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Comparison of the Efficiency of Two Different Methods in Orthognathic Model Surgery in Models with Anterior Skeletal Open Bite

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Abstract

Objective: This study compares the success of the piezoelectric and conventional methods in orthognathic model surgery.

Material and Method: In this study, plaster models obtained on phantom models were used. Anterior skeletal open bite models for maxillary subapical osteotomy planning were created and 50 maxilla models were included in the study. Twenty-five plaster models were prepared for model surgery with a piezoelectric device, and 25 models were prepared for subapical maxillary osteotomy surgery with a handpiece device. Statistical significance was accepted as (p<0.05).

Results: The study was carried out on a total of 50 plaster models, 50% (n=25) of which were applied piezo surgery and 50% (n=25) of the handpiece method, at Van Yüzüncü Yıl University Faculty of Dentistry in 2022. According to the methods, no statistically significant difference was found between the incidence of model breakage on plaster (p>0.05). The osteotomy time of the plaster model in which piezosurgery was applied was statistically significantly higher than the plaster model with the handpiece applied (p=0.001; p<0.01). There was no statistically significant difference between osteotomy times in the plaster model with piezosurgery and the model fracture (p>0.05). According to the model fracture, there was no statistically significant difference between osteotomy times in the plaster model applied handpiece (p>0.05).

Conclusion: In this study, it was observed that the surgical handpiece method was faster than the piezo surgical method in terms of the procedure time.

Keywords: *Handpiece, Model surgery, Orthodontics, Piezo surgery.*

Anterior İskeletsel Açık Kapanışa Sahip Modellerde Ortognatik Model Cerrahisinde İki Farklı Yöntemin Etkinliklerinin Karşılaştırılması

Özet

Amaç: Bu çalışmanın amacı, ortognatik model cerrahisinde piezoelektrik ve geleneksel yöntemin etkinliğinin karşılaştırılmasıdır.

Gereç ve Yöntemler: Bu çalışmada fantom modeller üzerinde elde edilen alçı modeller kullanılmıştır. Maksiller subapikal osteotomi planlaması yapılan anterior iskeletsel açık kapanış modelleri oluşturulmuş ve 50 maksilla modeli çalışmaya dahil edilmiştir. 25 alçı model piezoelektrik cihazı ile 25 model ise piyasemen cihazı ile subapikal maksiller osteotomi cerrahisi için model cerrahisine hazırlandı. İstatistiksel anlamlılık $p<0,05$ olarak kabul edildi.

Bulgular: Çalışma 2022 yılında Van Yüzüncü Yıl Üniversitesi Diş Hekimliği Fakültesi'nde %50'si (n=25) piezo cerrahi, %50'si (n=25) piyasemen yöntemi uygulanan toplam 50 alçı model üzerinde yapılmıştır. Yöntemlere göre alçı üzerinde model kırılması görülme oranları arasında istatistiksel olarak anlamlı farklılık saptanmamıştır ($p>0,05$). Piezo cerrahisi uygulanan alçı modelin osteotomi süresi, piyasemen uygulanan alçı modele göre istatistiksel olarak anlamlı düzeyde yüksek saptanmıştır ($p=0,001$; $p<0,01$). Piezo cerrahisi uygulanan alçı modelde model kırığına göre osteotomi süreleri arasında istatistiksel olarak anlamlı farklılık saptanmamıştır ($p>0,05$). Piyasemen uygulanan alçı modelde model kırığına göre osteotomi süreleri arasında istatistiksel olarak anlamlı farklılık görülmemiştir ($p>0,05$).

Sonuç: Bu çalışmada cerrahi piyasemen yönteminin işlem süresi açısından piezo cerrahi yönteminden daha hızlı olduğu görülmüştür.

Anahtar Kelimeler: *Model cerrahisi, Ortodonti , Piezo cerrahi, Piyasemen, Model cerrahisi.*

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Introduction

Many treatment methods for the correction of the dentofacial structure are recommended by orthodontists to patients and/or parents. Proffit[1] offers growth modification, camouflage treatment of skeletal incompatibility or orthognathic surgery treatment for patients with skeletal problems.[1] Nowadays, orthodontic treatments have moved to invasive dimensions due to the increase in aesthetic expectations. The most important thing to do in the preoperative period in orthognathic surgery is occlusion, for this a stable occlusion must be provided.[2] Orthodontic preparation is critical to the success of orthognathic surgery. Preparation before orthognathic surgery is critical to surgical success, and inappropriate treatment planning is often the source of adverse outcomes or complications.[3] In orthognathic surgery, a planning system is required to detect occlusion problems, the amount of osteotomy to be performed, and the changes in the position of the model segments. One of the common auxiliary tools that we can use for this is modelling.[4] Model surgery provides guidance in the measurement of tissue volumes to be removed and added to the newly repositioned osteotomy segments, and these measurements can move a few millimeters specifically in a limited way, but complex three-dimensional movements are difficult.[4]

The plaster model method, which is taken into the articulator, is frequently used to transfer the measurements of patients undergoing orthognathic surgery in the treatment planning to real surgical procedures.[5] One of the most common mistakes in orthognathic model surgery occurs when placing the models in the articulator.[6] In order to maximize the accuracy of orthognathic surgery by comparing surgical changes with model surgery, it becomes important in modeling incisions.[7] Traditional methods such as jigsaws are used while making incisions in these models. Piezoelectric surgery device is a system developed to cut bone with micro vibrations and allows the amount of vibration to be adjusted digitally. The most important advantage is that it recognizes the hardness of the material, makes the incision line more straight and makes selective cutting.[8,9] Since the precision of preoperative modeling is important in orthognathic surgery, the aim of our study is to compare the sensitivity, reliability and success of the measurements with

the Piezoelectric and conventional method. Our Null hypothesis is that there is no difference between the piezo surgery method and the handpiece method in orthognathic surgical incisions.

Material and Method

This study was carried out in Van Yüzüncü Yıl University Faculty of Dentistry, Department of Orthodontics. In this in vitro study, plaster models obtained on standard phantom models produced as fabrication were used. In this study, after all the plaster models on the phantom models were obtained within a period of 10 days, the model surgery procedures were completed within 1 week. The study was carried out in 2022.A total of 50 maxilla models to be planned for orthognathic surgery were divided into two groups. Anterior segmental osteotomies planned for the treatment of open bite were performed on models. Model surgery was performed by a 3-year-old surgical assistant (OS) and under the control of an associate professor. The models were first taken to the articulator by the assistant of Oral and Maxillofacial Surgery of Van Yüzüncü Yıl University Faculty of Dentistry and the maxillary first premolars were scraped up to the cervical level on the articulator. Vertical osteotomies starting from the mesiodistal midpoint of the first premolar teeth were combined with a horizontal osteotomy, parallel to each other. In group 1, piezosurgery device (EMS Piezon Master Surgery, EMS Electro Medical Systems Company Nyon, Switzerland) on 25 models, in group 2, handpiece device on 25 models (Coxo, CX.235-2F, Coxo Medical Instrument Co. , Ltd., China) was used. Piezosurgery method, with E-BS1 tip under saline irrigation and cooling in all models, at maximum speed; In the method performed with the handpiece, 1:1 reduction handpiece connected to the physiodispenser device (NSK SurgicAP, ISD-900, NSK Co., Tokyo, Japan) was applied with a 1mm thick fissure bur at 2000 rpm under saline irrigation and cooling in all models. Surgical procedures in group 1 or group 2 were performed in the articulator according to the established protocols. All models were mobilized with a cement spatula. According to the desired occlusion, the desired overjet-overbite relationship was achieved and the models were fixed with wax after adjustments were made. In this way, model surgeries were performed (Figure 1, Figure 2,

Figure 1. Preparation of plaster models from silicone-based material

Figure 2. Model's fixation with wax after mobilization.

Figure 3. Model before and after osteotomy.

Statistical Reviews

Statistical evaluations were made with the NCSS (Number Cruncher Statistical System) program. Descriptive statistical methods (mean, standard deviation, median, frequency, percentage, minimum, maximum) were evaluated. The conformity of the quantitative data to the normal distribution was evaluated with the Shapiro-Wilk test and graphical examinations. Student-t test was used for comparisons of normally distributed quantitative variables between two groups, and the Mann-Whitney U test was used for comparisons between two groups of non-normally distributed quantitative variables.

Pearson chi-square test was used to compare qualitative data. Statistical significance was accepted as $p<0.05$.

Results

The study was carried out on a total of 50 plaster models, of which 50% (n=25) piezoelectric and 50% (n=25) handpiece method were applied at Van Yüzüncü Yıl University Faculty of Dentistry.

No statistically significant difference was found between the incidence of model breakage on plaster according to the methods ($p>0.05$). The osteotomy time of the piezoelectric applied plaster model was found to be statistically significantly higher than the hand-held plaster model. ($p=0.001$; $p<0.01$). (Table 1, Figure 1)

Table 1. Evaluation of Model Fracture Presence and Osteotomy Times According to Methods

		Piezosurgery	Handpiece	Total	*p*
Model Fracture	**Absence**	18 (72,0)	18 (72,0)	36 (72,0)	[a]**1,000**
	Presence	7 (28,0)	7 (28,0)	14 (28,0)	
Osteotomy Time	*Mean±Sd*	7,43±1,78	4,10±0,84	5,76±2,18	[b]**0,001****
	Median (Min-Max)	7,07 (4,2-10,5)	4,11 (2,4-6,2)	5,30 (2,4-10,5)	

[a]*Pearson Chi-Square Test* [b]*Student-t Test* ***p<0,01*

There was no statistically significant difference between osteotomy times in the plaster model with piezo surgery compared to the model fracture ($p>0.05$). There was no statistically significant difference between osteotomy times in the plaster model applied handpiece compared to the model fracture. ($p>0.05$) (Table 2)

Table 2. Evaluation of Osteotomy Times According to the Presence of Model Fracture in Methods

Mead±Sd		Osteotomy Time		
		Median (Min-Max)	*p*	
Piezosurgery	**Model Fracture (-)**	7,44±1,76	7,14 (4,2-10,12)	[c]**0,694**
	Model Fracture (+)	7,39±1,99	6,28 (5,53-10,50)	
Handpiece	**Model Fracture (-)**	4,03±0,63	4,07 (3,2-5,29)	[c]**0,586**
	Model Fracture (+)	4,26±1,28	4,38 (2,41-6,17)	

[c]*Mann Whitney U Test*

Discussion

The aim in orthognathic surgery is to position both the maxilla and the mandible in the three-dimensional plane to the desired region, and as a result, to provide both functional and aesthetic benefits. Positioning both the maxilla and the mandible in the three-dimensional plane to the desired region not only has an effect on the appearance of the chin, but also has effects on the lower and upper lips and nose, which are repositioned on these structures. During the surgical planning, which occurs primarily in the desired harmony of the bone segments with the orthognathic surgery planning, the soft tissue changes that are secondary to the surgical procedure should also be considered. The maxilla, which has a complex structure in terms of anatomical diversity and neighborhoods, has a more difficult anatomy than the mandible.[10]

Obtaining the desired functions of the jaws, functional occlusion, ideal soft tissue aesthetics and its retention are the goals of orthognathic surgery.[11] Good planning is very important for success in orthognathic surgery.[12,13] The main lines of orthognathic surgery procedures consist of the following steps:[14] History and clinical examination, cephalometric evaluation, examination of intraoral examination and occlusion, evaluation for orthodontic treatment, model surgery and splint construction, fixation techniques.

Dental models and facial arch should be transferred to the articulator in order to evaluate the degree of anomalies in the jaws, the alignment of the arches of the teeth in the maxilla and mandible, and the cant formed in the occlusion in three dimensions. Model surgery is needed to evaluate the two-dimensional data obtained in cephalometric evaluation in three dimensions, and how to move the maxilla and mandible in this way is evaluated.[15,16]

Traditional model surgery; creating reference planes on the models, measuring the distance between the teeth and the reference planes, dividing the models into segments, determining the segments according to their new positions in accordance with surgical treatment purposes, and acrylic splint production stages.[15,17] Because traditional model surgery involves multi-stage laboratory procedures, it is very difficult for clinicians to spend a lot of time. Model surgery applications involving different treatment plans or in more complex two jaw surgery ca-

ses; it takes more time than a surgical operation.[15, 16]

In traditional model surgery, errors may occur in the arrangement of reference planes, the creation of segments of the models, the three-dimensional repositioning of the maxilla and the evaluation of the motion ratios of the segments. Especially in the repositioning of the maxilla, the reliability rate is discussed. In order to reduce these errors, special tools and techniques are used; however, these tools are difficult to use because of their complexity and some limited use.[18, 19]

When the literature is review, digital methods have started to replace the traditional method in model surgery before orthognathic surgery in recent years. 3D imaging and intraoral scanning methods depending on the developing technology; It can transfer the hard and soft tissues of the patient's mouth, chin and face to the computer environment and allows planning with specific programs. It has become possible to produce surgical splint or splintes suitable for the case by making surgical planning on the program without the need for any model. This, like model surgery, has eliminated the need for many procedures that are needed and necessary in the traditional method.[19] Besides the many advantages of the digital method, the biggest disadvantage is the extra cost it brings to the patients. Cost calculation should also be taken into account when planning patients, and the traditional method can be preferred, especially in planning involving segmental osteotomies where total jaw movement is not desired.

When traditional model surgery methods were examined in the literature, no study was found comparing piezo surgery and surgical handpiece. In this study, it was observed that there was no difference between the piezo-surgical and surgical handpiece methods in terms of model breakdown. It has been observed that the procedure time is shorter in the surgical handpiece method. These results show that the use of surgical handpiece is more advantageous in cases where model surgery is planned. These results do not support our null hypothesis. It should be noted that piezo surgical equipment with different brands and tips may yield different results.

Conclusion

In this study, it was observed that the surgical handpiece method was faster than the piezo surgical method in terms of the procedure time. In cases where model surgery is considered, it will be more advantageous to perform osteotomies by surgical handpiece.

References

1. Proffit WR, Phillips C, Douvartzidis N. A comparison of outcomes of orthodontic and surgical-orthodontic treatment of class II malocclusion in adults. Am J Orthod Dentofac Orthop. 1992;101(6):556-65.

2. Anwar M, Harris M. Model surgery for orthognathic planning. Br J Oral Maxillofac Surg. 1990;28(6):393-7.

3. Larson BE. Orthodontic preparation for orthognathic surgery. Oral Maxillofac Surg Clin North Am. 2014;26(4):441-58.

4. Lockwood H. A planning technique for segmental osteotomies. Br J Oral Maxillofac Surg. 1974;12(1):102-5.

5. Tsang ACC, Lee ASH, Li WK. Orthognathic model surgery with LEGO key-spacer. J Oral Maxillofac Surg. 2013;71(12):2154.e1-9.

6. Bowley JF, Michaels GC, Lai TW, Lin PP. Reliability of a facebow transfer procedure. J Prosthet Dent. 1992;67(4):491-8.

7. Sharifi A, Jones R, Ayoub A, Moos K, Walker F, Khambay B, vd. How accurate is model planning for orthognathic surgery? Int J Oral Maxillofac Surg. 2008;37(12):1089-93.

8. Robiony M, Polini F, Costa F, Vercellotti T, Politi M. Piezoelectric bone cutting in multipiece maxillary osteotomies. J Oral Maxillofac Surg. 2004;62(6):759-61.

9. Gruber RM, Kramer FJ, Merten HA, Schliephake H. Ultrasonic surgery an alternative way in orthognathic surgery of the mandible; A pilot study. Int J Oral Maxillofac Surg. 2005;34(6):590-3.

10. Rosen HM. Aesthetic orthognathic surgery. Mathes JM Ed. Plastic Surgery, Vol. 2, China: Saunders. 2006:649-86.

11. Bergamo AZN, Andrucioli MCD, Romano FL, Ferreira JTL, Matsumoto MAN. Orthodontic– surgical treatment of class III malocclusion with mandibular asymmetry. Braz Dent J. 2011;(22): 151–56.

12. Guven O. Sınıf III vakalarında ortognatik cerrahi (vaka raporu). Turk J Orth 1998; 1:245–48.

Enacar A, Aksoy AÜ. Ortognatik cerrahi uygulanmış vakalarda profil değişiklikleri. Turk J Orth. 1988; 1:80–9.

14. Olmez H, Sağdıç D, Bengi O, Şengün O. İskeletsel sınıf III olgularda ortognatik cerrahi (iki olgu nedeniyle). Turk J Orth. 1994; 7:213–16.

15. Gosain AK. Plastic Surgery Educational Foundation DATA Committee. Distraction osteogenesis of the craniofacial skeleton. Plast Reconstr Surg. 2001;107(1):278-280.

16. Bong Chul K, Chae Eun L, Wonse P, Moon-Key K, Piao Z, Hyung-Seog Y ve ark. Clinical experiences of digital model surgery and the rapidprototyped wafer for maxillary orthognathic surgery, Oral Surg Oral Med Oral Pathol Oral Radiol Endod. 2010.

17. Profitt WR, White RP, Sarver DM. Contemporary Treatment of Dentofacial Deformity. 2002. ISBN 0-323-01697-9.

18. Baek SH, Kang SJ, Bell WH, Chu S, Kim HK. Fabrication a surgical wafer splint by three-dimensional virtual model surgery. Bell WH, Guerrero: 80 Distraction osteogenesis of the facial skeleton. Hamilton: BC Decker Inc. 2007:115–30.

19. Ghanai S, Marmulla R, Wiechnik J, Mühling J, Kotrikova B. Computer-assisted three dimensional surgical planning: 3D virtual articulator: technical note. Dent J Oral Maxillofac. 2010:39:75-82.