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Effects of Third Molars on Anterior Crowding and Relapse After Orthodontic Treatment

Ortodontik Tedavi Sonrası Üçüncü Molar Dişlerin Anterior Çapraşıklık ve Relaps Üzerine Etkilerinin Değerlendirilmesi

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ABSTRACT

Aim: This study aimed to evaluate the effect of the absence or presence of third molars on the relapse of mandibular incisor crowding after orthodontic treatment and to determine the indication for prophylactic third molar extraction in orthodontic patients based on Ganss ratios.

Material and Methods: The study was conducted with the dental models, panoramic and lateral cephalometric radiographs, and intraoral and extraoral photographs of 42 patients (26 females, mean age 16.56±4.96 years; 16 males, mean age 17.52±4.39 years). Data were collected at three time points: before (T1), at the end of (T2), and at least 2 years after the end of orthodontic treatment (T3). The patients were divided into two groups: those with impacted or erupted third molars (Group 1, n=22) and those with agenesis or extracted third molars (Group 2, n=20). Panoramic radiographs were used to determine the presence or absence of third molars at the three time points and to calculate Ganss ratio (GR) (1). Dental models were scanned with the 3 Shape TRIOS oral scanner (3 Shape Co. Copenhagen, Denmark) and mandibular anterior crowding was assessed using Little's Irregularity Index (LII) (2). Statistical significance was set at P<0.05.

Results: There was no statistically significant difference between the groups in terms of the relapse of mandibular anterior crowding and the presence or absence of mandibular third molars (P=0.940).

Conclusion: Prophylactic third molar extraction after orthodontic treatment does not seem necessary.

Keywords: Third molar, anterior crowding, orthodontic treatment, Little's Irregularity Index, Ganss ratio

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ÖZ

Amaç: Bu çalışmanın amacı, ortodontik tedavi sonrası üçüncü molar dişlerin varlığının mandibular kesici diş çapraşıklığı üzerine etkisini değerlendirmek ve gömülü üçüncü molar dişlerden elde edilen Ganss oranları ile ortodontik hastalarda profilaktik üçüncü büyük azı dişlerinin çekim endikasyonunu belirlemektir.

Gereç ve Yöntemler: Bu çalışmanın materyalini 42 hastanın (26 kadın, ortalama yaş: 16.56±4.96; 16 erkek, ortalama yaş:17.52±4.39) dental alçı modelleri, panoramik ve lateral sefalometrik radyografileri ile ağız içi ve ağız dışı fotoğrafları oluşturdu. Veriler üç aşamada analiz edildi; T1: ortodontik tedavi öncesi, T2: ortodontik tedavi bitimi, T3: ortodontik tedavinin bitiminden en az 2 yıl sonra. Çalışma grupları; Grup 1: üçüncü molar dişleri gömülü veya sürmüş olan hastalar (22 hasta). Grup 2: üçüncü molar dişleri hiç oluşmamış veya çekilmiş olan hastalar (20 hasta). Panoramik radyografiler, T1, T2 ve T3 dönemlerinde üçüncü molar dişlerin varlığını veya yokluğunu tespit etmek ve Ganss oranının (GR) değerlendirilmesi için kullanıldı.1 T1, T2 ve T3 aşamalarında alınan diş modelleri 3 Shape TRIOS oral tarayıcı (3 Shape Co. Kopenhag, Danimarka) ile tarandı ve mandibular anterior çapraşıklık Little's Irregularity Index (LII) ile ölçüldü. İstatistiksel anlamlılık P<0.05 olarak belirlendi.

Bulgular: Mandibular anterior çapraşıklığın nüksetmesi ve mandibular üçüncü molarların varlığı veya yokluğu açısından gruplar arasında istatistiksel olarak anlamlı fark yoktu (P=0.940).

Sonuç: Ortodontik tedaviden sonra profilaktik üçüncü molar diş çekimi zorunlu görünmemektedir.

Anahtar Kelimeler: Üçüncü molar, anterior çapraşıklık, ortodontik tedavi, Little's Düzensizlik İndeksi, Ganss oranı

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INTRODUCTION

Relapse after the long and arduous process of orthodontic therapy is an undesirable situation for both patients and physicians. Tending to occur immediately after the debonding phase of orthodontic treatment, relapse is thought to occur because of the time required for the periodontal and gingival fibrils to adapt to the new place of the teeth.[1]

The effect of the 3rd molars on incisor crowding has been studied for over 160 years. However, the relation between 3rd molars and orthodontic relapse is controversial, and clinical practices vary in terms of prophylactic removal of the 3rd molars.[2] There is still no consensus in the literature on this subject. While some studies have reported that the presence or absence of mandibular 3rd molars does not affect the relapse of anterior crowding in orthodontically treated patients[3-8], other studies have reported that these teeth may contribute to crowding of the incisors.[9-12] Zachrisson[13] stated that the etiology of lower incisor crowding after orthodontic treatment was multifactorial. Angle[14] argued that normal occlusion together with ideal interdigitation after orthodontic treatment would prevent the recurrence of incisor crowding. However, Vego[15] reported that erupting lower 3rd molars can exert force on the adjacent teeth, and the results of a recent cone beam computed tomography study suggested that although crowding is a complex phenomenon with a multifactorial etiology, 3rd molars have an effect on late incisor crowding.[12] On the other hand, in a recent meta-analysis and systematic review by Pithon et al.[5] no statistically significant difference was found in the degree of incisor crowding after orthodontic treatment between patients with 3rd molars and those with agenesis of these teeth. Therefore, it was concluded that prophylactic extraction of the 3rd molars is not indicated for orthodontic patients. Due to these conflicting results in the literature, this study aimed to evaluate the effect of 3rd molars on the relapse of incisor crowding after orthodontic treatment and to determine the indication for prophylactic 3rd molar tooth extraction in orthodontic patients based on Ganss ratios. First discovered by Olive and Basford in 1981 and later developed by Ganss et al., the ganns ratio is the ratio of the length of the retromolar region and the mesiodistal width of the third molar.[12]

MATERIAL AND METHODS

This study was approved by the Non-Invasive Clinical Trials Publication Ethics Committee at XXX University (2021.10.416.). The G*Power program (version 3.1.9.2, Universität Düsseldorf, Germany) was used to calculate the sample size based on an alpha significance level of 5% and power of 80% to detect a minimum intergroup difference of 0.94 mm with a standard deviation of 1.40 for Little's Irregularity Index (LII).[16] The power analysis indicated that at least 36 patients were required for this study. The records of a total of 250 patients were analyzed and the 42 patients who met the inclusion criteria were included.

The inclusion criteria were:

1. Full dentition except for the 3rd molars;
2. Skeletal Class I, dental Class I or II malocclusion with mild, moderate, or severe anterior crowding treated by orthodontic treatment without premolar extraction;
3. Orthodontic treatment completed at least 2 years earlier;
4. Complete minimal diagnostic records (dental stone models, panoramic films, and extraoral photographs) for the analyzed time points.
5. Patients using essix plates after orthodontic treatment

Exclusion criteria were:

1. Presence of polydiastema, anomalies of tooth form (e.g., macrodontia, microdontia), or orofacial syndromes;
2. History of orthognathic surgery or any anterior tooth restoration;
3. Undergoing anterior/posterior dental stripping during orthodontic treatment
4. Patients using fixed retainers after orthodontic treatment

Study groups

The stone models, panoramic and lateral cephalometric radiographs, and intraoral and extraoral photographs of 42 eligible patients who underwent orthodontic treatment between 2014 and 2019 were analyzed in this study.

The study material was analyzed at three time points: before orthodontic treatment (T1), at the end of orthodontic treatment (T2), and at least 2 years after the end of orthodontic treatment (T3). The patients were classified into two groups for comparison. Patients in Group 1 had impacted or erupted 3rd molar teeth in T3 records. Group 2 included patients without 3rd molars because of agenesis (no 3rd molar in T1-T3) or extraction (3rd molar present in T1 or T2 but absent in T3).

Analyzed Variables

Skeletal malocclusions were determined from cephalometric radiographs, while the 3rd molars were assessed from panoramic radiographs. Dental stone models taken at T1, T2, and T3 were also scanned with a 3 Shape Trios oral scanner (3 Shape Co.,Copenhagen, Denmark) and the amount of crowding was measured using the computer program.(3 Shape Ortho Analyzer Copenhagen, Danimarka)

Ganss Ratio: The Ganss ratio, used to make the decision of whether to extract 3rd molars, can be measured for each quadrant of the dental arch. If there is not enough space for eruption, the 3rd molar may affect the movement of the other teeth, and therefore prophylactic extraction is recommended.[17] The measurement of this ratio is shown in Figure 1. On the panoramic radiograph, a line perpendicular to the mandibular occlusal plane was drawn from the distal of the second molar. The distance between this point and the anterior border of the ramus on the occlusal plane was determined as the retromolar distance. The Ganss ratio was calculated as the ratio of this distance to the mesiodistal width of the 3rd molar.

Figure 1. *The measurement of Ganss ratio (GR) on panoramic radiographs (GR=a/b).*

Little's Irregularity Index:[18] LII is one of the methods frequently used to measure the amount of crowding in the dental arches.[19-20] The measurement of LII is shown in Figure 2. LII was measured on a digital model to calculate the amount of anterior crowding at T1, T2, and T3.

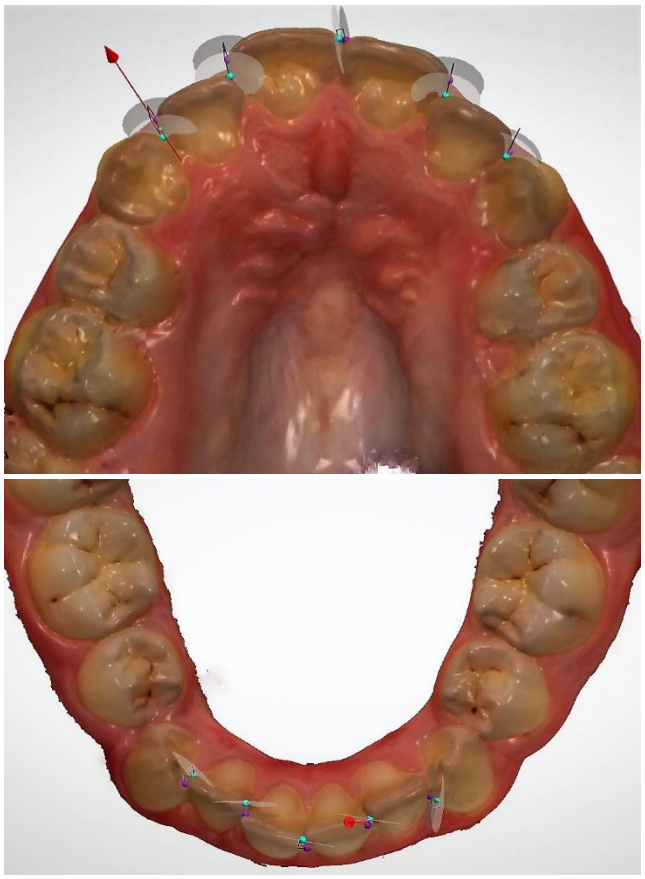

Figure 2. *The measurement of Little's Irregularity Index with 3 Shape Trios oral scanner models.*

Method Error

One month after completing the measurements on panoramic films and digital plaster models, 20% of the study material was randomly selected and re-evaluated by the same researcher. Method error was assessed by calculating intraclass correlation coefficients (ICC) for the first and second measurements.

Statistical Analysis

Statistical analysis was performed with SPSS for Windows version 26.0 (IBM Corp, Armonk, NY). After the normal distribution test, parametric tests were chosen because the data showed normal distribution. Pearson chi-square test was used for gender comparison, and the independent-samples t-test was used for mandibular LII comparison. Ganss ratios of mandibular impacted 3rd molars at T1-T3 were evaluated by repeated-measures ANOVA test. The relationship between Ganss ratio and LII in Group 1 at T3 was evaluated with the Pearson correlation test. Statistical significance value was determined as $P<0.05$.

RESULTS

The demographic characteristics of the participants by gender is shown in Table 1. Of the 42 patients in the study, 26 were female (mean age: 16.56±4.96 years) and 16 were male (mean age: 17.52±4.39 years). Group 1 included 22 patients (15 female, 7 male) with erupted or impacted 3rd molars and Group 2 consisted of 20 patients (11 female, 9 male) without 3rd molars because of agenesis or extraction.

Table 1. Demographic characteristics of participants at the start of orthodontic treatment (T1).

	Male	Female	P-value#	Age (years), mean (SD)	P-valueΩ
Group 1: Impacted/Erupted Mandibular Third Molars	7	15	0.527	13.63 (2.19)	< 0.001
Group 2: Absent/Extracted Mandibular Third Molars	9	11		20.56 (4.03)	

Pearson chi-square test; Ω Independent-samples t test.

The mandibular LII scores in the groups at T3 are shown in Table 2. The mean LII score was 1.71±1.07 in Group 1 and 1.60±1.45 in Group 2. There was no difference between the groups in terms of the amount of crowding due to relapse after orthodontic treatment (P=0.488).

Table 2. Mandibular Little's Irregularity Index two years after orthodontic treatment (T3).

	Mandibular Little's Irregularity Index, mean (SD)	P-value#
Group 1: Impacted/Erupted Mandibular Third Molars	1.71 (1.07)	0.488
Group 2: Absent/Extracted Mandibular Third Molars	1.60 (1.45)	

Results of the independent-t test.

The Ganss ratios of impacted mandibular 3rd molars at T1-T3 in Group 1 are shown in Table 3. There was a statistically significant increase in Ganss ratios in both the right and left mandibular 3rd molars over time (P<0.05). However, Pearson correlation analysis revealed no association between Ganss ratio and mandibular LII (Table 4).

Table 3. Ganss ratios of the mandibular third molars in patients in Group 1 with impacted third molars.

	Ganss ratio, mean (SD)			P-value#
	T1	T2	T3	
Left Mandibular Third Molars	0.65 (0.22)	0.82 (0.29)	0.82 (0.23)	**0.004**
Right Mandibular Third Molars	0.66 (0.25)	0.76 (0.25)	0.81 (0.27)	**0.009**

Results of repeated-measures ANOVA test (Wilks' lambda). T1: Before orthodontic treatment, T2: At the end of orthodontic treatment, T3: Two years after orthodontic treatment

Table 4. Pearson correlations between mandibular third molars Ganss ratios and mandibular Little's Irregularity Index in patients with impacted mandibular third molars two years after orthodontic treatment (T3).

		Ganss Ratio of Left Mandibular Third Molar	Ganss Ratio of Right Mandibular Third Molar
Mandibular Little's Irregularity Index	r	-0.091	-0.028
	P	.688	.900

In the evaluation of method error between the first and second measurements of LII and GR, we obtained ICCs between 0.954 and 0.983, indicating that these measurements can be repeated with high reliability.

DISCUSSION

The lack of a definitive consensus in the literature on the effect of the 3rd molars on mandibular incisor crowding formed the basis of our study. While some recent meta-analyses reported that the 3rd molars do not exert a force that affects incisor crowding,[3-8] other studies have indicated that impacted molars may affect incisor crowding in proportion to the level of impaction.[11,21] However, some researchers argue that prophylactic 3rd molar extraction is advisable to prevent lower incisor crowding.[22,23] Of course, 3rd molar teeth are not the only cause of the incisor crowding that occurs in the long term or with relapse after orthodontic treatment.[7] Factors associated with incisor crowding include compression forces in the posterior of the dental arch due to physiological mesialization[7]; the crowns of the anterior teeth being more mesially inclined than their roots, which changes the intercanine distance and dental arch lengths with orthodontic treatment after the eruption of the second molar teeth[24,25]; the mesial force vector occurring during contraction of the perioral muscles[26] , mouth breathing, and late mandibular growth.[27] Considering the

presence of 3rd molars is one of the only factors in this complex process that is controllable and there are conflicting reports regarding their role in late incisor crowding in the literature, this study sought to evaluate the impact of wisdom teeth on mandibular incisor crowding.

In our study groups, the mean age at the beginning of treatment (T1) for patients in Group 1 was 13.63 years, while that of the patients in Group 2 was 20.56 years. Although the initial age of the patients with impacted 3rd molars seems relatively young, we did not consider this a problem in terms of evaluating the possible effects of 3rd molar eruption, as T3 records were obtained at least 2 years after T2. Furthermore, the measurements used in this study (ratio of the retromolar distance to the mesiodistal width of the 3rd molar) do not require root formation, so the inclusion of adolescent subjects should not interfere with the results. Similar studies evaluating the effects of 3rd molar teeth on anterior crowding have also included adolescents.[4,22,28]

The individuals in this study were divided into two main groups according to the presence or absence of 3rd molars. Group 1 included patients with erupted or impacted 3rd molars and Group 2 included those with extracted or absent 3rd molars. Although we intended to further divide each of these groups into two subgroups and analyze the data in a total of 4 groups, the study was carried out with only the two main groups because there were not homogeneous and sufficient numbers of patients in the subgroups. When similar studies in the literature are examined, Andreasen et al.[29] formed two groups according to the presence or absence of 3rd molars, as in our study, whereas Ades et al.[16] divided the individuals into four groups (3rd molar impacted, erupted, extracted, or agenesis). In another study[30], individuals were grouped according to whether the 3rd molar erupted to the occlusal plane, was impacted, or was absent due to agenesis. As can be seen, different classifications have been made in the literature. It can be said that in clinical practice, 3rd molars are evaluated as present or absent in orthodontic treatment, and extraction indication is considered for erupted or impacted teeth .[10] However, we believe it would be beneficial to conduct further studies with larger samples and a sufficient number of participants in the subgroups (those with impacted, erupted, agenesis, and extracted 3rd molars).

Several methods are used to evaluate tooth-arch size discrepancies. The tooth size-arch length discrepancy method developed by Lindauer et al.[31] assesses dental arch lengths between the distal surfaces of the second premolars. In the method developed by Lundstrom[32], length deviations between 36 and 46 are analyzed in six segments. Because these methods are not specific to the incisors and include complex elements, for this study we preferred to use LII, which is easy to apply and is the most common method used in the measurement of anterior incisor crowding[18,20,33]. In addition, the Ganss ratio is frequently used to make decisions regarding prophylactic 3rd molar extraction.[34] In this study, we calculated Ganss ratios in patients with impacted 3rd molars from panoramic radiographs, although some researchers reported that it would be more useful to evaluate the 3rd molars on lateral cephalograms.[35]

The groups in our study showed no difference in LII associated with relapse after orthodontic treatment. In other words, lower incisor crowding after the retention period was similar in Groups 1 and 2. This suggests that mandibular incisor relapse occurs independently of the presence or absence of 3rd molars. As mentioned before, although there is no definitive evidence in the literature, some authors state that the increase in incisor crowding after orthodontic treatment is a physiological phenomenon observed with age and is associated with lifelong mesialization of the teeth and a decrease in arch length.[1,3,15,16] In Group 2, the Ganss ratios of both the right and left mandibular 3rd. molars were increased significantly at the end of and 2 years after orthodontic treatment compared to before treatment. This change is thought to be related to the increase in retromolar distance. Although the Ganss ratio is defined as a criterion that can be used for prophylactic 3rd molar extraction[9], some authors have stated that this ratio does not have a major impact on extraction decision-making because it is based on a limited sample size[35]. Another study reported that impacted mandibular 3rd molars were associated with decreased faciocranial height and increased cranial width.[8,36]

This study has certain limitations. As mentioned earlier, if there had been a sufficient number of

samples in the subgroups formed in Groups 1 and 2, we planned to conduct analyses in two main and four subgroups in total. However, as a sufficient number of samples could not be achieved, the study was conducted with only the two main groups. Although there was no difference in mandibular anterior crowding based on the presence or absence of 3rd molars and this somewhat eliminates the need to form subgroups, we still recommend further studies including larger groups of participants of similar age. Moreover, the patients in this study had only a retention protocol with clear aligners, without the use of a lingual retainer after orthodontic treatment. It should be kept in mind that the duration of clear aligner use by patients is also a factor influencing the relapse of mandibular anterior crowding. In this study, the angle between the lower incisors and the mandibular plane was not evaluated at the finishing stage. Evaluating this aspect in future studies may provide safer results.

CONCLUSION

The findings of this study suggest that 3rd molars are not a factor that increases mandibular incisor crowding, and prophylactic 3rd molar extraction does not seem necessary to prevent the relapse of mandibular incisor crowding in patients undergoing orthodontic treatment. There is no significant correlation between the impaction rate of mandibular 3rd molars and mandibular lower incisor crowding. These results are relevant for patients with similar characteristics to the groups examined in this study.

ETHICAL COMMITTEE APPROVAL

The ethical approval for this study was received by Nevşehir Hacı Bektaş Veli University Rectorate Non-Interventional Clinical Research Publication Ethics Committee (approval no: 2021.10.416).

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CONFLICT OF INTEREST

The authors deny any conflicts of interest related to this study.

AUTHOR CONTRIBUTIONS

Design: SKB, FA Data collection and processing: SKB,FA,HY Analysis and interpretation: SKB,KKD , Literature review: HY, KKD, Writing: KKD.

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