



Biomechanical advantages and adverse effects of Lingual Orthodontic treatment: a review

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Abstract

Backgrounds: The use of lingual orthodontic treatment is increased in recent years, especially between late adolescents and adults, for aesthetic reasons. The new lingual bracket systems developed (fully customized brackets, that use CAD/CAM technologies) have shown a good adaptation on the teeth's surfaces and less discomfort compared to traditional lingual treatment. The aim of this review is to assess the advantages and disadvantages of lingual treatment and compared specific aspects with conventional labial system.

Methods: An electronic research of articles published through 2013 to 2019 on Pubmed was carried out. Retrospective and prospective studies, articles that evaluated clinical aspect of lingual treatment (compared or not to labial treatment) were included.

Results: Only 23 articles were selected. Three biomechanical advantages, in addition to aesthetic, were found: expansion of lower arch, bite opening and en-masse retraction with segmented mechanics. All of the selected studies founded the same type of discomfort for the patients with labial treatment: irritation to the tongue, speech difficulties, eating difficulties and poor control of oral hygiene. One study referred a less demineralization rate for lingual aspect of the teeth. Also, the Lingual group exhibited significantly less lower incisor proclination during the Herbst phase (not significant for the total treatment period).

Conclusions: Lingual orthodontic is a good treatment option and discomforts were less presented in the customized bracket group. Further researches are required with a large sample. Nowadays the heterogeneities between different studies on lingual treatment are still many.

Introduction

Over the years the aesthetic demands of patients have been increased, regarding not only the treatment objectives, but also the orthodontic appliances themselves. This aspect is a direct consequence of the increased number of adults that require and accept

to do an orthodontic treatment, where the aesthetic appearance is more relevant. As a result, aesthetic techniques have been introduced in clinical practice, including Invisible aligner and lingual orthodontics. First lingual orthodontic appliance was introduced around the end of 1970s and several system and technologies have followed it. New lingual bracket systems are continuously been developed including simpler method of bonding and ligation method. For example, the custom made appliances that use CAD/CAM technology to adapt the bracket base with precision on the lingual surface of the teeth, with lower profile (for patient's comfort), precise initial placement using a transfer tray and requiring less filler/resin in indirect bonding procedure. Nevertheless, the use of lingual treatment is almost limited because is considered less practical for the patient (irritation to the tongue, speech difficulties, poor control of oral hygiene) and for the orthodontists (problems with appliance manufacture, mechanic and clinical outcome). So, as a technique that has undergone a resurgence and popularity over the last few years, the aim of this review is to assess the advantages and disadvantages of lingual treatment and also compared specific aspects with traditional labial treatment.

Materials and Methods

An electronic research of articles published through 2013 to 2019 on Pubmed was carried out using the following keywords: *lingual, orthodontic, treatment, adverse effects*. This inclusion criteria have been used: patients of both sexes and of all ages, retrospective and prospective studies, articles that evaluated the clinical aspect and the adverse effects of lingual treatment compared to labial treatment. Articles not in English, animal and in vitro studies, case reports and opinion article were not included.

Results and Discussion

Of the 2156 articles initially found, only 23 have been selected and reviewed, based on the criteria previously reported.

Although the aesthetic benefit of lingual appliances, has been reported other three biomechanical

advantages over traditionally labial treatment: expansion of lower arch, bite opening and en masse retraction with segmented mechanics (4). In fact, lingual arch wire is shorter than a similar labial arch wire and if placed in an arch that is transversally narrow, the lingual arch wire is, on a shorter distance, relatively more compressed. This implies that a more efficient corrective force is applied especially with Ni Ti arch wire. It is known that with conventional labial appliances, opening the bite is extremely difficult if a continuous arch wire is used. By using lingual appliances, the bite opens as soon as the maxilla has been bonded, because the patient bites onto the anterior brackets and the posterior open bite closes quickly with molar extrusion. Also, the intruding forces work closer to the center of resistance of the anterior teeth so that tipping effects are limited.

Moreover, lingual appliance has been strongly associated with patient discomfort and dysfunction. Pain and discomfort from conventional orthodontic appliances is a well recognized phenomenon, experienced by patients immediately after the placement of a lingual or labial orthodontic appliance, and gradually disappears during the next three months. Obviously, patients with lingual appliance would be more likely to suffer from pain in tongue, while patients with labial appliance in cheek and lip (2,19,21). It was suggested that SNA and SNB were good predictors for the level of tongue space restriction, the smaller the angles, the more prone the patients were to experiencing discomfort (7). Between patients that experienced discomfort and functional difficulties, these discomforts were present to a lesser extent in the customized bracket group.

Khattab et al. (1) reported that chewing difficult was the most severe problem encountered by patients with lingual appliances, particularly in the immediate period after brackets placement. Problems associated with eating can be seen with any type of fixed orthodontic appliance. However, eating disturbances caused by lingual appliance may be worse than those conventional with an adaptation period longer (6,21). Papageorgiou et al. (19) proposed that a possible explanation for prolonged eating difficulties might be the posterior disocclusion caused by the bite planes incorporated on the maxillary anterior lingual (palatal) brackets that were used.

Also, wider lingual brackets cause a reduced inter bracket distance and make oral hygiene procedures very difficult, with consequent risk for plaque accumulation and gingivitis. Food and plaque deposits are difficult to remove with standard oral hygiene procedure around lingual brackets. Therefore, oral

hygiene instruction would be essential in all cases of orthodontic treatment, and the use of adjuncts such as sonic electric toothbrushes, interproximal brushes, chlorhexidine mouthwashes, fluoride mouthwashes, and regular professional cleaning should be reinforced (8). Despite this tend to plaque accumulation, the lingual surfaces of the teeth appear to be less prone to caries than the buccal surfaces, which is most likely due to differences in surface morphology, plaque retention, salivary flow and the mechanical cleaning of surfaces by the tongue. Mistakidis et al. (15) reported that buccal caries lesions that formed or progressed during buccal fixed appliance treatment was approximately five times higher than the number of lingual caries lesions in lingual treatment. In fact, the lingual tooth surface is less prone to demineralization and caries in comparison to the corresponding labial surface in contact with a labial appliance (7).

Not all are in agreement with Khattab et al. (1), arguing that the most severe problem encountered by patients with labial appliances is speech difficulty (6). Speech is a finely coordinated and subconscious skill requiring very specific positioning of the tongue. In the case of lingual appliances, they are on the lingual surfaces of the teeth and can be in both upper and lower dental arches. This means that speech sounds that require tongue to tooth contact (linguodental sounds) may be distorted. *T* is an unvoiced sound, which can become more of an *S* sound if the tongue is unable to create a seal to allow the sudden escape of air required to produce the *T* sound. *D* is a voiced sound and may distort to sound more like a *Z* (6,13). Studies using sonography to evaluate speech performance, have shown that there is a true deterioration in articulation, even up to 3 months after the placement of any lingual appliance, although with lower profile customized brackets, this impairment in sound performance can be significantly reduced in comparison to prefabricated brackets (7). There are a small group of patients that are likely to have difficulty with adapting to lingual treatment, so referral to a speech therapist could be considered.

Ziebur et al. (10) investigated on the frequency and localizations of bond failures in patients treated with either lingual and buccal brackets in both arches. They had concluded that a lot of interindividual variations influenced the rate of bonding failure (age, bonding procedure, oral hygiene) and in view of the higher failure rates in molars, the use of occlusal pads in lingual appliances and cemented bands in buccal appliances should be considered.

Nassif et al. (22) compared the magnitude of external

apical root resorption (EARR) of maxillary incisors in patients with mild to moderate anterior crowding, treated with lingual and conventional orthodontics. They reported that the magnitude of apical root resorption in the maxillary incisors was similar regardless of the orthodontic technique used, lingual or conventional.

Ata Ali et al. (23) evaluated possible differences in treatment effects between labial and lingual appliances from the radiographic perspective, based on changing in cephalometric parameters. They founded no statistically significant cephalometric differences between the two technique and a tendency to increase the interincisal angle and reduce the angle between the major axis of the upper central incisor and the sellar nasion plane. These findings indicate that treatment with lingual appliances favors incisor tipping by exerting lingual crown torque.

Finally, Bock et al. (17,22) analyzed and compared the effects during Herbst treatment when combined with labial or lingual fixed brackets, concluding similar effects occurred during Herbst treatment whether combined with completely customized lingual MBA or standard labial MBA. Also, the Lingual group exhibited significantly less lower incisor proclination during the Herbst phase, this effect was not significant for the total treatment period.

Conclusions

Lingual orthodontic treatment is a good option for many adolescent and adult patients. Full customization removes many of the difficulties associated with conventional lingual treatment mechanics. Further research is required in the form of randomized controlled trial and prospective clinical trial with a large sample. Several aspects of lingual treatment were difficult to be efficiently evaluated due to the study design, different type of lingual brackets system studied, heterogeneity and small sample size.

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