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RESEARCH ARTICLE

LONG-TERM STABILITY OF ANTERIOR OPEN BITE TREATMENT BY INTRUSION OF POSTERIOR TEETH USING TEMPORARY ANCHORAGE DEVICES: A SYSTEMATIC REVIEW AND META-ANALYSIS

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ABSTRACT

Objective: Posterior teeth intrusion performed by means of temporary anchorage devices (TADs) offers the possibility of closing anterior open bite, but data on the long-term stability of the treatment effect are lacking. This systematic review and meta-analysis evaluates the post treatment stability of anterior open bite patients performed by posterior teeth intrusion using temporary anchorage devices. ***Methods**:* The Pub Med, EMBASE, Web of science, Scopus, and Cochrane library databases were searched comparing effect of temporary anchorage devices on open bite treatment and posttreatment stability in studies performed using lateral cephalograms. No language restriction, authors were contacted and reference list screened. Screening and data extraction were performed by two independent investigators. Outcome measures were amount of changes in cephalometric variables measurement of upper and lower posterior teeth after intrusion using temporary anchorage devices. Standardized mean difference (SMD) and their corresponding 95% confidence intervals (95% CIs) were calculated. Quality and risk of bias were assessed by using Newcastle Ottawa scale and methodological index for non-randomized trials (MINORS) respectively. ***Results:*** Studies involving 115 patients; (mean age, 24.8 years) were included. There were significant differences in amount of upper and lower molar intrusion with open bite correction (SMD -1.63, 95% CI -2.68 to -0.57; P = 0.003) and (SMD -2.67, 95% CI -4.33 to -1.00; P = 0.002), respectively. No significant differences existed between upper and lower molar relapse with open bite recurrence for one year (SMD -0.41, 95% CI -1.04 to 0.22; P = 0.02) and more than one year posttreatment (SMD -0.41, 95% CI -0.55to 0.64; P = 0.88). ***Conclusions**:* TADs produce greater amount of molar intrusions which results into autorotation of mandible along with open bite correction. Greater percentage of molar and overbite relapse seems to occur during the first year posttreatment than the next subsequent years but doesn't result in relapse of open bite malocclusion.

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INTRODUCTION

Skeletal open bite is a vertical malocclusion, often called long-face syndrome which requires complex correction and long-term treatment stability has been a challenge for orthodontists (1).The prevalence of skeletal open bite ranges from 1.5% to 11% among various age and ethnic groups (2). Morphologically open bite patients are characterized by longer vertical dimensions (3), an increase in development of the maxillary and /or posterior dentoalveolar structure (1) a steep mandibular plane (4), obtuse gonial and mandibular plane angle (5), large interlabial gap, short posterior face height, thin and long morphology of mandibular symphysis(6). The skeletal open bite deformity is caused by multifactorial etiology, including genetic (7), sucking habits (7-9), inadequate tongue posture and function (10, 11),

nasopharygeal airway obstruction (12, 13), unfavorable growth pattern (14-16) and weak musculature (17-19).Frequently, some of these etiologic factors may occur on the same patient, thus treatment plan should consider the need for an interdisciplinary approach, which may require an orthodontist, oral surgeon, speech and language therapist, otolaryngologist, and psychologist. Various orthodontic treatment modalities have been proposed for correcting skeletal open bitedepending on patient age and growth potentials. Firstly, in growing patients,based on the rate of vertical growth changes of the dentoalveolar and apical bases, conventional orthodontic treatment for skeletal open bite can be accomplished with functional or fixed appliances such as high pull head gear, bite-blocks, habit-breaking appliances and vertical chin cups (20). These treatment results intosmaller posterior vertical dentoalveolar growth (relative intrusion), concurrent with an increase of posterior facial height contributing to open-bite closure and mandibular counterclockwise rotation (21). Even when orthopedic open-bite treatment is early performed, the skeletal effects are very poor, and dentoalveolar changes remain as the most important anatomical contributions for open bite correction (22). Secondly, in non-growing patients treatment of severe open bite is more difficult because the absence of significant dentoalveolar and skeletal growth causes ineffective achievement of an actual or relative intrusion of the posterior teeth by conventional orthodontic mechanics such as multiloop edgewise archwires with elastic, nickel-titanium archwires (23) extraction, high pull head gear (24). Open-bite correction with anterior vertical elastics and premolar extractions cause extrusion and drawbridge effect on the incisors which can result in increased gingival exposure during smiling because incisors are often already overerupted to compensate the excessive anterior facial height (25). It can result in unfavorable smile and compromised facial esthetic (26-30).

Orthognathic surgeryhas been a well-accepted treatment in non-growing patients due to inherent limitations of conventional orthodontic mechanics. It provides significate rotation of mandible upward and forward, decreasing the anterior facial height along with correction of anterior open bite. However, high financial costs, surgical and postsurgical risks and discomfort, good patient self-perception and self-esteem, and acceptable orofacial functions can lead the patient to refuse orthognathic surgery (12, 31, 32).Recently, surgical viewpoint has been modified by temporary anchorage devices such as dental implants, surgical miniplates and miniscrews, which have showed similar skeletal results as compared with the surgical approach (33, 34).

Temporary anchorage devices brought several orthodontic mechanical advantages and possibilities, such as actual posterior teeth intrusion, allowing autorotation of mandible and open bite correction, efficient vertical dimension control without patient compliance, and elimination of side effects associated with molar intrusion mechanics like extrusion of the anchored teeth. Despite of this advantage relapses is still common (1, 34-37). The potential of relapse of anterior open bite after treatment is one of the main factors influencing treatment prognosis. Although stability and retention have been researched in orthodontics after posterior teeth intrusion using temporary anchorage devices (38, 39), to date findings on the amount of relapse after intrusion which is considered less stable than mesiodistal movement or rotation is relatively scarce (40). Thus, it is unknown if the treatment effects remain stable in the long term. This review systematically synthesizes and analyzes information available in the literature on the long-term stability after posterior teeth intrusion using temporary anchorage devices. The information obtained is required for orthodontic diagnosis, treatment planning and posttreatment stability of open bite.

MATERIAL AND METHODS

Information source and study selection: Comprehensive electronic database search on the topic was performed to identify all relevant publications published on Medline (PubMed), EMBASE, Cochrane Central Register of Controlled Clinical Trials, Scopus and Web of Science using the following medical subject headings (MeSH terms): (1) “molar intrusion,” “posterior teeth intrusion,” “anterior open bite”; (2) “treatment outcome,” “follow-up studies,” “Stability,” “relapse” from their origin to November 2017. The reference lists of eligible studies were also screened for additional relevant search. No attempt to search for grey literature was undertaken. We aimed at primary studies, thus books and reviews were not considered. Full texts of potentially eligible studies were retrieved and reviewed to identify the studies which met the inclusion criteria. Furthermore, authors were contacted for missing data, unpublished or ongoing trial whenever necessary. Assessments of studies for inclusion in this review were performed independently and in duplicate. One author assessed all studies and the other two authors each assessed half of the retrieved studies. Investigators were not blinded on the authors or the results of the search and any disagreements were resolved by discussion and consensus with an independent expert who was not involved in the original screening of the studies.

Eligibility criteria

The following selection criteria were applied

Inclusion criteria were: (1) Patients aged > 12 years with incisor open bite (incisor overbite <-1mm), High angle (SN/MP) > 40 with permanent dentition; (2)Patients undergoing orthodontic treatment for open bite correction by posterior teeth intrusion in the upper and/or lower arch using temporary anchorage devices; (3) No restriction to study design; (4) At least 12 months of follow-up after debonding; (5) The main outcome measure was overbite and maxillary and mandibular plane angle (MMA); between Go-Gn or Me-Go and reference plane (FH or SN); lower anterior facial height (LAFH), Jarabak ratio; Y-axis angle, the angle between Sella-Nasion (SN) and Sella-Gnathion (S-Gn); (L6-MP), the distance between lower first molar (L6) and mandibular plane; and (U6-PP),the distance between upper first molar U6 and the reference plane, either palatal plane or horizontal plane and (6) Studies that included sagittal skeletal class I or class II discrepancy.

Exclusion criteria were: (1) Studies that were not performed in humans, case reports, discussions, debates; (2) Patients in the mixed dentition stage; (3) Studies involving orthognathic surgery; (4) Subject with craniofacial anomalies or syndrome (potentially influencing stability) and (5) low angle studies.

Data treatment: Data were extracted independently and in duplicate in similar protocol to that of inclusion criteria. Pre piloted data extraction form were used. The following information were recorded from selected articles: year of publication, study design, age, treatment period, posttreatment follow-up, amount of molar intrusion and relapse, amount of open bite reduction and relapse, sample description, intervention (temporary anchorage devices), outcomes (cephalometric measurements) and author’s conclusion.

Quality assessment and risk of bias in individual studies: One author extracted the mentioned data from the included articles and the second author checked for quality and risks of bias. Any disagreement was resolved with discussion between the two authors until a consensus was reached. The risk of bias was assessed according to the methodological index for non-randomized trials (MINORS) tool (41). Quality assessment was performed using the Newcastle-Ottawa Quality Assessment Scale (NOQAS).

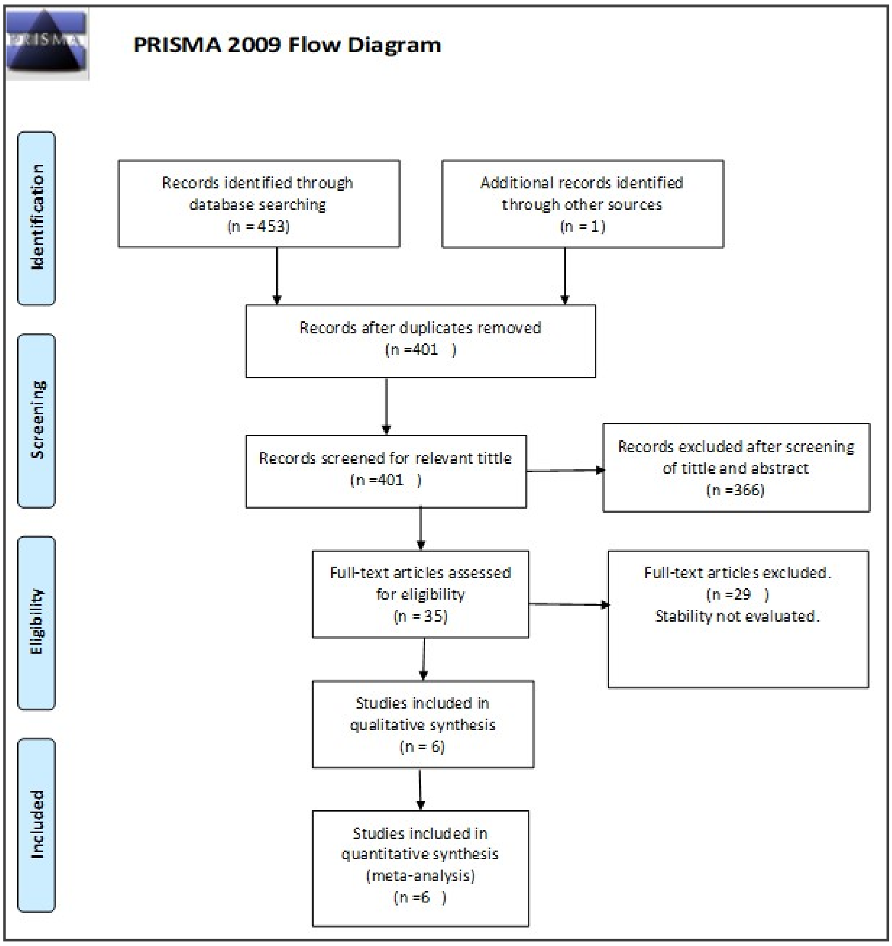


Figure 1. Flow chart of article screening and selection process. From Moher et al. For more information visit www.prismastatement.org

These tools evaluate studies based on 8 domain, which were divided into three broad aspects: selection, comparability, and outcome. Scores ranged from 0 to 9 points. High quality studies at low risk of bias could receive the maximum of 9 points. Studies having 6, 7, or 8 points were considered to have moderate quality, and a rating of 5 stars or fewer signified low quality.

Approach to statistical analysis (meta-analysis): The values studied in this meta-analysis were the (1) Amount of upper and lower molar intrusion posttreatment and the amount of over bite attained. (2) Amount of upper and lower molar relapse as well as over bite relapse during one year and more than one year posttreatment follow-up. As not all the included articles presented the values for lower molar intrusion, the analysis performed included all the data presented in each selected study. Amount of molar intrusion, over bite reduction, amount of molar relapse, open bite relapse, mean and standard deviation of the total samples were used. The random effect method was used to estimate the variability between and within the studies. Inverse variance method was used to assess the weight of each study. Statistical heterogeneity was assessed using the Q Cochran Test and the I^2 statistics. The 95% confidence interval (CI) values were calculated to indicate the precision of pooled means and the results were compared using Z test. Results with $p < 0.05$ were considered significant. Statistical analysis was carried out using RevMan (version 5.3). Amount of molar intrusion and relapse, amount of over bite attained and relapse were assessed according to changes in cephalometric measurements values pretreatment, at debonding and posttreatment follow-up.

RESULTS

The search strategies identified 453 articles, and 401 studies were considered potentially eligible for detailed evaluation. After examining tittle, abstract and full-text of the articles, 365 studies were excluded, and six (42-47) were found eligible for inclusion in qualitative and quantitative review according to our criteria for considering studies (Fig. 1). Manually search was conducted within the references of approved articles, it was found that all related studies were includes in the initial electronic search process. The characteristics of all six included studies are shown in Table 1. All the six included studies were retrospective studies non-randomized clinical trials (Non-RCTs). The six included studies have a total of 115 patients; (mean age, 24.8 years), all were subjected to lateral cephalometric in different periods during treatment.

The six studies returned in the search had reports allowing extraction of mean over bite and amount of intrusion data for preintervention (T1), posttreatment results after TADs intervention (T2), and long-term stability follow-up (T3). These data were pooled to enable evaluation of stability of open bite treatment after therapy. One study shows posttreatment follow-up data for 12 months (47) and the rest shows long-term stability follow-up of more than one year (42-46). The study design for the six studies were as follows: five were case series studies and one was longitudinal clinical trial. This clinical trial study (43) includes two distinct groups of patients: one group with nonimplant therapy, another with implant therapy (TADs). Since the second group provides data that meets the inclusion criteria, it was deemed appropriate for inclusion. All the studies included in our methodological scoring process have low to moderate quality. The methodological quality score derived from Newcastle-Ottawa scale, are presented in Table 2. Generally, two studies (43, 47) were considered to be of low quality and four studies (42, 44-46) were shown to have moderate quality. Since no studies received the maximum score of 9 points, none were assessed as having high quality.

Table 1. Characteristics of the included studies

References	Study design	Age	Sample size	images	Follow-up time	Outcomes	Author's conclusion
Sugawara et al. 2002	R,CS	13.3 to 28.9	9 patients	Lateral cephalometric	12months	ANB,FH/MP,LAFH Overbite,U6-PP,L6-MP	SAS is effective for open bite treatment; overcorrection is necessary
Lee and Park 2008	P,L,CS	18.2 to 31.1	11patients	Lateral cephalometric	17.4months	ANB,SN/MP,LAFH Overbite,U6-PP	Intrusion of maxillary posterior teeth is effective for overbite correction
Baek et al. 2010	R,CT,CS	18.3 to 31.1	9patients	Lateral cephalometric	28.8months	ANB,SN/GoMe,LAFH, Overbite,U6-PP,L6-MP	Adequate retention for long –term stability is necessary
Deguchi et al. 2011	R,L,CT	22.9 to 25.7	30patients	Lateral cephalometric	2 years	ANB,SN/MP,LAFH Overbite,U6-PP,L6-MP	Overcorrection and myofunctional therapy is recommended. Keep screws longer time or use retainer with occlusal stops in mandible
Scheffler et al. 2014	R,L,CS	12.7 to 48.1	30patients	Lateral cephalometric	2 years	SN/GoGn, LAFH, Overbite,U6-PP,L6-GoGn	Control vertical position of mandibular molar for proper overbite correction
Marzouk et al. 2016	R,L,CS	19 to 28	26patients	Lateral cephalometric	4 years	ANB,SN/MP,LAFH Overbite,U6-PP,L6-MP	Stability of open bite attributed to stability of molar and incisor intrusion

Abbreviation: P prospective, R retrospective, CT clinical trial, CS case series, L longitudinal, Me Menton, Go Gonion, Gn gnathion, SN Sella-Nasion, MP mandibular plane, FH Frankfurt horizontal, MPA mandibular plane angle, MMA maxillary mandibular angle, L6 lower first molar, U6 upper first molar, PP palatal plane.

Table 2. Quality assessment of the included studies according to the Newcastle-Ottawa scale

References	Selection	Comparability	Outcome	Total Score
Sugawara et al. 2002 [47]	2	2	2	6
Lee and Park 2008 [44]	2	3	3	8
Baek et al. 2010 [42]	2	2	3	7
Deguchi et al. 2011 [43]	2	2	2	6
Scheffler et al. 2014 [46]	2	2	3	7
Marzouk et al. 2016 [45]	2	3	3	8

Table 3. Risk of bias in the included studies based on the methodological index for non-randomized trials (MINORS) tool

item	*Sugawara et al 2002*	*Lee and park 2008*	*Baek et al 2010*	*Deguchi et al 2011*	*Scheffler et al 2014*	*Marzouk et al 2016*
1. A stated aim of the study	1	2	2	2	1	2
2. Inclusion of consecutive patients	0	0	0	2	2	2
3. Prospective collection of data	0	1	1	1	0	0
4. Endpoints appropriate to the study aim	2	1	2	2	2	2
5. Unbiased evaluation of endpoints	0	0	0	0	0	0
6. Follow-up period appropriate to endpoint	2	2	2	2	2	2
7. Loss to follow up not exceeding 5%	2	2	2	2	0	0
8. A control group having the gold standard intervention	2	-	-	2	-	-
9.Contemporary group	0	-	-	2	-	-
10. Baseline equivalence of groups	0	-	-	1	-	-
11.Prospective calculation of the sample size	0	0	0	0	0	0
12. Statistical analyses adapted to the study design	2	2	2	2	2	2
Total points	11	10	11	18	9	11

All studies achieved 2 points for selection domain of study groups. Two studies achieved the maximum of 3 points for compatibility of study groups. Four studies scored the maximum of 3 points for ascertainment of outcome of interest. Most studies had a high risk of selection bias, with some difficulty on baseline equivalence of groups, inclusion of consecutive patient, and prospective collection of data. Nearly all six studies had maximum of 2 points scores on two domain; follow-up period appropriate to end points and on statistical analysis adopted to the study design. Similarly, zero point on unbiased evaluation of end points and prospective calculations of the sample size. (Table 3).

Sensitivity analysis: Sensitivity analyses of data with both fixed-effects and random-effects models showed results were robust and reliable (data not shown).

Results on the long-term stability after posterior teeth intrusion using temporary anchorage devices: The TADs as an intervention for posterior teeth intrusion was the main discriminator used to judge the studies in the included articles. In the five studies used, patients underwent both maxillary teeth intrusion (42, 44-46) and in one study underwent both maxillary and mandibular intrusion (47). Nearly all the studies had mean and standard deviation treatment changes variables on maxillary posterior teeth intrusion (T2-T1), and relapse during retention (T3-T2). Four studies had both mandibular and maxillary posterior teeth intrusion (T2-T1) and relapse during follow-up (T3-T2). The outcome measures for stability assessed in these six studies were upper and lower posterior teeth intrusion and amount of over bite changes observed pre and posttreatment as described in the next section of our study.

Upper posterior teeth intrusion changes posttreatment: The overall cephalometric changes posttreatment derived from the six studies (N = 6), involving 115 participants (42-47) are given in Fig. 2. The results indicated significant change in the pooled standardized mean difference in upper molar intrusion U6-PP↑ (upper first molar to palatal plane) scores with reduction of open bite (SMD -1.63, 95% CI -2.68 to -0.57; P =

0.003). This demonstrate statistically improvement in upper molar intrusion with over bite correction. However, results should be interpreted with caution because of significate heterogeneity detected among studies (I^2 = 91%). Five studies showed large effect sizes, and one study (46) had low effect size because of relatively small changes during intrusion, possibly due to lower molar eruption as the upper molar were intruded.

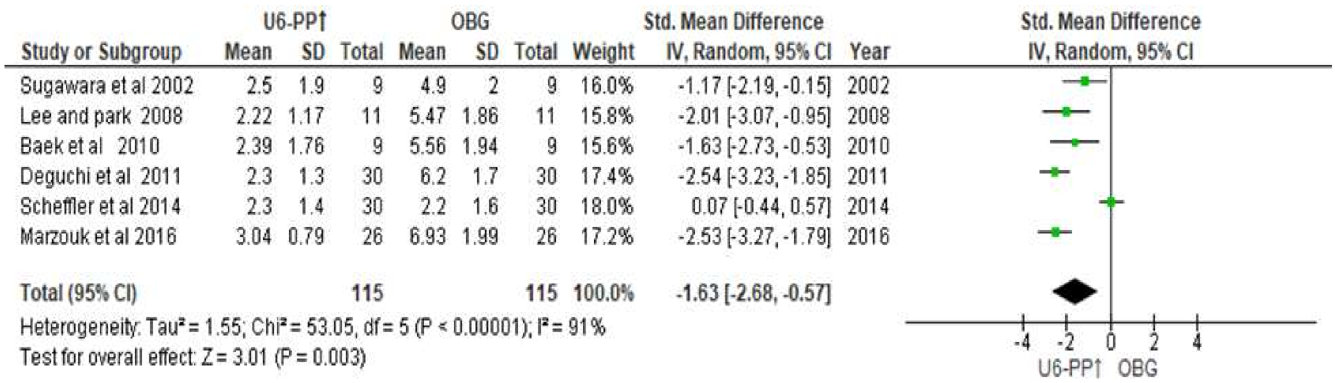
Lower posterior teeth intrusion changes posttreatment: In our review, we identified four studies (N = 4), with 95 subjects comparing lower posterior teeth intrusion with over bite correction in Figure 3.The meta-analysis revealed statistically significant difference in lower molar intrusion L6-MP↑ (lower first molar to mandibular plane) scores with reduction of open bite in patients (SMD -2.67, 95% CI -4.33 to -1.00; P < 0.002). There was evidence of significant heterogeneity among studies (I^2 = 94%).

Upper posterior teeth relapse changes posttreatment follow-up: All six studies with 97.39% (112/115) subjects were included after one year follow-up and three studies were excluded at more than one year post treatment follow-up (43, 44, 47) (Fig. 4). The excluded studies were due to absence of data for more than one year post treatment follow-up. Results showedno statistical difference in upper molar relapse U6-PP↓ (upper first molar to palatal plane) scores compared to over bite increase after one year (SMD -0.73, 95% CI -1.69 to 0.22; P = 0.13) and more than one year posttreatment (SMD 0.09, 95% CI -0.27 to 0.45; P = 0.61).

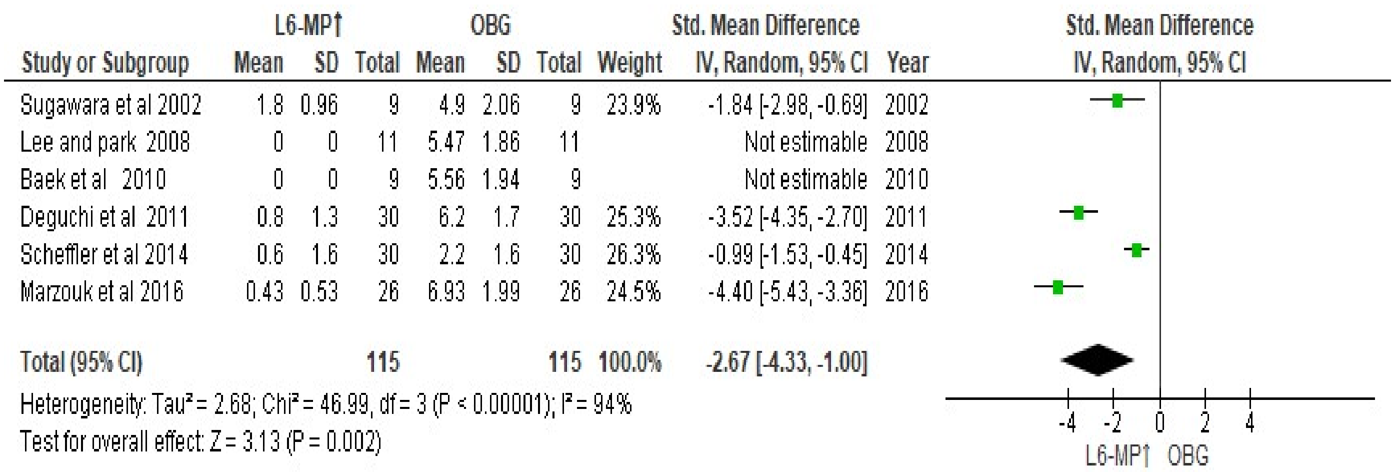
The effect size could be considered small at more than one year posttreatment follow-up. The overall effect of analysis for one and more than one year also showed no statistical significant different between upper molar and over bite relapse posttreatment (SMD -0.41, 95% CI -1.04 to 0.22; P = 0.20). Although this was less than that observed in the upper molar intrusion, the relapse was classified as small. Interestingly, there was evidence of significant heterogeneity among studies within one year posttreatment (I^2 = 90%). However, such evidence was missing for more than one year posttreatment (I^2 = 0%). Overall results showed significant heterogeneity evidence among studies (I^2 = 87%).

Lower posterior teeth relapse changes posttreatment follow-up: Similarly, analyses of data showed no statistical significant difference in lower molar relapse L6-PP↓ (lower first molar to mandibular plane) scores compared to over bite reduction for one and more than one year posttreatment (SMD 0.30, 95% CI -0.50 to 1.10; P = 0.46) and (SMD -0.43, 95% CI -1.12 to 0.26; P = 0.22), respectively. Likewise, the overall effect between lower molar and over bite relapse for one and more than one year posttreatment showed no significant difference in patients who were treated with temporary anchorage devices (SMD -0.41, 95% CI -0.55 to 0.64; P = 0.88; Fig. 5). However, significant heterogeneity existed among studies after one year posttreatment (I^2 = 90%) and more than one year posttreatment (I^2 = 67%). The overall analysis also showed evidence of significant heterogeneity among studies (I^2 = 83%).

Outcome: A. Upper posterior teeth intrusion.



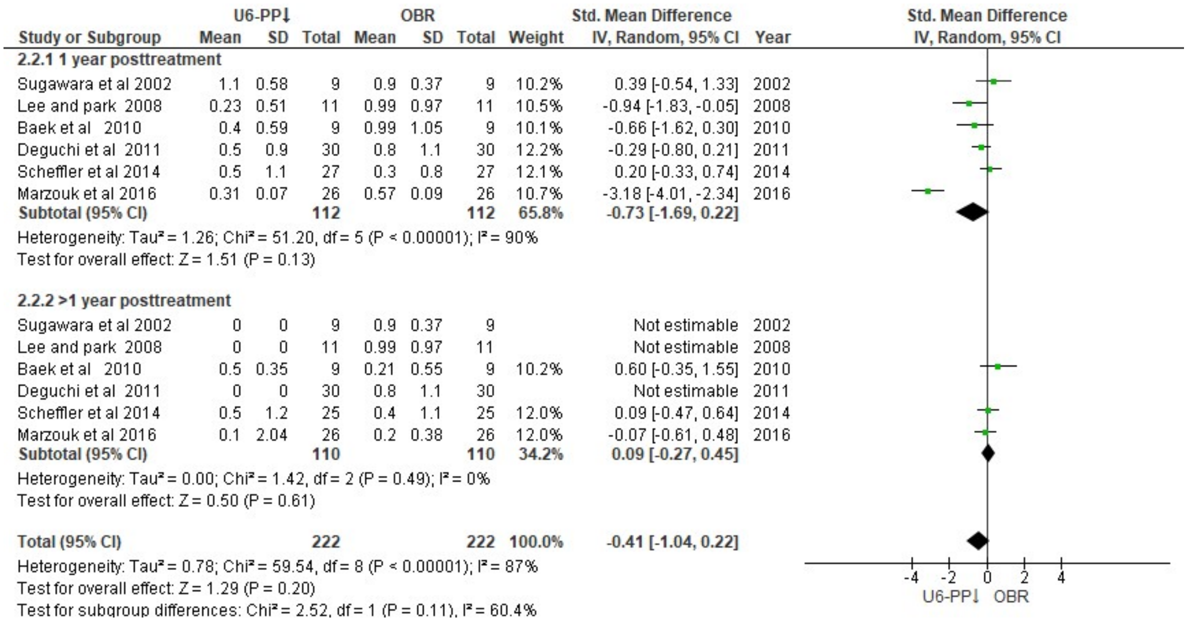
Outcome: B. Lower posterior teeth intrusion.



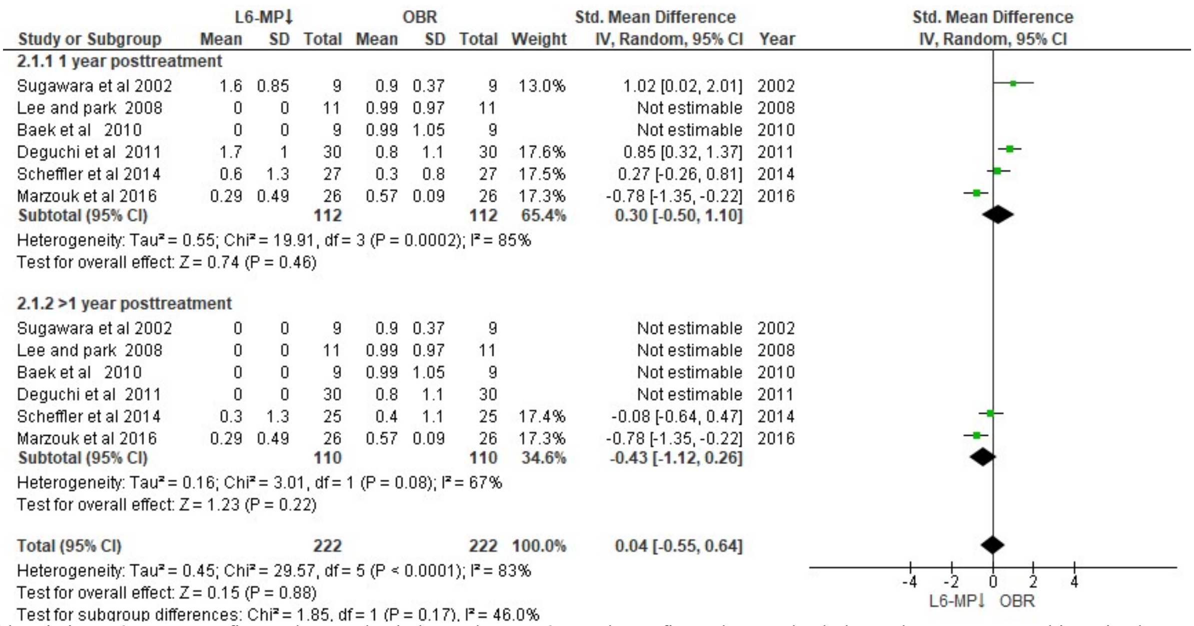
Abbreviation: U6-PP↑ upper first molar to palatal plane intrusion, L6-MP↑ lower fist molar to palatal plane intrusion, OBG over bite gained.

Figure 2. Cephalometric variables changes posttreatment.

Outcome: A. Upper posterior teeth intrusion



Outcome: B. Lower posterior teeth intrusion



Abbreviation:U6-PP↓ upper first molar to palatal plane relapse, L6-MP↓ lower fist molar to palatal plane relapse, OBR over bite gained.

Figure 3. Cephalometric variables changes follow-up period

DISCUSSION

The results of this systematic review and meta-analysis demonstrate that molar intrusion is one of the valid treatment approaches for correction of open bite as indicated by differences in upper and lower molar intrusion U6-PP↑ L6-MP↑, respectively with reduction of open bite in patients. The posttreatment follow-up of open-bite treatment with temporary anchorage devices (TADs) by intrusion of mandibular and/or maxillary molar shows some relapses, overbite decrease, but the amount observed does not contribute to bite opening in most of the patients. Results indicate stability in treatments because there were no statistical significant differences in molars relapse when compared to bite opening. Lower molars relapse had much contribution to the recurrence of open bite.To the best of our knowledge, this is the first systematic review and meta-analysis investigating long-term stability of anterior open bite treatment by intrusion of posterior teeth using temporary anchorage devices. Open bite treatment still presents challenge for orthodontist although there is much progress in orthodontic treatment techniques. Despite the relative stability of the surgically corrected anterior open bite, non-surgical orthodontic treatment using temporary anchorage devices for molar intrusion resulted intodentoskeletal changes, mandibular autorotation (34, 36, 47, 49) and finally bite closure, can achieve equivalent treatment results as to those obtained by orthognathic surgery (33, 43). Since these findings were previously known, surprisingly our finding supports the previous research that intrusion of posterior teeth can produce counterclockwise rotation of the mandible which is termed as skeletal effect (anteroposterior) which lead to reduction in the amount of open bite.

Most previous published studies show greater percentage, almost 80% of the observed relapse occurred during the first year after debonding (42-47). Interestingly, our findings show the similar results that upper and lower molar relapse occurs during the first year posttreatment and less relapse occurs during more than one year posttreatment. Moreover, the maxillary molar relapses were more pronounced in the first year posttreatment than mandibular molar and the reverse is true for the mandibular molar similar to the previous studies (43, 45-47). This may be attributed to the fact that fewer studies performed on the mandibular molar intrusion alone (43) or maxillary molar intrusion alone or both using temporary anchorage devices and occlusal cover were given to the patients (46). In the studies that were performed using mandibular or maxillary molar intrusion alone compensating eruptions were observed on the opposing molars that contribute to less amount of over bite correction (46). Generally, intrusion of the upper and lower molar simultaneously will increase the amount of open bite correction (33). However, our results should be interpreted with caution as the study is associated with several limitations. Firstly, comparing pre and posttreatment measurement changes in both upper and lower molar were performed independently in both studies. Due to lack of studies about stability of open bite using TADs, the retrieved studies present small sample size and doesn't represent the general population. According to methodological index for non-randomized trials (MONORs) risk of bias these studies were classified as having poor quality and low level of evidence which signify that these results should be interpreted with caution. Further well-design studies are required to confirm our findings. Secondly, high heterogeneity observed between studies that signify reduction of power of values. It indicates that, the range of treatment effect (molar intrusion) and long-term outcome of open bite therapy can be expected. This may have been caused by differences in sample selection, short follow-up period, and presence of confounding factors, sex, gender, inclusion criteria and different measurement standards. Young adults (growing patient) were also included in one study, this may have contributed significant effect on amount of molar relapse posttreatment (43, 46).Point estimate summaries should therefore be interpreted with care. Nevertheless, these reports represent a starting point for future studies with more rigorous design to deem with our findings.

Thirdly, no randomized clinical trials were performed focused on the open bite treatment using temporary anchorage devices. Presence of randomization is an important issue to consider when determining the best treatment modality for posterior teeth intrusion. It is clinically important to investigate the amount of mandibular rotation during open bite treatment by means of TADs in comparison with other therapeutic treatment options (such as MEAW, premolars extraction, high-pull headgear, and orthognathic surgery), as well as evaluation of the long-term stability of posterior teeth intrusion by different techniques. This drawbacks in most of the articles should be avoided in future studies so as to reach a more accurate conclusion concerning open bite treatment. Finally, our meta-analysis faced challenges, data from studies used different measures which were based on different scales (42-47). We combined the data and summarize using standardized mean difference, mean over bite changes and standard deviation data were pooled using random effect model, one method of determining effect size. The use of effect size has been advocated due to unlikely inferential statistical analysis such as p value. Our results have implication in orthodontic diagnosis, treatment planning and posttreatment stability of open bite preferably when option for using TADs is chosen.

CONCLUSION

This meta-analysis indicates that

- Greater percentage of molar and over-bite relapse seems to occur during the first posttreatment year. Although doesn't result in open bite relapse a careful protocol of retention should be planned in open-bite patients treated with posterior teeth intrusion using TADs. An active retainer should be recommended for at least one year posttreatment.
- TADs produce greater amount of molar intrusions which results into autorotation of mandible and open bite correction, it can be recommended for treating this challenging orthodontic problem when orthognathic surgery is unacceptable to the patient.
- The level of evidence on long-term outcomes of open bite patients was low, thus the results of this meta-analysis must be regarded with caution.

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