptional adhesion when used with the right adhesive system.[1]

Cementation is one of the most important steps for the success of laminate veneers prepared with minimally invasive approach. [11-13] Adhesive resin cements are used for the cementation of laminate veneer restorations. Resin cements can be classified as self-curing, light-curing and dual curing; according to their polymerization methods. Self and dual curing resin cements include tertiary amines which may cause decolorization in time,[14,15] for this reason light curing resin cements were preferred for the cementation of no-prep laminate veneer restorations in the current study. Also, the polymerization shrinkage occurs towards the light source, this was taken into consideration as the restorations were luted and the light curing was done from the lingual side first in order to lower decementation risk.

CONCLUSIONS

The no-prep laminate veneer restorations have been around more than two decades. Improvements of the materials and the adhesive techniques make these procedures on par with traditional laminate veneers. Minimally invasive approach is the greatest advantage of this procedure. It is a highly successful and esthetically pleasing treatment option if the right case is selected and the technique is carefully applied.

REFERENCES

[1] Matsumura H, Aida Y, Ishikawa Y, Tanoue N. porcelain laminate veneer restorations bonded with a three-liquid silane bonding agent and a dual-activated luting composite. J Oral Sci 2006; 48:261-266.

[2] Guess PC, Selz F, Stampf S. Prospective Clinical Study of Press-Ceramic Overlap and Full Veneer Restorations: 7-Year Results. Int J Prosthodont 2014; 27:355-358.

[3] Lee IB, An W, Chang J, Um CM. Influence of ceramic thickness and curing mode on the polymerization shrinkage kinetics of dual-cured resin cements. Dent Mater 2008; 24: 1141–1147.

[4] Wells DJ. "No-prep" veneers. Inside Dent 2010;6: 56–60.

[5] DiMatteo AM. Prep vs no prep: the evolution of veneers. Inside Dent 2009;5:72–79.

[6] Wells DJ. Don't we all do cosmetic dentistry? Dent Econ 2007;97:106–109.

[7] Dumfahrt H, Schaffer H. Porcelain laminate veneers: a retrospective evaluation after 1–10 years of service. Int J Prosthodont 2000;13:9–18.

[8] Radz GM. Enhancing the esthetics through addition: no prep porcelain veneers. Oral Health 2009;99:23–30.

[9] Alghazzawi TF, Lemons J, Liu P, Essig ME, Janowski GM. The failure load of CAD/CAM

generated zirconia and glass-ceramic laminate veneers with different preparation designs. J Prosthet Dent 2012;108:386-393.

[10] Radz G. Minimum thickness anterior porcelain restorations. Dent Clin North Am 2011;55:353-70.

[11] Arrais CAG, Giannini M, Rueggeberg FA. Kinetic analysis of monomer conversion in auto- and dual-polymerizing modes of commercial resin luting cements. J Prosthet Dent 2009;101:128-136.

[12] Guess PC, Schultheis S, Wolkewitz M, Zhang Y, Strub JR. Influence of preparation design and ceramic thicknesses on fracture resistance and failure modes of premolar partial coverage restorations. J Prosthet Dent 2013;110:264-273.

[13] Fradeani M, Redemagni M, Corrado M. Porcelain laminate veneers: 6- to 12-year clinical evaluation—a retrospective study. Int J Periodontics Restorative Dent 2005;25:9–17.

[14] Beier US, Kapferer I, Burtscher D, Dumfahrt H. Clinical performance of porcelain laminate veneers for up to 20 years. Int J Prosthodont 2012;25:79-85.

[15] Petridis HP, Zekeridou A, Malliari M, Tortopidis D, Koidis P. Survival of ceramic veneers made of different materials after a minimum follow-up period of five years: a systematic review and meta-analysis.Eur J Esthet Dent 2012;7:138-52.

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CLINICAL AND RADIOLOGICAL EVALUATION OF THE PROBLEMS OCCURED DUE TO INAPPROPRIATE TREATMENT OF A PATIENT WITH ANTERIOR OPEN BITE: A MALPRACTICE CASE

Orhan AKSOY [1], Sercan KÜÇÜKKURT [2]

ABSTRACT

During practices in health care, patients could be seriously harmed by either conscious or unconscious wrong approaches of the clinicians. In this report, we discuss a malpractice case and the results of the malpractice on an adult female patient with anterior open bite.

A 23-year-old female patient was admitted to our hospital of faculty of dentistry complaint with anterior open bite and toothache. Patient history revealed that 2 years ago posterior teeth were shortened by a clinician without a prosthetic restoration until her anterior open bite disappeared. However not only the problem relapsed but also the shortened teeth needed root canal treatment which are also done by another clinician. Besides it has been learned that temporomandibular joint problems occur after these treatments. Thorough clinical and radiological examinations, it was decided that patient needs a multidisciplinary problems which must be solved together with departments of orthodontic, endodontics, restorative dentistry, prosthetic, oral and maxillofacial surgery and implantology. Indeed only an orthodontic and surgical treatment was generally enough to treat anterior open bite cases, as a result of malpractice this case get complicated which needs very complex treatments.

The treatment method performed by the clinician for treatment of anterior open bite, both ignored the morphological, functional, ethological facts of orthodontic treatments for such patients and also led to dental pain, damage and loss of function. This kind of an approach does not correspond with any ethical, scientific, or esthetical criteria.

Keywords:*Malpractice, Anterior Open Bite, Orthodontic Treatment, Unappropriate treatment*

ÖZET

Sağlıkla ilgili uygulamalarda hekimin bilinçli ya da bilinçsiz kusurlu yaklaşımları neticesinde hastalar ciddi şekilde zarar görebilmektedir. Bu olgu sunumunda bir ön açık kapanış vakasında diş hekimi tarafından yapılmış hatalı uygulamadan ve hastada neden olduğu sorunlardan bahsedilecektir.

23 yaşındaki kadın hasta, ön açık kapanış ve diş ağrısı şikayetiyle fakülte hastanemize başvurmuştur. Hastanın anamnezinden, 2 yıl önce ön açık kapanış şikayetiyle gittiği pratisyen diş hekimi tarafından posterior dişlerinin ön dişlerdeki açıklık kapanana kadar, herhangi bir protetik restorasyon yapılmaksızın vertikal yönde kısaltıldığı fakat zamanla bu açıklığın yeniden oluştuğu öğrenilmiştir. Ayrıca hasta, kron boyu kısaltılan dişlerinde ağrı oluştuğunu ve farklı bir hekim tarafından posterior dişlerine kanal tedavileri uygulandığını belirtmiştir. Hastanın temporomandibular eklem yönünden de yapılan tedaviler sonrası problemlerinin oluştuğu öğrenilmiştir. Hastanın yapılan klinik ve radyolojik tetkikleri sonrası hastaya ortodonti, endodonti, restoratif diş tedavisi, protez, ağız, diş çene cerrahisi ve implantoloji bölümlerinin müdahalesini gerektiren kapsamlı bir tedavi planı oluşturulmuştur. Normal şartlarda yalnızca ortodonti ve ağız, diş çene cerrahisi bölümlerinin yaklaşımlarıyla tedavi edilebilecek durumdaki hasta, uygulanan yanlış tedaviler sonrası oldukça karmaşık bir hal almıştır.

Hastanın ön açık kapanışının tedavisi için hekiminin tercih ettiği yöntem bu tip vakaların ortodontik tedavisinde göz önüne alınması gereken morfolojik, fonksiyonel, etiyolojik faktörler ve stabiliteyi göz ardı etmekle birlikte hastada dental ağrı, hasar ve fonksiyon kaybına yol açmıştır. Bu yaklaşım hiçbir şekilde diş hekimliğinin etik, bilimsel ve estetik kriterlerine uymamaktadır.

Anahtar Kelimeler: *Malpraktis, Ön Açık Kapanış, Ortodontik Tedavi, Hekim hatası, Yanlış tedavi*

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INTRODUCTION

Medical malpractice can be defined as the failure of a clinician to exercise the degree of care and skill that a physician or surgeon of the same medical specialty would use under similar circumstances[1]. In our country, with the establishment of laws in recent years, favoring the protection of patient rights, this term has gained further importance and thus more legal regulations are getting into effect[2]. In a survey conducted by Kandemir[3], restorative dentistry was found to be the most common area where malpractice occurred (64%), followed by maxillofacial surgery (18%), prosthetic treatments (14%) and orthodontic treatments (3%). In this case report, we present a case with anterior open bite in which clinical malpractice was performed by a dentist.

CASE REPORT

A 23-year-old female patient was admitted to our faculty of dentistry hospital with the complaint of toothache and anterior open bite. Patient history revealed that the patient was admitted to a private dentistry clinic 2 years ago with the complaint of malocclusion, which constituted an aesthetical problem for the patient and caused difficulty biting. The clinician shortened the height of the crowns of the posterior teeth both in the maxilla and mandibula until their average height were 1-2 mm. However, not only the anterior open bite relapsed over time but also the posterior teeth had sensitivity and had positive percussion findings.

In the intraoral examination, the right upper canine and the first left upper molar teeth were not present, the right upper first molar and the left upper second molar teeth had amalgam filling, and temporary restorations were observed in the left lower second premolar, the left lower first molar, the right lower first premolar, and the right lower second molar teeth. Angle type II molar relationship and posterior cross closure was seen on the right side and an anterior open bite of 5 mm was present (Fig. 1).

Figure 1. Intraoral images (A: Frontal, B: Right side, C: Left Side, D: Mandible, E: Maxilla)

The lower middle line was deviated to the right side for 2.5 mm although it was slightly corrected at maximum opening. The patient felt pain when she opened her mouth in the bilateral condylar area.

Radiological evaluation of the patient was performed with panoramic, lateral, cephalometric, and anteroposterior radiograms. In the panoramic radiogram, the right upper canine tooth was found to be embedded and to be in the vertical position. It was learned that the root treatment for the vertically shortened right lower first molar, left lower second premolar, left lower first and second molars, and right upper second molar was performed by another clinician. The right lower second molar was extirpated and the root treatment could not be performed.

Consultation from the orthodontics department was sought. In the orthodontic

examination, asymmetrical facial presentation was observed. The inferior tip of the jaw was deviated to the right. Occlusal cant was seen in the maxilla. The patient had a convex profile. The patient could not close her lips when the teeth were in occlusion, in the free position without muscular hyperactivity (Fig. 2).

Figure 2. Extraoral images

No pathological finding was observed in the maxillary sinuses. Asymmetry was seen between the right and left mandibulocondylar areas. While the right mandibulocondyle was in normal relationship with the glenoid fossa, the left mandibulocondyle was displaced to the inferior side. In the lateral cephalometric radiogram, a skeletal relationship of class II was found and the angle was discovered to be vertically high. Skeletal stricture was seen in the maxilla in anteroposterior radiogram and the tip of the mandibular jaw was deviated to the right (Fig. 3).

Figure 3. Orthopantomography and Cephalometric images

Magnetic resonance imaging (MRI) was utilized for better evaluation of the temporomandibular joint (TMJ). Anterior displacement without reduction in the right TMJ disc and subluxation of the right condyle and osteophytosis was observed. When the mouth tried to move to the open position, the condyle could only move a little forward. Anterior displacement of the left TMJ disc without complete reduction, subluxation of the condyle, and slight osteophytosis were observed When the mouth tried to get into the open position, the condyle could only move to the lower posterior part of the temporal eminence (Fig. 4).

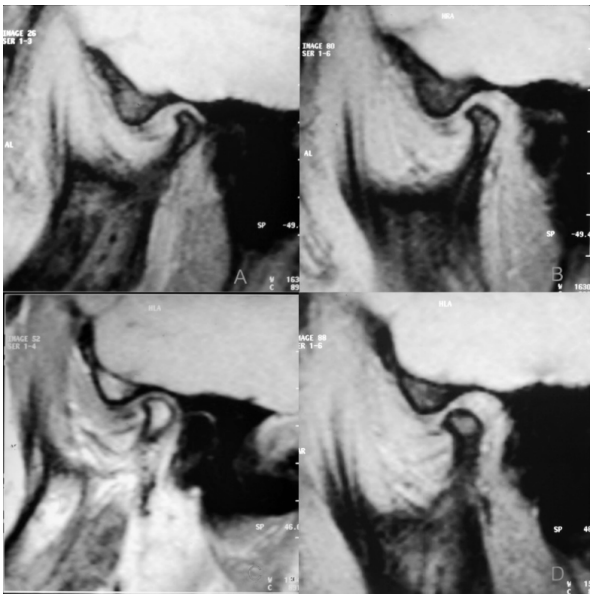

Figure 4. MRI of TMJ (A: Right - Open B: Right - Close C: Left - Closed D: Left - Open)

The patient was consulted with the Ear, Nose, and Throat (ENT) department for through evaluation of the skeletal and dental etiology of the open bite in terms of nasopharyngeal airway. In the clinical and radiological examination, hypertrophy in the right and left lower concae, and right septum deviation were detected. Medical treatment of the hypertrophy of the concae was followed by surgical treatment of the septum deviation.

Current and/or future pathologies of the patient were evaluated in a multidisciplinary approach and the treatment plan was constructed accordingly. Symptomatic splint was prepared for the TMJ symptoms of the patients and the follow-up period was planned. Therapeutic position was decided to ensure the adaptation of the occlusion orthodontically and decompensation before orthognathic surgery. With the utilization of orthognathic surgery (Lefort 1 and/or bilateral sagittal split osteotomy), the skeletal and dental relationships of TMJ were planned to be healed to the maximum level. The patient was informed about the treatment plan; however, the patient refused the treatment plan and was lost to follow-up.

DISCUSSION

Malocclusion of the anterior open bite may result from various etiologies caused by craniofacial, dentoalveolar, and soft tissue pathologies. The patients with this type of malocclusion constitute the most difficult cases for orthodontists[4]. Common characteristics seen in patients with skeletal open bite include posteriorly rotated mandibula[5], increase in the vertical growth of posterior dentoalveolar structures[6, 7], shortness in the height of the posterior aspect of the face[8], posterior rotation of the palatal plate[9], increase in the height of anterior aspect of the face[10], wideness in the distance between upper and lower lips[10].

The etiology of anterior open bite cases is not apparent, but they are considered to be multifactorial[10]. The changes in the structure of the muscles of mastication and the resting length of the tongue and its location are among these etiological factors. In these patients, the tongue rests between the upper and lower incisors during swallowing. Thumb licking and abnormal pressure habits in the tongue and lips, airway obstructions, and genetic skeletal developmental abnormalities may cause vertical malocclusion. The cornerstone of orthodontic treatment is the presence of normal, permanent, appropriate teeth and surrounding tissue structure. Precise establishment of the etiology of open bite increases the chance of successful treatment[5].

In these types of cases, early diagnosis and avoidance of harmful behavior with the help of growth may lead to healing without utilization of any treatment. In older cases, if the growth

is continuing, functional apparels including bite-block and bionator or orthopedic devices such as vertical jaw split could be used in treatment. In cases where the growth is completed, the treatment is planned based on the severity of the anomaly. Treatment options include a mask with fixed mechanics or orthognathic surgery[5].

In the case presented in this study, denial of the sagittal, vertical and transverse problems and the treatment concepts by the dentist and the vertical shortening of the posterior teeth did not help the treatment of the patient. This approach also led to significant loss in the height of the crown of the teeth, resulting in TMJ damage. The approach used by the dentist did not follow any of the ethical, scientific, or aesthetic criteria of dentistry. It also ignored the basic morphological, functional, and etiological and stability principles of basic orthodontics.

CONCLUSIONS

The primary target of a dentist must be to preserve the tissues and organs of the patient and to preserve the enamel to aid the general wellbeing and aesthetic concerns of the patient. Prior to the treatment, all therapeutic methods must be evaluated through a wide perspective. When necessary, an interdisciplinary approach should be utilized, and the dentist should not only satisfy the aesthetic concerns of the patient but also consider the occlusive and functional aspects. Otherwise, as seen in the case presented, the interventions may harm the patient and the physician as well. Although there are legal regulations protecting the rights of the patients, the physician is responsible for protecting the body of the patient.

REFERENCES

[1] Uzel İ, Kadıoğlu FG. Diş hekimliğinde Meslek Kusurları (Malpraktis). T Klin Tıbbi Etik 1995; 2-3:66-71

[2] Altun G, Yorulmaz AC. Yasal Değişiklikler Sonrası Hekim Sorumluluğu ve Malpraktis. Trakya Univ Tip Fak Derg 2010;27:7-12

[3] Kandemir S, Ergun N. Diş Hekimliğinde Uygulama Hataları. Ege Üniversitesi Diş Hekimliği Fakültesi Dergisi 1991;12:163-6

[4] Piancino MG, Isola G, Merlo A, Dalessandri D, Debernardi C, Bracco P. Chewing pattern and muscular activation in open bite patients. Journal of Electromyography and Kinesiology 2012;22:273–279.

[5] Arvystas MG. Treatment of anterior skeletal open-bite deformity. Am J Orthod 1977;72:147–64.

[6] Sassouni V, Nanda S. Analysis of dentofacial vertical proportions. Am J Orthod 1964;50:801–23.

[7] Schudy FF. Vertical growth versus anteroposterior growth as related to function and treatment. Angle Orthod 1964;34:75–93.

[8] Lopez-Gavito G, Wallen TR, Little RM, Joondeph DR. Anterior openbite malocclusion: a longitudinal 10-year postretention evaluation of orthodontically treated patients. Am J Orthod 1985;87:175–86.

[9] Kim YH. Anterior open bite and its treatment with multiloop edgewise archwire. Angle Orthod 1987;57:290–321.

[10] Richardson A. Skeletal factors in anterior open bite and deep over bite. Am J Orthod 1969;56:114–27.

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PROLIFERATIVE VERRUCOUS LEUKOPLAKIA: FIVE YEARS FOLLOW-UP

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ABSTRACT

Background: Proliferative verrucous leukoplakia (PVL) is the rarest and stubborn subtype of oral leukoplakia (OL). The origin of PVL is still unknown and because the possible risk factors of OL are not in complete accordance with PVL, diagnosing the disease is very hard. PVL also needs special attention because of the high progression rate of squamous cell carcinoma and verrucous carcinoma.

Case Report: A 54 year old female patient was admitted to our department with the complaint of painless white lesions in anterior region of the floor of the mouth. In the light of the clinical and radiological findings, with the initial OL diagnosis, lesion was excised using electrocautery as a whole under local anesthesia and sent for histopathological examination. Final diagnosis was "Proliferative Verrucous Hyperplasia". After 60 months of follow-up, there was no recurrence.

Conclusion and Clinical Relevance: Since PVL has high progression rate for malign lesions and high relapse rates, it is important to detect the disease at early stages, and long term follow-up after surgical excision is needed.

Keywords: *leukoplakia, proliferative verrucous leukoplakia, potentially malignant disorders, oral cancer, verrucous hyperplasia*

ÖZET

Giriş: Proliferatif verrüköz lökoplaki (PVL), oral lökoplakinin (OL) en nadir görülen ve inatçı tipidir. PVL'nin kökeni halen tam olarak anlaşılamamıştır. PVL ile OL'nin muhtemel risk faktörlerinin birbirine uyum göstermemesi de hastalığın teşhisini zorlaştıran bir faktördür. Ayrıca PVL, yüksek oranda squamous cell karsinoma ve verrüköz karsinoma'ya dönüşüm gösterme oranı nedeniyle de dikkat edilmesi gereken bir hastalıktır.

Olgu Sunumu: 54 yaşındaki bir kadın hasta, kliniğimize ağız tabanında yerleşim gösteren ve 5-6 yıldır iyileşme göstermeyen ağrısız beyaz lezyon şikayetiyle başvurmuştur. Klinik ve radyolojik tanıların eşliğinde, oral lökoplaki ön tanısı ile lezyon elektrokoter yardımıyla eksize edilmiş ve histopatolojik incelemeye gönderilmiştir. Histopatolojik tanı proliferatif verrüköz lökoplaki olarak konulmuştur. Yapılan 60. ay takibinde nüks gözlenmemiştir.

Sonuç ve Klinik Önem: PVL'nin yüksek oranda malign lezyonlara dönüşüm gösterebilmesi ve yüksek nüks oranı nedeniyle, hastalığın erken tanısı ve tedavi sonrası dönemde uzun dönem takiplerinin yapılması önem arz etmektedir.

Anahtar Kelimeler: *lökoplaki, proliferative verrüköz lökoplaki, premalign lezyonlar, oral kanserler, verrüköz hiperplazi*

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INTRODUCTION

Oral leukoplakia (OL) is a common premalign disease of oral mucosa. It may be defined as a white patch or plaque that cannot rubbed-off, which may be associated with any other disease clinically or histopathologically.[1] OL is macroscopically evaluated under two main classes; Homogeneous and non-homogeneous. Proliferative verrucous leukoplakia (PVL) is a subtype of the non-homogeneous type.[2]
PVL is slightly newer than the other types of OL, and it was defined by Hansen et al.[3] in 1985. Origin of PVL is still unknown and because the possible risk factors of OL are not in complete accordance with PVL, it is very hard to diagnose. PVL is also the rarest and stubborn type of OL[4].

PVL needs special attention because of its high rate of progression to squamous cell carcinoma and verrucous carcinoma.[4] Clinically, it is characterized with the slow growth tendency on cheek mucosa and gingiva, and observed as papillary verrucoid hyperkeratotic plate. Distinct from other subtypes of OL, it is not highly associated with smoking. Incidence of PVL is more frequent in females over the age of 60 years.[5]

CASE REPORT

A 54 year old female patient was admitted to our department with the complaint of painless white lesions in anterior region of the floor of the mouth, which had not recovered for 5-6 years. The patient had no systemic disease, and smoked a pack of cigarette per day for 10 years.

In the clinical examination; lobule, hard, immobile, hyper keratinized and paving-stone like white lesions that started from the right of the lingual frenulum but especially localized on the left side and reach towards the 2nd molar teeth through the lingual sulcus and embodied the floor of the mouth mucosa, lingual gingiva and alveolar crest, were determined. (Fig. 1) There was no lymphadenopathy. In the orthopantomography examination, there was no finding that led to an intraosseous pathology. (Fig. 2)

Figure 1. Pre-operative intraoral image

Figure 2. Pre-operative orthopantomography image

In the light of the current clinical and radiological findings, with the initial OL diagnosis, lesion was excised using electrocautery as a whole under local anesthesia and sent for histopathological examination. Remaining oral mucosa was

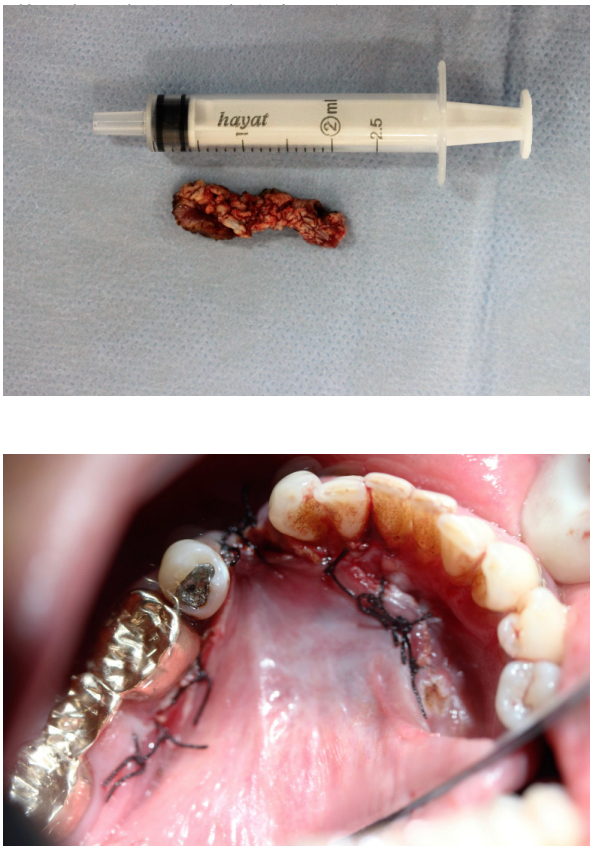

Figure 3. Post-operative image and Excised lesion

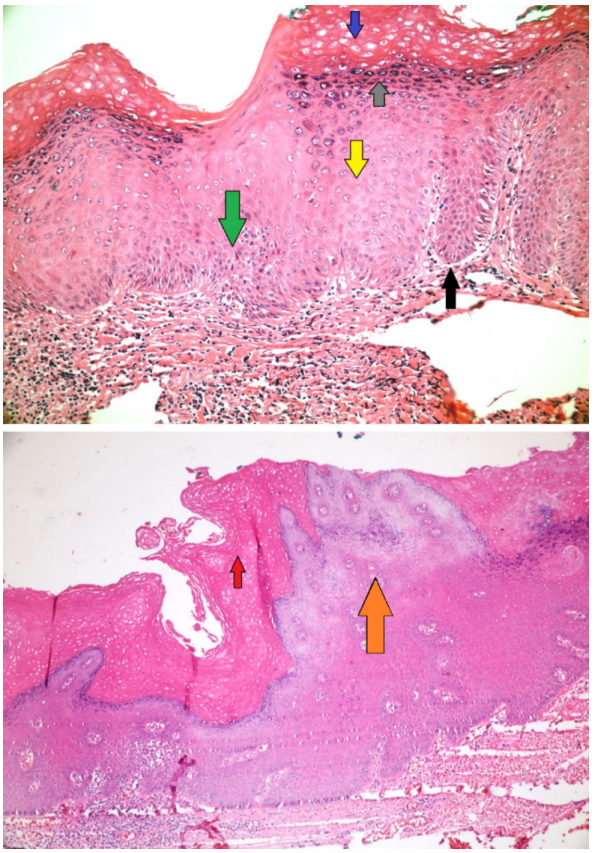

Figure 4. Histopathological images (Green arrow: Increase of nucleus-cytoplasm ratio, large mononuclear cells, hyperchromatic nuclei and increase in mitosis, Blue arrow: Keratin, Yellow arrow: Acanthosis, Grey arrow: Hypergranulosis, Black arrow: Papillomatosis, Orange arrow: Verrucous morphology, Red arrow: Keratin) (H&E x200)

In the histopathological examination; it was reported that there was no abnormal mitosis in the 3.5 x 1.2 x 0.7 cm sized soft tissue specimen; there was no carcinoma in situ from the bottom to the top; intermediate cellular and intermediate structural dysplasia were detected, and final diagnosis was "Proliferative Verrucous Hyperplasia". (Fig. 4)

Postoperative period was uneventful and the patient was taken into follow-ups once every three months for the first year and once every six months in the following years. After 60 months, there was no recurrence. Follow-ups of the patient still continue. (Fig. 5 and 6)

Figure 5. Follow-up images (12, 36 and 60 months)

Figure 6. Follow-up Orthopantomography (60 months)

DISCUSSION

In order to diagnose PVL, Cerero et al.[6] suggested five major and four minor criteria and stated that at least three major criteria, or with a combination of two major and two minor criteria must exist. The major criteria are; 1. Leukoplakia to include at least two different areas in the oral region like gingiva, alveolar crest and palate, 2. To be located in a verrucous field, 3. Lesion to spread and grow in the development phase of the disease, 4. Occurrence of a relapse in the treated area, 5. Display of simple epithelial hyperkeratosis, verrucous hyperplasia, verrucous carcinoma or squamous cell carcinoma in the histopathologic examination. The minor criteria are; 1.To consist of at least 3 cm field where all affected area is included, 2. Patient to be female, 3. Patient to be a non-smoker, 4. Disease to exist for at least five years. Our case is consistent with the four major criteria (1, 2, 3 and 5) and three minor criteria (1, 2, and 4).

PVL is a progressive developmental disease and usually develops in 4 clinical phases. 1. Focal early period. 2. Showing regional enlargement. 3. Verrucoid/warty development. 4. Cancer development.[5] It is thought that our case was in phase three while it was

interfered with. Batsakis et al.[7] suggested that histopathological appearance of PVL needs to be examined in 4 phases. According to this classification: 1. Clinical flat leukoplakia that does not include any atypical cell. 2. Verrucous hyperplasia 3. Verrucous carcinoma, and 4. Squamous carcinoma. In the histopathological examination of our case, there were findings consistent with phase two.

Differential diagnosis for OL includes other white lesions of the oral cavity such as oral candidiasis, liken planus, linea alba, leukoedema and friction keratosis.[5]

In a systemic review, Abadie et al.[4] stated the average age as 63.9 for 329 PVL patients. 220 patients were women (66.9%), where only 96 of them (34.78%) reported tobacco usage. Gingiva takes the first place as the lesion area, buccal mucosa is reported as the second. While general relapse rate is reported as 157 (71.2%) of PVL and/or carcinoma in the treated patients, invasive carcinoma development was observed in 177 (63.9%) patients. In another systemic review, Pentenero et al.[8] reported that 322 (%71.5) of the 450 patient was female and the average age was 63.2. Average rate of smoking was determined as 35.3%. Recurrence rate was reported as 77.6%. Silverman and Gorsky[9] reported the same malign transformation rate in smokers and non-smokers. Similarly, Gandolfo et al.[10] reported no connection between malign transformation of OL and tobacco usage.

It is known that PVL has higher risks than other types. Malign transformation time interval of PVL has been reported between 4.7 - 11.6 years with a mean of 6 years.[6] Some areas, like floor of the mouth and ventral surface of tongue has higher dysplasia and carcinoma transformation rates as 45%.[11] Histopathologic examinations can provide more accurate results about determining the premalign lesion transformation than clinical observations. In our case, intermediate dysplasia was determined as a result of the histopathological examination.

For surgical excision of PVL, scalpel and electrocautery can be used. In our case, surgical excision with electrocautery was preferred as it provides relatively bloodless surgical area. Abadie et al.[4] reported the relapse rates after surgical excision on 222 patients as 71.2%. Radiotherapy, laser therapy, chemotherapy, photodynamic therapy, topical agents, cryotherapy, multiple biopsy and retinoids can be considered as other treatment options. It has been reported that non-surgical treatment options of PVL does not provide the desired success on their own or in combination. The most effective approach was to determine the cancer at early stages by executing regular checks and executing invasive wide localization when possible.[5]

Since PVL has high progression rate for malign lesions and high relapse rates, it is important to determine the disease at early stages and long term follow-up after treatment is needed.

REFERENCES

[1] Lodi G, Sardella A, Bez C, Demarosi F, Carrassi A. Interventions for treating oral leukoplakia. The Cochrane database of systematic reviews. 2006(4):CD001829.

[2] Kumar A, Cascarini L, McCaul JA, Kerawala CJ, Coombes D, Godden D, et al. How should we manage oral leukoplakia? The British journal of oral & maxillofacial surgery. 2013;51(5):377-83.

[3] Hansen LS, Olson JA, Silverman S, Jr. Proliferative verrucous leukoplakia. A long-term study of thirty patients. Oral surgery, oral medicine, and oral pathology. 1985;60(3):285-98.

[4] Abadie WM, Partington EJ, Fowler CB, Schmalbach CE. Optimal Management of Proliferative Verrucous Leukoplakia: A Systematic Review of the Literature. Otolaryngology--head and neck surgery : official journal of American Academy of Otolaryngology-Head and Neck Surgery. 2015;153(4):504-11.

[5] Gillenwater AM, Vigneswaran N, Fatani H, Saintigny P, El-Naggar AK. Proliferative verrucous leukoplakia: recognition and differentiation from conventional leukoplakia and mimics. Head & neck. 2014;36(11):1662-8.

[6] Cerero-Lapiedra R, Balade-Martinez D, Moreno-Lopez LA, Esparza-Gomez G, Bagan JV. Proliferative verrucous leukoplakia: a proposal for diagnostic criteria. Medicina oral, patologia oral y cirugia bucal. 2010;15(6):e839-45.

[7] Batsakis JG, Suarez P, el-Naggar AK. Proliferative verrucous leukoplakia and its related lesions. Oral oncology. 1999;35(4):354-9.

[8] Pentenero M, Meleti M, Vescovi P, Gandolfo S. Oral proliferative verrucous leucoplakia: are there particular features for such an ambiguous entity? A systematic review. The British journal of dermatology. 2014;170(5):1039-47.

[9] Silverman S, Jr., Gorsky M. Epidemiologic and demographic update in oral cancer: California and national data--1973 to 1985. Journal of the American Dental Association. 1990;120(5):495-9.

[10] Gandolfo S, Castellani R, Pentenero M. Proliferative verrucous leukoplakia: a potentially malignant disorder involving periodontal sites. Journal of periodontology. 2009;80(2):274-81.

[11] Silverman S, Jr., Gorsky M, Lozada F. Oral leukoplakia and malignant transformation. A follow-up study of 257 patients. Cancer. 1984;53(3):563-8.

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CHAIRSIDE CEREC SYSTEM AND CAD/CAM MATERIALS

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ABSTRACT

Background
As chairside Computer Aided Design and Computed Aided Manufacturing (CAD/CAM) have gained popularity in dentistry in the last decade, the variety of novel CAD/CAM blocks have been introduced for CAD/CAM applications.

Mainly glass ceramics/ceramics and resin composites were used in the production of CAD/CAM restorations. Recently new formulations for chairside CAD/CAM materials have been developed to combine the advantageous properties of ceramics and composite resins.

Conclusion
In this review, computer aided dentistry and the materials used for chairside CEREC System for designing CAD/CAM restorations from past to present are summarized.

Keywords: *CAD/CAM, CAD/CAM Materials, CEREC, chairside, glass-ceramic, metal-free, optical impression, resin nanoceramic*

ÖZET

Giriş
Son on yılda hasta başında, Bilgisayar Destekli Tasarım ve Bilgisayar Destekli Üretim'in (CAD/CAM) diş hekimliğinde popülerlik kazanması ile CAD/CAM uygulamaları için yeni CAD/CAM blokları geliştirilmiştir. CAD/CAM restorasyonların yapımında ağırlıklı olarak cam seramik, seramik ve kompozit rezinler kullanılmıştır.

En son olarak seramik ve kompozit rezinlerin avantajlı özellikleri birleştirilerek hasta başında kullanılmak üzere yeni formülasyonlara sahip CAD/CAM malzemeleri geliştirilmiştir.

Sonuç
Bu derlemede geçmişten günümüze bilgisayar destekli diş hekimliği ve hastabaşında CEREC Sistem kullanılarak dizayn edilen CAD/CAM restorasyonlar için kullanılan materyaller özetlenmektedir.

Anahtar Kelimeler: *CAD/CAM, CAD/CAM materyalleri, cam seramik, CEREC, hasta başında, metal desteksiz, optik ölçü, rezin nanoseramik*

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INTRODUCTION

The new developments in digital computer technology led to research into related applications in the world of dentistry. The goal was to allow clinicians to design, produce and apply individual restorations directly at the point of treatment (chairside) in a single appointment.[1] Based on this goal, various systems were introduced.

The Cerec System was introduced by Drs Mörmann and Brandestini to make one visit restorations in dental clinics in 1988.[2] In this system, an optical impression of a cavity preparation is taken with a small optoelectronic videocamera and subsequently saved. The digital 3-dimensional (3D) data is transmitted to a computer and the clinician interactively designs the restoration on the screen which is called computer-aided design (CAD). These datas are used for the milling of an industrially prefabricated block with a special diamond-coated disk incorporated into a 3-axis milling unit which is called computer-aided machining (CAM).[3]

CEREC 1 had enabled the scanned images of 2 dimensional view and with this system only inlay resrorations could be milled. The developments of software and hardware programs of computer systems have led to 3 dimensional (3D) design.[4] CEREC 3D System has increased the various types of restoration production. Inlays, onlays, crowns, laminates and three unit bridges also implant abutments can be milled from CAD/CAM blocks.[5]

CAD/CAM Systems based on the production method can be divided into three different groups:[6]

1. Chairside System: The clinican scans the prepared tooth intraorally, creates restorations

chairside and then seats it within a single appointment (Figure 1).

2. Laboratory System: Laboratories scan models made from physical impressions and use CAD/CAM to produce restorations (Figure 2).

3. Centralized Production: The clinician takes the digital impressions and then sent datas via the internet to the laboratory.[4]

Figure 1. Chairside System: Planmeca E4D Technologies

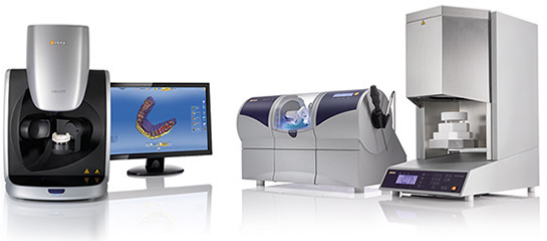

Figure 2. Laboratory System: Sirona Cerec inLab

Chairside CEREC CAD/CAM Materials

CEREC or Cerec means; Chairside Economical Restoration of Esthetic Ceramics or CEramic REConstruction.[7] According to this description, this system is mainly based on chairside treatment which is very comfortable to the clinican and the patient completing the process in a single appointment.

Vita™ Mark I

In 1985 CAD/CAM ceramic blocks were firstly introduced to dental markets as Cad/Cam restorative materials (Vita™ Mark I, Vita Zahnfabrik, Bad Sackingen, Germany). These blocks were comprised of fine grain feldspathic ceramic with a flexural strength ~120 MPa that were used for inlay, onlay and veneer restorations.[8]

Vita™ Mark II

In 1991, Vita™ Mark II (Vita Zahnfabrik, Bad Sackingen, Germany) improved ceramic blocks were developed (Figure 3).[8] They exhibited better mechanical properties than Vita ™ Mark I with a reported flexural strength from 100 MPa to 160 MPa when glazed.[9] Vita™ Mark II was considered suitable for the fabrication of inlays, onlays, monolithic anterior crowns and veneers.[10]

Vitablocs Mark II was approved of the oldest-marketed chairside CAD/CAM material by the clinical studies.[11] A review of 29 clinical studies have stated that the fracture of the ceramic restoration was found to be the primary mode of failure while the tooth fracture, wear of the cement, and postoperative sensitivity were indicated as less common failures after CAD/CAM restorations.[12] In 2012 Beier et all. have evaluated the clinical performance of 547 glass ceramic inlay/onlay restorations on the posterior teeth of 120 patients and reported 12-year survival rate as 89.6% for the inlay restorations.[13]

Figure 3. Cad/Cam Blocks VitaBlocs

ProCAD

In 1998, ProCAD (Ivoclar-Vivadent, Schaan, Liectenstein), the first leucite-reinforced glass-ceramic CAD/CAM blocks were introduced to be used with Cerec System. Nine popular shades with either a high translucency (HT) or low translucency (LT) version were avalible for ProcCAD blocks. When the structure of this material examined, it was found to be smilar to the heat pressed ceramic Empress™ (Ivoclar Vivadent).[14]

EmpressCAD

In 2006, EmpressCAD material which was superior to Empress Procad was introduced

to the dentists. EmpressCAD has 45% leucite with particle size about 1-5µm that helps resistance to the machining damages. EmpressCAD was recomended for single tooth restoration due to the flexural strength of ~ 160 MPa. It had three forms: polychromatic, high and low translucency.[15]

VITABLOCS

VITABLOCS are fine-structure feldspatic ceramic blocks used for producing inlays, onlays, veneers and crowns with CEREC. VITABLOCS had improved Mark II ceramic blocks and then produced VITABLOCS TriLuxe in 2003. In 2007 VITABLOCS TriLuxe forte had been available on the market. And finally VITABLOCS RealLife was introduced in 2010 (Figure 3).[16]

CEREC Blocks

CEREC blocks are fine-structured feldspathic ceramics manufactured by Sirona (Figure 4). CEREC Blocs are indicated for the CEREC/ inLab CAD/CAM production of inlays, onlays, overlays, partial crowns, full crowns and endocrowns.

There are two types of CEREC Blocks. One is CEREC Bloc C in monocolor that is highly translucent and especially used in the production of inlays and partial crowns. The other one is CEREC Bloc C PC (polychromatic) which is particularly suitable for producing crowns for the posterior teeth.[17]

In 2013 Vichi et. all tested eight types of cerec cad cam materials which were on the market and they compared the mean flexural strength of these materials: Paradigm C, IPS Empress CAD LT, IPS Empress CAD Multi, Cerec Blocs, Cerec Blocs PC, Triluxe, Triluxe Forte, Mark II. As a result of the study, they stated that IPS Empress CAD had higher mean flexural strength than Cerec Blocs and Cerec Blocs PC. All the materials tested in this study had a flexural strength more than 100 MPa. which is an ISO standard for the clinical indications of these materials.[18]

Figure 4. Cad/Cam Blocks Sirona Cerec Blocks

IPS e.max

IPS e.max CAD (Ivoclar Vivadent) is a lithium disilicate glass-ceramic for CAD/ CAM applications (Figure 5). Lithium disilicate has flexural strength between 350-450 MPa which is higher than lecuite-reinforced dental ceramics.[19]

In 2015 Albero et. all investigated the mechanical properties of Polymer-Infiltrated-Ceramic-Network (Vita Enamic) and compared its performance with other materials used for Cerec chairside system. Polymer-infiltrated ceramic (Vita Enamic), Nano-ceramic resin (Lava Ultimate), Feldspathic ceramic (Mark II), Lithium disilicate ceramic (IPS-e max CAD) and Leucite based ceramic (Empress - CAD) test blocks were investigated according to the flexural strength, fracture stress and hardness of each material. IPS-e max CAD's strain at failure, flexural strength and hardness exhibited significantly higher values compared to others materials. [20]

Figure 5. Cad/Cam Blocks IPS e.max CAD

Paradigm MZ100

In 2000, 3M ESPE introduced a resin based composite (85% zirconia-silica ceramic by weight) called Paradigm MZ100 which was an aesthetic material with improved physical properties and clinical performance. The indications of this material were veneers, crowns, inlays and onlays.[21,22]

Paradigm C

In 2006 a new material, Paradigm C, introduced by 3M ESPE that was a glass ceramic block made out of a two phase leucite-reinforced ceramic. The indications of this material were the same like Paradigm MZ100. Pradigm C has six different shades.[21]

Vita™ Enamic

ENAMIC (VITA Zahnfabrik, Bad Sackingen, Germany) is a newly developed hybrid material that combines ceramic with composite materials properties. The hybrid material is defined as, the dominant fine-structure ceramic network strenthened by a polymer network, according to the manufacturer.[23] PICN (Polymer-Infiltrated-Ceramic-Network) consist of, 75% of its volume feldspathic ceramic (86% ceramic by weight) and 25% polymer.[24] The pores in the structure-sintered ceramic matrix are filled with a polymer material. This hybrid combination increases the fracture strength, flexural strength and elastic properties of the material compared to traditional ceramics.[8,21,24]

He and Swain stated that the hardness and elastic modulus of enamic were very similar to human tooth structure values (natural dentin and enamel) which makes this material a good choice for inlay restorations in the posterior region.[25,26,27]

Lava Ultimate

Lava Ultimate is called as a resin nanoceramic (Figure 6). The composition of this material is composite resin (BisGMA, UDMA, BisEMA, TEGDMA) with 80 wt % silica and zirconia nanoparticles and zirconia/ silica nanoclusters.[28] The indications of Lava Ultimate are; veneers, crowns, inlays and onlays. This novel material can be repaired both intraorally and extraorally.[21]

In 2015, El-Damanhoury HM et. all, tested three endocrowns produced from different types of materials; feldspatic porcelain (CEREC Blocks, Sirona Dental Systems GmbH, Bensheim, Germany), lithium disilicate (e-max, Ivoclor Vivadent, Schaan, Liechtenstein) and resin nanoceramic (Lava Ultimate, 3M ESPE, St Paul, MN, USA); according to the marginal leakage and fracture resistance. As a result, although resin nanoceramic endocrowns showed better fracture resistance than the other investigated ceramic blocks, more microleakage had been observed with this material.[29]

Figure 6. Cad/Cam Blocks 3M Lava Ultimate

Cerasmart

Cerasmart is a force absorbing, flexible nano ceramic CAD/CAM Block (Figure 7). It has natural opalescence and florescence. Koizumi et. all evaluated surface roughness and gloss of current CAD/CAM resin composites before and after toothbrush and stated that the Ra and Rz **of** Cerasmart **and** Shofu Block were significantly higher than the ceramic block.[30]

Figure 7. Cad/Cam Blocks GC Cerasmart

Suprinity

Suprinity (VITA Zahnfabrik, Bad Sackingen Germany) is a CAD/CAM glass-ceramic material which is reinforced with zirconia. Suprinity has a fine-grained and homogeneous structure with 10% weight of zirconia. It has a flexural strength 420MPa Vita Suprinity has superior aesthetic properties with excellent translucency.[21]

CONCLUSIONS

Improvements in CAD/CAM technology have facilitate the developments of all restorations with superior mechanical properties and aesthehtics. This technology is effective, time saving and can be applied successfully in clinical practice. The digital impression, the design software and the milling procedure in the same clinic allow to produce restorations in a single visit. Although the material selection is still related to the type of the restoration, the way of designing the restorations made with chairside CAD/CAM device is preferred by most of the clinicians in recent years.

REFERENCES

[1] Otto T, Schneider D. Long-term clinical results of chairside Cerec CAD/CAM inlays and onlays: a case series. Int J Prosthodont. 2008; 21(1):53-9.

[2] Liu PR. A panorama of dental CAD/CAM restorative systems. Compend Contin Educ Dent. 2005; 26(7):507-27.

[3] Mörmann WH, Brandestini M, Lutz F, Barbakow F. Chairside computer-aided direct ceramic inlays. Quintessence Int. 1989; 20(5):329-39.

[4] Mörmann WH. The origin of the Cerec method: a personal review of the first 5 years. Int J Comput Dent. 2004; 7(1):11-24.

[5] Mörmann WH. The evolution of the CEREC system. J Am Dent Assoc. 2006; 137 Suppl: 7-13.

[6] Mörmann W, Krejci I. Computer-designed inlays after 5 years in situ: clinical performance and scanning electron microscopic evaluation. Quintessence Int. 1992; 23(2):109-15.

[7] Mörmann W, Brandestini M, Ferru A, Lutz F, Krejci I. Marginal adaptation of adhesive porcelain inlays in vitro. Schweiz Monatsschr Zahnmed, 1985; 95(12):1118-29.

[8] Lauvahutanon S, Takahashi H, Shiozawa M, Iwasaki N, Asakawa Y, Oki M, Finger WJ, Arksornnukit M. Mechanical properties of composite resin blocks for CAD/CAM. Dent Mater J. 2014; 33(5):705-10.

[9] Bindl A, Lüthy H, Mörmann WH. Fracture load of CAD/CAM-generated slot-inlay FPDs. Int J Prosthodont. 2003; 16(6):653-60.

[10] Fradeani M, Redemagni M, Corrado M. Porcelain laminate veneers: 6- to 12- year clinical evaluation--a retrospective study. Int J Periodontics Restorative Dent. 2005; 25(1):9-17.

[11] Fasbinder DJ. Clinical performance of chairside CAD/CAM restorations. J Am Dent Assoc. 2006; 137 Suppl: 22S-31S.

[12] Martin N, Jedynakiewicz NM. Clinical performance of CEREC ceramic inlays: a systematic review. Dent Mater. 1999; 15(1):54-61.

[13] Beier US, Kapferer I, Burtscher D, Giesinger JM, Dumfahrt H. Clinical performance of all-ceramic inlay and onlay restorations in posterior teeth. Int J Prosthodont. 2012; 25(4):395-402.

[14] Li RW, Chow TW, Matinlinna JP. Ceramic dental biomaterials and CAD/CAM technology: state of the art. J Prosthodont Res. 2014; 58(4):208-16.

[15] Giordano R, McLaren EA. Ceramics overview: classification by microstructure and processing methods. Compend Contin Educ Dent. 2010; 31(9):682-700.

[16] VITABLOCS® Working Instructions. Spitalgasse 3 D-79713 Bad Säckingen Germany. Retrieved February 09, 2016, from http://vitanorthamerica.com/wp-content/uploads/2012/06/VITABLOCS-Working-Instructions_1769E.pdf

[17] New for CEREC: CEREC Blocs and CEREC Blocs PC in VITA Classical colors. Sirona - The Dental Company. Salzburg. Retrieved February 09, 2016, from http://www.sirona.com/en/news-events/news-press/corporate-news-detail/32754.

[18] Vichi A ,Sedda M, Del Siena F, Louca C, Ferrari M. Flexural resistance of Cerec CAD/CAM system ceramic blocks. Part 1: Chairside materials. Am J Dent. 2013; 26(5):255-59.

[19] IPS e.max CAD Scientific Documentation IPS e.max. Lichtenstein. Retrieved February 02, 2016, from http://www.ivoclarvivadent.us/emaxchangeseverything/ system/index.php.

[20] Albero A, Pascual A ,Camps I, María Grau-Benitez. Comparative characterization of a novel cad-cam polymer-infiltrated-ceramic-network. J Clin Exp Dent. 2015; 7(4):495-500.

[21] Sannino G, Germano F, Arcuri L, Bigelli E, Arcuri C, Barlattani A. CEREC CAD/CAM Chairside System. Oral Implantol (Rome). 2015; 7(3):57-70.

[22] Awada A, Nathanson D. Mechanical properties of resin-ceramic CAD/CAM restorative materials. J Prosthet Dent. 2015; 114(4):587-93.

[23] Coldea A, Swain MV, Thiel N. Mechanical properties of polymer-infiltrated-ceramic-network materials. Dent Mater. 2013; 29(4):419-26.

[24] Coldea A, Swain MV, Thiel N. In-vitro strength degradation of dental ceramics and novel PICN material by sharp indentation. J Mech Behav Biomed Mater. 2013; 26:34-42.

[25] He LH, Swain M. A novel polymer infiltrated ceramic dental material. Dent Mater. 2011; 27(6):527-34.

[26] He L, Purton D, Swain M. A novel polymer infiltrated ceramic for dental simulation. J Mater Sci Mater Med. 2011;22: 1639-43.

[27] Bottino MA, Campos F, Ramos NC, Rippe MP, Valandro LF, Melo RM. Inlays made from a hybrid material: adaptation and bond strengths. Oper Dent. 2015; 40(3):83-91.

[28] Stawarczyk B, Liebermann A, Eichberger M, Güth JF. Evaluation of mechanical and optical behavior of current esthetic dental restorative CAD/CAM composites. J Mech Behav Biomed Mater. 2015; 55:1-11.

[29] El-Damanhoury HM, Haj-Ali RN, Platt JA. Fracture resistance and microleakage of endocrowns utilizing three CAD-CAM blocks. Oper Dent 2015; 40 (2):201-10.

[30] Koizumi H, Saiki O, Nogawa H, Hiraba H, Okazaki T, Matsumura H. Surface roughness and gloss of current CAD/CAM resin composites before and after toothbrush abrasion. Dent Mater J. 2015; 34(6):881-7.

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NANOCERAMICS AND HYBRID MATERIALS USED IN CAD/CAM SYSTEMS

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ABSTRACT

CAD/CAM systems are widely popular in contemporary procedures. There are many products and materials to use with different cases and indications in the market. In the current study, most current materials, mainly nanoceramics and hybrid ceramics are investigated, their advantages and disadvantages are evaluated, and the current products in the market are listed.

Keywords: CAD/CAM, nanoceramics, hybrid.

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ÖZET

CAD/CAM sistemleri günümüzde yaygın olarak kullanılmaktadır. Farklı endikasyonlara uygun restoratif çözümler için birçok malzeme bu sistemlerle kullanılmak üzere piyasada mevcuttur. Bu derlemede, en güncel malzemeler olan nanoseramikler ve hibrid malzemeler incelenmekte, mekanik özellikleri, avantajları ve dezavantajları değerlendirilmekte ve piyasada mevcut ürünler belirtilmektedir.

Anahtar kelimeler: CAD/CAM, nanoseramik, hibrid

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INTRODUCTION

Currently, various restorative materials are used with CAD/CAM systems. Glass ceramics are often preferred especially in anterior restorations according to their high aesthetic characteristics.[2, 11-14, 19] The mechanical properties of glass-ceramics can be improved using different methods.[27, 33-35] Furthermore, alternative materials that have proper characteristics of ceramics are also improved. Nanoceramics and hybrid ceramics were developed to combine the favorable properties of ceramics and composites. The aim of this review is to give information about newly developed nanoceramic and ceramic hybrid materials used with CAD/CAM systems.

Nanoceramics (Resin nanoceramics)

Recently, silica based ceramics are frequently used with CAD/CAM systems in consequence of their unique aesthetic properties. Feldspathic ceramics and leucite reinforced glass ceramics has not only high esthetical properties but also low fatigue resistance.[4, 22] Due to the poor mechanical characteristics of glass ceramics, composite-based restorative materials are preferred instead.[15, 17] Composite-based restorative materials' elastic modulus value is close to tooth and they both have similar occlusal force absorption capacity. However, composite material undergoes more surface wear due to the inadequate hardness, for this reason the surface polish has not last longer.[12, 16] Therefore, favorable properties of composites and ceramics were integrated using nanotechnology and developments in the production of new dental restorative materials shows remarkable progress (Figure 1).

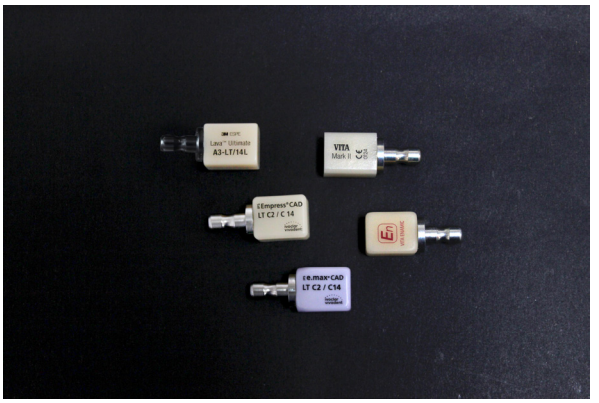

Figure 1: CAD/CAM block samples: LAVA Ultimate (Nanoseramic), Vita Mark II (Feldspathic ceramic), IPS Empress CAD(leucite reinforced), Vita Enamic (ceramic-composite hybrid) ve IPS e.max CAD(lithium disilicate).

The science of controlling matter on the atomic and molecular level is named as nanotechnology. Particle size of the materials and chemical properties can be changed by nanotechnology.[28] The chemical reactivity of the material increases whenever the particle size of materials reduced to nanoscale dimensions.[7]

Nanoceramics are comprised of nano-sized ceramic particles, Bis-GMA, UDMA, Bis-EMA and TEGDMA containing resin matrix. The structure of the matrix consists of 20 nm in diameter silica nanomers and 4-11nm in diameter zirconia nanomers. Silane molecule joined in the structure during production of the blocks and provides the formation of chemical bonds between the resin matrix and the nano-structure.[15]

Silane is a bifunctional molecule and capable of forming chemical bonds between the organic (resin based materials) and

inorganic (ceramic and oxidized metal alloys) materials.[25, 26] Constituent particle of the silane molecule is 3-methacryloxy propyl-trimetoksisilan. Silane molecule contains two different chemical structures including methacrylate and methoxy groups. While methacrylate group is connecting organic matrix of the resin structure, methoxy group forms a chemical bond with the ceramic structure.[1]

Nanoceramics are composed of 80% ceramics and 20% resin materials. It is stated that, a high proportion of nanoparticles embedded in resin matrix enables the material abrasion and fracture resistant. Nano-sized structure of the ceramics also strengthens chemical bonds formed between inorganic ceramics and organic resin matrix. The dimensions of nanoparticles are ranged between 0.6-1 micrometers.[24]

The modulus of elasticity is defined as the measure of elastic deformation of the material under stress. The elastic moduli of restorative materials used in dentistry have to be compatible with elastic modulus of tooth. This compatibility has a positive impact on the long-term success of the restorations.[3, 21]

It is stated that, concordant elastic modulus value of tissues and nanoceramics prevents material from fractures and provides long-term of success in high rates. The minimum thickness of the nanoceramic restorations has to be at least 1mm in order to exhibit sufficient fracture resistance against occlusal forces.[6, 15] However, hardness value of nanoceramics is compatible with tooth, for this reason, the amount of wear on the opposing teeth formed quite low. Additionally, ceramic material in the structure provides high color stability when compared to the composite materials. Simple surface finishing process and long-term survive of polished surfaces were reported as a major advantage of nanoceramic materials.[5, 30]

Recent developments in the field of dental technology enable treatment of edentulous regions with dental implants. Dental implants have proper features like, giving any damage to adjacent tissues, increasing the chewing efficiency, fulfilling the esthetic and phonation. However, one of the most important disadvantages of the implants is inability to form periodontal ligament.[18] Periodontal ligaments are located between the root surface and alveolar bone; and ligaments absorb chewing forces, and distribute them to the alveolar bone.[42] Therefore, choosing force-absorbing featured restorative materials in the production of implant prosthesis is very important.[29] It was stated that the force-absorption capacity of the nanoceramics was higher than traditional ceramics used in the fabrication of implant prosthesis.[24]

Lava Ultimate (3M ESPE, USA) is in the group of nanoceramics and used in conjunction with CAD/CAM systems. As a reason of the strong chemical bonds formed between nanoceramic structure and resin, the material has high fracture strength. Besides, flexural strength of the material is 200 MPa. Lauvahutanon and et al. reported the elastic moduli of Lava Ultimate as 29.8 GPa and stated that this value is very close to the dentin.[23] For this reason, it was thought that force-absorbing property of the material is high enough and this allows fabrication of posterior nanoceramic restorations.[24, 29]

Inlay, onlay, laminate veneers and crown restorations can be manufactured with Lava Ultimate blocks. Adhesive bonding systems

are recommended in the cementation of restorations that fabricated with this system. In contrast to conventional adhesive cementation technique the inner surface of the restoration that fabricated with this system does not require hydrochloric acid etching. Sand blasting technique is more proper to roughen the inner surface of the restorations.[6, 24]

Lava Ultimate has high translucent (HT) and low translucent (LT) blocks, and each block has 8 different shades (A1, A2, A3, A3.5, B1, C2, D2 and Bleach). In order to produce larger restorations in 14 L-size blocks are also available.[24]

Hybrid ceramics (Polymer infiltrated glass-ceramics)

Materials consisting of two penetrated phases have higher flexural strength when compared to the single-phase materials.[32, 37, 39] Hybrid ceramics was developed according to this this idea. Hybrid ceramics are formed by a combination of inorganic and organic components. Inorganic and organic structures were consisting of ceramics and polymers, respectively.

Composite materials contain inorganic filler particles and organic matrix. However, unlike composites, inorganic filler particles and organic matrix penetrated to each other in hybrid ceramics. For this reason, the mechanical property of the material was improved. A crack occurred in the ceramic phase could be prevented by the polymer structure of the material. Chemical structures of the hybrid ceramics provide occlusal forces to spread from contact points to a wide area and reduce the stress. The occlusal load-compensation capacity of hybrid ceramic is higher than traditional ceramics.[8, 9, 10]

Hybrid ceramics contains 86% of ceramics and 14% of polymer. Ceramic structure includes, 58-63% SiO_2, 20-23% Al_2O_3, 9-11% Na_2O, 4-6% K_2O, 0.5-2% B_2O_3 and less than 1% ZrO2 and CaO. Resin structure was composed of urethane dimethacrylate (UDMA) and triethylene glycol dimethacrylate (EGDMA).[40]

Primarily, the pre-sintered porous structured feldspathic ceramics are produced. Changing size of the ceramic particles and firing temperature affects the porosity of the ceramic structure. In the second stage, porous ceramic structure is filled with resin. Prior to the infiltration of the resin structure into the ceramic structure silane is added as a bonding agent. The chemical bond between polymer structure and ceramic structure is occurred due to the silane.

Vita Enamic (VITA Zahnfabrik, Germany) is placed in the hybrid ceramics group and flexural strength, elastic modulus and stiffness (hardness) of the material is, 150-160 MPa, 30 GPa and 2.5 GPa, respectively.[40] Elastic modulus value of Vita Enamic is 30 GPa and material exhibits similar elastic properties like teeth.[9, 40]

Hardness value of hybrid ceramics were lower than silica-based ceramics, therefore hybrid ceramics cause less wear than traditional ceramics. Moreover, due to the low hardness of the hybrid ceramics, the amount of material lost by wear over time is more than traditional ceramics.[8, 30, 31]

Vita Enamic allows producing inlays, onlays, laminate veneers, crowns and anterior-posterior restorations. The material has high translucent (HT) and low translucent (T) blocks and for all groups totally 10 shade (OM1, 1M1, 1M2, 2M2 and 3M2)

options are available. In the production of laminate veneers and anterior restorations HT blocks are recommended, however, in the restorations of discolored teeth T blocks are recommended. Additionally, 14L sized blocks are also available for larger restorations.

The restorations obtained from Vita Enamic block must be cemented with adhesive bonding systems. In contrary to nanoceramics, the inside of the hybrid ceramic restorations are etched with hydrofluoric acid in the concentration of 5% applied on the surface for 5 minutes.[38, 40]

Zirconia reinforced lithium disilicate ceramics

Currently, widespread use of the CAD/CAM systems leads up various materials with improved mechanical and aesthetic properties. Lithium disilicate reinforced glass ceramic blocks were the first blocks used in CAD/CAM systems and recently, lithium disilicate reinforced glass ceramics were used as a basis to develop zirconia infiltrated lithium disilicate ceramic blocks. Ceramic structure is composed of, 56-64% SiO_2, 15-21% Li_2O, 1-4% K_2O, 3-8% P_2O_5, 1-4% Al_2O_3, and 8-12% ZrO_2 materials.

Zirconia reinforced lithium disilicate ceramics allow the manufacture of inlays, onlays, crowns, partial crowns and laminate veneers. Additionally, more esthetic restorations can be obtained with cut back technique.

Vita and Dentsply, introduced zirconia reinforced lithium disilicate glass ceramic blocks in 2013. The brand name of zirconia reinforced lithium disilicate glass ceramic block of Vita is Vita Suprinity (Figure 2).

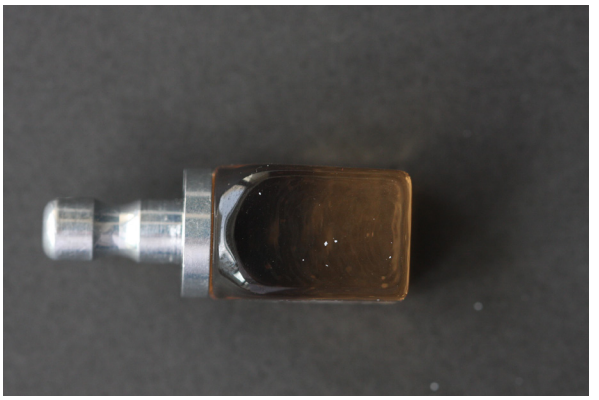

Figure 2: Vita Suprinity block.

The material has translucent (T) and high translucent (HT) blocks.[41, 43] The brand name of zirconia reinforced lithium disilicate glass ceramic block of Dentsply is Celtra CAD. The material has low translucent (LT) and high translucent (HT) blocks.

CONCLUSIONS

Nanoceramics and ceramic-composite hybrids are recently introduced in prosthetic and restorative dentistry, and these materials have a potential success in clinical use.

In-vivo and in-vitro studies evaluating clinical use of lithium disilicate ceramics and leucite-reinforced ceramics are in progress.

REFERENCES

[1] Akgüngör N. Lityum Disilikat esaslı press-seramik sistemlerinin farklı kalınlıkları ve farklı polimerizasyon yöntemleri kullanıldığında dentine bağlantı etkisinin incelenmesi. Doktora bitirme tezi 2009; 24-25.

[2] Albakry M, Guazzato M, Swain MV. Biaxial flexural strength and microstructure changes of two recycled pressable glass ceramics. J Prosthodont. 2004; 13: 141-149.

[3] Alshehri SA. An investigation into the role of core porcelain thickness and lamination in determining the flexural strength of in ceram dental materials. J Prosthodont. 2011; 20: 261-6.

[4] Anusavice KJ. Phillips RW. Phillips' Science of Dental Materials 2003 11th ed. St. Louis: W.B. Saunders, 486-467, 657-704.

[5] Carvalho AO, Bruzi G, Maia HP, Giannini M, Magne P. Fatigue resistance of CAD/CAM fabricated full-coverage crowns. Dent Mater. 2012; 28: 65-66.

[6] Chen C, Trindaed FZ, Jagger N, Kleverlaan CJ, Felizer AJ. The fracture resistence of a CAD/CAM resin nano ceramic (RNC) and a CAD ceramic at different thicknesses. Dent Mater. 2013; 30: 54-62.

[7] Çıracı S, Süzer Ş, Bengü E, Gürsel İ, Dana A. Bilim ve Teknik Aylık Popüler Bilim Dergisi Sayısı 2006 Aralık: 2-14.

[8] Coldea A, Swain MV, Thiel N. In vitro strength degredation of dental ceramics and novel PICN material by sharp indentation. J Mech Behav Biomed Mater. 2013; 26: 34-42.

[9] Coldea A, Swain MV, Thiel N. Mechanical properties of polymer-infiltrated-ceramic-network materials. Dent Mater. 2013; 29: 419-426.

[10] Coldea A., Swain M.V., Thiel N.. Hertzian contact responser and damage tolerance of dental ceramics. J Mech Behav Biomed Mater. 2014; 34**:** 124-133.

[11] Fasbinder DJ. Materials for chairside CAD/CAM restorations. Compend Contin Educ Dent. 2010; 31: 702-4,706,708-9.

[12] Fasbinder DJ. Chairside CAD/ CAM: an overview of restorative material options. Compend Contin Educ Dent. 2012; 33: 52-58.

[13] Giordano R. Materials for chairside CAD/CAM-produced restorations. J Am Dent Assoc. 2006; 137: 14-21.

[14] Guess PC, Zavanelli RA, Silva NRFA, Bonfante EA, Coelho PG, Thompson VP. Monolithic CAD/CAM lithium disilicate versus veneered Y-TZP crowns: a comparison of failure modes and reliability after fatigue. Int J Prosthodont. 2010; 23: 434-442.

[15] Guth JF, Zuch T, Zwinge S, Engels J, Stimmelmayr M, Edelhoff D. Optical properties of manually and CAD/ CAM fabricated polymers. Dent Mater. 2013; 32: 865-871.

[16] Höland W, Rheinberger V, Apel E, Hoen C, Höland M, Dommann A, Obrecht M, Mauth C, Graf-Hausner U. Clinical applications of glass ceramics in dentistry. J Mater Sci Mater Med. 2006; 17:1037-42.

[17] Höland W, Rheinberger V, Schweiger M. Control of nucleation in glass ceramics. Phil Trans R Soc Lond A 2003; 361: 575-89.

[18] Huang Y, Jacobs R, Van Dessel J, Bornstein MM, Lambrichts I, Politis C. A systematic review on the innervation of peri-implant tissues with special emphasis on the influence of implant placement and loading protocols. Clin Oral Implants Res. 2014; 6: doi: 10.1111/clr.12344.

[19] Ivoclar Vivadent IPS e.max Lithium Disilicate: The future of all- ceramic dentistry- materials science, practical applications, keys to success. Amherst, N.Y. Ivoclar Vivadent 2009; 1-5.

[20] Kelly JR, Tesk JA, Sorensen JA. Failure of All-ceramic Fixed Partial Dentures in vitro and in vivo: Analysis and Modeling. J Dent Res. 1995; 7: 1253-1256.

[21] Kinney JH, Marshall SJ, Marshall GW. The mechanical properties of human dentin: a critical rewiev and re-evaluation of the dental literature. Crit Rev Oral Biol Med. 2003; 14: 13-29.

[22] Kontanasaki E, Kantiranis N, Papadopoulou L, Chatzistavrou X, Kavouras P, Zorba T, Sivropoulou A, Chrissafis K, Paraskevopoulos KM, Koidis PT. Microstructural characterization and comparative evaluation of physical, mechanical and biological properties of three ceramics for metal ceramic restorations. Dent Mater. 2008; 24:1362-1373.

[23] Lauvahutanon S, Takahashi H, Shiozawa M,

Iwasaki N, Asakawa Y, Oki M, Finger WJ, Arksonnukit M. Mechanical properties resin blocks for CAD/CAM. Dent Mater J. 2014; 33: 705-10.

[24] Lava Ultimate Restorative Brochure, 2011

[25] Matinlinna JP, Lassila LV, Özcan M, Yli-Urpo A, Vallittu PK. An introduction to silanes and their clinical applications in dentistry. Int J Prosthodont. 2004; 17:155-64.

[26] Matinlinna JP, Vallittu PK. Silan based consepts on bonding resin composite to metals. J Contemp Dent Pract. 2004; 8: 1-8.

[27] Mehulic K. Glas Ceramics. Acta Stomatol Croat. 2005; 39: 477-86.

[28] Melo MAS, Guedes SFF, Xu HHK, Rodrigues LKA. Nanotechnology- based restorative materials for dental caries management. Trends Biotechnol. 2013, 31: 459-467.

[29] Mihali S, Bortun C, Bratu E. Nano-ceramic Particle Reinforced Composite- Lava Ultimate CAD/CAM Restorative. Rev Chim. 2013; 64: 435-437.

[30] Mörmann WH. Stawarczyk B, Ender A, Sener B, Attin T, Mehl A. Wear characteristics of current aesthetic dental restorative CAD/ CAM materials: Two- body wear, gloss retantion, roughness and Martens hardness. J Mech Behav Biomed Mater. 2013, 20: 113-125.

[31] Nguyen JF, Ruse D, Phan AC, Sadoun MJ. High- temperature- pressure polymerized resin-infiltrated ceramic networks. J Dent Res. 2014; 93: 62-67.

[32] Prielipp H, Knechtel M, Claussen N, Streiffer SK, Müllejans H, Rühle M, Rödel J. Strength and fracture toughness of aluminum/alumina composites with interpenetrating networks. Mat Sci Eng A. 1995; 197: 19–30.

[33] Reich S, Hornberger H. The effect of multicoloured machinable ceramics on the esthetics of all-ceramic crowns. J Prosthet Dent. 2002; 88: 44–49.

[34] Russell G. Materials for chairside CAD/CAM –produced restorations. J Am Dent Assoc. 2006; 137: 12-2.

[35] Schweiger M, Frank M, Cramer von Clausbruch S, Höland W, Rheinberger V. Microstructure and properties of pressed glass-ceramic core to zirconia post. Quintessence Dent Technol. 1998; 21: 73-79.

[36] Scientific Documentation: IPS e.max Press, Research and Development Scientific Service 2005; Ivoclar.

[37] Travitzky NA, Shlayen A. Microstructure and mechanical properties of Al_2O_3/Cu-O composites fabricated by pressureless infiltration technique. Mat Sci Eng A. 1998; 244: 154–60.

[38] Tinschert J, Zwez D, Marx R, Anusavice KJ. Structural reliability of alumina-, feldspar-, leucite-, mica-,and zirconia-based ceramics. J Dent. 2000; 27: 529 -535.

[39] Wegner LD, Gibson LJ. The fracture toughness behaviour of interpenetrating phase composites. Int J Mech Sci. 2001; 43: 1771–91.

[40] Vita Enamic Technical and Scientific Documentatiton, 2013.

[41] Vita Suprinity, Technical and Scientific Documentation, 2013.

[42] Yoshida N, Koga Y, Peng CL, Tanaka E, Kobayashi K. In vivo measurement of elasticlic modulus of the human periodontal ligament. Med Eng Phys. 2001; 23: 567-572.

[43] Zimmermann M, Mehl A, Reich S. New CAD/ CAM Materials and Blocks for Chairside Procedures. Int J Comput Dent. 2013; 16: 173-81.

ABOUT THE JOURNAL

The Aydın Dental Journal is the scholarly publication of the İstanbul Aydın University, Dental School. The Journal is distributed on a twice a year basis. The Aydın Dental Journal is peer-reviewed in the area of dentistry and is published in English language; however, authors are requested to provide their **abstracts** in **both English** and **Turkish**. Language support for Turkish translation is given to those abstracts received in English and accepted for publication. The content of the Journal covers all aspects of dentistry including but not limited to epidemiology and oral health, oral and maxillofacial surgery, implantology, oral diseases, periodontology, restorative dentistry, endodontics, prosthodontics, geriatric dentistry, pediatric dentistry, orthodontics, maxillofacial imaging, and dental education. The Journal aims to meet the needs of the general practitioners, specialists, academicians, and research scholars of Oral Health Care Sciences and Practices as well as undergraduate and postgraduate dental students. The Aydın Dental Journal offers a wide spectrum of publication including

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- Letter to the Editor
- Reviews that comprehensively and systematically covers a specific aspect of dentistry under debate

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Manuscripts may be submitted through electronic manuscript submission system or dentaydinjournal@aydin.edu.tr for evaluation and publication. A cover letter with a statement of responsibility detailing what each author contributed to the manuscript should accompany the manuscript. An electronic mail will be sent to the corresponding author confirming receipt of the manuscript.

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Submissions to Aydın Dental Journal are rigorously refereed using a double-blind peer review process; authors and reviewers are anonymous to each other. Within a period of eight to ten weeks, the contributors will be informed about the reviewers' comments together with the decision of the editor about the manuscript as acceptance, minor revisions, major revisions or rejection.

Authors submitting manuscripts for publication in Aydın Dental Journal warrant that their manuscripts are the work solely of the author(s) stated, that they have not been previously published elsewhere nor are currently under consideration by any other publication and that the material contained within the work is not subject to any other copyright, unless required consents have been obtained.

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Research Articles presenting ethical, original, well-documented research with valid findings that add value to the existing evidence, and with implications in clinical practice are given preference.

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Reviews must include recent research and summarize important concepts. Use of diagrams, flow charts, tables and figures to enhance clarity rather than using block bulk of written information is encouraged.

Opinions should represent concise opinion pieces that address various topics of relevance to dental practice. These topics may highlight controversial opinions, or issues within the field. These topics may also include public health care, patient safety, or surgical trends, government actions, and commentaries on specific article or editorial that has been published by the Aydın Dental Journal.

Manuscript format
In preparation of their texts, the authors must pay attention to the points listed below:

Manuscripts should be prepared in A4 format with margins of 3cm from all the four sides. Pages must be numbered consecutively throughout the document. The entire manuscript should be typed in Times New Romans, 12 point font and half-spaced. Headings and subheadings should be typed in bold faced letters without a colon, or any other mark at the end. Headings should be typed in capitals while subheadings should be typed in lower-case, capitalize the first letter. Type all text justified margin. A blank line between paragraphs, between headings and text, and between references should be inserted, no indentation. The preferred submission format is Microsoft Word.

Manuscript sections
Order of manuscript should follow as Title Page; Abstract and Key Words (for Research Articles and Reviews); Main Text; Conflict of Interest; Acknowledgements (optional); References; Appendix/Appendices (optional); Tables; Figure Legends and should be combined into a single Word document.

Title Page: Each manuscript should have a title page providing the article title (in capital and bold faced letters and no more than 12 words); full names of each author with degrees, professional title; authors' institutional affiliations including city and country; name, address, telephone, fax and email address of the author responsible for correspondence.

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Key words (3-10 words) highlighting the article's most important topics should be listed afterwards.

Main Text:
Research Article should be presented in the order of Introduction, Methods, Results, and Discussion sections. The main text of manuscripts submitted as Research Articles should have a limit of 3000 words.

Case Report should be consisted of a short introduction, case report, discussion and conclusion sections.

Letter To The Editor should have a limit of 600 words and written nonstructured format.

Review Invited or non-invited reviews will be published.

Conflict of interest: Please disclose whether any authors received any financial support for the conduct of the research or any commercial affiliations that could be considered to pose a conflict of interest regarding the submitted manuscript. If so, briefly describe the role of the sponsor(s).

Acknowledgements: If applicable, acknowledgements should be grouped in a paragraph at the end of the text and before the references. Permission and approval of the wording must be obtained from the person thanked.

Tables and Figures: A maximum of seven figures and four tables should be submitted. Tables and figures must be numbered consecutively. Ensure that each table and figure is cited in the text.
A short descriptive title should appear above each table. Do not draw vertical rules in tables. Figures should be submitted separately in TIFF, JPEG or EPS format in grayscale. Figures should have a caption. If the patient is clearly identified in the article, his/her written permission must be obtained.

Citations: Cite references in the text sequentially as a superscripted number after any punctuation mark. For example:
...as reported by Saito et al.[2]
If a reference is cited more than once, the same number is used. A hyphen should be used to link numbers which are consecutive, and a comma used where numbers are not consecutive. For example:
Several studies[3–6, 11, 15] have shown that primary stability in dental implants.

References: All references cited in the text must be included in the list of references at the end of the paper. The accuracy of references is the responsibility of the author. References are listed in the order in which they are cited in the text.

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When citing papers from periodicals, give the author's name, article title, journal name as abbreviated in Index Medicus, year, volume, pagination. For example:
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When citing papers from books, give the author, year of publication, title of chapter, title of book, editor of book, place, publisher, and first and last page numbers respectively. For example:
Costich ER, White RP. Fundamentals of oral surgery. 1st ed. Philadelphia: WB Saunders, 1971: 201-20.

Internet pages and online resources may be included within the text and should state as a full URL and date of access. For example:
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Efthimiadou D. (2006) Evaluation of Dental and Skeletal Changes Due To Surgically Assisted Rapid Maxillary Expansion. PhD Thesis, Istanbul, Marmara University, Institute of Medical Sciences.

CHECKLIST

Only complete manuscript submissions will be considered for publication. Complete submission must include:

1. Cover letter for manuscript submission
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In the actual article, ensure that the following information is provided:

Title page (double spaced)

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- Running title not exceeding 50 characters
- Corresponding author's contact details (name, e-mail, mailing address, telephone and fax numbers)

Abstract max 250 words and 3-10 key words (double spaced)
Main text with appropriate section headings (double spaced)
References (double spaced), on a new page
Tables (double spaced), each on a new page
Figures and/or illustrations should be JPG/TIFF format and separate files

GENEL KAPSAM

Aydın Dental Journal, İstanbul Aydın Üniversitesi Diş Hekimliği Fakültesi'nin senede 2 defa yayınlanan hakemli bilimsel yayınıdır. Derginin yazı dili Türkçe ve İngilizce'dir. Yurt dışından gönderilen ve kabul edilen İngilizce makaleler için Türkçe çeviri desteği sağlanmaktadır. Dergi içeriği ağız sağlığı ve epidemiyoloji, ağız diş ve çene cerrahisi, implantoloji, ağız hastalıkları, periodontoloji, restoratif diş hekimliği, endodonti, protetik diş tedavisi, geriatrik diş hekimliği, pedodonti, ortodonti, ağız, diş ve çene radyolojisi ve diş hekimliği eğitimi konularını da içine alacak şekilde diş hekimliğinin tüm yönlerini kapsamaktadır. Aydın Dental Journal, diş hekimliğinin tüm uzmanlık dallarındaki akademisyenler, pratisyen ve uzman diş hekimleri, lisans ve doktora öğrencilerine ulaşmayı hedeflemektedir.

Dergi Orijinal Araştırma, Olgu Raporları, Klinik Uygulamaya Yönelik Yorum/Değerlendirme ve Derlemeleri yayımlar. Olgu Raporları, klinik uygulamaya katkı sağlayacak üç ana başlık altında toplanır. Bu başlıklar; tanıda güçlük yaratabilen olgular, ileri tanı ve tedavi yöntemleri ve klinik komplikasyonların yönetimi olarak belirlenmiştir. Derlemeler, diş hekimliği alanında tartışmalı her türlü konu için güncel literatürü içine alacak şekilde kapsamlı ve sistematik olarak hazırlanması koşulu ile kabul edilir.

YAZARLARA BİLGİ

Makale Gönderimi

Makaleler dentaydinjournal@aydin.edu.tr elektronik posta adresi üzerinden Aydın Dental Journal Editörüne gönderilmelidir. Editöre gönderilen makale metnine, makaleye katkıda bulunan her bir araştırmacının sorumluluklarını detaylı bir şekilde listeleyen editöre kapak yazısı eşlik etmelidir. Makale dergiye ulaştığında sorumlu yazara elektronik posta ile bilgi verilecektir.

Yayın Politikası

Dergiye gönderilen makale, hakemlerin ve yazarların kimliğinin gizli tutulduğu çift taraflı kör değerlendirme sistemi ile değerlendirilecektir. Sorumlu yazara, makalenin kabul edildiği, reddedildiği veya değişiklik istendiğine dair editör kararı ve hakem yorumları, 8-10 hafta süre içinde bildirilir.

Yayımlanmak üzere gönderilen çalışmanın tümüyle metinde belirtilen yazarlara ait olduğu, daha önce başka bir dergide yayımlanmamış veya yayımlanmak üzere gönderilmemiş olduğu, çalışmada yer alan materyallerin telif hakkına tabi olmadığı veya gerekli izinlerin alınmış olduğu sözü sorumlu yazar tarafından verilmiş kabul edilir.

Gönderilen metnin dergimizde yayına kabul edilmesi durumunda basım öncesi, makaleye katkıda bulunan tüm yazarların "Yazar Bildirim Formu"nu imzalamaları istenecektir.

Doğrudan insan, insan materyali veya deney hayvanlarına ait verileri sunan makalelerde, araştırmanın ilgili kurumlarının etik kurulunca değerlendirilmiş; etik kurul onayı almış olması gereklidir.

Makale metninin Yöntem bölümünde etik kurul değerlendirme ve onayı belirtilmelidir. İnsan araştırmalarında, katılımcılardan yazılı "bilgilendirilmiş olur" alındığı da belirtilmelidir.

Makalelerin yazım dili hem Türkçe hem de İngilizce'dir. Yurtdışından gönderilen ve kabul edilen makalelere Türkçe çeviri desteği sağlanacaktır. Yurtiçinden gönderilen çalışmaların kabul edilmesi durumunda makalenin hem Türkçe hem de İngilizce versiyonu yazarlardan talep edilmektedir.

Makalenin prova kopyası, son düzeltmeler için sorumlu yazara PDF dosyası olarak elektronik posta ile gönderilir. Bu düzeltmelerin en geç 5 gün içinde tamamlanıp dergiye tekrar gönderilmesi gereklidir.

Makalenin yayımlanmasını takiben sorumlu yazara, Aydın Diş Hekimliği Dergisi'nin makalenin yayımlandığı sayısının bir kopyası ve elektronik posta yolu ile makalenin PDF dosyası gönderilir.

Aydın Diş Hekimliği Dergisi'nde yayımlanan tüm yazıların telif hakkı dergiye aittir. Yayıma kabul edilen makale metni ve görselleri bir kısmı veya tümüyle, Aydın Diş Hekimliği Dergisi'nin yazılı izni olmaksızın ne yazılı ne de elektronik olarak başka her hangi bir yerde yayımlanamaz. Dergide yayımlanan içeriğin kopyalarını talep eden taraf Aydın Diş Hekimliği Dergisi'nin iznini almalıdır.

YAZI TÜRLERİ

Etik ve özgün nitelikte, geçerli bulgularla mevcut kanıtlara katkı sağlayan ve klinik uygulamalarla bağlantılı araştırma makalelerine öncelik verilir.

Olgu raporları bilgilendirici nitelikte olup şu özelliklerden birini içeriyor olmalıdır: Tanıda güçlük yaratabilen olgular; ileri tanı, tedavi ve cerrahi yaklaşımlar; klinik komplikasyonların yönetimi. Olgu raporlarında nadir görülme şartı aranmaz. Tanıda güçlük yaratabilen olgular ayrıcı tanılar ile tartışılarak sunulmuş olmalıdır. Komplikasyonların yönetimi, klinik karar verme mekanizmasına katkı sağlayacak nitelikte sunulmuş olmalıdır. Bu bölümdeki yazılar, gerekli yerlerde klinik fotoğraf, fotomikrograf ve radyograflar ile görsel olarak desteklenmiş olmalıdır.

Derlemeler, önemli kavramlar üzerinde ve güncel araştırmaları kullanarak özlü bir şekilde hazırlanmalıdır. Blok halde yazılı metinden ziyade, diyagram, akış şeması, tablo ve figürler ile anlaşılırlık güçlendirilmelidir.

Yorumlar, klinik uygulamaya yönelik konularda kısa ve öz biçimde yazılmış olmalıdır. Yorumlar, tartışmalı konu ve görüşleri aydınlatmaya yönelik konuları içerebilir. Toplum sağlık hizmetleri, hükümet eylemleri, hasta güvenliği, cerrahi trendler, yeni gelişen bilim alanları veya Aydın Diş Hekimliği Dergisi'nde yayınlanmış bir makaleye yönelik yorumlar da değerlendirmeye alınır.

Makalenin Hazırlanması

Dergide yayınlanması istenilen yazı için aşağıdaki kurallara uyulmalıdır**.**
Makale A4 sayfa formatında ve kenar boşlukları 3cm olacak şekilde hazırlanmalıdır. Tüm sayfalar sırası ile numaralandırılmalıdır. Yazı bir buçuk satır aralıklı olarak, Times New Roman 12 punto ile

iki yana yaslı olarak yazılmalıdır. Başlık ve alt başlıklar koyu renk karakter ile yazılmalı ve sonuna herhangi bir noktalama işareti konmamalıdır. Ana başlıklar büyük harf kullanılarak yazılmalı; alt başlıklar ise her sözcük büyük harf ile başlayacak şekilde küçük harf kullanılarak yazılmalıdır. Paragraflar arası, başlık ile paragraf arası ve kaynaklar arasında boşluk bırakılmalı fakat girinti olmadan yazılmalıdır. Yazıların Microsoft Word formatında olması tercih edilir.

Makale Bölümleri

Makale metni şu bölümleri içermelidir: Başlık Sayfası; Özet ve Anahtar Sözcükler (Araştırma Makaleleri ve Derlemeler için); Ana Metin; Çıkar Çatışması/İlişkisi; Teşekkür (gerekli ise); Kaynaklar; Tablolar; Şekil Alt Yazıları. Tüm bölümler tek bir Word dosyasında sunulmalıdır.

Başlık Sayfası: Makale başlıkları koyu ve büyük harf kullanılarak yazılmalı ve 12 kelimeyi geçmemelidir. Başlık sayfasında tüm yazarlara ait isim, unvan, kurum bilgilerine yer verilmelidir. Sorumlu yazara ait isim, ülke ve şehir bilgilerini içeren kurum bilgileri, adres, telefon, faks ve elektronik posta adresleri belirtilmelidir.

Özet ve Anahtar Kelimeler: Değerlendirmeler hariç, araştırma makaleleri, olgu raporları ve derlemeler özet içermelidir. Araştırma makalelerinde özet 250 kelimeyi aşmamalıdır. Olgu raporları ve derlemelerde özet en fazla 150 kelime olmalıdır. Araştırma makalelerinde özet Amaç, Gereç ve Yöntem, Bulgular ve Sonuç olmak üzere dört başlık altında yazılmalıdır. Derlemelerde özet, Amaç, Derleme Yöntemi (Derleme yönteminin açıklanması), Bulgular ve Klinik Bağlantı olmak üzere dört başlık altında yazılmalıdır. Vaka raporlarının özet yapısı ise Amaç, Olgu Sunumu, Bulgular ve Klinik Bağlantı şeklinde olmalıdır. Anahtar sözcükler, bilimsel yazının ana başlıklarını yakalayan en az üç, en fazla on sözcükten oluşmalıdır.

Ana Metin: Orijinal Araştırma metni, Giriş, Gereç ve Yöntem, Bulgular ve Tartışma bölümlerinden oluşmalıdır. Orijinal Araştırmalar 3000 sözcüğü; Derlemeler 5000 sözcüğü; Olgu Raporları ve Yorumlar 1500 sözcüğü aşmayacak şekilde yazılmalıdır.

Çıkar Çatışması-İlişkisi: Lütfen makalede sunulan çalışma için maddi destek alınıp alınmadığını veya yazarların çalışma ile bağlantılı çıkar ilişkisi oluşturabilen herhangi bir ticari bağlantısı olup olmadığını kısa bir açıklama ile bildirin.

Teşekkür: Teşekkür, mevcut ise, metnin sonunda kaynak bölümünden önce bir paragraf halinde sunulmalıdır. Teşekkür edilecek kişinin sözlü onayı yada izni alınmış olmalıdır.

Tablo, Şekil ve Resimler: Makaleler en fazla 4 şekil ve 4 tablo ile desteklenmelidir. Tablo ve şekiller sırası ile numaralandırılmalı ve her biri metin içinde anılmalıdır. Tablonun üst kısmına kısa ve açıklayıcı bir başlık yazılmalıdır. Tablolarda dikey çizgilerin kullanımından kaçınılmalıdır. Şekiller ve resimler TIFF, JPEG veya EPS formatında ayrı bir dosya halinde sunulmalıdır. Şekiller açıklamalar içermelidir. Fotoğraflarda yüzü belli olan hastalardan yazılı izin alınmalıdır.

Atıflar: Kaynaklar metin içinde yer aldığı sıra ile yazılmalı ve cümle sonunda noktalama işaretlerinden hemen sonra "Üst Simge" olarak belirtilmelidir.
Örnek:
…….. Saito ve ark. tarafından bildirilmiştir.[2]
Metin içinde aynı kaynağa birden fazla atıfta bulunuluyor ise aynı numara kullanılmalıdır. Ardışık kaynakların numara yazımında ''kısa çizgi/tire'' kullanılmalıdır. Ardışık olmayan birden fazla kaynak ise birbirinden virgül ile ayrılmalıdır.
Örnek:
Birçok çalışma[3-6,11,15] dental implantlarda primer stabiliteyi….

Kaynaklar: Metin içinde atıf yapılan tüm kaynaklar makale bitiminde liste halinde belirtilmiş olmalıdır. Kaynakların doğruluğu yazarların sorumluluğundadır. Kaynaklar metin içinde yer aldığı sıra ile numaralandırılmalıdır. Orijinal Araştırmalar 30 kaynak; Derlemeler 50 kaynak; Yorumlar ve Olgu Raporları 10 kaynak sınırını aşmamalıdır.

Kaynaklar aşağıdaki örneklerde görüldüğü şekilde düzenlenmelidir:
Makale için; Yazar(lar)ın soyad(lar)ı ve isim(ler)inin başharf(ler)i, makale ismi, dergi ismi, yıl, cilt, sayı, sayfa no'su belirtilmelidir.
Örnek:
Halsband ER, Hirshberg YA, Berg LI. Ketamine hydrochloride in outpatient oral surgery. J Oral-Surg 1971;29:472-6.

Kitap için; Yazar(lar)ın soyad(lar)ı ve isim(ler)inin başharf(ler)i, kaçıncı baskı olduğu, bölüm başlığı, kitap ismi, editörün(lerin) ismi, şehir, yayınevi, yıl ve sayfalar belirtilmelidir.

Örnek:
Costich ER, White RP. Fundamentals of oral surgery. 1st ed. Philadelphia: WB Saunders, 1971: 201-20.

Web sitesi ve online kaynaklar için; tam URL (bir örnek kaynak konumlayıcı) adresi ve erişim tarihi belirtilmelidir.
Örnek:
http://www.tdkterim.gov.tr/bts/ (12.10.2014)

Tez için;
Örnek:
Efthimiadou D. (2006) Evaluation of Dental and Skeletal Changes Due To Surgically Assisted Rapid Maxillary Expansion. PhD Thesis, Istanbul, Marmara University, Institute of Medical Sciences