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RESEARCH ARTICLE

Bibliometric Analysis of Three Oral and Maxillofacial Surgery Journals

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Abstract

Introduction

Bibliometric analysis is a quantitative analysis that evaluates the publications in the aspect of subject, author, citations etc. In this study, we aimed to contribute to publication profile in the field of international oral and maxillofacial surgery (OMFS). For this reason we examined the studies published during 2016 in three chief journals (Journal of Oral and Maxillofacial Surgery, International Journal of Oral and Maxillofacial Surgery, Journal of Craniomaxillofacial Surgery) of OMFS.

Material And Methods

This report was designed as an observational study. The articles, which were available at PubMed database and published by Journal of Oral and Maxillofacial Surgery, International Journal of Oral and Maxillofacial Surgery, Journal of Craniomaxillofacial Surgery between in 2016, were included into study.

Results

Total of 594 studies were examined in this study. They consisted of 450 research, 78 review, 49 case report and 17 others (unclassified). The most studied subject was deformities and cosmetic surgery with 166 studies (%27,95). While only 13 studies (%2,18) had one author, 428 studies (%72,05) had ⩽6 authors. More than one-third of all works are from the countries USA (%13,9), Germany (%10,88) and China (%10,21). However most of the studies origined from Europe with a rate of %42,79.

Conclusion

Our study showed that deformities-cosmetic surgery and oncology-reconstructive surgery were the main topics among the articles published by three chief oral and maxillofacial surgery journals in 2016. Wide interest area of oral and maxillofacial surgery allows to perform further bibliometric studies by using different parameters.

Keywords: oral and maxillofacial surgery, bibliometric, review

Introduction

Oral and maxillofacial surgery, which is the specialty of dentistry, aims to improve the quality of life of the patients by providing the aesthetic and functional integrity of soft and hard tissue repairs of diseases, injuries and defects related to oral and maxillofacial region.

With the expansion of the scope of oral and maxillofacial surgery, the number and variety of scientific and academic studies in this field has also increased rapidly throughout the world. Especially in recent years, it has been seen that the studies conducted in recent years can be grouped under the following headings with the effect of new technological advances, patient and physician awareness and the emergence of modern life and the diseases and disorders which are newly emerging or increased in incidence:

- Anaesthesia and facial pain
- Deformities and Cosmetic Surgery
- Dental Implants
- Dentoalveolar Surgery
- Oncology and Reconstructive Surgery
- Pathology
- TMJ
- Trauma
- Others

Several statistical methods are used to compare journal and article activities in scientific platform such as bibliometric analysis.[1] Bibliometric analysis is a quantitative analysis that evaluates the publications in the aspect of subject, author, citations etc.[2] Thus, it emerges as an important tool that

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facilitates archiving and classification of scientific information. In this study, we aimed to contribute to publication profile in the field of international oral and maxillofacial surgery (OMFS). For this reason we examined the studies published during 2016 in three chief journals (Journal of Oral and Maxillofacial Surgery, International Journal of Oral and Maxillofacial Surgery, Journal of Craniomaxillofacial Surgery) of OMFS.

Material And Methods

This report was designed as an observational study. The articles, which were available at PubMed database and published by Journal of Oral and Maxillofacial Surgery, International Journal of Oral and Maxillofacial Surgery, Journal of Craniomaxillofacial Surgery between in 2016, were included into study. Following parameters were used for evaluation:

1. Type of studies: research, review, case report, others
2. Subject of article: all studies were gathered under 9 topics. Anaesthesia and facial pain, Deformities and Cosmetic Surgery, Dental Impplants, Dentoalveolar Surgery, Oncology and Reconstructive Surgery, Pathology, TMJ, Trauma and the others.
3. Number of authors
4. Origin: Stratified based on the data regarding geographic origin of the corresponding author.

Articles published before 2016, letters to the editor, letters, meeting reports, questions were excluded from the analyses. Statistical Package for Social Sciences (SPPS) version 19.0 (IBM Corp.; Armonk, NY, USA) was used for analyzing the datas. Parameters were analyzed by using the Pearson's chi-square test. A p-value of ←0.05 was considered statistically significant.

Results

Total of 594 studies that had been published by JOMS, IJOMS and JCMFS in 2016, were examined in this study. They consisted of 450 research, 78 review, 49 case report and 17 others (unclassified). (Table 1)

The most studied subject was deformities and cosmetic surgery with 166 studies (%27,95). It was followed by oncology-reconstructive surgery, the others (unclassified), dentoalveolar surgery, TMJ, trauma, dental implants, pathology an anaesthesia-facial pain respectively. (Figure 1)

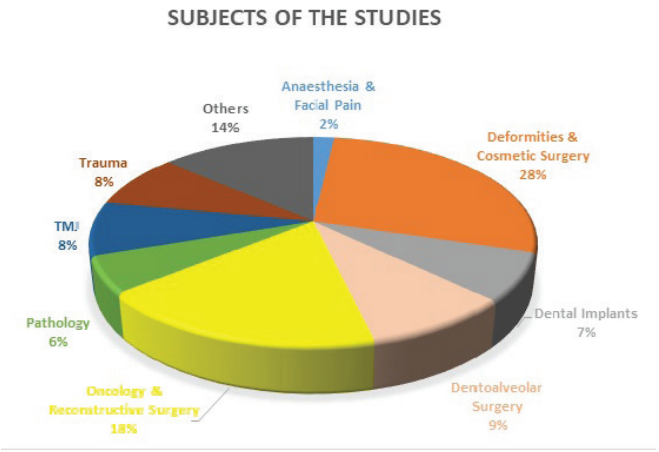

Figure 1: Distribution of subjects of the studies

Outcomes obtained from number of authors analysis is shown in Table 2. While only 13 studies (%2,18) had one author, 428 studies (%72,05) had ↖6 authors. It also summarizes the distribution of the number of authors according to the subjects. TMJ studies had the highest rate of ↖6 authors with a percentage of %90.

The origins of studies were assessed and classified according to country of corresponding author (Table 3). In addition continental distribution is shown in Figure 2. More than one-third of all works are from the countries USA (%13,9), Germany (%10,88) and China (%10,21). However most of the studies origined from Europe with a rate of %42,79.

Discussion

Bibliometric analysis can be useful in classification of scientific information as well as access to it.[1] In addition, it provides proper datas for developing research strategies.[3] Consequently there is a rapidly increase in bibliometric studies in recent years. In our study, it was aimed to identify some characteristics of articles published in three OMFS journals which has the highest impacted factor. In the first study that quantifies and analyzes the most highly cited papers in OMFS, the authors identified these four high impact factor journals through the SCOPUS database; Journal of

TYPES OF STUDIES	NUMBER AND RATES
RESEARCH	n=450 (%75,76)
REVIEW	n=78 (%13,13)
CASE REPORT	n=49 (%8,25)
OTHERS	n=17 (%2,86)

Table 1: Types of papers published in JOMS, IJOMS, JCMFS in 2016

SUBJECTS	NUMBER OF AUTHORS															
	1 author	2 authors	3 authors	4 authors	5 authors	6 authors	7 authors	8 authors	9 authors	10 authors	11 authors	12 authors	13 authors	14 authors	15 authors	16 authors	63 authors
Anaesthesia & Facial Pain	-	3	1	4	-	-	1	-	1	-	1	-	-	-	-	-	-
Deformities & Cosmetic Surgery	5	13	15	35	23	31	19	8	9	4	2	-	-	-	1	-	1
Dental Implants	2	7	2	5	8	10	3	4	2	-	-	-	-	1	-	-	-
Dentoalveolar Surgery	1	5	4	11	10	11	6	1	3	1	-	1	-	-	-	-	-
Oncology & Reconstructive Surgery	-	4	6	15	14	22	13	16	5	4	3	2	1	-	-	1	-
Pathology	-	-	3	11	4	5	3	3	-	1	-	3	-	-	-	-	-
TMJ	1	6	5	9	14	10	3	1	-	-	-	-	-	-	1	-	-
Trauma	1	5	5	12	5	11	6	3	1	-	-	-	1	-	-	-	-
Others	3	5	10	16	6	14	10	8	4	1	2	1	-	-	-	-	-
Total	13	48	51	118	84	114	64	44	25	11	8	6	3	1	2	1	1

Table 2: Number of authors according to the study topics

COUNTRY	NUMBER OF STUDIES	RATES
Australia	n=11	%1,84
Austria	n=5	%0,8
Belgium	n=8	%1,34
Brazil	n=37	%6,19
Canada	n=4	%0,67
Chile	n=5	%0,8
China	n=61	%10,21
Colombia	n=3	%0,5
Denmark	n=6	%1
Egypt	n=4	%0,67
England	n=19	%3,19
Finland	n=3	%0,5
France	n=17	%2,86
Germany	n=65	%10,88
Greece	n=2	%0,33
Holland	n=35	%5,89
Hong Kong	n=2	%0,33
India	n=21	%3,53
Iran	n=16	%2,69
Israel	n=6	%1,01
Italy	n=23	%3,87
Japan	n=51	%8,54
Lithuanian	n=1	%0,16
Malaysia	n=1	%0,16
Mexico	n=1	%0,16
Nijeria	n=3	%0,5
Norway	n=2	%0,33
Poland	n=4	%0,67
Portugal	n=1	%0,16
Romania	n=1	%0,16
S. Arabia	n=3	%0,5
Scotland	n=1	%0,16
Serbia	n=3	%0,5
South Korea	n=26	%4,37
Spain	n=24	%4,04
Sweden	n=2	%1,01
Switzerland	n=7	%1,17
Taiwan	n=7	%1,17

Thailand	n=3	%0,5
Turkey	n=15	%2,52
USA	n=83	%13,9
Yemen	n=2	%0,33

Table 3: Origins of studies according to country of corresponding author

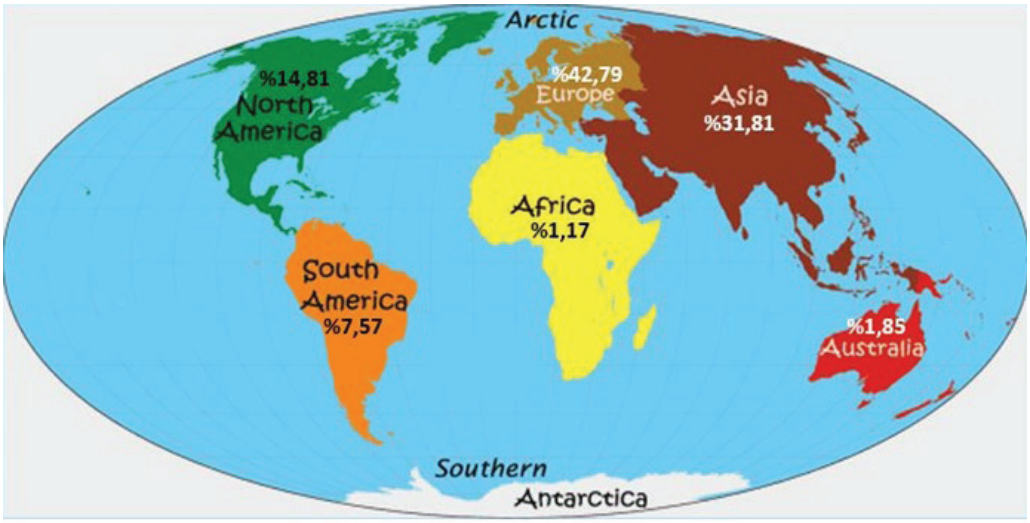

Figure 2: Continental distribution of the publications

Oral and Maxillofacial Surgery (JOMS), British Journal of Oral and Maxillofacial Surgery (BJOMS), International Journal of Oral and Maxillofacial surgery (IJOMS), Journal of Cranio-Maxillofacial Surgery (JCMS) (table 4)[4]. This study analyzed the most cited 200 papers according to their topics, authorship, article type, country of origin, level of evidence and publication years. On the contrary of our results, pathology was found as the most published category in this study. However, USA had highest publication rate (%44) similar to our study.

In 2013 Tahim et al [5] reviewed oral surgery-related papers published in the British Journal of Oral and Maxillofacial Surgery during 2011-2012. They examined 57 articles under 6 categories. Most of the articles were related with dentoalveolar surgery. In addition Payne et al [6], Sadiq et al [7] and Gulati et al[8] reviewed the papers published in the British Journal of Oral and Maxillofacial Surgery in topics of trauma, orthognathic surgery and salivary glands respectively. The present study differs by its wide topic scope and number of articles.

Although research papers showed a significant rate of %75,7 in the present bibliometric analysis, case reports can offer a different perspective. In our analysis only 49 of 594 studies were case reports. Nabil and Samman[9] evaluated all case reports and their citation datas published in four outstanding OMFS journals. Only 38 case reports (%7,2) have 5 or more citations. It showed that case reports can affect the jornal impact factor negatively.

Conclusion

Our study showed that deformities-cosmetic surgery and oncology-reconstructive surgery were the main topics among the articles published by Journal of Oral and Maxillofacial Surgery, International Journal of Oral and Maxillofacial Surgery, Journal of Craniomaxillofacial Surgery in 2016. Approximately three forth of these studies were researches.

The results also showed that scientific activities in the field of oral and maxillofacial surgery concentrated in USA and Europe. Bibliometric analysis is an important effective tool to observe the characteristic of scientific publications and new research trends. Also it's useful for developing new scientific strategies. Wide interest area of oral and maxillofacial surgery allows to perform further bibliometric studies by using different parameters.

Source of Finance

The study needs no financial support

Conflict of Interest

The authors have no conflict of interest to declare

Authorship Contributions

Tolgahan Kara and Ahmet Altan designed the study and gathered the data. Nihat Akbulut analyzed the data. Nihat Akbulut and Tolgahan Kara wrote the majority of draft.

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RESEARCH ARTICLE

Dental Anxiety Affects Operation Quality and Surgeon's Comfort in Oral Surgery

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Abstract

Introduction

Impacted third molar extraction generally provokes a high level of anxiety in patients, and causes stress and discomfort to the operating surgeon. The aim of this study is to evaluate the influence of anxiety on the surgery quality and surgeon's comfort in third molar surgery.

Materials and Methods

"STAI-T" and "STAI-S" questionnaires, which are used to measure anxiety, was administered to 110 patients via an interview in order to measure their levels of preoperative anxiety. The time necessary for the tooth extraction (starting from the first incision to the last suture) was recorded. After the operation, a questionnaire including eight questions was administered to surgeons who performed the third molar surgery.

Results

The results of STAI-T and STAI-S questionnaires were not statistically different between men and women ($p \rightarrow 0.05$). Trouble in pain control was seen in patients with high scores of STAI-T. Negative correlation was found between STAI-S scores and operation quality and surgeons' comfort.

Conclusion

Patient cooperation is an important factor in oral surgery procedures. Assessing the patient's anxiety level and taking necessary precautions before the operation is important for both patient and surgeon's comfort during the oral surgery operations.

Keywords: Dental Anxiety; Impacted Third Molar Surgery; Oral Surgery; STAI-T and STAI-S Questionnaires; Third Molar

Introduction

Response to a stressful dental process is defined as dental anxiety. The prevalence of dental anxiety has been reported as 20% in different studies[1]. It is a stressful condition for both patients and dental practitioners. Dental anxiety including dental phobia that avoids dental management was reported around 5%[1,2]. People with dental phobia are the most challenging patients for dentists[3]. The difficulties in those group of patients generally lead prolonged visits with a tense atmosphere during treatment. Even in some cases, patients' appointments could be canceled.

The severity of dental anxiety can be assessed by using several questionnaires[4,5]. The information obtained from these questionnaires could be helpful for identifying those patients who need special dental care due to high anxiety. Determining dental anxiety before any dental intervention is essential because it is important to assess to what extent the patient able to cop.

Impacted third molar extraction is the most common surgical procedure performed in maxillofacial surgery field. It generally provokes anxiety in patients and also causes stress and discomfort to the operating surgeon. Increased anxiety and stress substantially decrease productivity and lead to longer operation times. Phobic patients are difficult cases to manage, and this condition makes a negative effect on the operation quality and the surgeon's comfort. To identify those patients

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while giving appointment and advise, premedication and/or sedation could be better for both the patient and surgeon.

The aim of this study was to evaluate the influence of anxiety on the quality of surgery and the surgeon's comfort in third molar surgery.

Materials and Methods

Participants

This work has been carried out in accordance with the Declaration of the Helsinki on medical protocol. The procedure was approved by the Institutional Review Board at Ondokuz Mayis University in Samsun (Clinical Research Ethics Committee of Ondokuz Mayıs University Experimental Medicine Research and Application Center; 2015/357). Patients who were referred to Ondokuz Mayıs University Faculty of Dentistry, Department of Oral and Maxillofacial Surgery with the complaint of impacted third molar requiring surgical approach were included in the study. It was found that the power of the test was 0.82 for 110 patients when Power Analysis was performed with reference to the work of Kömerik et al[6]. After obtaining their consent, the patients were asked to join the study during the time they spent in the waiting room before third molar surgery. Exclusion criteria included; a previous third molar extraction, a neurological disease, taking anxiolytic medication or antidepressants. The "STAI-T" and "STAI-S" questionnaires, which are used to measure anxiety, were administered to 110 patients via an interview in order to measure their anxiety level.

Operative procedure

Third molar surgeries were performed in local anesthesia by post-graduate oral and maxillofacial surgeons at Ondokuz Mayıs University Faculty of Dentistry. All teeth were partially or completely covered by mucosa. Articaine with epinephrine (Ultracain® D-S Forte, Sanofi Aventis, Istanbul, Turkey) were used for local anesthesia. A buccal mucoperiosteal flap was raised in order to see the impacted tooth. A round bur with sterile saline irrigation was used to remove the bone over the impacted tooth. If needed, sectioning of the crown and roots was performed during removing the tooth. The mucoperiosteal flap was repositioned and sutured with 3-0 silk suture. The duration of the procedure was recorded. After the operation, a questionnaire including eight questions was administered to surgeons who performed the third molar surgery. The questions in the questionnaire were presented in Table 1.

Measures

Dental anxiety was evaluated by two tests: Spielberger State-Trait Anxiety Inventory-Trait (STAI-T) and Spielberger State-Trait Anxiety Inventory-State (STAI-S). STAI-T contains 20-item self-evaluation questions. The questions are scored using a 4-level frequency scale which ranges from "almost never" to "almost always," showing various degrees of anxiety about situations that patients perceive as threatening. The STAI-S contains 20-item self-evaluation questions that are scored using a 4-level frequency scale which ranges from 0 to 3, that evaluate transient emotional state or condition as characterized by subjective feelings of tension and apprehension that can fluctuate in time and intensity[7].

Table 1. The questions asked to the surgeons after the operation.

1.	Did you experience any trouble with pain control?
2.	Did syncope occur during the operation?
3.	Did patient feel vomiting sensation in the operation?
4.	Did you experience any co-operation problem with the patient during the operation?
5.	Did the patient try to stop the operation and extend the operation time?
6.	Did the patient do anything to affect your concentration during the operation?
7.	Did the patient do anything that affects the quality of surgery?
8.	Did you prefer to do this operation under sedation?

Statistical Analysis

SPSS 20.0 (IBM Corp. Released 2010; IBM SPSS Statistics for Windows, Version 19.0 Armonk, NY; IBM Corp.) was used for statistical analyses. Normality of the data was calculated using SaphiroWilks test. Independent Sample T-Test for numerical variables was used to analyze data. A probability value of 0.05 was considered significant. Point be-serial correlation coefficient was computed to assess the relationships between the anxiety test scores and quality of surgery-surgeon comfort (Table 2).

Results

A total of 110 patients (71 females and 39 males; mean age 25,13±4,94 and 24,17±5,38 years) were included in the study. Age and gender were not found to be correlated with anxiety levels and surgeons' questionnaire results ($p>0.05$).

There was a weak, positive correlation between the STAI-S scores of the patients and the questions 4, 5, 6, 7, 8. A week correlation was also found between the STAI-T scores and question 1 ($p<0.05$; Table 2).

Table 2: Point be-serial correlation coefficient test. (Correlations between the anxiety level of the patient and the answers of surgeons. *p<0.05, ** p<0.01, *** p<0.001)

Anxiety scale	QUESTIONS							
	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8
STAIT	0.179	0.126	0.022	0.202*	0.363**	0,207*	0.215*	0.285**
TRAIT	0.192*	-0.045	-0.154	0.070	0.183	0.003	0.097	0.141

Discussion

Anxiety is defined as a response to a stimulation of stress[8,9]. When a stimulus is considered as "threat" to one's well-being, a series of reaction occur in the body[10]. Spielberger, defined the difference between state and trait anxiety as follows: State anxiety is an emotional and somatic reaction towards a stimulus of threat in a particular context while trait anxiety refers to individual differences in reactions towards a perceived threat in the environment in general[7]. Many scoring systems have been used to evaluate preoperative anxiety[5]. STAI is one of the most commonly used scale for assessing anxiety[11]. The goal of the STAI was to create a series of questions that assess different types of anxiety[5]. State anxiety test can be affected by emotions, such as fear, nervousness, and discomfort. On the other hand trait anxiety test was designed to evaluate the longer period of this emotion, in other words, how the individual feels "generally." STAI score was determined as an objective, reliable and high viability scoring system in measuring anxiety by numerous clinical researches[5]. In this study, STAI-State(S) and STAI-Trait(T) scores were used in the measurement of anxiety levels of patients.

In relation to gender, the large majority of studies have found higher prevalence rates for dental anxiety in females than males[1,12]. In our study, we found no significant difference between the anxiety levels of female and male patients. According to Milgrom et al.[3], patients under 40 years old maybe 1.5 times more anxious than those over 40. Similarly, Liau et al.[13] and Sitheeque et al.[14] suggested that younger patients had higher anxiety levels. In contrast, Liddell and Locker[15] and Thomson et al.[16] found that preoperative anxiety decreased with age. In our study, we found no significant relationship between age and anxiety levels.

Patient anxiety can be a very important difficulty in third molar extraction, especially when only local anesthesia is used. Aznar-Arasa et al.[17] evaluated 108 patients who had third molar surgery and reported that impacted lower third molar extractions were significantly more difficult in anxious patients. They used two parameters for determining surgery difficulty: operation time and difficulty VAS. In our study, we prepared a questionnaire including eight questions that consist of common intra-operative complications and difficulties in surgery. Operation time was not considered as surgery difficulty because the positions and bone retention of the third molars were not standardized in our study group. We found that surgeons had experienced trouble in pain control with patients with high scores of STAI-T during the surgery. Furthermore, the surgeons generally had difficulty in cooperation with patients who had higher STAI-S scores. This group of patients tends to stop the operation during surgery which decreases the motivation of the surgeons. According to surgeons, the patients who had higher scores in STAI-S were also affecting the success of the operation. In our study, all of the surgeons were trainees in the same maxillofacial surgery department for 2 to 4 years, and the patient cooperation was far more important for inexperienced surgeons than seniors.

In general, while giving an appointment to a patient for an oral surgery procedure after a detailed explanation of the surgery, surgeons ask patients whether they prefer sedation or general anesthesia. However, patients may not always be able to determine their anxiety levels truly. Especially in some particular oral surgery procedures, the quality of surgery is directly associated with the patient's cooperation. Also, the surgeon's concentration and hand sensation are very important for the success of the operation. In our opinion, surgeons should carefully evaluate the anxiety levels of the patients to advise sedation or general anesthesia techniques more strongly in such cases. STAI-S and STAI-T are useful tools for assessing patient anxiety before the operation. In patients who suffer from mild fear or anxiety, surgeons can relax the patients with a detailed explanation of the surgery. In addition, specific techniques to reduce anxiety such as premedication can be used the night before the operation. In patients with severe anxiety, surgeons can advise conscious sedation or general anesthesia, especially if the surgery needs a strong patient co-operation.

Conclusion

Patient co-operation is an important factor in oral surgery procedures. Assessing the patient's anxiety level and taking necessary precautions before the operation is important for both patient and surgeon's comfort during the surgery.

Source of Finance

None declared.

Conflict of Interest

None declared.

Authorship Contributions

Consept: Dr. Burcu Baş
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Critical review: Dr. Bora Özden

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RESEARCH ARTICLE

Comparison of Primary Stability of Sinus Implants and Standart Implants

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Abstract

Background

The BoneTrust® Sinus implant (BTSI) enables optimal primary stability by its special design with reduced thread section in cases of reduced vertical bone availability, thus allowing in many cases a one-step operative procedure even if less than 5mm of the bone level is available in the sinus region. The aim of this in vitro study was to analyze the primary stability of BoneTrust® Sinus implant in comparison with standart implants.

In the years 2015-2017, partially edentulous patients were consecutively provided with implant-supported fixed restorations with the use of 11 BoneTrust® Sinus implants of the Medical Instinct® System (Medical Instinct Production GmbH, Bovenden, Germany) (Group A) and the 11 standard OXY implants of Biomec System (Biomec system Italy) (Group B) at Baskent University, Department of Oral and Maxillofacial Surgery.In this study, measurements were conducted with the Resonance Frequency Analysis method by using Osstell device on 11 BoneTrust® Sinus implants of the Medical Instinct® System (Medical Instinct Production GmbH, Bovenden, Germany) and 11 standart OXY implants of Biomec System (Biomec system Italy).

Results

Primary and secondary ISQ values implants were compared and there was no statistically significant difference between these two groups in terms of these parameters.No significant difference was found between the two groups in terms of bone loss after 6 months.

Conclusion

This present study did not demonstrate a statistically significant difference, between the primary and 6th-month ISQ values of the standard implants group and sinus implants group.

None of the authors have any competing interests in the manuscript.

Keywords: sinus implant, ISQ, primary stabilty, lateral sinus lifting

Introduction

Sinus augmentation is performed when the floor of the sinus is too close to an area where dental implants are to be placed. This procedure is performed to ensure a secure place for the implants, while also protecting the sinus at the same time[1,2].

In the literature, it has been shown that the initial bone height, fixture diameter, and fixture length are the factors that influence the implant stability on the posterior edentulous maxilla. On the other hand, the initial bone width, bone graft and sinus elevation procedure, graft material, and the approach method for sinus elevation do not affect the implant stability on the posterior edentulous maxilla[3]. Although postoperative stability is independent of the initial bone width; the implants on the posterior edentulous maxilla are more stable with a longer fixture length and a wider fixture diameter. Bone graft or sinus elevation procedure does not create a difference in stability, so it is recommended to install the fixtures accurately in a larger diameter and longer length by performing bone graft and sinus elevation[3].

The Osstell instrument measures the implant stability by assessing the bone-implant unit's own resonance characteristics when a screwed-on transducer transfers specific vibration frequencies onto it. This is termed resonance frequency analysis (RFA).[4]

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Resonance Frequency Analysis (RFA) is a noninvasive intraoral method designed to assess bone-implant interface and may therefore provide clinical evidence of implant stability[5]. Due to its high reproducibility and soundness, this technique has progressively, in the last years, outperformed the all techniques previously proposed to monitor implant stability[5].

The BoneTrust® Sinus implant (BTSI) which was developed in cooperation with Dr. Kay Pehrsson at Haranni Clinic, Herne, in Germany, was introduced by Medical Instinct® (Medical Instinct Production GmbH, Bovenden, Germany) in 2011. According to the information provided by the manufacturer, the BoneTrust® Sinus implant enables optimal primary stability by its special design (Figure 1) with reduced thread section in cases of reduced vertical bone availability, thus allowing in many cases a one-step operative procedure (augmentation and simultaneous implantation), even if less than 5mm of the bone level is available in the sinus region[6].

To the best of our knowledge, in 2006 an experimental study on bone trust sinus implants was published but no controlled clinical studies on bone trust sinus implants exists in the literature[6]. The aim of this present study was to analyze the primary stability of BoneTrust® Sinus implant (BTSI) which enables optimal primary stability by its special design with reduced thread section in cases of reduced vertical bone height, in comparison with standard implants.

BoneTrust® Sinus implant

Patients And Method

This study was approved by Baskent University Institutional Review Board (Project No: D-KA19/36) and supportted by Baskent University Research Found the years 2015-2017, partially edentulous patients were consecutively provided with implant-supported fixed restorations with the use of 11 BoneTrust® Sinus implants of the Medical Instinct® System (Medical Instinct Production GmbH, Bovenden, Germany) (Group A) and the 11 standard OXY implants of Biomec System (Biomec system Italy) (Group B) at Baskent University, Department of Oral and Maxillofacial Surgery. Before implant placement, patients were treated for periodontal diseases (in case it was needed to achieve periodontal health). Systemic antibiotics were prescribed to all patients for 7–10 days, starting from the day of the implant insertion.

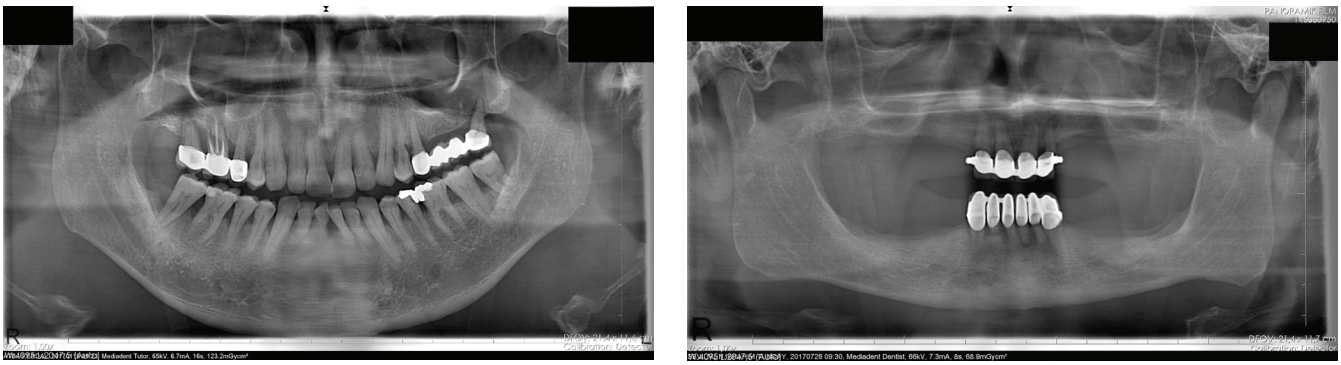
A computer tomography scan was used to evaluate the amount of bone at individual implant sites under the maxillary sinus to see whether the patient could be included in the study. Patients who had a residual bone height of less than 2 mm were excluded. The other exclusion criteria were sinus pathologies, systemic diseases, smoking habits, alcohol consumption and poor oral hygiene.

Surgical Procedure: Sinus lifting and implant insertion procedures were performed under local anesthesia. After mucoperiosteal flap elevation, five or six holes were drilled using a round bur in order to outline the planned window. Lateral window osteotomies were created to allow good access for dissection, as well as for sinus membrane elevation, and insertion of graft materials. No perforation of the sinus membrane was observed. The particulate graft materials Geistlich Bio-Oss®, North America were inserted in the cavity and a collagen membrane (Geistlich Bio-Gide®, North America) was placed over the grafted site. Thereafter, simultaneous insertion of dental implants was performed (Figure 2). Care was taken not to lacerate the sinus membrane with the tip of the implants during the insertion. The implant stability quotient (ISQ) was measured after the implant surgery. Mucosa was re-adapted and sutured with restorable sutures.

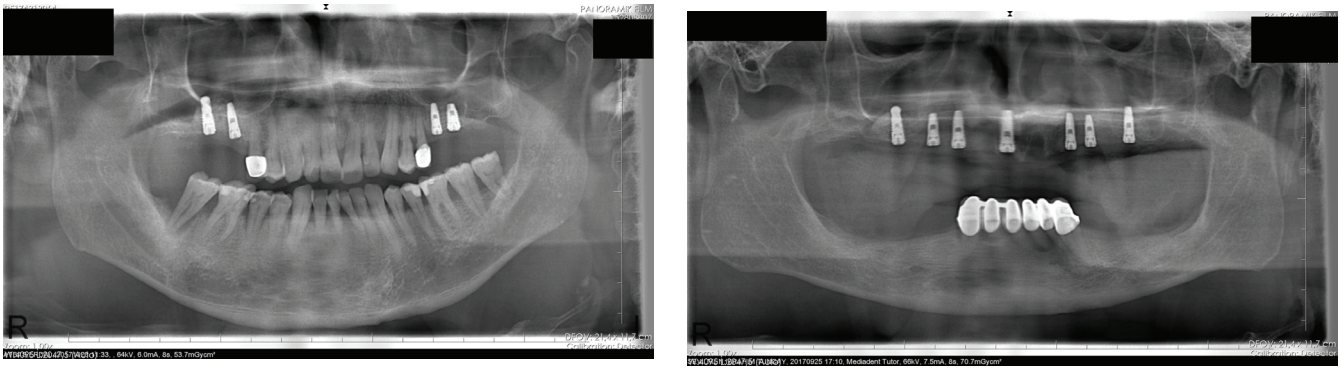
ISQ measurements were repeated 6 months after the surgery. All the measurements were taken twice in each direction (in the buccolingual direction from the buccal side and from the palatinal side). The average of the two measurements was recorded.

The success rates of the implants were analyzed based on the criteria of the Pisa Consensus Conference. In both groups, pain, exude history, mobility and radiographic bone loss were assessed[7].

For the evaluation of radiographic bone loss, a control radiograph was taken at the time of patient recall. Linear distance between the implant shoulder and bone crest were recorded in mesial and distal aspect of the implants. The average values were used as a single measurement for each implant.



a,c: Preoperative Radiographic View



b.d: Postoperative Radiographic View

Results

Table 1 shows the data of 11 patients with 11 standard implants. The age of the patients, the height and width of the residual bone, and the diameter and height of the 11 implants placed, the primary ISQ values measured at the time of the first implantation of the implants, the ISQ values measured in the postoperative period, the amount of bone loss occurring 6 months after implant placement and classifications of the success criterion of the implants informations are shown on the table. The same parameters are shown for 11 cases in which 11 standard implants were placed in Table 2. (Group B)

There was no statistical difference between the two groups in terms of age distribution of the patients. The residual alveolar bone width and height were compared between the two groups and the result was not statistically significant.

When the implant diameters were examined, the length of the implants placed in the first group (in the group of sinus implants) was longer than the second group and this difference was statistically significant. The diameter distribution of the implants was similar between the two groups.

Primary and secondary ISQ values of Group A placed implants and primary and secondary ISQ of implants included in Group B were compared and there was no statistically significant difference between these two groups in terms of these parameters.

No significant difference was found between the two groups in terms of bone loss after 6 months.

The results of the t test were given in the Table 3.Implant length (12 ± 0,00) in the group B implants was statistically higher than the implants in group A (10,36 ± 0,81) ($p \leq 0,001$).

For the other parameters, there was no significant difference between experimental and control groups ($p \leq 0.05$).

Table 1 Sinus implants

	Age	Residuel alveolar bone height	Residuel alveolar bone width	Primer ISQ	6.month ISQ	Implant diameters	Amount of bone loss mm	Success Criteria I SUCCESS II Satisfactory survival IIICompromised survival IV FAİL
1.	55	4, 3 mm	6 mm	55	76	4,0 12	1-1	1
2.	62	4,5 mm	6,3 mm	57	81	4,0 12	0-0	1
3.	57	4,5 mm	5,8 mm	58	78	4,0 12	0,8-07	1
4.	43	5mm	7,2 mm	53	88	4,0 12	1.4-1,3	1
5.	67	5,5 mm	6,3mm	54	89	4,0 12	1.1-1	1
6.	45	4mm	7mm	45	82	4,0 12	0-0	1
7.	71	3,75mm	6,5mm	48	75	4,0 12	0,9-08	1
8.	64	4, 3 mm	6,1mm	55	78	4,0 12	0-0,5	1
9.	65	4mm	8mm	69	88	5,0 12	0-0	1
10.	58	5mm	8,8mm	55	75	4,0 12	0-0	1
11.	67	5,8 mm	9mm	50	80	5,0 12	0-0,1	1

Table 2 Standart implants

	Age	Residuel alveolar bone height	Residuel alveolar bone width	Primer ISQ	6.month ISQ	Implant diameters	Amount of bone loss mm	Success Criteria I SUCCESS II Satisfactory survival IIICompromised survival IV FAİL
1.	49	5,8 mm	6 mm	54	75	4,5 10	0-0	1
2.	67	4,7 mm	6,3 mm	50	80	4,0 10	0,2-0	1
3.	47	4mm	5,8 mm	45	78	4,0 12	1-0	1
4.	53	5,8 mm	7,2 mm	56	73	4,0 10	0,3-0,5	1
5.	59	6 mm	6,3mm	49	85	4,5 12	0-0,4	1
6.	53	4,5 mm	7mm	51	75	4,0 10	0,8-07	1
7.	71	4 mm	6,5mm	58	84	5 10	1-1,5	1
8.	64	5,3 mm	6,1mm	53	78	4,5 10	0-1	1
9.	67	5,8 mm	9mm	68	85	5 10	0-0	1
10.	68	5mm	8,6mm	54	78	4,5 10	0-0,2	1
11.	55	5mm	9mm	51	84	5 10	0,2-0	1

Table 3. Results of t tests between Group A and Group B

		N	Mean	Standart Deviation	p
Residual bone height	Group A	11	5,08	0,73	0,120
	Group B	11	4,60	0,65	
Residualbone weight	Group A	11	7,07	1,23	0,886
	Group B	11	7,00	1,13	
Primer ISQ	Group A	11	53,55	5,96	0,730
	Group B	11	54,45	6,20	
6.Month ISQ	Group A	11	79,55	4,37	0,517
	Group B	11	80,91	5,28	
Implant diameter	Group A	11	4,45	0,42	0,135
	Group B	11	4,18	0,40	
Implant length	Group A	11	10,36	0,81	0,000*
	Group B	11	12,00	0,00	
Bone loss	Group A	11	0,35	0,38	0,522
	Group B	11	0,48	0,52	

*p<0,001

Discussion

Lateral window sinus lifting surgery with simultaneous implant insertion procedures in posterior atrophic maxillae are well-documented techniques in the literature for the rehabilitation of cases with a presence of 5 mm bone between the alveolar crest and the maxillary sinus[8,9]. Furthermore, the recent articles in the literature have reported that these simultaneous implant placement techniques have provided quite successful outcomes even when the residual alveolar bone was shorter than 5 mm. The recent publications have emphasized that the successful outcomes of the sinus lift surgeries, which were performed using the lateral window technique along with the implant placement, have been associated with the alveolar bone width and primer stability rather than the vertical distance between the alveolar crest and the sinus[10].

While the implant survival rates associated with this procedure are over 90% routinely [sinus paper 26,27], the lateral window sinus technique still remains to be a highly sensitive and delicate procedure due to the high risk of complications including Schneiderian membrane perforation and bleeding[11,12].

In 2011, Dr. Kay Pehrsson introduced BoneTrust® Sinus implants. It is estimated that, until today, more than 2000 BoneTrust® Sinus implants have been placed worldwide. BoneTrust® Sinus implants are specifically designed and produced only in a limited variety of sizes, that is, 12 mm long implants with diameters of 4.0 mm or 5.0 mm[6]. The main advantage provided by this special design is that the implant does not detract the graft materials in the region when it is simultaneously placed with the lateral sinus procedure. All clinicians performing this procedure aware of the fact that the implants detract the graft materials with their threads, therefore, they re-apply the graft material after the placement of the implant. Then they perform the graft adaptation through the lateral window again to finalize the augmentation procedure.

Due to its special design in the apical region, bone trust sinus implants are predicted to be friendly to the Schnider membrane and prevent the membrane from being damaged by the implant grooves. Furthermore, thanks to this particular design, it is also claimed that the apical region without a groove will be less aggressive to the graft materials placed through the lateral sinus lift window and will not remove the particles away from the region during insertion of the implant.

The question to which the authors mainly focused on while planning this study was to see how the primary and secondary stability of bone trust sinus implants (which are recommended for use in sinus augmentation regions) will be affected by the presence of the non-grooved apical region of the implant. This study compared primary and secondary stabilities of sinus implants and standard implants by RFA measurements.

Since 1996, numerous works have proven that the RFA analysis system is useful for obtaining an objective assessment of implant stability[13,14]. RFA allows implant monitoring through sequential stability measurements, as well as indirect assessment of the influence of osseous remodeling around the implant on secondary implant stability.

A previous experimental study was planned by inserting bone trust sinus implants. In this study, a total of 88 implants were inserted. The ISQ values were in the ranges of 71-84 for 4-mm-diameter sinus implants, 64-80 for the 4-mm-diameter standard implants, 63-78 for 5-mm-diameter sinus implants, and 64-80 for 5-mm-diameter standard implants. Within the limitations of this in vitro experimental study using cattle ribs, a higher primary implant stability was demonstrated for 4-mm-diameter BoneTrust® Sinus implants compared to Standard BoneTrust® implants[6].

To the best of our knowledge, no controlled clinical studies on bone trust sinus implants have been published yet in the literature.
Our study did not demonstrate a statistically significant difference, between the primary and 6th-month ISQ values of the standard implants group (group A) and sinus implants group (group B).

Despite the short follow-up period, the implant success rates of both groups were 100%. No pain, no findings of exudate, no mobility, or no radiographic bone losses were observed in any of the groups. As regards to mean bone loss, no statistically significant difference was noted between the two groups.

Conclusion

As a conclusion within the limitations of this clinical study, the use of BoneTrust® Sinus implants could present optimal ISQ values during simultaneous implant placements simultaneously with lateral sinus floor augmentation, as suggested by the manufacturer. There is a need for further studies with larger sample sizes and longer follow-up periods to fully evaluate this subject. In addition, the use of this specifically designed implant concurrently with the sinus lift osteotomy technique, which is a frequently used surgical technique, requires further evaluation as regards to the risk of membrane perforation and long-term success rates.

Source of Finance:
None declared

Conflict of Interest:
The authors declare that there are no conflicts of interest.

Authorship Contributions:
CC and TK analyzed and interpreted the patient data NA performed the surgeries and was a major contributor in writing the manuscript. All authors read and approved the final manuscript.

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CASE REPORT

Le Fort I Osteotomy with Iliac Bone Grafts and Delayed Oral Implants for the Rehabilitation of Extremely Atrophied Maxilla

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Abstract
In this case report, the rehabilitation of a severely resorbed edentulous maxilla with Le Fort I osteotomy combined with inter-positional autogenous bone grafts was presented. A 46-year-old woman applied to our clinic for the rehabilitation of edentulous maxilla and mandible. Her systemic history revealed diabetes type 1. It was seen that the maxilla was severe atrophic and inter-occlusal distance was increased due to excessive bone loss both vertically and horizontally. The patient was planned to undergo iliac bone graft with Le Fort 1 osteotomy. The maxilla was positioned 6 mm forward and 3 mm down. First, interposition grafting was performed in combination with Le Fort I surgery. Implants were placed after 4 months. Le Fort I osteotomy combined with inter-positional autogenous bone grafts gives successful results in the edentulous patient who has excessive resorption pattern with Class-III occlusal relationships and increased inter-occlusal distance.

Keywords: Le Fort I osteotomy; Iliac bone graft; Dental implants; Edentulous maxilla

Introduction
Rehabilitation of the atrophic maxilla with dental implants is troublesome for the oral and maxillofacial surgeons. Multidimensional resorption of the maxilla is seen in type V and type VI according to the classification of Cawood and Howell[1]. In particular, severe atrophy of these types of edentulous maxilla can lead not only to insufficient bone volume, but also to a negative vertical, transverse and sagittal inter-arch relationship due to the longitudinal three-dimensional resorption pattern of the maxilla[2]. In addition, maxillary sinus pneumatisation can further reduce the available bone for a reliable implant-supported dental rehabilitation. In such cases, dental implant placement may be possible with some well-known techniques such as onlay bone grafts, maxillary sinus grafting and guided bone regeneration. However, it is difficult to restore an accurate intermaxillary relationship. In these cases, the maxilla is repositioned both vertically and downwards by Le Fort I osteotomy with interposition autogenous bone grafts. Thus, both the intermaxillary relationship is corrected and sufficient bone height is provided for implant placement[3,4,5].

In this case report, we want to present the case which rehabilitated with Le Fort I osteotomy combined with inter-positional autogenous bone grafts known as the maxillary down-grafting procedure.

Case Presentation
A 46-year-old woman applied to our clinic for rehabilitation of edentulous maxilla and mandible. Her systemic history revealed diabetes type 1 and a HbA1c of 8.1. It was also learned that she had undergone dental implant surgery in another centre but she had lost the implants after 1 year due to mobility. After a detailed intra-oral and radiographic examination, it was seen that the maxilla was severe atrophic (Fig 1). Inter-occlusal distance was increased due to excessive bone loss both vertically and horizontally, and a Class-III relationship was observed. Since the patient's HbA1c was high, it was recommended that the patient first apply diet and use her medication regularly to reduce this value. HbA1c decreased to 5.9 at the end of 3 months and the patient was planned to undergo iliac bone graft with Le Fort 1 osteotomy.

The surgery was performed under general anaesthesia with nasal endotracheal intuba- tion. At the start of the operation the patient was given 1 g sefazolin. Local anaesthesia with vasoconstrictor was used to minimise bleeding in the soft tissue. A vestibular incision was made from the premolar area on one side to the other. The mucoperiosteal flap was elevated. While the sinus walls and nasal floor were exposed, the alveolar crest was not opened due to the thickness of the alveolar ridge is sufficient. The surgical procedure for the Le Fort I consisted of maxillary bilateral osteotomy from the piriform rim to the pterygoid plate, lateral nasal and septal

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osteotomy with pterygo-maxillary separation. The down-fracture was performed according to the method described by Precious et al[6]. The nasal mucosa was sutured because of the small lacerations. After that the sinus membrane was removed from the sinus floor. Since the procedure was performed with a single team, donor site surgery was started following Le fort I osteotomy. The iliac crest was exposed and cortico-cancellous bone block was harvested from the anteromedial side of the ilium in one peace. The block was cut into pieces according to the shape of the recipient region with a bone saw and the blocks were fixed with screws to the nasal and sinus floor regions of the maxilla (Fig 2). The grafted maxilla was positioned 6 mm forward and 3 mm downwards and it was stabilized by two titanium mini-plates on each side of the nasal aperture and zygomatico buttress. In addition, the gap region was supported by particulate autogenous grafts. (Fig 3-4). A few pieces of block autogenous grafts were also used to increase the vertical height of the mandibular crest. The region was primarily closed with 3-0 silk suture. The patient was hospitalised for 2 days. There was no complication on the postoperative period. The patients were instructed not to wear their removable denture during the postoperative period. After a healing time of 4 months dental implants were placed in the grafted maxilla (Fig 5-6).

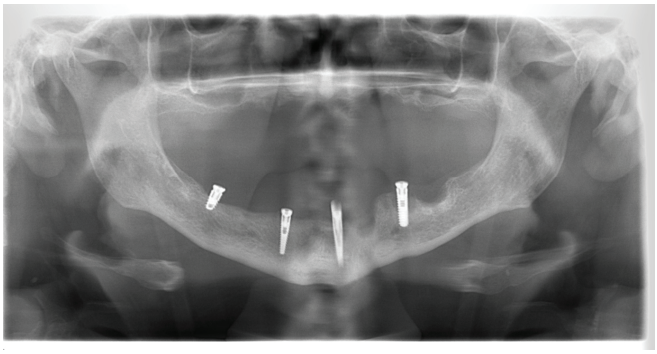

Figure1: Preoperative radiographic image

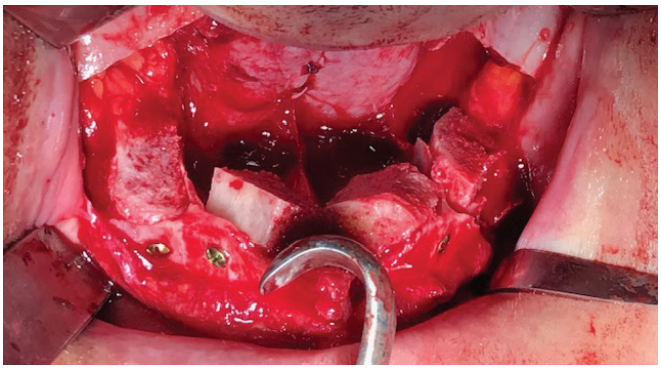

Figure 2: The received block grafts fixed to the nasal base and to the sinus region with screws.

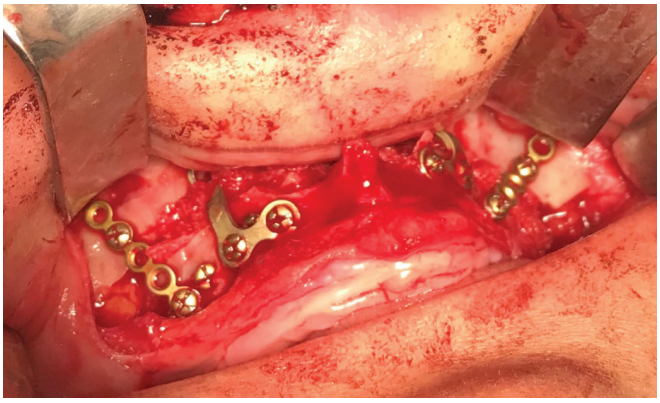

Figure 3: The maxilla was fixed to the cranial base with mini-plates and screws traditionally.

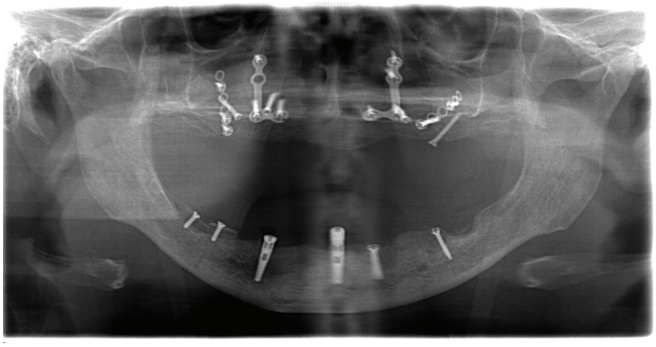

Figure 4: Early postoperative radiographic image after operation.

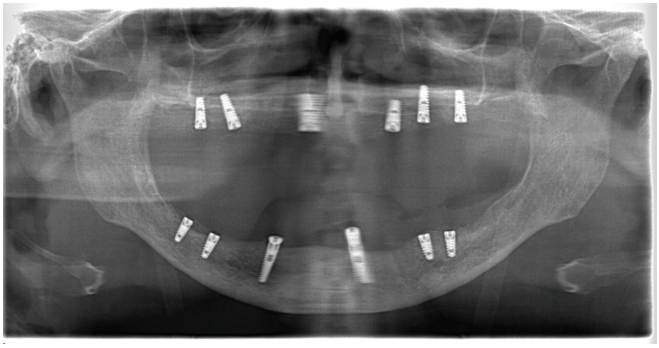

Figure 5 The dental implants were placed in the newly created bone regions.

Discussion

The main purpose of the rehabilitation of edentulous maxilla or mandible is providing bone mass to place dental implants. This can be obtained by performing some techniques including vertical or horizontal bone augmentations, sinus floor elevation and orthognathic surgery[7,8,9]. The excessive resorption of edentulous maxilla and mandible often cause Class-III malocclusion[10]. In such cases, the patient has a little chance of having a successful implant-supported prosthesis with only augmentation procedures. Therefore, there is no alternative to orthognathic surgery for the partial or complete resolution of the resulting Class-III relationship. In our case, we performed Le fort I osteotomy because there was a serious resorption and a class 3 occlusion relationship. Because of the high amount of compact bone in edentulous mandibula,

we did not perform sagittal split osteotomy in the mandible due to the possibility of bad split.

Patients who have knife-edge alveolar crests (adequate height and inadequate width bone volume) were described by Cawood and Howell as Class-IV bone resorption[1]. The cases with this resorption are contraindicated for this procedure because the thin alveolar crest remains after the Le Fort I osteotomy and the problem persists when the time for implant surgery comes.

In patients with inadequate bone height due to severe alveolar resorption (Cawood Class-V), such as a flat crest form, or in patients with significant basal bone loss (Cawood Class-VI), the intermaxillary vertical distance is increased and a Class-III relationship is evident. In such cases, Le Fort I osteotomy with inter-positional bone grafts is preferred as in our case.
For many years, Le Fort-I osteotomy has been performed in such cases. Some authors have argued that single-stage surgery (simultaneous placement of implants) has low morbidity and provides reliable long-term results[3,11]. However, others have reported that two-stage surgery gives more reliable results, that the risk of bone necrosis is reduced and that implants can be placed in more accurate positions[4,5]. In this case, we preferred two-stage surgery. Because we aimed to ensure osteointegration of the grafts in the region and to place the implants according to the final position of the jaws.

Conclusion

Le Fort I osteotomy combined with inter-positional autogenous bone grafts gives successful results in the edentulous patient who has excessive resorption pattern with Class-III occlusal relationships and increased inter-occlusal distance.

Source of Finance

No

Conflict of Interest

No conflict of interest

Authorship of Contributions

Alparslan Esen, Gökhan Gürses

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CASE REPORT

Rehabilitating Wide Maxillary Defect with Distraction Osteogenesis and Khoury Technique: Case Report

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Abstract

Maxillary and mandibular bone defects can result from injury, congenital defect or accident, or as a consequence of surgical procedures when treating pathology or defects affecting jaw bones. And with conventional bone grafting techniques, it is not possible to close these kind of defects. Distraction osteogenesis has become a very popular technique, as the ability to reconstruct combined deficiencies in bone and soft tissue makes this process unique and invaluable to all types of reconstructive surgeons. The aim of this article is to present the case of a 52-year-old female patient, who, in 2016, was operated at another center for tumour resection. After these, patient referred to our center and we treated the wide anterior maxillary bone and soft tissue defect by using bilateral alveolar cleft distractor. After narrowing the wide defect with distraction osteogenesis, khoury technique was used for rehabilitating the small defect. As a result, using cleft distractor is an effective method for rehabilitation of the large maxillary defects.

Keywords: Distraction osteogenesis, Khoury technique, maxillary defect, maxillectomy

Introduction

Maxillary and mandibular bone defects can result from injury, congenital defect or accident, or as a consequence of surgical procedures when treating pathology or defects affecting jaw bones[1]. With conventional bone grafting tecniques, it is not possible to close these kind of defects. Distraction osteogenesis (DO) is a biological process of generating new bone and soft tissue by gradual traction of the clinical bone segments[2]. This technique, which can provide skeletal advancement and expansion of soft tissue simultaneously, has became an effective surgical tecnique for patients with jaw deformities[3]. DO technique has been found to be an impressive alternative to conventional reconstruction methods with its recent popularization[3,4]. The aim of this article is to present a wide bone defect repair with combine surgical techniques.

Case Report

A 52-year-old female patient was referred to our clinic for functional oral rehabilitation, who, in 2016, was operated at another center for tumor resection. Anterior partial maxillectomy was performed, but post operatively wide anterior maxillary defect was present extending across the midline. She had a 24 mm-wide bony defect extending from the left premolar region to the maxillary anterior region. We planned closing the maxillary bone and soft tissue defect by using bilateral alveolar cleft distractor. Two cleft distractor (kılsmartin Louis cleft distractor) applied both side of the wide defect under general anesthesia with intranasal intubation. At the right side, segmental osteotomy with three teeth was done, and left side only segmental osteotomy was done without any teeth. After osteotomy, both of these distractors were applied and tested in the same session. Distraction phase started after a 7-day latency period at a rate of 0.5 mm in the morning and 0.5 mm at night for a total of 1.0 mm per day. (Figure 1)

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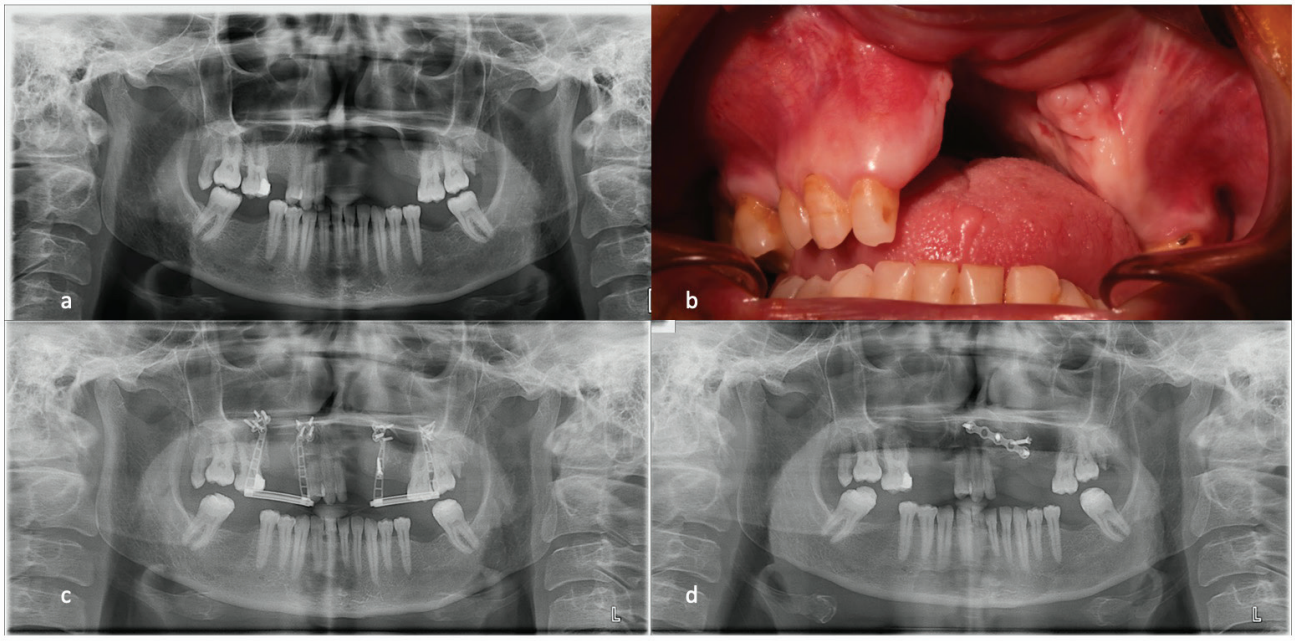

Figure 1. a) preoperative view of the patient with wide defect, b) intraoral view of the defect, c) after the activation phase of the distraction, d) final radiographic view after the khoury technique

The distractor was left in place for 3 months to allow consolidation and removed then under local anesthesia. After this phase of the surgery a 6 mm-wide bony defect remained at the anterior maxllary region. Following one-month recovery period, the patient was operated again. In this second operation, khoury technique was used for rehabilitating the small defect in the anterior maxilla region by using autogenous bone block graft material. In our operation we used the symphysal donor area for the restoration of lost horizontal alveolar bone volume in the anterior maxilla. After exposing the donor area, we used the piezo electric surgery and rotational instruments. The obtained block was mobilized manually via surgical chisels. Then it was immediately immersed into sterile saline solution to prevent dehydration. The hemorrhage in the donor bed was controlled by firm gauze pressure, and the flaps were repositioned. Subsequently, the flap was sutured using 3.0 vicryl sutures. The block was slightly trimmed for better adaptation and four osteosynthesis screws were used to fix the block bone to the recipient area. The flap was repositioned by monofilament 3.0 sutures (Vicrly, Ethicon, USA). For the initial control of hemorrhage, sterile saline-soaked gauze was applied over both wound areas. Antibiotics (Amoxicillin & clavulanic acid 1000 mg x2 daily for five days; Klamoks BID, Bilim İlaç, İstanbul, Turkey) and a 0.2 % chlorhexidine mouthwash (Klorheks, Dorgsan Pharma, İstanbul, Turkey) was prescribed to prevent the risk of infection in the post-op period. The patient was instructed to follow meticulous plaque control and a soft diet for one week. After operations mentioned above, 18 mm bone gain was obtained only by distraction osteogenesis and 6 mm bone gain with autogenous grafting.

Discussion

First introduced by orthopedists for lengthening long bones, DO in the maxillofacial complex was initially used to correct mandibular deficiencies and advancement of maxilla and midface[1]. In the dentoalveolar area, it was used to reconstruct vertical alveolar defects and, later, in other situations (ie, advancing the anterior maxilla, accelerating orthodontic treatment, resolving dental crowding)[5]. Although the technique is used to reconstruct a myriad of clinical situations and appears to be well tolerated, DO is not without its drawbacks[6]. Complications associated with this procedure include fractures of basal bone, fracture of transport segment, breakage of distractor, mechanical problems, and infection[7]. However, as shown here, the distraction osteogenesis technique by using bilateral alveolar cleft distractor is useful for orodental/alveolar rehabilitation in patients with partial maxillary defects[8].

The absence of sufficient bone volume is one of the most relevant problem in our case. Grafting from exogenous sources may provide a limited gain but exhibits poor performance in large bone defects[9]. But, autogenous bone block transfer (ABBT) from the mandibular symphysis, for example, has been used with varying rates of success[4]. The symphysal ABBT procedure was successful for the restoration of the horizontal bone defect in the anterior maxilla[4].

In conclusion, the findings of this study show that distraction osteogenesis and the treatment with using the khoury tecnique, can produce significant bone and soft tissue improvement of the maxilla. Using cleft distractor is an effective method for rehabilitation of the large maxillary defects. Also, symphysal ABBT procedure was successful for the restoration of a horizontal bone defect in the anterior maxilla.

Source of Finance:
There were no additional costs.

Conflict of Interest:
There are not any.

Authorship Contributions:
I think using cleft distractor is an effective method for rehabilitation of the large maxillary defects and symphysal ABBT procedure was successful for the restoration of a horizontal bone defect in the anterior maxilla.

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CASE REPORT

Unusual Radicular Cyst Formation Derived From Primary Teeth in Hyper Immunoglobulin E Syndrome

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Abstract

Introduction

Hyperimmunoglobulin E syndrome (HIES) is a rare genetic based multi-system disorder. It is characterized by high serum levels of IgE, pulmonary and recurrent skin infection except for these conditions abnormalities of the dentition, bones and connective tissue could be seen. The etiology of HIES is considered to be dominant-negative alterations in signal transducer and activator of transcription 3 (STAT3). STAT3 is integral to signal transduction for multiple cytokines. STAT3 is well expressed across tissue types.

Case Report

In this paper, we report a 7-year-old boy with HIES and a rare clinical manifestation regarding radicular cyst which is related to the deciduous tooth.

Conclusion

Chronic usage of antibiotics in the HIES patients can cause that sup-pressed serious lesion so that radicular cysts may be missed. Therefore, dentists should be alert on clinical and radiologic examination.

Keywords: Hyperimmunoglobulin E syndrome, HIES, Radicular cysts,

Introduction

Hyperimmunoglobulin E syndrome (HIES), also known as Job syndrome, is a rare genetic immune disorder which was first described by Davis in 1966.[1,2] Every HIES patients have increased IgE level is the 10 times greater than the upper limits of normal blood level (→2,000 IU/mL) and other common symptoms include cellulitis, staphylococcal dermatitis and folliculitis (cold abscesses), atopic eczema, recurrent pneumonia, constantly long bone fracture, osteopenia and pulmonary abscesses[1,3-6]

In patients with HIES, bacterial infections originate from Staphylococcus Group A and B, Haemophilus Influenza, Streptococci, and also other gram-negative organisms may exist. In addition, fungal infections caused by Candida albicans are most commonly seen.[3,7] Clinical findings include recurrent, severe pneumonia and furunculosis caused by Staphylococcus aureus, besides recurrent bronchitis usually occurs in infants and younger children. The abscess usually localizes in the neck, face, and scalp in that age group. Pruritic dermatitis frequently shows up around the hairline, behind the ears, and flexural areas of the body, and may turn to impetigo.[6] Sinusitis, chronic otitis media, and otitis externa are frequently seen along with "Coarse face," which consists of fleshy nasal tip and broad nasal bridge, prominent forehead, high-arched palate, irregularly proportioned cheeks and prognathism, in HIES patients (Figure 1A). Craniosynostosis case was reported infrequently. Besides recurrent fractures due to unexplained osteopenia is common in HIES patients. Oral symptoms of the HIES include retained primary teeth, cleft palate, and tongue.[1,4-6] Studies showed the failure of root resorption of primary teeth was 64%, 72%, and 75% respectively.[3,8,9]

The etiology of HIES is considered to be negative alterations in signal transducer and activator of transcription 3 (STAT3). STAT3 is integral to signal for multiple cytokines. STAT3 is well expressed across tissue types.[1] Recurrent infections and connective tissue abnormalities are linked with STAT3, which was identified in 2007.[1] T-cell differentiation-dependent processes of STAT3 lead to the failure by the alteration in

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STAT3, and this is the may be explanation of the tendency to infection in patients with HIES. Also, serum eosinophilia is laboratory finding in patients with HIES.[1,7]

Radicular cysts are known as the most common odontogenic cystic lesions of the jaws. Radicular cysts are believed to originate from proliferation of epithelial residues of Malassez as a result of inflammatory activities. Usually it is not asymptomatic until it become well developed.[10] The radicular cyst is seen mostly in the third decade of life.[11] However, studies showed that these cysts are rare in pediatric population.[12]

This report presents a patient with HIES and a rare clinical manifestation regarding radicular cyst which is related to the deciduous tooth.

Case Report

A 7-years-old boy with the diagnosis of HIES, was admitted to Kirikkale University, Faculty of Dentistry, Clinic of OMFS, regarding the prolonged retention of his mandibular incisal primary teeth. Informed consent was taken from patient's parent. The patient's medical history consisted of recurrent pulmonary infection, skin abscesses, otitis media and elevated serum IgE levels (Figure 1B). Intraoral examination revealed the presence of various dental caries and median rhomboid glossitis-like lesion distributed over less than one-third of the dorsal tongue (Figure 1C). Also, the presence of a cyst in the right mandibular corpus related to primary second molar was detected in the radiographic examination. It was assumed that the radicular cyst's size is 20mm×17mm (Figure 1D).

Ceftriaxone was admitted a day before the operation and continued five days after operation 1000 mg intravenously a day. Also, intravenous (i.v) immunoglobin (IG) was admitted two days before the operation 1000 mg for each day by pediatric staff due to consultation. The cyst and related primary teeth were removed by enucleation under general anesthesia. The removal of the cyst was performed with caution to avoid damaging neighboring vital tissues, especially the second premolar tooth germ. (Figure 1E)

The histopathologic evaluation was consistent with the radiographic appearance of a radicular cyst. The histology of the cyst showed a fibrotic cyst wall which contained proliferating strands of odontogenic epithelium and a chronic inflammatory infiltration that is rich in plasma cells. (Figure 1F)

The healing completed uneventfully, and no complications have occurred within 3 months of follow-up.

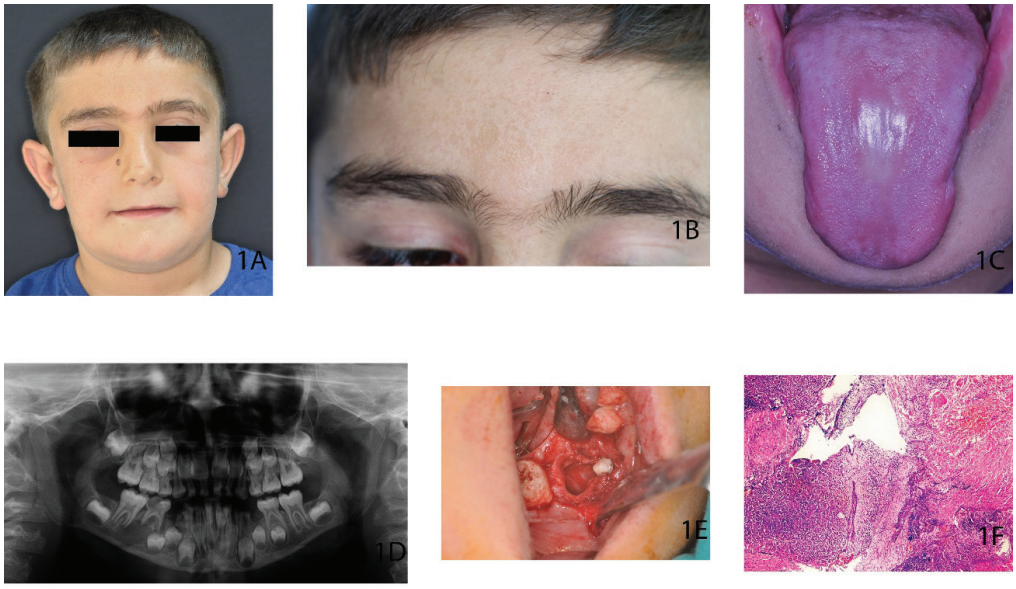

Figure 1A: HIES patient's characteristic facial appearance
Figure 1B: Patient's scars caused by the skin infections
Figure 1C: Median rhomboid glossitis-like lesion in the middle of the dorsal tongue
Figure 1D: Patient's panoramic radiograph
Figure 1E: Intra-operative vision after the removal of cyst.(there is a primary teeth germ by the cyst cavity)
Figure 1F: Chronically inflamed fibrotic wall of the radicular cyst (H-E; X100)

Discussion

HIES is characterized by high serum levels of IgE, recurrent pulmonary and skin infections, typically caused by Staphylococcus aureus and Candida albicans. Sinusitis, otitis externa and chronic otitis media are also common diseases.[4] Intermittent or long-term anti-staphylococcal antibiotics, cyclosporine, ascorbic acid and cimetidine, high-dose IVIG and interferon gamma have been used in HIES.[4] In this case, the patient has been treated with the anti-staphylococcal antibiotic, cyclosporine, and high-dose IVIG because of the recurrent skin and pulmonary infections and chronic otitis media. The patient had increased IgE level (→2,000 IU/mL).

Delayed eruption of the persistent teeth due to prolonged retention of the deciduous teeth are common oral signs of HIES patients.[8] Oral candidiasis is a common finding in the HIES patients. Also, the presence of asymptomatic midline tongue deficiency in two affected siblings has been reported.[8] HIES patients have lesions of the dorsal tongue and hard palate about 55% and 60%.[9] Our patient had prolonged retention of his mandibular incisal primary teeth and rhomboid glossitis-like lesion distributed over less than one-third of the dorsal tongue. Only 0.5-1% of all radicular cysts are associated with primary teeth.[11] This rare clinical manifestation conjunction with the primary mandibular molars (%67), respectively maxillary molars (%17), and anterior teeth.[13]

Long-term use of penicillinase-resistant antibiotics to prevent staphylococcal infection has the most successful treatment chance in HIES patients.[14] Because other antibiotics or antifungal agents are required for specific infections; they should be added, also using either trimethoprim-sulfamethoxazole or dicloxacillin with prophylaxis may prevent infections.[15] Our patient has been using IVIG regularly for 5 years and especially for his recurrent pulmonary infection that he had had recently. For the chronic otitis media treatment, he was medicated with anti-staphylococcal antibiotics and cyclosporine, so in our opinion; an acute infection was prevented unlikely the patients who are not under their control.[16] On the other hand; dentists should be aware of that an acute infection can develop in HIES patients. In the instance of infection, treatment plan should be early and aggressive, with intravenous antibiotics administration, surgical incision and drainage.[16]

Chronic usage of antibiotics in the HIES patients can cause that suppressed serious lesion so that radicular cysts may be missed. Therefore, dentists should be alert on clinical and radiologic examination.

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There is no conflict of interest

Authorship Contributions
M. Ercüment ÖNDER : Performing the operation, writing the article
Berkan ALTAY: follow-up of the patient
Fethi ATIL: follow-up of the patient
Umut TEKİN: Performing the operation
İ. Doruk KOÇYİĞİT: writing the article
Özkan ÖZGÜL: writing the article

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REVIEW ARTICLE

Complications Associated With Orthognathic Surgery

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Abstract

Introduction

Orthognathic surgery is a well-established treatment modality for the treatment of advanced dentofacial deformities. On the other hand, there are also numerous complications associated with orthognathic surgery.

Material & Methods

The purpose of this study was to review the literature for gathering and summarizing the pre-operative, intra-operative and post-operative complications associated with orthognathic surgery, providing adequate knowledge for the oral and maxillofacial surgeon.

Results

There is no consensus on the incidence of complications in orthognathic surgery but the most commonly reported complications were found to be hemorrhage, nerve damage, infection, bad splits or undesired fractures at the osteotomy lines or distant places, post-operative nausea and vomiting, aseptic necrosis, mal-union, non-union, relapse, and dental injuries. If timely precautions are not taken, the result of some serious complications such as hemorrhage and infections might even be lethal.

Conclusion

Surgeons need to be well prepared to avoid and manage all possible complications associated with orthognathic surgery and inform their patients extensively about these prior to the operation, getting their written consents. This will help prevent medicolegal issues, leading to better treatment outcomes and patient satisfaction.

Keywords: Orthognathic Surgery, Complications, Treatment

Introduction

Orthognathic surgery is a well-established method for the correction of dentofacial deformity[1,2]. Orthodontia is usually sufficient for the treatment of solely dental deformities. Orthodontists can align the teeth within the alveolar bone to achieve a functional occlusion with desirable esthetics [2].

In the presence of dentofacial deformities, applying only orthodontic treatment would not be sufficient, and a combined treatment of orthodontia with orthognathic surgery would be necessary. These patients suffer from various types of functional deformities and poor esthetics[3].

Various complications may occur in orthognathic surgery similar to any surgical operation[3]. The severity of these complications differ due to many risk factors, including but not limited to: clinical expertise of the surgeon, the surgical techniques, and the factors associated with the patient [1]. Some complications may even be lethal if not managed urgently and appropriately[4]. Complications associated with orthognathic surgery may be sub-divided into three major groups; Pre-operative, intra-operative and post-operative.

I. Pre-Operative Complications

1. Inaccurate Treatment Planning

Orthognathic surgery is a multidisciplinary subject. As such, orthodontists and oral and maxillofacial surgeons need to collaborate comprehensively for the definitive treatment planning. Surgeons and orthodontists usually don't know each other's limits in their treatments. They should therefore always decide together what is feasible and not for the patient during every single phase of the treatment. Otherwise, it might create a negative impact on the duration and/or the end result of the treatment, sometimes even causing irreversible

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situations[5].

2. Root Resorption

Apical root resorption may be an undesirable side effect of orthodontic treatment[6]. Maxillary incisors are the most effected group of teeth in terms of root resorption and mandibular incisors follow the maxillary incisors[7,8,9]. Excessive extension of the maxillary arch in class III cases may cause root resorption. The amount of expansion should be determined in advance by the analysis to be performed in the mouth and on the cast models. Additionally, if there's a lack of cooperation in between the surgeon and the orthodontist, the orthodontic treatment could be revised and/or reversed in the late phases of pre-operative planning, which could also result in possible root resorptions. If the pace of the orthodontic movements is not arranged properly, this might also result in root resorption[10].

II. Intra-Operative Complications

1. Hemorrhage

Hemorrhage occurs as a nature of all surgical operations, but excessive hemorrhage needs to be prevented. The source of the hemorrhage needs to be determined intra-operatively; hemorrhage from soft tissues and hard tissues are addressed and managed differently. Unexpected intra-operative bleeding could usually be prevented by taking a good medical history. Prothrombin time, partial prothrombin time and bleeding time tests should be requested if necessary[11].

Iatrogenic excessive hemorrhage has several reasons: lack of hypotensive anesthesia, inaccurate flap design, traumatic surgical intervention, abnormal anatomy, and the lack of surgical skills or experience. Long-term digital pressure with damp gauze pads is usually sufficient for simple soft tissue hemorrhage. During the maxillary osteotomies, maxillary, tonsillar and descending palatine arteries, and during the mandibular osteotomies, facial and lingual arteries need to be protected carefully to prevent excessive and even massive bleeding. A large amount of oxidized cellulose and/or 0.5-1g of intravenous tranexamic acid can be used to manage the hemorrhage besides using local anesthetics with epinephrine. If the bleeding vessels can be identified, they could be clamped and tied with preferably non-resorbing 3-0 silk sutures[12]. Some surgeons prefer to ligate the descending palatine arteries routinely during their Le Fort 1 osteotomies even if they are not ruptured, but there's no scientific evidence to support this application, and this might even jeopardize the viability of the maxilla. If the bleeding is severe and persistent, the external carotid artery may need to be ligated or else the situation may even be lethal[13]. Several units of blood transfusion may be necessary as required.

2. Nerve Damage and Blindness

During orthognathic surgery, infraorbital, inferior alveolar (IAN), mental, lingual and less commonly, branches of the facial nerve, might be injured[13]. Almost all patients undergoing Le Fort 1 osteotomy experience some degree of sensation loss in the maxillary teeth, buccal mucosa, palatal mucosa, alar and malar skin but these are usually transient and are expected to disappear within 6 to 12 months[13]. Marking the maxillary canine and the first molar root tips is a useful hint to prevent performing low osteotomies, the main cause of sensation loss in the maxillary teeth. Intra-operative traction of the infraorbital nerve, direct contact to the anterior, medial and posterior superior alveolar and nasopalatine nerves may cause this paresthesia. Careful retraction of the infraorbital nerve is required to prevent long lasting paresthesia in the facial soft tissues. The recovery of sensation loss varies conforming to the degree of nerve injury and the age of the patient[10]. Post-operative neurosensory loss is more common than intra-operative nerve transection injury[14].

IAN is the most affected nerve due to its anatomical position in the mandibular osteotomies. It is most commonly injured during the bone splitting of the sagittal split osteotomies. Risk factors are: low corpus height, class 2 malocclusion due to mandibular retrognathia, excessive mandibular advancement, genioplasty at the same session with the sagittal split osteotomy, and the age of the patient. The most appropriate site for the anterior vertical osteotomy is in between the first and the second molar region of the buccal bone to prevent nerve damage during the sagittal split osteotomy. This area usually has the thickest bone and the inferior alveolar nerve is the farthest from the lateral cortex[13]. When the osteotomy is completed, one should carefully check the position of the IAN and free it from the proximal segment with a blunt instrument if it is found to be attached to this segment. Before plating or placing transcortical screws for fixation in the mandible, care should be taken not to compress the nerve as well[13].

Neurosensory loss in the chin and lower lip area is caused not only by IAN damage but also due to mental nerve injury during genioplasty. Excessive dissection should be avoided in the area, and myelin sheath of the mental nerve should be protected if ever possible. Some of these cases may be accompanied by the asymmetry of the lower lip however it is often unclear whether this complication is the result of motor nerve injury or direct muscle trauma[13]. As the age of the patient increases, the chance of lower lip paresthesia to be permanent also increase[15].

Lingual nerve injury usually occurs due to the inaccurate flap design, careless lingual retraction or due to over drilling or placement of excessively long bicortical fixation screws during sagittal split osteotomy[15]. Fortunately this complication is fairly rare and usually transient[13].

Facial nerve injury is uncommon and may rarely result due to the setback of the distal segment and placement of a retractor in the posterior ramus[16].

To prevent permanent nerve damages, operations need to be performed under good direct visualization of the field, with good lighting, and excessive tensile forces and traumatic procedures need to be avoided[13].

In case of a direct visualization of complete transection of any of the associated nerves during orthognathic surgery, it is recommended to suture it with 6-0 or 8-0 monofilament

nylon microsurgical sutures under magnification with direct clear view[13]. If the patient presents with dysesthesia findings post-operatively, a close follow-up needs to be carried out routinely for two months to see if surgical nerve repair would be necessary, and the patient needs to be referred to an oral and maxillofacial surgeon with the expertise of nerve repairs.

Post-operative abducens nerve (CN VI) paralysis and oculomotor nerve (CNIII) damage have also been reported. Optic nerve (CNII) injury causes blindness and this is undoubtedly one of the worst complications to be encountered during orthognathic surgery. A few cases were reported where xerophthalmia (dry eye) has been caused by damage to the secretory fibers of CN VI[15] .

3. Incorrect Osteotomy Lines and "Bad Splits"

This complication is most commonly seen in the sagittal split ramus osteotomy, which is a technique-sensitive procedure, where meticulous osteotomy lines need to be performed. Due to anatomical variations, it might be difficult to establish ideal osteotomy lines. As a result, undesirable fractures of the osteotomy line may occur[17].

Before the osteotomy, guidelines should be marked with a bur or sterile pencil to prevent complications. Incorrect osteotomy lines, generally occurs in the lower part of the lateral vertical osteotomy if marking is insufficiently made. The badly fractured segment needs to be stabilized by rigid fixation methods. Fractures may occur in the buccal region of the proximal segment; this commonly happens in excessive advancements of the mandible where the proximal and distal fragments are almost non-contacting. In such cases, the condylar position is also difficult to maintain[13].

Fractures may also occur above the subcondylar region in some cases. If so, initially, the fractured segment of the condyle needs to be anatomically repositioned and fixated; following this, the sagittal split osteotomy segments needs to be fixated[13].

In some other cases, fractures may occur on the lingual region of the proximal segment. Presence of a wisdom tooth could increase bad splits in the mandible. Therefore, extraction of these teeth is recommended at least 6 to 9 months before the operation. Additionally, incomplete osteotomy lines in the medial horizontal ramus may cause undesired fractures in the sagittal split osteotomies. In such cases, the free lingual segment needs to be fixated to the proximal segment with two cortical screws[3].

Fracture of the pterygoid lamina, instead of the pterygoid plates, is another possible complication in the Le Fort 1 osteotomy. Careful use of appropriate tools is a necessity. Apart from the pterygoid lamina, avulsion of the vomer and fracture lines may occur in the sphenoid bone and middle cranial fossa. The fracture of the anterior wall of the maxillary sinus may occur when creating modified osteotomy lines, which should be treated with plate-screw fixation[13].

Too inferiorly planned osteotomy lines in Le Fort 1 osteotomies can result in cutting the apices of some teeth (canines and first molars) and too superiorly planned osteotomy lines could damage the infraorbital nerves; as such, these need to be avoided.

III. Post-Operative Complications

1. Dental Injuries

Fracture of a tooth or burring a segment of a tooth may occur during interdental, maxillary and mandibular osteotomies. Osteotomy lines need to be marked to prevent injury to the root tips of maxillary and mandibular teeth and there should be at least 5mm of distance in between the osteotomy line and the teeth. This distance should ideally be 10mm, however it is not always possible to establish an ideal osteotomy line due to anatomic variations. Periapical films could be helpful to measure the safe distance[3]. Tooth discoloration could be observed in the post-operative follow-ups, indicating a possible necrosis. Necrotic teeth need to be root canal treated to prevent periapical pathology.

2. Infection

Post-operative cellulitis, abscess, maxillary sinusitis and osteomyelitis may be seen. Infection rate is fortunately fairly low in today's world thanks to aseptic techniques. If an infection develops, it can usually be adequately treated with early diagnosis[18]. Small infectious areas could be treated with incision and drainage and administration of systemic and/or local antibiotics. For larger infectious areas, aggressive debridement, bone grafting or both of these could be applied[4]. Studies show that infection rate after mandibular osteotomies is higher compared to maxillary osteotomies and double jaw operations have a higher infection rate compared to single jaw operations[4,18,19].

3. Hematoma and Edema

Edema is intercellular blood plasma fluid and is a natural response to surgical trauma. Excessive edema could be prevented using atraumatic surgical skills, post-operative intermittent application of cold (ice) to face and use of non-steroid antiinflammatory drugs and corticosteroids[20]. Mini vacuum drains may also help in reducing post-operative edema[21].

Hematoma should be considered if there is significant post-operative pain, severe swelling, and local thermal increase over the skin. Ultrasonography could be used to confirm diagnosis. Hematoma needs to be treated by drainage because it may not resolve on its own and could get infected. The rapid increase in the size of a hematoma may be a sign of arterial bleeding; in such a case, first the arterial bleeding should be managed in a timely manner and then the hematoma needs to be drained consecutively.[10]

4. Change of Nasal Morphology

Nasal morphology changes post-operatively in maxillary osteotomies with the repositioning of the bony structures. Patients should be informed about the possible need for an additional post-operative rhinoplasty if maxillary osteotomies cause an unfavorable esthetics in the nose[22].

The position of the anterior nasal protrusion, septal cartilage and vomer should all be evaluated during the operation prior to plating. Especially in maxillary impaction cases, these structures may be compressed and thus deviations from the midline might occur, which may result in airway obstruction[23]. In order to prevent this, a portion of the lower nasal septal cartilage should be removed, and a groove should be prepared on the maxilla for the septum to be seated passively. If septum deviation is permanent post-operatively, a septoplasty could be performed[24]. Some surgeons also choose to suture the nasal septum, using non-resorbable sutures, to the anterior nasal protrusion to prevent it from buckling.

Another important point to consider is to place a synch suture to prevent alar base widening post-operatively[25]. Again, a non-resorbable suture needs to be used for this purpose.

5. Salivary Gland Injury

Parotid gland damage is usually seen following operations with an extra oral approach. There may be pain, swelling, sialocele and fistula formations in the parotid area[26].

6. Sinus Pathology

Chronic sinusitis after Le Fort 1 osteotomy is rare[27]. Infection may develop post-operatively due to hematoma in the maxillary sinus. It could be prevented by peri-operative prophylactic antibiotic use and post-operative maintenance therapy with decongestant drugs. The development of sinus infection may be associated with pre-existing sinus disease, smoking, or other odontogenic infections that may result from tooth damage, the presence of debris or foreign bodies within the sinus[27].

7. Malocclusion

Postoperative malocclusion may result from undetectable interferences during intermaxillary fixation of the Le Fort 1 osteotomy. It can be seen as a result of relapse in maxillary transverse irregularities or due to condylar resorption in the long term[28]. This topic is further discussed in the "Relapse" section.

8. Fistula Formation

It usually occurs due to perforation of the palatinal mucosa during maxillary osteotomies. Oronasal or oroantral fistulas may occur most commonly in the area where the palatinal mucosa is thinner due to osteotomy and expansive forces in the palatinal midline. Extension of the palatal mucosa more than 6-8 mm is a risk factor[2].

9. Epiphora

Epiphora occurs if there's excessive tear production or if the nasolacrimal duct is blocked causing the tears to accumulate in the eye. It could be seen following Le Fort 1 osteotomy, and/or during partial inferior turbinectomy (if it is performed above the lateral nasal wall resulting in nasal mucosal edema). It often heals spontaneously. If excessive tear flow persists for 3 weeks, a silicone tube between the tear sac and the nasal cavity can be placed to keep the duct open[29].

10. Frey's Syndrome

Frey's Syndrome is a result of auriculotemporal nerve damage[30]. Parasympathetic fiber degeneration occurs and sweat glands are affected. Sweating of the cheeks during chewing is a typical sign. Botulinum toxin is injected for treatment[31].

11. Avascular (aseptic) Necrosis

A large portion of blood flow in the maxilla is reduced during the first post-operative period due to various causes such as hypotensive anesthesia, osteotomies and/or clamping the vessels feeding the maxilla. However, since maxilla is a highly vascularized bone and is well perfused, avascular necrosis is a rare complication following Le Fort 1 osteotomy with an incidence less than 1%[32].

Some of the complications associated with diminished blood flow in the maxilla are devitalization of teeth as a result of disruption of the blood supply, periodontal defects, gingival papillary necrosis, alveolar necrosis or necrosis of bony segments[32].

The risk factors associated with the etiology of avascular necrosis are: Surgical procedures of the maxilla involving more than two bony segments, advancement of the segments over 10 mm, inadequate irrigation during osteotomies causing excessive heat production, insufficient segment stabilization, pressure caused by palatal plaque, diseases affecting vasculature, diseases impairing wound healing, smoking, and prolonged hypotensive anesthesia. If maxillary perfusion is not followed up adequately in the early phases of the post-operative period, signs of avascular necrosis may be missed causing serious outcomes.

During mandibular osteotomies, the blood supplies must be protected in order to prevent segmental devitalization of soft tissue and muscle attachments. The necrosis of the proximal segment during mandibular osteotomies is mostly seen in the intraoral vertical subcondylar osteotomy. The reason for this is the lack of adequate blood supply as a result of excessive removal of periosteum attachments[13].

12. Temporomandibular (TMJ) Problems

A very small percentage of orthognathic patients experience TMJ problems. However, class II patients with open or deep bites and patients having dentofacial deformities with immature dental contacts are more prone to experiencing TMJ problems[33,34]. On the contrary, TMJ disorders can be improved after orthognathic surgery since the function is improved with correct positioning of the jaws[35]. However, this doesn't mean that the orthognathic surgery should be the first choice for TMJ disorders; instead, adequate TMJ treatments need to be carried out for TMJ patients[36].

After orthognathic surgery, some patients may experience a restricted mouth opening. In these cases, normal mouth opening can be restored up to two years with post-operative physiotherapy[37].

13. Temporomandibular Condyle Resorption

In order to be able to speak of a condyle resorption, there should be at least a shortening of the condyle by 2 mm and

a decrease in the ramus height of 6% or more compared to the pre-operative panoramic film. Condyle resorption or progressive condyle remodeling occurs in 5-10% of all surgical patients[28].It has been reported that condyle resorption is more frequent in patients with TMJ problems. In addition, excessive amount of mandibular advancement is a risk factor for condyle resorption[15]. Condylar resorption affects the volume of the condyle and the condyle-fossa relationship in three directions of space. This causes the occlusion to deteriorate towards class II and open bite[37].

14. Non-union or Mal-union of the Osteotomy Lines

Major risk factors for non-union and mal-union are inadequate fixation and the amount of mobility in between the bony segments[10]. Additional fixation is necessary in cases such as sleep apnea patients where the jaws will be advanced at least more than 7 mm. There may also be a need for an interpositional block bone grafting when there's a disimpaction of the maxilla over 5mm[38].

15. Relapse

Relapse is a very unpleasant post-operative change in time following orthognathic surgery[10]. The amount of tension and mobility in the osteotomy sites and the type of management of the soft tissues and muscle attachments, mandibular growth angle, surgeon's experience, growth potential, adequate pre-operative planning and treatment are all factors associated with relapse after orthognathic surgery[1,39]

Relapse could occur either in early post-operative period or in late phases of healing. Early relapse is commonly associated with the fixation method and the osteotomy technique. Late relapse occurs more often as a result of unstable forces in the stomatognathic system. In general, changes that occur less than 2 mm after treatment are not clinically significant; however changes greater than 2 mm are interpreted as relapse[40].

Studies have found that the maxillary impaction is the most stable orthognathic movement. Retracting the mandible, downward movement of the maxilla and transverse maxillary movements were found to be the least stable orthognathic procedures[14].

Many factors affect the stability of the mandible after surgical advancement. Advancement of more than 7 mm is more prone to relapse. Surgical advancement of the mandible causes stretching of the soft tissues, periosteum and the supra-hyoid muscles. These structures are further stretched when the surgical procedure is combined with the advancement of the chin[39]. In the sagittal split ramus osteotomy, anticlockwise rotation of the distal segment has been reported to cause more relapse than clockwise rotation. Mandibular advancement by counterclockwise rotation of the occlusal plane is a stable procedure in patients with healthy TMJ, while significant relapse may be seen in patients with previous existing TMJ problems. Malocclusion may be encountered when sagittal split ramus osteotomy is applied to growing individuals with Class III[36].

When the stability of the maxillary procedures is evaluated, it is stated that the rate of relapse is slightly higher when Le Fort 1 osteotomies are simultaneously combined with other operations. Maxillary advancements and disimpactions have accentuated soft tissue effects; therefore the risk of relapse increases. The relapse risk also increases with post-operative changes in the condylar position in an inferior and posterior direction[11].

16. Emotional and Psychiatric Problems

Difficulty in eating and drinking due to intermaxillary fixation after orthognathic surgery is a challenging process due to swelling and pain. Patients should be well informed prior to operation about the post-operative nutrition period. The aesthetic expectations of the patient should be thoroughly discussed and the patient should be given explanatory brochures with the most common complications.

Uncomfortable presence in the operating room and unrecognized psychological disorder prior to the operation may negatively affect the post-operative psychiatric behavior. Emotionally unstable individuals with body dysmorphic disorder may become more aggressive post-operatively and are difficult to control. Sleep apnea patients with large bimaxillary advancements may also be difficult to manage post-operatively in terms of fear of being unable to breathe. Psychiatric consultation before and after surgery is necessary in these patients[10].

Conclusion

Orthognathic surgery is a commonly used treatment modality in the treatment of dentofacial deformities. Orthognathic surgical procedures also do have complication risks as every other surgical procedure. However, these operations appear to be safe procedures if they are performed by experienced surgeons in accordance with well-established surgical principles. Surgeons should inform their patients about possible complications prior to the operation and obtain the necessary consent. The patient's wishes should be discussed thoroughly prior to the operation and their expectations need to be evaluated in detail. Complications directly affect patient satisfaction and leave a negative impression following the operation. The secret to patient satisfaction is providing aesthetics and function as well as a comfortable operation and a painless, uneventful post-operative period.

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