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THE IMPACT OF LINGUAL ORTHODONTICS ON GINGIVAL AND PERIODONTAL HEALTH; A SYSTEMATIC REVIEW OF CONTROLLED CLINICAL TRIAL STUDIES

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ABSTRACT

Linguistic orthodontics is a highly successful and visually pleasing treatment method for addressing malocclusions. It possesses a multitude of advantages in addition to potential disadvantages, including speech impairments, mastication restrictions, and oral agitation. Lingual braces can cause gingival hyperplasia and impact the health of the gums and periodontal tissues. This study conducted a systematic review following the PRISMA standards, specifically examining lingual orthodontic treatments that were the subject of randomized controlled trials. The study found that lingual brackets are more advantageous than buccal brackets for flat surfaces. Both types of brackets have been found to be associated with an elevation in plaque retention, gingival irritation, and S. mutans count. Because of an increased demand for adult orthodontic care, there are designed discrete treatment options such as lingual bracket systems. The demand is largely driven by appearance and cosmetics. Apparently, lingual brackets proved to be more efficacious for the prevention of caries on flat surfaces. Additional research is necessary to gain a comprehensive understanding of lingual orthodontic efficacy and safety compared to its counterpart.

KEYWORDS: Lingual orthodontics, outcome, gingival health, periodontal health, braces.

INTRODUCTION

The orthodontic therapy system is recognized as a core component of dental treatment that is utilized to treat misalignments and enhance oral health and beauty. The adult requirements for orthodontic

therapy systems have skyrocketed in the past several decades [1]. This phenomenon could be explained by several significant factors; for example, the choice of appearance has altered as societal norms become more developed. It may be said that the fixed lingual bracket systems have grown increasingly popular in the previous three decades due to the ability to meet these standards while only affecting appearance. The systems provide an almost undetectable orthodontic remedy [2].

The term "lingual orthodontics" refers to the application of orthodontic devices, such as brackets and wires, on the lingual surfaces of teeth, offering a less conspicuous alternative to traditional buccal braces. This approach not only rectifies teeth misalignments but also eliminates the visual consequences of treatment, rendering it particularly attractive to those who prioritise physical attractiveness throughout orthodontic therapy [3].

Lingual orthodontics is commonly considered a highly preferable option for persons who choose a treatment method that is visually attractive and easy to notice. Lingual braces are not visible to the unaided eye because they are positioned on the lingual or inner surface of the teeth, in contrast to conventional orthodontic braces that are put on the front or labial open surface of the teeth. The main issue linked to traditional braces is effectively alleviated by this unique methodology. It allows patients to undertake orthodontic treatment while maintaining their visual integrity [4].

Lingual orthodontics has numerous advantages, such as greater visual appeal, decreased discomfort to soft tissues, and enhanced dental cleanliness. Lingual braces offer a very efficient method for teeth realignment, whilst maintaining a nearly imperceptible appearance, so enhancing patient self-assurance and contentment. Furthermore, they have the ability to mitigate soft tissue irritation on the lips, cheeks, and gums. It enhances the comfort of the therapy. Lingual braces promote improved oral hygiene by stopping any interference with brushing and flossing. this in turn facilitates patients to adhere to excellent oral hygiene habits which can lead to healthier gums and a decreased likelihood of periodontal problems [5].

Given the advantages of lingual appliances, the use of lingual orthodontics has been common in the whole world. Nonetheless, the existing studies identified some of the possible drawbacks, including “disturbances of speech, limitations of masticatory function, and oral discomfort” with premanufacture systems. The possibility of gingival hyperplasia, that is excessive gum growth, might increase in the use of lingual braces, especially when the distance between the teeth and the lingual brackets is not enough. All this, in turn, can lead to swelling, pain, and difficulties in maintaining oral hygiene [6].

Despite the numerous advantages it offers in terms of patient happiness and appearance, the dental community remains highly interested in and divided concerning the impact of lingual orthodontics on gingival and periodontal health. The maintenance of dental health and the support of teeth are contingent upon the gingiva, commonly referred to as gums and the underlying periodontal structures. The integrity and health of these critical tissues may be influenced by many orthodontic treatment approaches, including lingual orthodontics [7].

Technological advancements, namely in the areas of automated arch wire manufacture and customized bracket design, have played a crucial role in addressing numerous challenges that are encountered in modern lingual orthodontics. However, research findings suggest that orthodontic treatments

employing conventional buccal equipment continue to raise concerns regarding iatrogenic effects, including heightened plaque formation and vulnerability to dental caries. It is crucial to comprehend the influence of various orthodontic methods on the health of the gums and periodontal tissues [8].

Most orthodontists would attest to the fact that the number of adults seeking orthodontic treatment has significantly increased recently, especially among females. Due to patient requests for discreet treatment, brackets in the color of their teeth are now commonly accessible. Even though porcelain and plastic brackets lessen the appliance's visual presence, some patients still find this to be an issue because they can still see the brackets [8,9]. Even though the majority of patients get orthognathic surgery for cosmetic reasons, postoperative functional issues frequently follow aesthetic gains. Patients must thus carefully consider if they are having orthognathic surgery for functional or aesthetic reasons. Orthognathic surgery carries a broad range of potential consequences. A discrete line should be drawn separating malfeasance from problems. If the reason is found early on and appropriate treatment is given, complications can be remedied without any major issues. In order to effectively treat patients who, experience problems, oral and maxillofacial surgeons need to be fully informed about the many kinds of complications, their causes, and how to treat them [10].

Periodontal health may suffer as a result of orthodontic treatment, particularly if it is coupled with the implantation of fixed retainers in the mouth. The incidence of recession, plaque retention, and bleeding on probing was found to be higher in patients with fixed retainers; however, the clinical relevance of the recession difference was minimal. As a result, careful dental hygiene and attentive observation are recommended both during and after treatment [11]. The association between periodontal and orthodontic conditions gets closer as the number of orthodontic patients rises. Although periodontal tissue can experience negative clinical issues during orthodontic therapy, this is not an uncommon occurrence. Orthodontic treatment can enhance periodontal condition [12]. Prominent mandibular incisor advancement can be used to address dentoalveolar retrusion in adolescent orthodontic patients without raising the risk of recession. Recession that takes place while receiving active treatment is not progressive. Patients who experience recession on one or more teeth during appliance therapy, however, may experience recession on other teeth following treatment [13]. The use of lingual orthodontic appliances has been linked to increased tongue pain, trouble speaking, and trouble keeping teeth clean [14].

Gingival recession has the potential to impact different tooth surfaces, exhibiting either localised or generalised manifestations. Apical displacement of the gingival boundary from the cemento-enamel junction (CEJ) is the defining characteristic. Gingival recession leads to the exposure of the root surface, which often negatively affects appearance and raises the likelihood of developing root caries and dentin hypersensitivity. The aetiology of gingival recessions is mostly attributed to two primary etiologic causes: mechanical trauma and periodontal disorders. However, it is important to note that there may be additional factors that contribute to the development of gingival recession, either simultaneously or equally. Additional secondary etiologic factors that could potentially be implicated include tobacco use, bone dehiscence, and tooth positioning [11].

The absence of regular monitoring during orthodontic therapy may potentially exert adverse effects on periodontal health. There may be a correlation between the augmentation of the oral microbiota's

abundance, composition, metabolic activity, and pathogenicity. An augmentation in the depth of pocket probing may be observed subsequent to tooth-banding. A statistically significant increase in black-pigmented bacteroides has been observed by researchers. According to a longitudinal research of patients, the clinical periodontal and microbiological parameters were influenced by the implantation of fixed orthodontic appliances. However, it was seen that these parameters were primarily adjusted three months after the removal of brackets. Although lingual therapy is considered the most visually appealing orthodontic treatment due to the absence of visible brackets and the absence of protruding lips, there have been multiple reports of discomfort, changes in speech, and difficulties in maintaining proper oral hygiene [15, 16].

METHODOLOGY

Data Search Strategy

The Impact of Lingual Orthodontics on Gingival and Periodontal Health relevant literature was found by a methodical and comprehensive search strategy. We looked at the following electronic databases in detail: Google Scholar; PubMed/MEDLINE; Elsevier. The search strategy included keywords and medical topic headings (MeSH) related to lingual orthodontics, gingival health, periodontal health, gums and brackets in order to effectively combine search phrases. The language, research design, and publication type of the search results were filtered. The English-language publications were included in the research.

Table 1 *(MeSH terms and keywords used in the systematic review)*

Category	Keywords/MeSH Phrases
Dental hygiene	"plaque" OR " black-pigmented bacteroides " OR " oral microbiota "
Gingiva	" gingival health " OR " gums " OR " Periodontal Health "
Dental implants	"orthodontics [mesh] OR orthodontic" OR ‘‘lingual orthodontics’’ OR ‘‘lingual bracket"

Inclusion Criteria:

- Included were studies that fulfilled the following criteria:
- Studies evaluating orthodontics or lingual orthodontics
- Studies that offer detail about periodontal health or gingival health
- studies that provide an insight into effect of orthodontics on gingival or periodontal health

Exclusion Criteria:

- Studies mentioned below were excluded:
- Studies that did not specifically address orthodontics

- studies that did not fully report their findings
- review articles
- Studies that are not publicly available in English.

Data Extraction

Using a systematic data extraction and synthesis technique, a thorough Impact of Lingual Orthodontics on Gingival and Periodontal Health was conducted. This involved assessing particular articles that were eligible with the preset standards. Relevant data was gathered from included research investigations, and interpreting noteworthy discoveries. A thorough analysis of the literature made possible by the methodical approach produced important results on the subject under focus. The rigorous selection and analysis of papers was made easier by the careful data management system, which ensured the validity and dependability of the review findings. Figure 1 describes the data extraction process used in this systematic review in accordance with PRISMA guidelines [17].

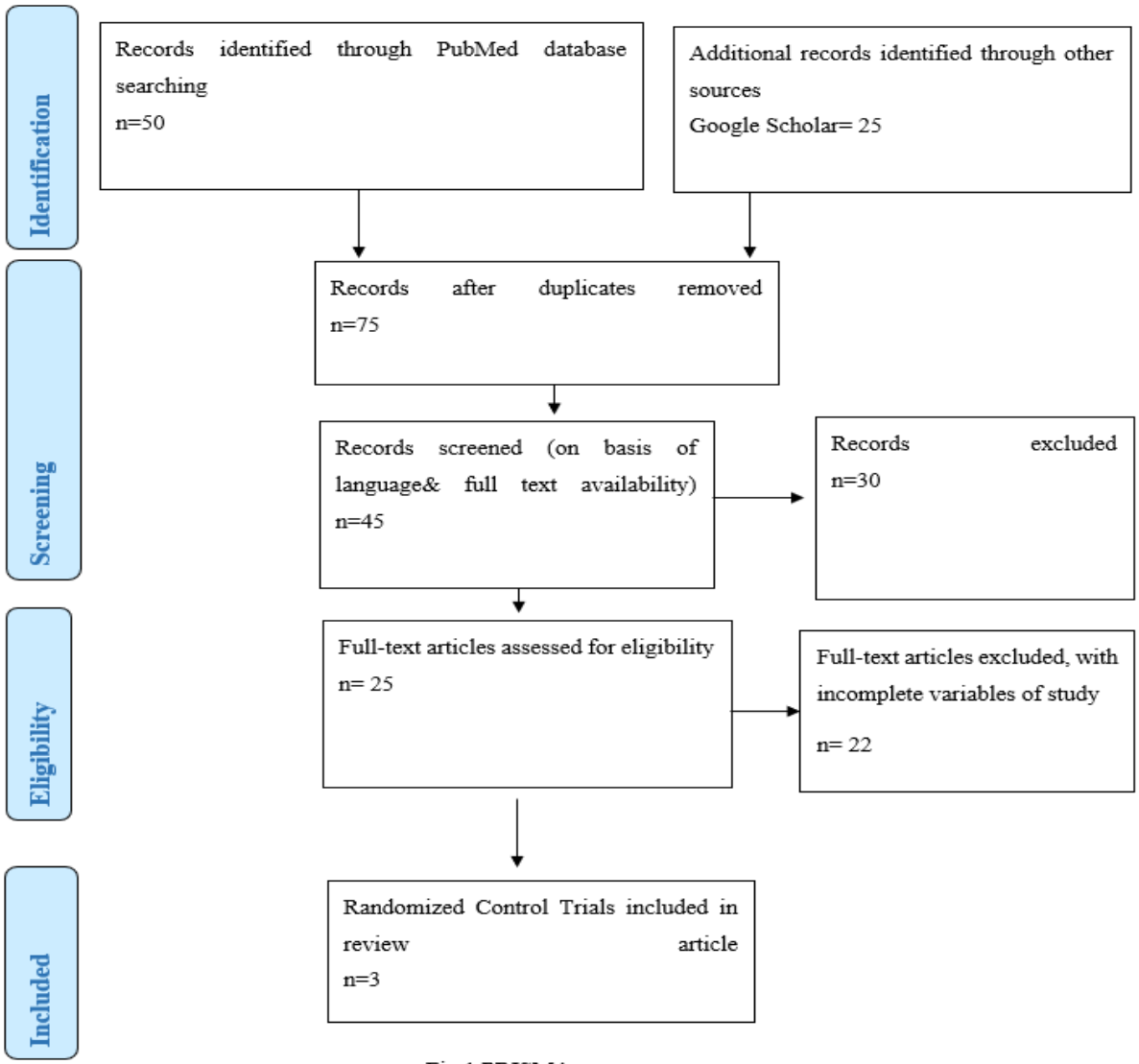

Fig.1 PRISMA

RESULTS AND DISCUSSION

Three relevant studies were included that matched the inclusion criteria set for this systematic review. All of the studies were RCT with focus on effect of lingual orthodontics with a comparison group. Table 2 provides a summary of the characteristics and conclusions of these investigations.

Table 2 *(Characteristics of Studies Included in the Systematic Review.)*

Study	Sample Size	Intervention	Comparison	Conclusion
Van der Veen et al., 2010 [18]	28	Lingual Orthodontics	Buccal Orthodontics	When considering caries incidence on the smooth surfaces, lingual brackets are preferred over buccal brackets when properly installed.
Khattab et al., 2013 [19]	34	Fixed Lingual Orthodontics	Fixed Labial Orthodontics	The lingual appliance presents greater challenges in speech articulation compared to the labial appliance. Participants of both types of appliances experienced varying levels of oral impairment. Lingual appliances exhibited a higher incidence of adverse effects, particularly within the initial month of treatment.
Lombardo et al., 2013 [20]	20	Lingual Orthodontics	Labial Orthodontics	Both lingual and labial orthodontic appliances have an impact on clinical parameters. Specifically, the use of STb lingual appliances has been found to increase plaque retention, gingival inflammation, and S. mutans counts. However, there are no significant differences observed in terms of Lactobacillus counts and saliva buffer capacity.

The present study aimed to assess and evaluate the speech performance and oral impairment levels. It consisted of 34 patients diagnosed with Class I division one malocclusion and mild crowding of upper teeth. The study specifically focused on comparing the effects of fixed lingual as well as labial orthodontic appliances. The patients were categorised into two cohorts. One of those who had treatment with fixed linguistic appliances. Second who received treatment with traditional fixed labial appliances. Speech performance was evaluated through the utilisation of spectrographic examination of the fricative /s/ sounds before and immediately following. It was also done one month after and three months after to the placement of brackets. Group A had a notable decline in articulation, whereas group B only experienced this decline at time 1. The lingual brackets group experienced notably greater

speech issues after 1 month after bracket insertion. The lingual appliance group experienced significantly higher levels of soft tissue irritation along with chewing trouble after 24 hours. The research findings indicate that speech impairment frequently occurs as a potential outcome of lingually cemented attachments during fixed orthodontic treatment. The installation of lingual brackets resulted in a slight decrease in oral impairment within the initial 3 months. By the end of the third assessment period, the majority of lingual patients expressed pleasure [19].

The utilization of fixed equipment has significantly transformed orthodontic therapy, but, it also leads to elevated rates of dental cavities as a result of plaque accumulation around brackets. Previous research has concentrated on the prevention of dental cavities through the use of topical fluoride, antimicrobial substances, and complete sealing of buccal surfaces. Customized lingual brackets, designed to fit specific teeth, may potentially improve the result of dental caries. The primary objective of this study was to examine the hypothesis that the utilization of lingually inserted brackets leads to a reduction in caries incidence throughout orthodontic treatment including fixed equipment.

A clinical trial was conducted to assess the effects of brackets put orally orlingually on the progression of dental caries on bracketed surfaces. The study consisted of a cohort of 28 participants, with ages ranging from 12 to 18 years. They were undergoing orthodontic treatment at a clinical centre situated in Bad Essen, Germany. In this study, a split-mouth design was utilised, specifically assigning subjects to either buccal brackets in the maxilla or lingual brackets in the mandible. The visual observation of caries advancement was conducted, and the condition was assessed using quantitative light-induced fluorescence (QLF) photographs both before and after therapy. Prior to orthodontic therapy, the study unveiled the existence of small white spot caries lesions (WSL) on the buccal surfaces of teeth no. 42 and 45. After undergoing orthodontic treatment, we can visually and quantitatively see the presence of WSL on the buccal surfaces of teeth 42, 43, and 45, as well as in the lingual groove of tooth 12. Regarding the outcome of caries on smooth surfaces, the findings of the study suggest that lingual brackets have more effectiveness in comparison to buccal brackets [18].

Another randomized control study conducted a comparison between the caries risk and oral hygiene of patients receiving the treatment with labial and lingual orthodontic equipment. A cohort of 20 individuals, ranging in age from 19 to 23 years, was divided into two distinct groups. One group consisted of 10 patients who were fitted with a Roth labial appliance, while the other group consisted of 10 patients who were fitted with a STb lingual appliance. The plaque index (PI), salivary pH, gingival bleeding index (GBI), saliva buffer capacity, and counts of Streptococcus mutans and Lactobacillus were assessed at three distinct time intervals: T0, T1, and T2. These measurements were taken before the placement of orthodontic appliances, T1, and T2, respectively. After the appliance was set, the patients completed education sessions on dental hygiene to be done regularly. Statistical analysis gave the following results for the PI scores of T0 vs T1 and T1 vs T0 and T2 and T0 vs T2 and T0 of GBI in the lingual appliance group. The GBI value increased significantly from T0 to T1, and also experienced a vast reduction from T1 to T2, labial appliance group. The counts of S. mutans in the saliva samples of the patients healed with a lingual appliance showed a significant increase from T0C to T2. There was no difference in the whole records for a salivary flow rate and saliva buffer capacity at the three-time points seen any difference in the two groups.It was concluded that patients who utilised STb lingual orthodontic device exhibited increased plaque retention at both the 4-week and 8-week marks

following bonding. Additionally, there was a higher incidence of gingival irritation and an elevated count of S. mutans at the 8-week mark following bonding. Similar results were seen in terms of Lactobacillus counts, salivary flow rate, and saliva buffer capacity between the two groups [20].

Only a single study was conducted that compared between two modes. In this investigation, the quantification of new WSLwas conducted using QLF. This study focused on quantifying the quantity of new white spot lesions rather than assessing their magnitude. Furthermore, it is evident that the statistical analysis was flawed due to the utilisation of the paired t-test on data that clearly did not exhibit a normal distribution, such as the data set ranging from 0.9% to 109.78%. Hence, it was not possible to conduct a comparative analysis of caries among the two methods in this systematic study [18].

The primary limitation of lingual brackets utilised in this investigation is their less convenient application compared to buccal brackets. Consequently, all teeth included in fixed-appliance treatment must be close to complete eruption at the onset of treatment [21].

CONCLUSION

Thus, the findings of the current review suggest that the lingual orthodontic interventions present with various disadvantages, among which are more severe pain, speech problems, and oral hygiene difficulties. However, it must be stressed that these findings should be treated with caution. Moreover, it emphasizes the importance of conducting further high-quality randomized controlled trials to compare lingual and buccal appliances, which would allow for more complete understanding of the unique aspects of the intervention, causing the improvements and worsening of the patient outcomes. Furthermore, the review suggests greater length of the follow-up studies. Such future efforts could help determine the effectiveness and safety of the lingual orthodontics more conclusively. Considering patient preferences, morphological differences, and treatment protocols, this study can help address the lack of evidence. Specifically, delivering the evidence to the practitioners can help patients to make informed decisions regarding the orthodontic therapy.

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