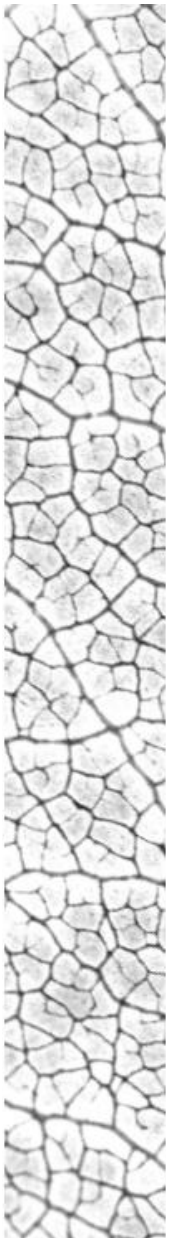

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Evaluate the effect of periodontally accelerated osteogenic orthodontics on gingivae and alveolar bone: a systematic review and meta-analysis

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Abstract

Background and aim: the aim of present systematic review and meta-analysis was evaluate the effect of periodontally accelerated osteogenic orthodontics on gingival and alveolar bone.
Method: From the electronic databases, PubMed, Cochrane Library, Embase, ISI have been used to perform a systematic literature between 2010 and 2020. Therefore, a software program (Endnote X8) has been utilized for managing the electronic titles. Searches were performed with mesh terms. Mean differences between two groups (PAOO group vs control group) with 95% confidence interval (CI), fixed effect model and Inverse-variance method were calculated. The Meta analysis and forest plots have been evaluated with the use of a software program Stata V16.
Result: A total of 360 potentially relevant titles and abstracts were found during the electronic and manual search. Finally, a total of four publications fulfilled the inclusion criteria required for this systematic review. Mean difference in Alveolar bone thickness between the PAOO and control group was 0.07mm (MD, 0.07mm 95% CI -0.39mm, 0.53mm. P= 0.76) and mean difference in GR between the PAOO and control group was 0.03mm (MD, 0.03mm 95% CI -0.05mm, 0.11mm. P= 0.49).
Conclusion: Periodontally accelerated osteogenic orthodontics had no negative effect on alveolar bone and gingival recession.

Keywords: alveolar process, orthodontics, periodontal

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INTRODUCTION

Malocclusion is one of the main problems in oral health that changes the function and aesthetics of teeth and can affect a person's mental and social health (Amuasi, et al. 2020). One of the reasons for orthodontic treatment is to improve the appearance of patients' smiles. Understanding the aesthetic components and patient satisfaction helps to achieve successful treatment results and is necessary. But the time required for orthodontics is one of the main concerns of most patients (Vannala, et al. 2019). The long orthodontic treatment time possess various disadvantages like higher predisposition to dental caries, gingival recession and root resorption (Muñoz, et al. 2016). Periodontally accelerated osteogenic orthodontics (PAOO) is a corticotomy assisted surgical method employed to reduce the orthodontic treatment time (Kamal, Fida, & Sukhia, 2019, AlHammadi, Wilcho, & Ferguson, 2019). This phenomenon includes a temporary burst of localized soft and hard tissue remodeling (i.e. regeneration) which rebuilds the bone back to its normal state. PAOO has shown to move the teeth 2-3 times further when compared to conventional orthodontic therapy (Muñoz, et al. 2020). Witch may increase the periodontal risk (gingival recession, esthetic failure, alveolar bone loss, dehiscence and fenestrations) of PAOO (Radhika, Rajasekar 2020, Xu, et al. 2020). As far as we know and repeated searches in this area, a systematic review and meta-analysis that study to examine evaluate the effect of PAOO on the gingivae and alveolar bone not done. Therefore the aim of present systematic review and meta-analysis was evaluate the effect of periodontally accelerated osteogenic orthodontics on gingival and alveolar bone.

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Table 1. PICO OR PECO strategy

PICO OR PECO strategy	Description
P	Population/ Patient: Patients during orthodontics treatment
E	Exposure/ Intervention: periodontally accelerated osteogenic orthodontics (PAOO)
C	Comparison: PAOO group vs control group
O	Outcome: Probing depth (PD), gingival recession (GR), alveolar bone thickness

Table 2. Studies selected for systematic review and meta-analysis

Study. Years	Study design	Number of patients				Mean/range of age (years)		Number of teeth		Bias assessment
		Test group		Control group		Test group	Control group	Test group	Control group	
		female	men	female	men					
Xu et al.2020	Non-RCT	20				18-30	18-30	60 maxillary anterior teeth	59 maxillary anterior teeth	5/7
		10		10						
		2	8	4	6					
Addanki et al.2017 (Xuan, (2020)	split-mouth	32				20-40	20-40	NR	NR	3/7
		16		16						
		NR	NR	NR	NR					
Cassetta et al. 2016	prospective cohort	20				17–28	17–28	NR	NR	5/7
		10		10						
		6	4	6	4					
Aksakalli et al. 2016	split-mouth	20				16.3 ± 2.4	16.3 ± 2.4	20 maxillary canines	20 maxillary canines	5/7
		10		10						
		4	6	4	6					

METHOD

Search strategy

From the electronic databases, PubMed, Cochrane Library, Embase, ISI have been used to perform a systematic literature between 2010 and 2020. Therefore, a software program (Endnote X8) has been utilized for managing the electronic titles. Searches were performed with mesh terms:

(((((((“Alveolar Process”[Mesh] OR “Alveolar Bone Loss”[Mesh]) AND “Cone-Beam Computed Tomography”[Mesh]) AND “Humans”[Mesh]) AND “Malocclusion, Angle Class III”[Mesh]) OR “Malocclusion”[Mesh]) OR “Malocclusion, Angle Class I”[Mesh]) AND “Orthodontics”[Mesh]) AND “Osteogenesis”[Mesh].

This systematic review has been conducted on the basis of the key consideration of the PRISMA Statement–Preferred Reporting Items for the Systematic Review and Meta-analysis (Moher, et al 2009), and PICO or PECO strategy (**Table 1**).

Selection criteria

Inclusion criteria

1. Randomized controlled trials studies, controlled clinical trials, and prospective and retrospective cohort studies, split-mouth study.
2. Human
3. Good periodontium health
4. Control group (Conventional method)
6. in English

Exclusion criteria

1. In vitro studies, case studies, case reports and reviews.
2. Animal studies
3. Oral and maxillofacial acute inflammation or tumor

Data Extraction and method of analysis

The data have been extracted from the research included with regard to the study, years, study design, number of Patient, mean/ range of age, number of teeth. The quality of Non-Randomized controlled trial studies included was assessed using the Newcastle-Ottawa Scale (NOS) (Stang, 2010). The scale scores range from 0 (lowest grade) to 7 (highest grade), and The quality of Randomized controlled trial studies assessed using the Cochrane Collaboration’s tool(Higgins, et al. 2011). The scale scores for low risk was 1 and for High and unclear risk was 0. Scale scores range from 0 to 6. A higher score means higher quality. For Data extraction, two reviewers blind and independently extracted data from abstract and full text of studies that included. Moreover, mean differences between two groups (PAOO group vs control group) with 95% confidence interval (CI), fixed effect model and Inverse-variance method were calculated. Random effects were used to deal with potential heterogeneity and I^2 showed heterogeneity. Chi-square (I^2) tests for homogeneity were done to quantify the extent of heterogeneity (P-value below 0.1 considered statistically significant). I^2 values above 50% signified moderate-to-high heterogeneity. The Meta analysis and forest plots have been evaluated with the use of a software program Stata V16.

RESULTS

According to the research design, 360 potentially important research abstracts and titles have been discovered in our electronic searches. At the first phase of the study selection, 312 research have been with regard to the topics and abstracts. Therefore, we fully assessed the complete full-text papers of the rest 56 studies in the second stage so that we excluded 52 publications due to the lack of the defined inclusion criteria. Then, four papers remained in agreement with our inclusion criteria required (**Fig. 1**). **Table 2** reports the individual studies in this meta-analysis.

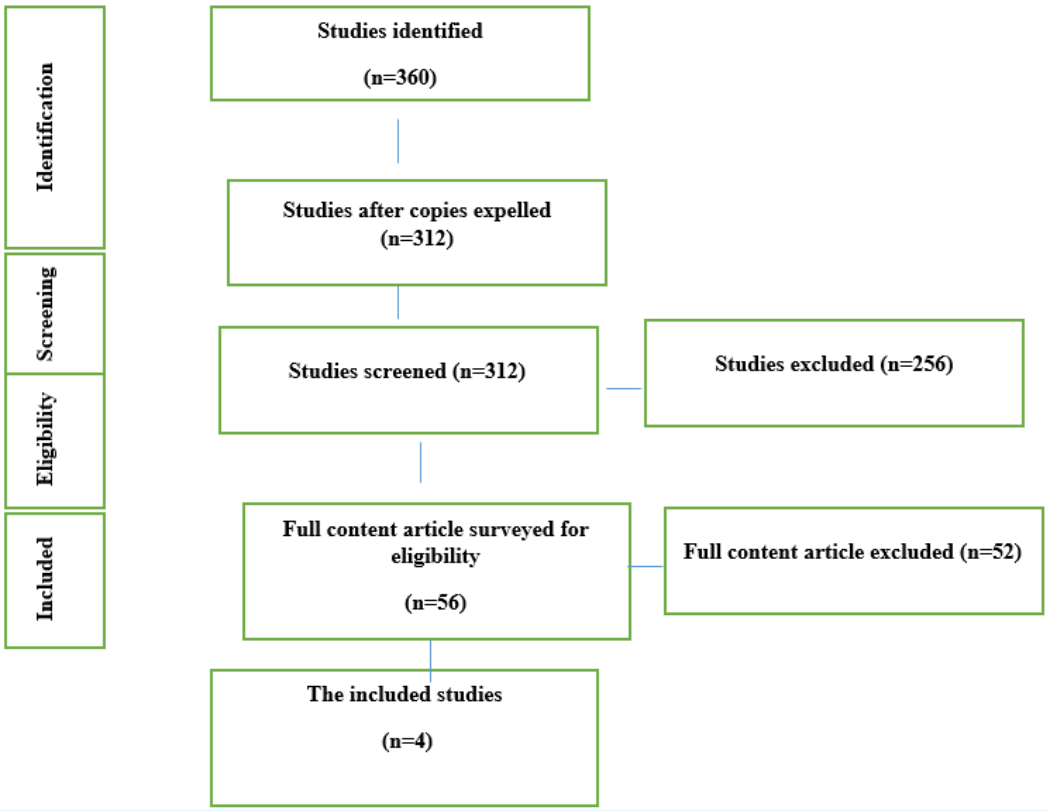

Fig. 1. Study Attrition

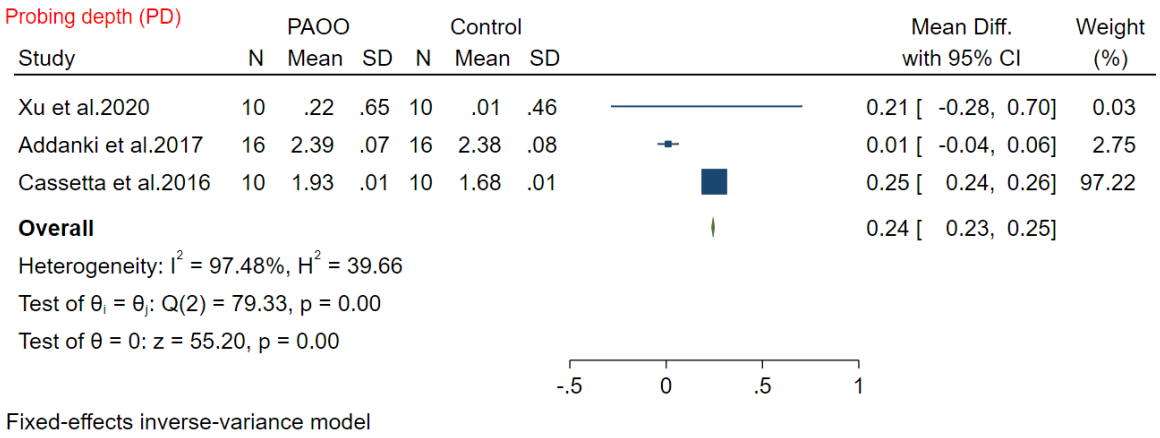

Fig. 2. Forest plot showed mean difference of probing depth between PAOO and control group

Study Attrition

Sample size

Therefore, four studies (one=Non-Randomized controlled trial, two=split-mouth and one= prospective cohort study) have been included. The Number of Patients a total was 92 with range of age 16 to 40 years (**Table 2**).

Bias assessment

According to Cochrane Collaboration's tool, one study (Aksakalli, et al. 2016). had a total score of 5/7, one study (Cassetta, et al. 2016) had a total score of 3/7. And According to Newcastle-Ottawa Scale, two studies had a total score of 5/7 (**Table 2**).

Probing depth (PD)

Mean difference in PD between the PAOO and control group was 0.24mm (MD, 0.24mm 95% CI 0.23mm, 0.25mm. P= 0.00) among 3 studies and heterogeneity found (I^2 = 97.48%; P =0.00). This result showed there was statistically significant difference between PAOO and control group (**Fig. 2**).

Gingival recession (GR)

Mean difference in GR between the PAOO and control group was 0.03mm (MD, 0.03mm 95% CI -

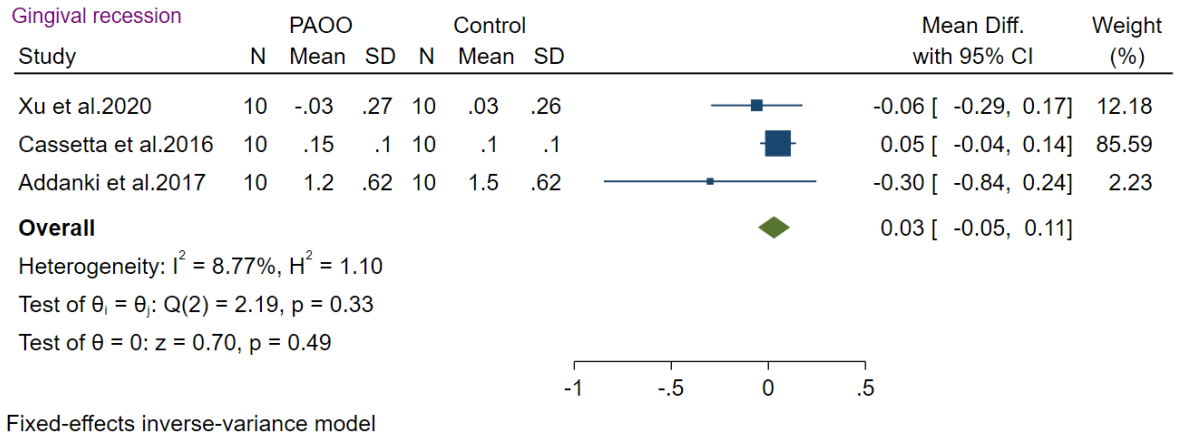

Fig. 3. Forest plot showed mean difference of gingival recession between PAOO and control group

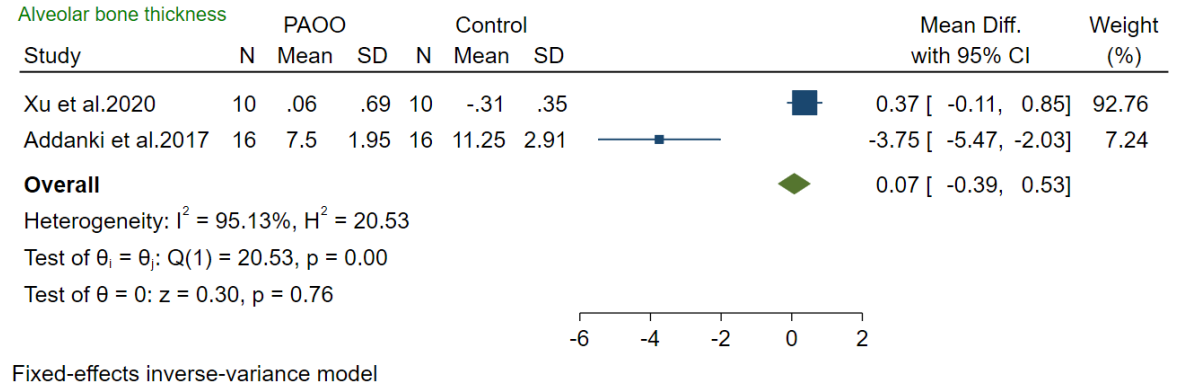

Fig. 4. Forest plot showed mean difference of Alveolar bone thickness between PAOO and control group

0.05mm, 0.11mm. P= 0.49) among 3 studies and heterogeneity found (I^2 = 8.77%; P =0.33). This result showed there was no statistically significant difference between PAOO and control group (**Fig. 3**).

Alveolar bone thickness

Mean difference in Alveolar bone thickness between the PAOO and control group was 0.07mm (MD, 0.07mm 95% CI -0.39mm, 0.53mm. P= 0.76) among 2 studies and heterogeneity found (I^2 = 95.13%; P =0.00). This result showed there was no statistically significant difference between PAOO and control group (**Fig. 4**).

DISCUSSION

In recent years, accelerated osteogenesis has sparked interest in the orthodontic community. As people get older, they become more interested in shortening orthodontic treatment time and compensating for the increase in the density of bone. Unfortunately, few studies have been conducted in this field, and most studies, including the quality of the method, low, medium, high heterogeneity and scientific evidence lead to several risks of bias. It is hoped that the results of the present study will be able to demonstrate the effects of PAOO on the periodontium by examining quantitative evidence (Xu, et al. 2020). The damaging effects on the periodontium are speculated to occur following alteration in the vascularity compromising viability of the bone and gingival tissues leading to adverse effects on periodontium (Xuan, 2020). Thin gingival biotype, plaque and inflamed gingival tissues are often implicated as possible contributors to the development of recession during orthodontic treatment Since in PAOO the movement occurs at a faster rate and involves an inflammatory process, it is expected to have some degree of root resorption and anchorage loss. The effect of corticotomy on root resorption was assessed and interpreted using different methodologies in various studies. Present systematic review and meta-analysis designed to evaluate the effect of PAOO in gingivae and alveolar bone thickness. Meta-analysis showed that indicating a greater periodontal risk for gingivae and alveolar bone. Also Meta-analysis showed that all periodontal parameters remained stable, except PD, and no signification differences were observed for GR between the PAOO and control group. PAOO did not lead to gingival inflammation, attachment loss, or gingival recession. Previous studies have reported similar results (Kamal, Fida, & Sukhia, 2019, Xu, X et al. 2020, Wilcko, et al. 2009. Ferguson, et al. 2014. Li, et al.

2018. Cheung, et al. 2016. Babanouri, Ajami, & Salehi, 2020).

The limitations of the present study were: heterogeneity was observed between studies, studies with similar working methods, larger sample size and high quality should be done in future studies. Many sources of bias could have potentially confounded the results including methodological issues, publication bias. A shortage of high-quality studies in this area is obvious. Most studies included have high degree of methodological heterogeneity making comparison challenging

CONCLUSION

Periodontally accelerated osteogenic orthodontics is effective in treatment, safe for periodontium and there was no negative impact on alveolar bone and gingival recession. There was statistically significant difference between PAOO and control group to PD.

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