Original Article

Evidence Based Review And Analysis On The Impact Of Orthodontic Intervention On Periodontal Clinical Attachment

Dr (Prof) Chetan Chandra[1], Dr. Gourav Patil[2], Dr.Danish Uz Zama Khan[3]*, Dr. Mahak Gupta[4], Dr. Anamika Gupta[5], Dr. Khwaja khijir[6],

[1]MDS, Professor, Periodontics, Saraswati Dental College and hospital, Lucknow. Email- chetanchandra321@gmail.com
[2]MDS, Orthodontics and dentofacial orthopaedics Email- gouravpatil01@gmail.com
*[3]Department of dentistry, Associate Professor, Era's Lucknow Medical College and Hospital, Email – danish07khan@gmail.com
[4]Junior Resident, Gandhi Medical College, Hamidia Hospital, Bhopal, Email: mahakgupta1494@gmail.com
[5]General Dentist, Email - anamikagupta.sidhi@gmail.com
[6]People's college of dental sciences and research centre, Bhopal, Email: khwajakhijirkhan832@gmail.com

***Corresponding Author:** Dr. Danish Uz Zama Khan,

*Department of dentistry, Associate Professor, Era's Luknow Medical College and hospital, Email – danish07khan@gmail.com
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Abstract

Background: By the means of this systematic review, we aimed to analyse the correlation present (if any) between orthodontic treatment modalities and their impact on periodontal clinical attachment levels.

Methodology: Using the PRISMA framework, a thorough review of research that were listed in the PubMed, Web of Science, and Cochrane library databases was performed which revealed 103 papers, 54 of which were thoroughly evaluated. Exclusion and inclusion criteria were employed to choose studies that were applicable for our review, and finally we shortlisted 10 studies that were found to be suitable for the review.

Results: No exact correlation could be drawn between orthodontic intervention and its subsequent impact on clinical attachment loss on the basis of the articles reviewed and thereupon statistical analysis.

Conclusion: There is a significant lack of evidence that suggests orthodontic treatment's impact on periodontal attachment, though it must be mentioned that further investigations in the future might unearth newer observations, and as such, the objective of our review is open to further debate.

Keywords: Attachment loss, orthodontic appliances, orthodontic treatment, periodontal indices

INTRODUCTION

Gingival recession appears to have a number of causes. It has been suggested that tooth movement caused by an orthodontic appliance may be a significant factor [1]. Results on whether or not orthodontic treatment might cause periodontal diseases vary [2]. It is essential to take precautions against gingival recession in clinical scenarios where it may happen after orthodontic treatment. The gingival margin's apical displacement in reference to the cemento-enamel junction is known as gingival regression. Labial, lingual, or interproximal zones can all experience gingival recession [3]. This may expose the root surface, making it more sensitive to air and cold, increasing the risk of developing root caries, and degrading the aesthetics. Moreover, the associated loss in attachment leads to further degradation of the periodontal ligament as well as surrounding musculature. More than 85% of adults over the age of 65 have gingival recession, which is more common as people age [4]. Both good and bad oral hygiene might cause gingival recession [5]. Mandibular incisors on the labial aspects and maxillary molars on the buccal aspects are the teeth that experience recession the most frequently [6].

Types	*Description*
Localised	Involvement of <30% of periodontal tissues/sites
Generalised	Involvement of >30% of periodontal tissues/sites
Low	Clinical attachment loss of around 1-2 mm
Moderate	Clinical attachment loss of around 3-4 mm
Severe	Clinical attachment loss of > 5mm

Table 1: Types of chronic periodontitis

Table 1 as shown above depicts the types of chronic periodontitis which is believed to be the primary culprit responsible for clinical attachment loss in the periodontium. The optimum circumstances for a healthy periodontium are circumferential bone present all around the teeth 1-2 mm from cemento-enamel junction, sufficient bone on the labial and lingual surfaces of the root by at least 1 mm, axial loading, and teeth that are properly aligned in the middle of the alveolar ridge. Even in people who practise good oral hygiene, gingival recession—which manifests as the apical displacement of the marginal gingival tissue—can happen [7]. In these circumstances, isolated teeth on the labial surfaces are primarily affected by gingival recession. On the other hand, a widespread gingival recession may be seen in patients with poor oral hygiene [8]. The breadth of the gingival soft tissue and bone morphology, such as the thickness of the alveolar bone, are the primary causes of gingival recession [9]. Gingival recession is thought to have a significant risk factor for alveolar bone dehiscence. Although gingival recession may always occur in the presence of alveolar bone loss, this is not a given. But there is always accompanying bone loss of the alveolar crest when gingival recession is evident. Consequently, there is a connection between alveolar bone dehiscence and gingival recession [10]. The buccolingual location of the teeth and tooth movement in the frontal plane are two risk factors for gingival recession and associated clinical attachment loss. The gingival-thickness and gingival-width of the keratinized gingiva are influenced by the tooth position in the buccolingual dimension. When the teeth are positioned lingually as opposed to buccally, there is an increase in the amount of keratinized gingival. Rapid palatal expansion uses stresses on the maxillary molars and premolars in the frontal plane in order to extend the maxillary arch. These devices shift the teeth buccally in the frontal plane, which may result in less gingival tissue covering the labial surfaces of the teeth [11].

The extrusion of teeth brought on by orthodontic tooth movement is another facet of orthodontics. Tipping and extrusion are the two most frequent tooth movements seen during orthodontic treatment. If teeth are extruded during orthodontic tooth movement, several authors have questioned whether this can have a deleterious impact on the periodontium [12]. Orthodontic extrusion occurs along with expansion. Extrusion rates with expansion appliances have been found to be comparable to those with quick palatal expanders [13]. Therefore, it appears that the typical orthodontic extrusion has no discernible impact on periodontal structures [14]. This has been supported by the findings showing that there are no negative effects on the periodontal tissues even after substantial extrusion of impacted canines to bring them into the dental arch.

The mandibular incisors are retroclined in patients with Class III malocclusion in order to accommodate the skeletal pattern. Lower incisors have more alveolar bone dehiscence in these circumstances, and the labial wall thickness is reduced [15]. These circumstances increase the risk of gingival recession. The gingival tissues in the lower anterior region may migrate apically as a result of improper management of Class III malocclusion. Mini-screws in the jaw bones and intermaxillary elastics from the mini-screws appear to be the best method for correcting class III skeletal relation [16]. There is less likelihood of periodontal side effects with this approach because the force is administered directly to the maxilla and mandibular bone, not the teeth. The class III malocclusion is repaired, the maxilla is advanced, and the perfect Class I relation is attained with the mini-screws. To create a Class I connection, mini-screws can also be employed to distalize or retract the entire maxillary and mandibular arches. [17]

Hence, through the means of this systematic review, we aimed to analyse the relationship between orthodontic treatments involving appliance application and its effect on periodontal clinical attachment by looking into studies which meet our objectives and inclusion/exclusion criterion.

MATERIALS AND METHODS

Protocol employed

This systematic review was performed as per the Preferred Reporting Items for Systematic Review and Meta-analysis (PRISMA) strategy and rules from the Cochrane group and the book Orderly reviews in Health care: Meta examination.

Review hypotheses

This systematic review aimed to analyse, by the means of selecting studies, the correlation between orthodontic treatment modalities and their effect (if any) on periodontal clinical attachment in susceptible individuals.

Study selection

There were a total of 103 documents discovered after extensive search on the online journals and 54 of the papers were selected initially. Following that, 22 similar/duplicate articles were eliminated, which resultantly made 32 separate papers available at first. The abstracts and titles of submissions were then reviewed, and a further 22 papers were eliminated. Finally, 10 documents that met the inclusion and exclusion criteria were chosen, which included study articles and randomised/non-randomised control trials

Eligibility criteria

For this systematic review, we employed the PICOS (Participants, Interventions, Comparison, Outcome, Study design) framework for assessment of studies fit for our investigation.

The following were excluded from the scope of our systematic review: incomplete data, enamel caries, patients afflicted with systemic disorders, individuals in whom orthodontic treatment had begun only recently, seminar presentations, scholarly articles, placebo controlled studies, opinion articles, and scoping reviews.
Since the literature available on this topic is quite scant in volume, we did not limit our search in terms of the time period when the studies were published i.e. we took into account all the papers that were published with context to our topic (where the number of papers itself was found to be quite sparse in number).
Placebo-controlled studies were not included in the analysis. Excluded were literature reviews and cases published in languages other than English.

Search strategy

The following databases were scoured for studies pertaining to the effects of SDF on biofilms: MEDLINE, PsychINFO, PubMed, Indian Council of Medical Research, and Cochrane. Other published works were found by scanning the reference lists of pertinent papers.

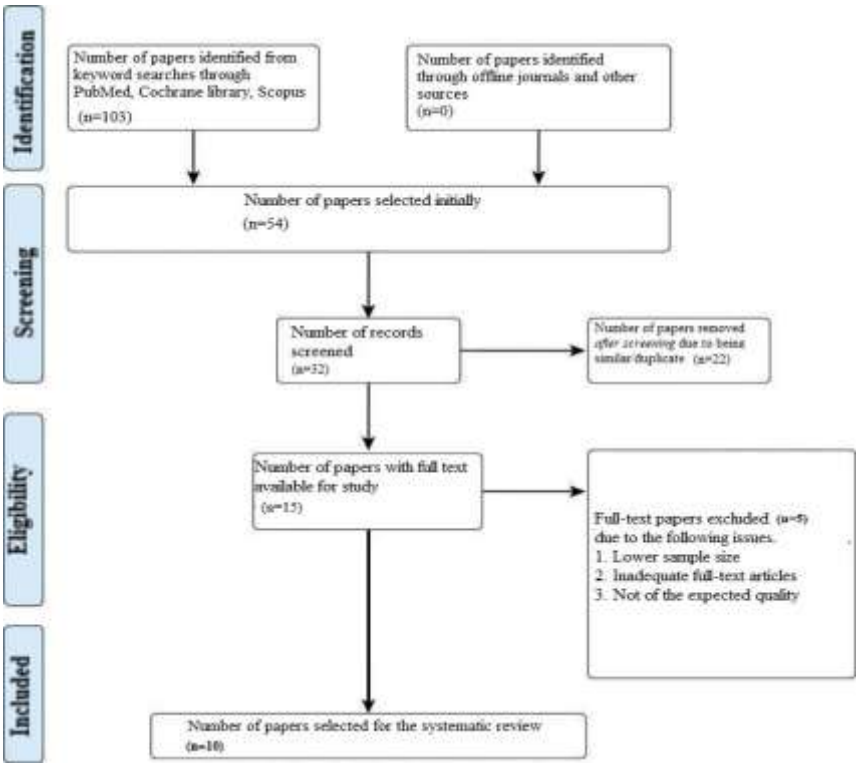

Figure 1: Representation of selection of articles through PRISMA framework

RESULTS

The results of the systematic review have been tabulated in table 2 presented below, with the details of the 6 studies that were selected for the review presented in the table, following which the figures 2, 3 and 4 given below shows the results of the meta analysis (using RevMan 5 software) in the form of a forest plot depicting all the studies taken up in this systematic review and evaluating them. Data on the sample size, variables analysed and different aspects of the investigations selected for our systematic review were entered in Revman 5 software and the forest plots representing the risk ratio, odds ratio and risk difference were obtained as part of the meta analysis for our review.

Author and year of study	*Sample size, mean age and study design*	*Study description*	*Study inference*
Agrawal et al (2016) [18]	62 (20 males and 42 females); 15 years; Non-randomised investigation	The active orthodontic treatment phase and the oral hygiene education phase were separated in the experiment. For the canines and first molars, measurements of plaque index, gingival index, probing pocket depth, and clinical attachment loss were made at baseline, after one month of orthodontic therapy, and then every three months until the end of the orthodontic treatment.	Implying that attachment loss cannot be fully explained by the impact of plaque or tooth bands, there was a statistically significant increase in all clinical measures (plaque index, gingival index, probing pocket depth, and attachment loss) on the first molars compared to the canines.

Amiri-Jezeh (2004) [19]	12 (4 males and 8 females); 12-48 years; Non-randomised investigation	Changes in attachment levels in patients whose maxillary incisors had protruded after an orthodontic treatment that lasted between 9 and 14 months were assessed. Clinical indicators such probing depth, level of attachment, and bleeding upon probing were assessed.	In individuals with excellent dental hygiene, orthodontic intrusion of the maxillary front teeth maintains constant periodontal characteristics and may even result in a minor clinical attachment gain.
Baka et al (2013) [20]	20 (all males); 14.2 years; Prospective investigation	Clinical measurements were taken before bonding, one week after bonding, and three months after bonding. These measurements included plaque index, probing pocket depth, and bleeding on probing.	Regarding the retention of dental plaque, self-ligating brackets and conventional brackets ligated using stainless steel ligatures are identical.
Cardoso et al (2015) [21]	16; 12-16 years; Non-randomised investigation	Eight patients received treatment using self-ligating brackets on the top dental arch and conventional brackets on the lower dental arch. Eight more people received conventional brackets in the top arch and self-ligating brackets in the lower arch. The subjects were given oral hygiene information and instructions. The clinical attachment level, gingival bleeding index, and visible plaque index were measured immediately following the placement of orthodontic appliances as well as 30, 60, and 180 days later.	Between subjects who received passive self-ligating brackets and those who received traditional brackets, there were no appreciable differences in the subjects' level of attachment to orthodontic treatment for the variables evaluated. All patients had their periodontal health evaluated and received oral hygiene education.
Carvalho et al (2009) [22]	20 (3 males and 17 females); 24 years; Non-randomised investigation	At baseline, after orthodontic treatment, and after four months, the following variables were measured: probing pocket depth, clinical attachment level, bleeding on probing, and dental plaque index. Monthly maintenance appointments were conducted with a tight dental biofilm control.	All clinical measures, including probing pocket depth, clinical attachment level, bleeding on probing, and tooth plaque index, improved between the baseline and 4 months following orthodontic treatment, according to statistical analysis.
Guo et al (2016) [23]	108 (46 adults and 62 children); Observational study	Clinical indicators such as the plaque index, gingival index, sulcus bleeding index, probing depth, and attachment loss of the seen teeth were looked at.	Both adults and children may have their periodontal and microbiological conditions affected by fixed orthodontic appliances, with children being more significantly affected than adults. Some clinical and microbiological indicators show synchronised trends.
Kaygisiz et al (2015) [24]	60 pateints; 12-18 years; Non-randomised investigation	The patients were split into three groups at random: the self-ligating bracket group, the control group, and the group receiving traditional braces that were ligated with steel ligature wires. A week before bonding, right before bonding, a week after bonding, four weeks after bonding, and eight weeks after bonding, periodontal records were gathered. The control group's measurements were taken again throughout the identical time frames.	Plaque index, gingival index, pocket depth, bleeding on probing, and halitosis were all found to change similarly across three independent groups over time, indicating that self-ligating brackets do not have an advantage over conventional brackets in terms of pocket depth and overall periodontal status.

Lu H et al (2010) [25]	11 adults; Randomised control trial	Before orthodontic therapy, the first month following treatment, and the third month after treatment, clinical periodontal indexes of the observed teeth were evaluated, and subgingival plaques were simultaneously collected at each time point. There were four clinical periodontal indexes: attachment loss, probing depth, sulcus bleeding index, and plaque index.	The sulcus bleeding index was higher in the first and third months compared to the baseline. The first month following therapy, probing depth increased; the third month, it decreased. All 11 subjects had a deeper probe than 2 mm. Attachment loss was not seen.
Zanatta et al (2014) [26]	330 (171 females and 159 males); 14-30 years; Cross-sectional investigation	Patients receiving fixed orthodontic treatment for at least six months had their plaque and gingival indices, probing pocket depth, clinical attachment loss, and gingival enlargement assessed by a single calibrated examiner.	Although no significant changes could be seen in the clinical attachment levels, anterior gingival expansion was associated with greater levels of proximal anterior haemorrhage and extra resin surrounding brackets in participants receiving orthodontic therapy.
Zasčiurinskienė et al (2018) [27]	50 adults; Randomised control trial	Following a baseline evaluation, supra- and subgingival debridement was performed on all patients. Patients in the control group underwent cause-related periodontal therapy prior to beginning orthodontic therapy, whereas patients in the test group underwent this therapy concurrently with orthodontic therapy.	Although no significant changes could be seen in the clinical attachment levels, anterior gingival expansion was associated with greater levels of proximal anterior haemorrhage and extra resin surrounding brackets in participants receiving orthodontic therapy.

Table 2: Tabular representation of the studies used for analysis in this systematic review

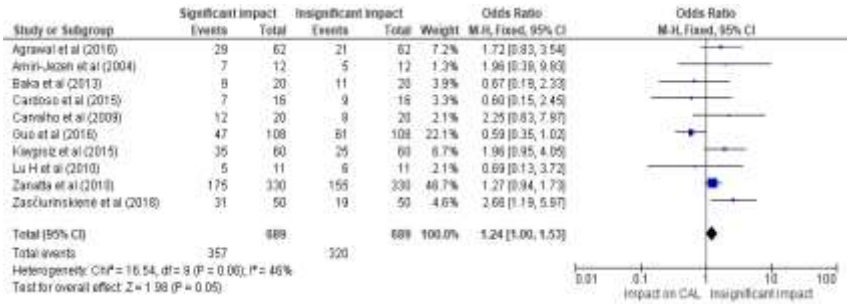

Figure 2: Events favouring impact on clinical attachment level (CAL) *vs.* other parameters that were insignificant to CAL levels that were part of the selected studies on the basis of the odds ratio represented on a forest plot

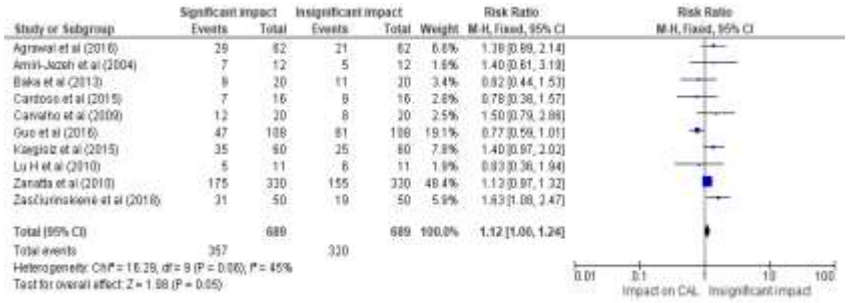

Figure 3: Events favouring impact on clinical attachment level (CAL) *vs.* other parameters that were insignificant to CAL levels that were part of the selected studies on the basis of the risk ratio represented on a forest plot

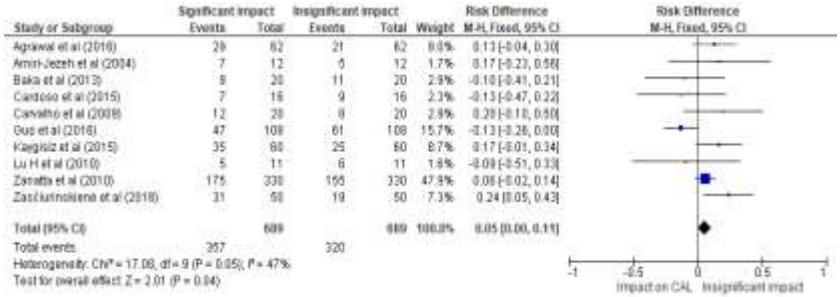

Figure 4: Events favouring impact on clinical attachment level (CAL) *vs.* other parameters that were insignificant to CAL levels that were part of the selected studies on the basis of the risk difference represented on a forest plot

DISCUSSION

The current systematic review summarises data from ongoing longitudinal clinical investigations on the impact of orthodontic appliance use on individuals with malocclusion's clinical attachment levels. There may be little to no clinically discernible attachment loss associated with orthodontic treatment or usage of orthodontic appliance-based treatment modalities, according to the ten clinical investigations that involved 689 treated individuals.

Orthodontists are seeing more patients with periodontal issues as more individuals seek orthodontic treatment. Adult and adolescent patients who are periodontally healthy and undergoing orthodontic treatment have been associated with a minimally invasive injury to the periodontal tissues and a generally temporary inflammatory process of the periodontium. Research also shows that orthodontic tooth movement can be successfully tolerated by a periodontally decreased but healthy periodontium without further treatment-induced attachment loss. This has also been immunologically validated, as orthodontic movement of teeth with deficient periodontal tissues that were not inflamed did not result in an increase in the parameters of tissue damage. Pathologically misaligned teeth can be corrected using orthodontics in order to reduce occlusal damage, stabilise the dentition, and enhance periodontal health. The impact of periodontally extruded teeth on periodontal tissues, however, is still debatable. Recent research suggests that abnormal extrusion and migration can be corrected with modest intrusive forces. [28]

(Black circle waala document ka rationale waala starting part after abstract) Fixed appliances make it more difficult to maintain good oral hygiene, which leads to more plaque building up and a consequent moderate inflammation of the oral tissues. Fixed appliances have been shown to significantly affect intraoral microbial and clinical conditions [29]. These effects can vary depending on the patient, the appliance, and the site, but are typically manifested as increased pocket probing depth, increased bleeding on probing, increased crevicular fluid volume, and a switch from aerobic to anaerobic microbial species (4, 5). However, it is thought that these treatment-induced abnormalities are largely temporary [30], return to normal, at least in part, after the orthodontic equipment are removed [31], and are not linked to any long-term negative effects on the nearby periodontal tissues.

The combined periodontal-orthodontic treatment may only slightly enhance the periodontal health in terms of attachment level and papilla height, according to data from indirect pooling of single-group cohort studies. [32] This could be explained by the orthodontically treated teeth having a relative intrusion into the alveolar bone, which might help to increase the clinical attachment. Contrast this with how orthodontic therapy affects patients with healthy gums, where there is just a slight loss of clinical attachment and marginal bone. [33] Increased blood flow to the periodontium, dental pulp, and alveolar bone, which may help the tissues heal, is one explanation for this phenomenon. Prior studies have shown the effectiveness of both surgical and non-surgical periodontal therapy, with greatest pocket reduction and attachment level improvements seen after a year in pockets that were initially deeper than 5 mm. [34-37] We may now predictably increase the margins of pocket reduction and attachment level gain following treatment when using sophisticated regenerative periodontal treatment technologies and after carefully selecting the right cases. However, considerable improvements like those seen following the combined periodontal-orthodontic treatment in our inquiry might only be comparable with the best treatment outcomes, which depend on a number of variables such surgical technique, biomaterials, and the operator's experience.

However, this study does have certain drawbacks. First and foremost, the majority of the studies in this systematic review were randomised or non-randomized, which may have an impact on the outcomes of the meta-analyses. Furthermore, despite our best efforts, we were unable to get any additional information or clarifications from several of the authors of the included research. For instance, clustering must be taken into consideration when reporting clinical attachment loss at the tooth level, as was done in one study, or the results may be impacted. Additionally, we planned and carried out our analysis using the patient as the measuring unit, preventing site-specific assessment of clinical attachment loss, even though this would already be impossible due to the poor reporting quality of prior research. A robust assessment of heterogeneity, subgroup analyses for a variety of factors (such as socioeconomic status, smoking, oral hygiene levels, and appliance type), small-study effects, and reporting biases for the majority of the outcomes were also made impossible by the small number of included trials. We rate the probability of publication bias as low because of our thorough literature screening, which included grey literature, even if publication bias could not be statistically tested due to the small number

of included research. Last but not least, there is a chance that measured clinical attachment loss has been overestimated because all studies reported on attachment loss during treatment, after appliance removal, or within the following months after appliance removal, when the periodontal connective tissue is likely still mildly inflamed and may cause the periodontal probe to penetrate deeper, increasing measured attachment loss.

CONCLUSION

Comprehensive orthodontic treatment with orthodontic appliances may have little to no clinically relevant negative influence on the clinical attachment levels of patients with malocclusion, according to the available evidence from prospective longitudinal research. Although there is significant relative variability among the studies that have already been done, the variation in the clinical attachment level change is just slight and falls below the measurement error. Adolescent and adult patients with a range of malocclusions who are periodontally healthy and are ready to receive fixed appliances can benefit from the study's findings. As long as the patients have gotten thorough periodontal treatment, don't exhibit any symptoms of inflammation, and haven't lost much periodontal support, they could use them. However, it should be mentioned that given the scarcity of moderate-quality evidence and the need for caution in the interpretation of these results and as such should be taken with a pinch of salt.

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