

Review Article

The Impact of Third Molars on Tooth Crowding in the Upper and Lower Dental Arch

Mistilidou Despoina¹, Minovgidou Maria², Tsiveli Stella², Chatzigianni Athina^{3*}

¹Dentist, Thessaloniki, Greece

²Student, Faculty of Dentistry, School of Health Sciences, Aristotle University of Thessaloniki, Greece

³Assistant Professor, Department of Orthodontics, Faculty of Dentistry, School of Health Sciences, Aristotle University of Thessaloniki, Greece

*Correspondence author: Chatzigianni Athina, Assistant Professor, Department of Orthodontics, Faculty of Dentistry, School of Health Sciences, Aristotle University of Thessaloniki, Greece; E-mail: achatzianni@dent.auth.gr

Abstract

Aim: The aim of this review was to evaluate the impact of third molars on secondary dental crowding in the upper and lower arches, taking into consideration confounding factors, such as long-life changes in arch dimensions, molar angulation or previous orthodontic treatment.

Materials and Methods: A comprehensive literature search of studies was performed, focusing on the relationship between third molars and anterior crowding. The studies included cross-sectional analyses, retrospective studies, randomized clinical trials and systematic reviews. Parameters evaluated included arch length characteristics, third molar eruption, impaction or agenesis, impacted molar inclination and angulation, retromolar space and Ganss ratio, previous orthodontic treatment and prophylactic extraction.

Results: Findings varied across studies. Some investigations reported a positive correlation between erupted or impacted third molars and dental crowding, especially when third molars were mesially inclined or had restricted retromolar space. On the other hand, many studies found no significant correlation between third molar status and dental crowding, indicating that other natural changes associated with aging may be stronger contributors. Evidence on prophylactic extraction of third molars was uncertain; while some studies reported benefits in preventing crowding, some others pointed out no predictable protective effect.

Conclusion: The contribution of third molars to dental crowding still remains controversial. Dental crowding is influenced by multiple factors, making it difficult to determine whether it can be caused exclusively by the presence of third molars. Clinical management should be individualized, with third molar extraction decisions based on multiple parameters.

Keywords: Tooth Crowding; Dental Arch; Clinical Management

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Introduction

Dental crowding constitutes a main orthodontic problem in the general population, which appears in patients with or without previous orthodontic treatment. A study in 2020 showed that dental crowding has a significant impact on aesthetics and influences a person's psychology, occlusal function and everyday life. In areas with intense crowding, tooth surfaces cannot be cleaned properly, thus, calculus or caries may develop, while periodontal problems may also occur [1]. Crowding by itself is related to many factors, such as childhood habits, genetic factors, jaw-tooth size discrepancies, primary loss of deciduous teeth or derangement of tooth eruption sequence, presence of third molars and others. Broadbent, developed the opinion that the presence of third molars plays no significant role on teeth crowding [2]. On the contrary, Bergstrom in 1961 was one of the first authors to study the effect of third molars on the developing dental arch and found out that there was a correlation between third molars and anterior teeth crowding [3].

The effect of upper and lower third molars on tooth crowding has been a debatable condition that deserves further investigation. Based on the importance of comprehending this topic, the aim of this review was to collect all evidence on the effects of third molars on dental crowding in relation to various confounding parameters that could influence their impact on the dental arches.

Long Term Dental Arch Characteristics

Lifelong changes of dentition are well known to be present, from its transition phases during childhood and adolescence, to its ageing during adulthood. It is a fact that the arch dental crowding is increasing over the years. Since third molars are developing in late adolescence or early adulthood, this period is mostly important for their overall evaluation. Barrow and White, observed that after the age of 17 and 18 years old, there is a tendency for a decrease in dental arch length and width [4]. They proposed several aetiologic factors for these changes, such as: 1) Proximal tooth wear (attrition) - with age, normal physiological wear of the proximal surfaces of teeth reduces their mesiodistal width. This wear leads to mesial drift, especially in the posterior teeth; 2) Lingual tipping of anterior teeth - the maxillary incisors may exhibit lingual tipping (tilting toward the tongue). This contributes to a reduction in upper arch length, particularly in the anterior segment; 3) Closure of Interproximal Spaces - as teeth move mesially, the interproximal spaces in the posterior region tend to close, which contributes to crowding or reduction in arch perimeter.

Bishara, et al., conducted a series of longitudinal studies on subjects from the Iowa Facial Growth Study, tracking dental and arch development during adolescence (ages ~12-25) and re-examining the same individuals in mid-adulthood (~45 years) and they found that the tooth size/arch length discrepancy increased between the ages 25 to 45 [5]. Arch length and perimeter decreased in both jaws during the same interval. These changes reflect progressive crowding over time.

A study took place in 2006 that involved 91 patients of at least 17 years old, with permanent dentition, no prior orthodontic intervention and good oral hygiene. This study examined the relation between dental crowding, mesiodistal width of teeth and length of the dental arch. They concluded that crowding is a result of a combination of factors, such as decreased arch length, increased size of teeth, abnormalities in tooth shape, intercanine dimension, interproximal tooth contacts and changes in the growth of the mandible due to adolescence [6].

Third Molar Eruption, Impaction or Agenesis

Dental arch length changes were also compared to dental crowding and the presence of third molars in several studies. In a study, a sample of non-orthodontically treated patients was divided into two groups, one with patients presenting all third molars and one with patients with mandibular third molars agenesis. The researchers found that teeth moved mesially in the quadrants where third molars had erupted in the mandible, while in the maxilla no difference was observed. Furthermore, they found that in jaws where third molars were present, more intense crowding was observed, meaning that third molars create pressure against the dentition. However, they conclude that dentitions with good alignment tend to remain stable. Finally, dental arches tend to shrink through the years, teeth rotation and misaligned teeth were observed in some cases with third molar absence and this shows that various factors are involved in dental crowding [7].

Additionally, Richardson, et al., tested the correlation between original crowding and crowding after five years in patients with impacted and erupted third molars bilaterally [8]. The results showed that those who have impacted third molars are more likely to have crowding of early permanent dentition, anteriorly and posteriorly.

Another relative study that took place at the University of Tikrit in 2014 involved students under 18, who didn't receive any orthodontic treatment, had good oral hygiene and no prosthetic restorations. The sample was divided into three groups based on the third molar condition. The first group involved individuals with impacted third molars, the second group involved those with erupted third molars and the third group consisted of students with third molar agenesis. When the dentitions were analyzed, dental crowding was most frequently present in cases with impacted third molars, while more rarely in cases with third molar agenesis [9]. More recently, in 1996 and in 2020 researchers mentioned that the anterior crowding is linked to the presence and increased size of impacted mandibular third molars [10,11]. These results can be confirmed by other recent studies, such as the study of Husain, et al., who found a positive correlation between mandibular third molars and mandibular incisor crowding [12]. Moreover, Gopaldasamy, et al., examined 537 patients with crowding and impacted third molars, concluding to similar results [13].

In contrast to the above, there was no demonstrable link between the presence, absence, eruption, impaction, or extraction of third molars and incisor crowding relapse after three years in orthodontic retention in a study that took place in 1997. The Little's Irregularity Index (LII) and the arch length discrepancy were measured and showed no difference in LII between the groups. Thus, third molar status did not predict anterior dental alignment stability, supporting the conclusion that third molars are not a clinically relevant factor in post-treatment crowding [14].

Additionally, Sidlauskas and Trakiniene found no significant difference in lower dental arch crowding between individuals with and without lower third molars. The presence or eruption status of the mandibular third molars did not significantly influence late lower incisor crowding. Their study suggests that other factors (e.g., growth patterns, tooth size, arch form) are likely more responsible for late lower arch crowding than the third molars themselves [6].

South African males in the Dart collection of human Skeletons, University of the Witwatersrand in 2017 were evaluated for dental crowding and third molar situation, agenesis or impaction, using Little's Irregularity Index. It was found that only the impacted third molars are correlated to the anterior crowding. However, their presence or absence does not play an important role in crowding. Also, the bilateral agenesis of third molars does not mean relief from crowding. Statistics about maxilla were in common with mandibula [15].

Similarly, another study found that third molar characteristics are not related to anterior crowding. The way the irregularity index has changed through 12-18 years is not associated with the maturity of third molar apex. Even the gender cannot influence either anterior crowding or the maturity of third molars. Additionally, the LII did not change between people with absent third molars due to hypodontia or extractions and those with third molars being present. As well as the situation of the third molar did not influence crowding significantly (erupted, unerupted, impacted) [16].

Moreover, Sood, et al., mentioned similar findings, that eruption level and remaining eruption space are factors that have no significant relationship with crowding [17]. Also, Zigante, et al., found that mandibular third molar development dynamics do not significantly affect late incisor crowding [16]. In Norway a study took place in 2021, in which 72 orthodontically untreated patients took part, using panoramic radiographs and dental plaster casts. The incisor irregularity changes through 12-21 years were assessed. The crowding was lower in clinical cases like hypodontia. The results did not differ in cases with unilateral or bilateral extractions. The situation of the third molar did not influence the incisors irregularity, but the last one is increasing by the age. The results showed that there was no relation between the maturity of third molars and irregularity as well as no correlation with the developmental dynamics, presence or absence of those teeth [16].

Impacted Molar Inclination and Angulation

Concerning third molar characteristics and crowding in the arch, a study took place in Second Xiangya Hospital of Central South University in 2023. Cone Beam Computed Tomography (CBCT) images were collected from 120 adults, 20-30 years old, 51 male 69 female. They were divided into three groups according to the buccolingual angulation, as well as into two groups according to mesiodistal angulation. The results of this study lead to the conclusion that the angulation of the mandibular impacted third molars causes dentoalveolar changes. The increased buccolingual angulation is related to the increase of anterior teeth inclination. The increased mesiodistal angulation leads to anterior teeth crowding and lower intermolar width between first and second molar. From a clinical perspective the accordance of impacted third molars with the arch discrepancy, position of incisors will assist making the final decision if the third molars are to be removed [18]. Similarly, another recent study in 2024 collected data from 240 patients aged 18 looking for orthodontic treatment. Among the objectives were the measurement of the dimensions of the lower arch, arch length, width and perimeter, and position and angulation of lower third molars and the association of these factors with crowding. The findings showed that the angle between the third molar and mandibular plane is smaller in the crowding group. In addition, the angle between second and third molars is higher in the crowding group. This led to the conclusion that mesial inclination of third molars applies mesial force on mandibular teeth. The highlight is that it is important to estimate arch dimensions and third molars when treating crowding [19]. Contradictory results were reported from other research groups. In a study in 2016 including 120 patients, 16-21 years old divided into two groups of Class I normal and Class I crowding dentition, the angulation of third molar to second molar and third molar to the base of mandible were analyzed on orthopantomograms. It was found that the prementioned factors are not correlated to lower dental crowding [20]. Also, Sood, et al., concluded that angulation, eruption level and remained eruption space are factors that have no significant relationship with

crowding [17].

Gökçe, et al., examined the relationship of impacted third molar angulation with anterior crowding and concluded that the inclination of third molars is not linked to anterior dental crowding [21]. In a recent study of 2024, 69 individuals were examined. Mandibular anterior crowding, space analysis and radiographic depiction of impacted third molars were estimated. The results showed that there is no correlation between crowding and impacted third molar angulation [22].

Retromolar Space and Ganns Ratio

Niedzielska, in 2005 in his study, measured the dental arches of 47 patients in order to examine the effect of third molars in lower incisor crowding [23]. They found that in most cases the length of the lower arch changed more compared to the upper arch. Associating the Ganns ratio with the topic, which is the ratio of retromolar space to the width of the crown of the third molar, they conclude that the Ganns ratio can be very useful at deciding the extraction or not of the third molar.

Selemi, et al., analyzed the retromolar space (Ganns ratio) on orthopantomograms. Their results showed that the retromolar area was not correlated with crowding. In agreement with the above findings, Sood, et al., found that the remained retromolar eruption space is a factor that has no significant relationship with crowding [17]. On the contrary, one recent study in 2024, with the aim to measure dimensions of the lower arch and the Ganns ratio with irregularity of the anterior teeth, concluded that the size of the retromolar space is associated with crowding [19].

Effect of Previous Orthodontic Treatment

Extraction vs Non-Extraction Orthodontic Treatment

Orthodontic treatment can follow two plans, the one with extractions and the other without extractions depending on the dental crowding. Zafarmand, et al., found that both ways of treatment show the same chance of incisor crowding relapse [24]. Francisconi, et al., conclude that there is no correlation between relapse, mandibular crowding and extraction and non-extraction orthodontic treatment [25]. However, Freitas, et al., mentions that in extraction patients crowding relapse was more common compared to untreated patients [26]. Also, Myser, et al., found that extraction patients are more likely to have relapse and interproximal restorations are risk factors for crowding [27]. Finally, Heiser, et al., and Erdnic, et al., concluded that there is no significant difference between extraction and non-extraction patients [28,29]. Hajar Ben Mohimd, et al., consider according to the results that a lot of factors influence the relapse like muscular and local factors [30].

In a study in 2004 that took place in Bauru Dental School, University of São Paulo, Bauru, Brazil 40 orthodontically treated patients were examined [31]. All patients were with Class I or II malocclusion and their treatment was non-extraction. The results showed that non-extraction treatment is associated with 1,95 mm relapse, counted with LII. In conclusion there is no factor that can help predicting crowding relapse in the future. At a study in 1999 from P Emile Rossouw, et al., a sample of 88 patients receiving premolar extraction and non-extraction treatment were examined [32]. The results showed that extractions do not ensure stability in lower incisors, but there are ways to maintain long-term stability. Retention is the most important factor that can keep the treatment result stable, and it is as crucial as the treatment. Also, the differences that were spotted between the two groups had to do with dimensions and growth patterns of mandible and maxilla. Moreover, the irregularity index was similar in the two groups.

Orthodontic Treatment with the Use of Headgear

Another factor which should be discussed is if there was a previous orthodontic treatment with headgear. Annelie Miclote, et al., studied panoramic radiographs of growing Class II children treated with headgear or Class II elastics [33]. They examined pre-treatment and post-treatment radiographs. Authors found that the increase in maxillary retromolar space in patients treated with headgear is smaller than in patients treated without headgear. However, they concluded that the use of headgear doesn't affect the angulation or vertical position of third molars and thus, dental crowding.

Relapse After Orthodontic Treatment

There was another study from Little, conducted at the department of Orthodontics at the University of Washington [34]. The study duration was 35 years and more than 600 patients were examined to determine if the orthodontic treatment was successful and the dental arches stable. They found that as the years pass arch length decreases following orthodontic treatment and the absence or presence of third molars and if they have erupted or impacted has a very small effect in relapse. They concluded that

relapse can be based on several factors and that radiographs pre or post the therapy cannot predict the result. In 2020 another study examined the effect of mandibular third molars on relapse of the orthodontic therapy especially in the anterior region. The sample was divided into 2 groups, depending on having or not third molars in three different stages, pre-treatment, post-treatment and post-retention. The results showed that there was no correlation between third molar presence and relapse after orthodontic treatment [35].

In another review article from Zawawi and Melis, which evaluated the role of third molars on anterior teeth crowding and on post-orthodontic relapse, it was found that there is no cause-and-effect relationship between third molars and crowding [36]. Lyros, et al., at their systematic review studied the effect of third molars on the lower arch in cases with previous orthodontic treatment [37]. They summarize to the result that there was no proven correlation between the presence of third molars and orthodontic relapse.

Third Molar Prophylactic Extractions

A controversial topic that must be considered is if prophylactic extraction of third molars is beneficial for the development of dentition. Lindquist, et al., who examined the effect of prophylactic extractions observed that the space change in the side of the extracted third molar has positive effect on crowding in 70 percent of the cases, so the prophylactic extractions should be taken into account in cases of severe crowding [38].

Nevertheless, according to Sidlauskas and Trakiniene, mandibular third molars are not a major etiological factor in post-adolescent lower dental arch crowding. Therefore, prophylactic removal of third molars solely to prevent anterior crowding is not supported by the evidence from this study [39]. Also, in another research, which compared the opinions from oral surgeons and orthodontists about third molar prophylactic extractions, the research has shown that oral surgeons are more likely to recommend third molar extraction than orthodontists and it is based on the year of graduation [40]. More recently graduated doctors had less possibilities to suggest third molar extraction than older ones.

Other authors came to the conclusion that periodically observation of asymptomatic third molars is the best strategy [41]. Lyros, et al., found no correlation between mandibular third molars presence and anterior crowding and they noted that American oral surgeons and orthodontists are more likely to suggest prophylactic extractions than Europeans [37].

Apart from the above, a direct association between prophylactic extraction of third molars and future crowding would be of great value. Notably, according to many authors, there is no effect on future crowding if third molars are extracted [42]. In contrast to the above, there were authors who found an association between prophylactic extractions and crowding. Song, et al., from their systematic review found a weak connection between the presence of third molars and crowding. Only 3 of the 21 studies they examined were supporting prophylactic extraction of third molars, but were described as presenting lack of robust methodology [39]. Gavazzi, et al., in their analysis compared opinions from Italian orthodontists and oral surgeons [43]. They suggested that lower third molars are more likely to cause dental crowding, in contrast to upper third molars, which does not have so much effect on dental crowding. So, they are more likely to suggest lower third molars extractions than upper third molar extractions. Third molars in accordance with previous orthodontic treatment is an important topic that should be analyzed. There are many studies that took place and consider the advantages and disadvantages of each molar extraction. The conclusion about the third molar was that it can be removed for prophylactic reasons and it relieves from dental crowding in orthodontic treatments [44]. According to Richardson, et al., third molars could be the reason of crowding in post adolescence, but there is no clear evidence [45,46].

Conclusion

Secondary dental crowding is a multifactorial phenomenon in which the role of third molars remains controversial. Although some studies indicate that the presence of impacted or mesially inclined third molars may contribute to anterior crowding, the majority of evidence suggests that other factors, such as lifelong arch changes, play a more decisive role. The presence, absence or prophylactic extraction of third molars alone cannot predict or prevent secondary dental crowding. Multiple interacting factors contribute to dental crowding, making it difficult to establish whether it is caused solely by third molars. Clinical decisions regarding third molar management should therefore be individualized, taking into consideration all potential influencing factors.

Conflict of Interest Statement

All authors declare that there are no conflicts of interest.

Informed Consent Statement

Informed consent was not required in this study.

Authors' Contributions

All authors contributed equally to this paper.

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