



Review Article

Impact of third molars on mandibular relapse in post-orthodontic patients: A meta-analysis



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KEYWORDS

little's irregularity index;
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prophylactic third molar removal;
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Abstract *Background/purpose:* Whether third molars contribute to or aggravate relapse, particularly in the mandibular dental arch, after orthodontic treatment remains controversial. Orthodontic clinicians vary widely in their practice regarding prophylactic third molar removal after orthodontic treatment. The present study systematically reviewed and meta-analyzed the available literature, and assessed the impact of third molar removal on the relapse of mandibular dental arch alignment after orthodontic treatment.

Materials and methods: Relevant literature was searched on online databases, namely Pubmed, Embase, and Cochrane. Outcomes of post-orthodontic mandibular relapse were evaluated in terms of the Little's irregularity index, intermolar width, and arch length. Statistical analysis was conducted using the Review Manager software (Version 5.3, The Cochrane Collaboration, Oxford, England).

Results: Our initial search strategy yielded 360 citations, of which three retrospective studies were selected. The Little's irregularity index (weighted mean difference = 0.80, 95% confidence interval = 0.13–1.47, $P = 0.02$) differed significantly between the erupted third molar extraction group and agenesis third molar group; whereas the arch length and intermolar width did not. No outcome differed significantly between the impacted third molar extraction group and agenesis third molar group.

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Conclusion: Removal of the mandibular third molars is recommended for alleviating or preventing long-term incisor irregularity.

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Introduction

Whether third molars contribute to or aggravate the relapse of dental arch alignment, particularly in the mandibular dental arch, after orthodontic treatment remains controversial. Several studies have reported inconsistent findings. And orthodontic clinicians vary greatly in their practice regarding prophylactic removal of third molars after orthodontic treatment.^{1–5}

Laskin¹ surveyed more than 1300 American orthodontists and oral surgeons. And found that approximately 65% of them recommended removal of unerupted or impacted third molars in patients during or after orthodontic treatment. These orthodontists believed that unerupted or impacted third molars occasionally produce an anterior force that cause separation in the contact points and subsequent crowding of the mandibular incisors. Niedzielska² reported that if sufficient space was unavailable for the third molars to erupt, they exert forces on the adjacent teeth, causing crowding. According to Tüfekçi,³ most US and Swedish orthodontists believe that the erupting lower third molars exert an anterior force and they “rarely” or “never” cause crowding of the dentition.

Some studies have reported contradictory opinions.^{4,5} Bishara⁴ reviewed the literature extensively, and Sidlauskas and Trakiniene⁵ studied a group of 91 participants (average age, 21.01 ± 4.13 years); these studies have concluded that insufficient evidence is available to determine whether third molars are the only or even, the major etiologic factors affecting posttreatment changes in incisor alignment.

The present study systematically reviewed and meta-analyzed the available literature and assessed the impact of third molar removal on the relapse of mandibular dental arch after orthodontic treatment.

Materials and methods

Selection criteria

The inclusion criteria of the present study were as follows: (1) Studies evaluating the impact of third molar removal on the post-treatment changes in the mandibular dental arch alignment in post-orthodontic patients, (2) studies which clearly documented the inclusion and exclusion criteria of patient selection, (3) studies which clearly documented the operative techniques, including extracted teeth and treatment protocols, and (4) studies which clearly documented the post-treatment evaluation methods and criteria. Studies were excluded from the analysis if the outcomes of interest were unclear.

Search strategy

We systematically searched the literature for studies assessing lower incisor relapses in post-orthodontic patients, regardless of the third molar removal. Studies were identified by searching databases, namely Pubmed, Embase, and Cochrane, online. Key terms included in the search were a combination of: third molar, impaction, wisdom tooth, wisdom teeth, orthodontic, crowding, relapse, stability, and retention. The “related articles” function was used to broaden the search, and all abstracts, studies, and citations retrieved were reviewed. In addition, we attempted to identify other studies by hand-searching the reference sections of these papers and by contacting known experts in the field. No language restrictions were applied. The last search was conducted in July 2015.

Study selection and data extraction

Two reviewers independently extracted the following information from each study: first author, year of publication, study population characteristics, study design, inclusion and exclusion criteria, matching criteria, number of participants operated on using each technique, operative parameters, complications, and postoperative recovery. The individually recorded decisions of the two reviewers were compared and disagreements if any were resolved by a third reviewer.

Outcome measures

The following outcomes were used to evaluate the mandibular relapse in post-orthodontic patients during follow-up period: (1) Little’s irregularity index, (2) intermolar width, and (3) arch length.

Statistical analysis

Statistical analysis was conducted using the Review Manager (RevMan) software (Version 5.3, The Cochrane Collaboration, Oxford, England). The meta-analysis of randomized controlled trials (RCTs) was conducted according to the Preferred Reporting Items for Systematic Reviews and Meta-Analysis (PRISMA) guidelines.⁶ Whenever necessary, standard deviations were estimated according to the reported confidence interval (CI) limits, standard error, and range values.⁷ The mean difference was calculated for continuous outcomes, and the weighted mean difference (WMD) was analyzed. The precision of an effect size was reported as a 95% CI. A pooled estimate of the mean difference was calculated using the DerSimonian and Laird

random-effects model.⁸ The data were pooled only for studies that exhibited adequate clinical and methodological similarities. Statistical heterogeneity was assessed using the I^2 test, with I^2 quantifying the proportion of total outcome variability attributable to the variability among these studies.

Results

Characteristics of the selected trials

Fig. 1 depicts the flowchart of the selection procedure of the trial selection. Our initial search strategy yielded 360 citations. Of these, 335 were excluded because they either were not clinical trials or focused on a different condition. Thus, 25 full-text articles were assessed, of which 22 did not meet the eligibility criteria: one was not a clinical trial,⁹ thirteen studies were review articles,^{10–22} and seven lacked sufficient data.^{13,23–28} One RCT²⁹ was excluded because the orthodontic procedure of the mandibular dental arch used in that study was different from the other studies that were included in the present meta-analysis. In total, three eligible trials were identified,^{30–32} all of which were retrospective studies. These studies were included in the meta-analysis and the measurable outcomes were pooled.

Table 1 presents the characteristics and patient demographic data of each trial. These studies were published between 1974 and 1990 and had sample sizes between 35 and 97. All patients had finished their orthodontic treatment and most were treated with the edgewise technique. Premolar extraction or not during orthodontic treatment was not limited. The mean postretention time ranged from 9.3³⁰ to 13 years,³¹ with the mean age ranging from 26.6 years³⁰ to 28 years 6 months.³¹ Both sets of ages were unavailable in Andreasen et al.³²

It existed some differences in these three controlled studies, including the postretention time and postretention age. The range of the mean postretention time is 9.3 to >10 years. And the mean postretention age was from 26.6 to 28.5 years. The differences cause some mild risk of bias, but it will not influence our results.

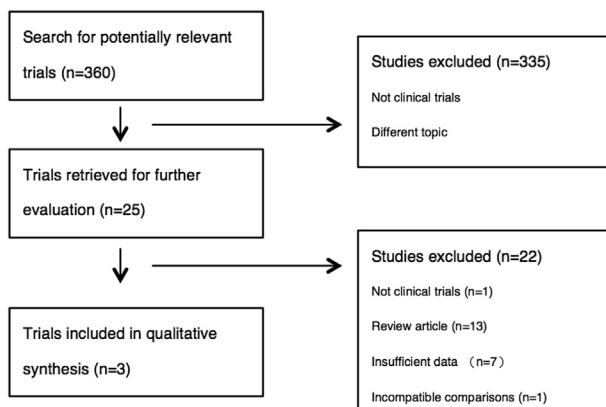


Figure 1 Flowchart of the trial selection.

The three controlled studies were included in this review “support” the cause-and-effect relationship between the eruption or impaction of the third molars and the development of anterior tooth crowding, but the relationship is weak. Because of the limitation in these trials, the definite relationship need more research to survey and make sure.

In Kaplan,³⁰ the cases were classified according to the status of the third molars as both erupted to occlusal plane, impacted, and agenesis. By contrast, in Ades et al.,³¹ the cases were classified according to the status of the third molars as erupted, impacted, agenesis, and extracted. In Andreasen et al.,³² two groups were formed depending on the presence of third molars. Outcome measures were compared between the groups included in these studies.

Outcomes of erupted or agenesis molars and impacted or agenesis molars

For practical clinical directions, the extracted data were combined as follows: patients with erupted or agenesis third molars and patients with impacted or agenesis third molars.

Data on the posttreatment changes in the mandibular dental arch of post-orthodontic patients in the three retrospective studies were used in the meta-analysis.

Erupted or agenesis third molars

The data were classified into the erupted third molar group and the agenesis third molar group and subjected to a meta-analysis. The two groups exhibited a significant difference in the changes in the Little’s irregularity index (WMD = 0.80, 95% CI = 0.13–1.47, $P = 0.02$, Fig. 2). However, the two groups did not differ significantly in terms of the changes in arch length and intermolar width (Figs. 3 and 4).

Impacted or agenesis third molars

The impacted third molar group and the agenesis third molar group exhibited no significant difference for all outcomes (changes in the Little’s irregularity index, arch length, and intermolar width; Figs. 5–7, respectively).

Discussion

Zawawi et al.²¹ and Stanaitytė et al.²² surveyed and systematically reviewed the literature.

Stanaitytė et al.²² surveyed the literature by using the Medline database. In total, 223 relevant articles published between 1971 and 2011 were identified. However, only 21 articles corresponded to the selected criteria and were analyzed. The results were contradictory: Some researchers opined that lower third molars cause teeth crowding, whereas the others confirm controversy.

Zawawi et al.²¹ reviewed 12 clinical studies to evaluate the role of third molars in the development of crowding or relapse after orthodontic treatment in the mandibular dental arch and discovered that the third molars did not correlate with severe anterior tooth crowding in most studies. However, four

Table 1 Three clinical studies describing the posttreatment changes in the mandibular dental arch in post-orthodontic patients.

Study [citation]	Study design	Inclusion criteria	Number of patients in each group	Age	Follow-up	Outcomes
Kaplan, 1974 ³⁰	Retrospective	1. Orthodontically treated Caucasian patients	Erupted: 30 Impacted: 20 Agenesis: 25	26.6 years (postretention)	9.3 years	Little's irregularity index Arch length Intermolar width
Ades et al., 1990 ³¹	Retrospective	1. All participants were Caucasian 2. Participants free of all retention for at least 10 years	Erupted: 32 Impacted: 14 Absent: 17 Extraction: 34	28 years 6 months (postretention)	13 years	Little's irregularity index Arch length
Andreasen et al., 1987 ³²	Retrospective	1. All the cases received the edgewise orthodontic treatment.	M + ^a P- ^b : 9 M + P + ^c : 8 M- ^d P-: 9 M-P+: 9	Not mentioned	Not mentioned	Little's irregularity index Arch length Intermolar width

^a Molar present.
^b Premolar extracted.
^c Premolar present.
^d Molar extracted.

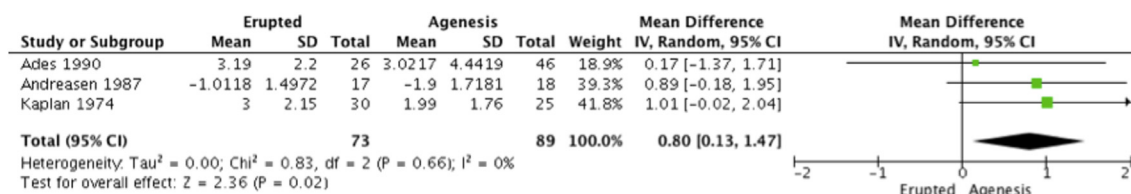


Figure 2 Forest plot of the erupted third molar group compared with the agenesis third molar group. Outcome: Changes in Little's irregularity index.

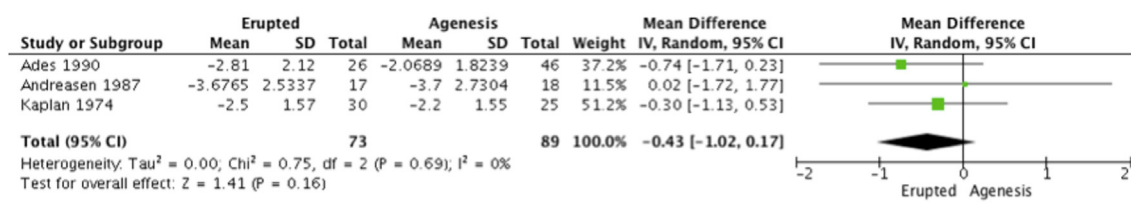


Figure 3 Forest plot of the erupted third molar group compared with the agenesis third molar group. Outcome: Changes in arch length.

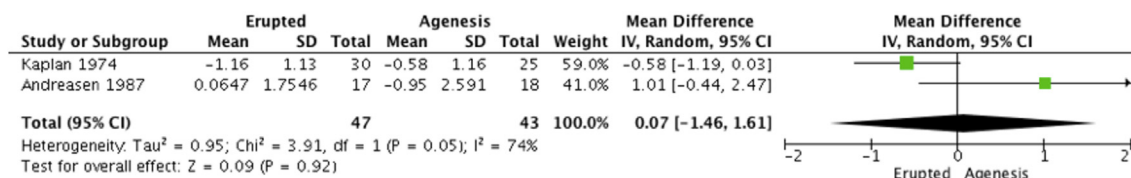


Figure 4 Forest plot of the erupted third molar group compared with the agenesis third molar group. Outcome: Changes in intermolar width.

studies reported a different outcome. A definitive conclusion on the role of third molars in the development of anterior tooth crowding could not be drawn. A high risk of bias was reported in most trials, and the outcomes were inconsistent.

However, most studies did not support a cause-effect relationship. Therefore, in their opinion, third molar extraction to prevent anterior tooth crowding or post-orthodontic mandibular relapse was unjustified.

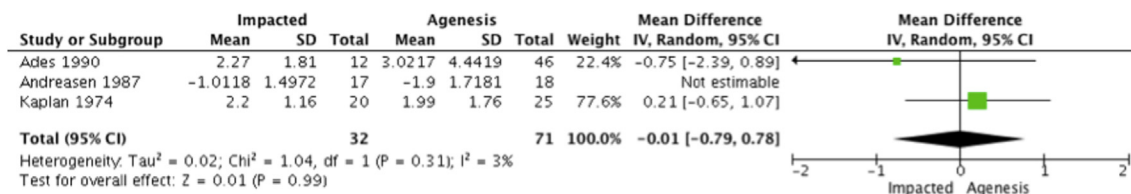


Figure 5 Forest plot of the impacted third molar group compared with the agenesis third molar group. Outcome: Changes in Little's irregularity index.

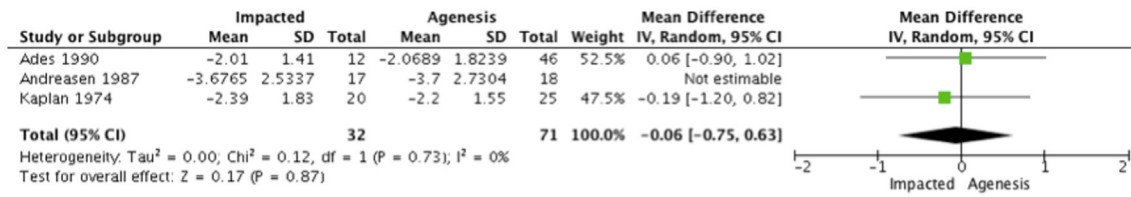


Figure 6 Forest plot of the impacted third molar group compared with the agenesis third molar group. Outcome: Changes in arch length.

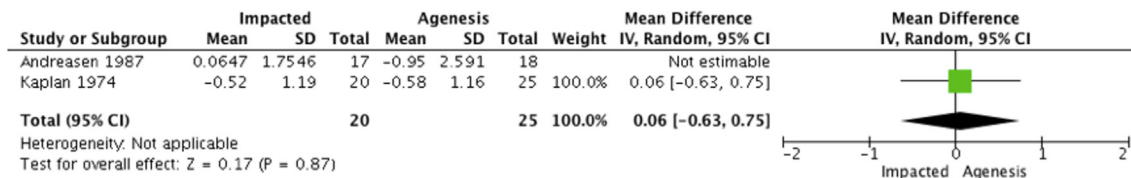


Figure 7 Forest plot of the impacted third molar group compared with the agenesis third molar group. Outcome: Changes in intermolar width.

Because of these contradictory opinions, we surveyed the literature and conducted a meta-analysis to identify some clinical directions for orthodontic clinicians regarding third molars.

The meta-analysis reviewed three studies. In Kaplan,³⁰ the cases were classified according to the status of the third molars as both erupted to occlusal plane, impacted, and agenesis. By contrast, in Ades et al.,³¹ the cases were classified according to the status of the third molars as erupted, impacted, agenesis, and extracted. In Andreasen et al.,³² two groups were formed depending on the presence of third molars. In our clinical practice, we come across patients with or without third molars. If the third molar was present, the need for extracting the third molars to prevent postretention crowding and the effect of impacted and erupted third molars were unknown. To offer a practically clinical reference, we combined the data to compare the populations with impacted or erupted third molar to those with the agenesis third molar. The impacted third molar group included patients in the impacted groups in Kaplan³⁰ and Ades et al.³¹ The agenesis third molar group included patients in the agenesis group in Kaplan,³⁰ patients in the agenesis and extracted group in Ades et al.,³¹ and patients in the third molars missing groups in Andreasen et al.³² (not considering premolars). The erupted third molar group included patients from the erupted groups in Kaplan³⁰ and Ades et al.³¹ and the third molars present group in Andreasen et al.³²

In Kaplan³⁰ and Ades et al.,³¹ no significant differences in the changes of all outcomes were observed between groups during the posttreatment period. Andreasen et al. study³² did not report data on comparison between the third molar subgroups; however, the researchers concluded that the absence of third molars did not increase the stability of the orthodontic results as evaluated by the changes in the incisor alignment, incisor angulation, or dental arch widths. As we pooled out the data from these studies and conducted a meta-analysis, different results were indicated as the sample numbers increased.

Overall, when the extracted data were classified into the erupted third molar group and the agenesis third molar group and subjected to a meta-analysis, a significant difference in the changes in the Little's irregularity index between the two groups were observed. However, the two groups did not significantly differ in terms of changes in the arch length and intermolar width. A comparison of the impacted third molar group and agenesis third molar group exhibited no significant differences for all outcomes (changes in the Little's irregularity index, arch length, and intermolar width). Further research is necessary to identify possible reasons and mechanisms.

Of the clinical studies we identified, the study by Haradine et al.²⁹ was the only RCT. The researchers randomized 44 of 77 patients to have their third molars removed after completion of retention after their orthodontic treatment. This study was excluded from our meta-analysis

because although all patients in this study had previously undergone the orthodontic treatment, all treatments offered in the mandibular dental arch simply comprised no treatment or premolar extractions only. More RCTs on this topic are necessary to offer stronger evidence.

There are several reasons might account for posttreatment relapse, such as growth related changes, muscular factors, periodontal ligament traction, bone adaptation, masticatory force, and third molars..., etc. On the basis of our results, third molars are not the major etiologic factors affecting posttreatment changes in incisor alignment. But after the meta-analysis we conducted, we still offer some clinical directions. While treating patients with erupted third molars, we suggest mandibular third molar removal for alleviating or preventing long-term incisor irregularity. However, all clinical studies selected were retrospective trials with risk of bias. In addition, the orthodontic treatment is complex. When treating a patient with or without third molar extraction before or during the orthodontic treatment, we recommend that additional clinical information be collected to obtain data on their strengths and weaknesses, such as patient age, potential development of pathogenesis, technical considerations of the surgical procedure, and long-term periodontal implications. Consultation and cooperation with other specialists are helpful.

RCTs are time-intensive studies but offer highly reliable evidence. Additional animal studies may provide possible explanations. Further investigations on the factors involved in postretention crowding are warranted.

In conclusion, our initial search strategy yielded 360 citations, of which three retrospective studies were selected. The Little's irregularity index (weighted mean difference = 0.80, 95% confidence interval = 0.13–1.47, $P = 0.02$) differed significantly between the erupted third molar extraction group and agenesis third molar group; whereas the arch length and intermolar width did not. No outcome differed significantly between the impacted third molar extraction group and agenesis third molar group.

We hypothesized that, compared to impacted third molars, erupted third molars might produce more anterior force and cause crowding of the mandibular incisors. On the basis of our results, while treating patients with erupted third molars, we suggest mandibular third molar removal for alleviating or preventing long-term incisor irregularity. However, additional clinical information should be collected, and consultation and cooperation with other specialists are still needed. Further investigations on the factors involved in postretention crowding are warranted.

Conflicts of interest

The authors have no conflicts of interest relevant to this article.

References

- Laskin DM. Evaluation of the third molar problem. *J Am Dent Assoc* Apr 1971;82:824–8.
- Niedzielska I. Third molar influence on dental arch crowding. *Eur J Orthod* Oct 2005;27:518–23.
- Tüfekçi E, Svensk D, Kallunki J, Huggare J, Lindauer SJ, Laskin DM. Opinions of American and Swedish orthodontists about the role of erupting third molars as a cause of dental crowding. *Angle Orthod* 2009;79:1139–42.
- Bishara SE. Third molars: a dilemma! Or is it? *Am J Orthod Dentofac Orthop* 1999;115:628–33.
- Sidlauskas A, Trakinienet G. Effect of the lower third molars on the lower dental arch crowding. *Stomatologija* 2006;8:80–4.
- Liberati A, Altman DG, Tetzlaff J, et al. The PRISMA statement for reporting systematic reviews and meta-analyses of studies that evaluate health care interventions: explanation and elaboration. *J Clin Epidemiol* Oct 2009;62:e1–34.
- Hozo SP, Djulbegovic B, Hozo I. Estimating the mean and variance from the median, range, and the size of a sample. *BMC Med Res Methodol* 2005;5:13.
- DerSimonian R, Laird N. Meta-analysis in clinical trials. *Control Clin Trials* Sep 1986;7:177–88.
- Riedel RA. Role of the mandibular third molar relative to lower arch crowding. *Am J Orthod Dentofac Orthop* 1989;95:25A–6A.
- Little RM. Stability and relapse of dental arch alignment. *Br J Orthod* 1990;17:235–41.
- Richardson ME. The role of the third molar in the cause of late lower arch crowding: a review. *Am J Orthod Dentofac Orthop* 1989;95:79–83.
- Vasir NS, Robinson RJ. The mandibular third molar and late crowding of the mandibular incisors—a review. *Br J Orthod* 1991;18:59–66.
- Kahl-Nieke B. The role of extraction in stability of orthodontic treatment. *J Orofac Orthop./Fortschr Kieferorthop* 1996;57:272–87.
- Kahl-Nieke B. Retention and stability: a review of the literature. *Am J Orthod Dentofac Orthop* 1998;114:299–306.
- Rupp RP. Orthodontic relapse and the mandibular third molar: a literature review. *Gen Dent* 2000;48:344–6.
- Sable DL. The effect of orthodontic treatment on third molar space availability: a review. *Ann R Australas Coll Dent Surg* 2002;16:156–7.
- Sumitra, Tandur AP. Third molars and late mandibular incisor crowding — a review. *J Ind Orthod Soc* 2005;38:100–11.
- Zachrisson BU. Mandibular third molars and late lower arch crowding — the evidence base. *World J Orthod* 2005;6:180–6.
- Rinchuse DJ, Miles PG, Sheridan JJ. Orthodontic retention and stability: a clinical perspective. *J Clin Orthod* Mar 2007;41:125–32.
- Prasad K, Hassan S. Influence of third molars on anterior crowding — revisited. *J Int Oral Health* 2011;3:37–40.
- Zawawi KH, Melis M. The role of mandibular third molars on lower anterior teeth crowding and relapse after orthodontic treatment: a systematic review. *Sci World J* 2014;2014, 615429.
- Stanaitytė R, Trakinienė G, Gervickas A. Do wisdom teeth induce lower anterior teeth crowding? A systematic literature review. *Stomatologija* 2014;16:15–8.
- Kahl-Nieke B, Fischbach H, Schwarze CW. Post-retention crowding and incisor irregularity: a long-term follow-up evaluation of stability and relapse. *Br J Orthod* 1995;22:249–57.
- Maia NG, Normando AD, Maia FA, Ferreira MA, Alves MS. Factors associated with orthodontic stability: a retrospective study of 209 patients. *World J Orthod* 2010;11:61–6.
- Shanley LS. The influence of mandibular third molars on mandibular anterior teeth. *Am J Orthod Dentofac Orthop* 1962;48:786–7.
- Sheneman J. Third molar teeth and their effect upon the lower anterior teeth; a study of forty-nine orthodontic cases 5 years after band removal. *Am J Orthod* 1969;55:196.
- Little RM. Stability and relapse of mandibular anterior alignment: University of Washington studies. *Semin Orthod* 1999;5:191–204.
- Rossouw PE, Preston CB, Lombard C. A longitudinal evaluation of extraction versus nonextraction treatment with special

- reference to the posttreatment irregularity of the lower incisors. *Semin Orthod* 1999;5:160–70.
29. Harradine NW, Pearson MH, Toth B. The effect of extraction of third molars on late lower incisors crowding. *Br J Orthod* 1998;25:117–22.
 30. Kaplan RG. Mandibular third molars and postretention crowding. *Am J Orthod* 1974;66:411–30.
 31. Ades AG, Joondeph DR, Little RM, Chapko MK. A long-term study of the relationship of third molars to changes in the mandibular dental arch. *Am J Orthod Dentofac Orthop* 1990;97:323–35.
 32. Andreasen GF, Lifshitz A, Wiemers C, Jakobsen J. A longitudinal analysis of relapse in the mandibular arch. *Quintessence Int* Mar 1987;18:203–10.