



Lingual vs. Labial fixed orthodontic appliances: comparison of adverse effects

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Abstract

Lingual orthodontic appliances have increased the acceptability of orthodontic care for those who have concerns over the appearance of appliance. Thanks to the technologic development, the labial treatment outcomes have become similar and comparable to those produced by labial orthodontic treatment. The aim of this systematic review is to compare the adverse effect of lingual appliance compared with labial orthodontic fixed appliances, taking into account clinical trials on human patients in an evidence-based manner.

Introduction

The aesthetic is an important parameter in our society.

Currently many adult patients want to improve own aesthetics, especially the look of their smile. Indeed the number of adult patients who accept an orthodontic treatment increased in the last years; thanks also to the aesthetic bracket and aesthetic appliance that have augment the acceptability of fixed orthodontic appliance. Some studies showed that an important number of adults who needs of treatment refuse it on the basis of the negative aesthetic appearance due to the orthodontic devices [3]. Lingual orthodontic is now widely requested from patient since this appliance is not visible.

Lingual technique was born in 1970s in USA, it peaked in popularity in the early 1980s, but quickly it fell out when ceramic labial bracket were introduced. Anyway in the last 10 years lingual technique has been progressively and widely used in Europe and Asia.

There were three main difficulties regularly encountered by lingual orthodontists throughout the 1990s

1. The bracket loss rate was high compared to labial cases and the rebonding procedures considered too complex and inaccurate;
2. Patients often found the appliances uncomfortable and never fully adapted to them, particularly when undergoing lingual treatment in both arches[3];
3. Finishing and detailing was time-consuming and the standard of finishing was much lower than that

achievable with labial appliances[4].

The development of new archwire materials, advanced laboratory techniques, and the widespread use of sophisticated computer programs have reintroduced lingual appliances as a promising and competing technique with the aim to solve some of the above mentioned disadvantages.

Nowadays there are mainly two type of different lingual techniques: prefabricated lingual brackets with straight wire and customized bracket and arch.

Prefabricated brackets have standard shape and need a composite base to fix them in their correct and individualized position. The advantage of using these brackets is the concomitant use of straight wires. However, the use of pre-fabricated brackets can lead to a number of clinical difficulties, such as a high bond failure rate, time consuming finishing processes and increased patient discomfort [18].

In the last year specific technological advances, including CAD-CAM software, have facilitated the development of precise fixed appliance system that are fully customize for each patient. It means that in lingual orthodontics the brackets and the archwires are made in accordance with each patient morphological need [5]. Indeed the whole appliance is made using CAD/CAM technology; both the archwires and brackets are designed for optimal performance. INCOGNITO system was the first fully-customized appliance and was launched in USA in 2004. HARMONY system developed in 2007 in France, It is a fully digital customized self-ligating lingual appliance system and was launched in 2011. Customized appliance could be more expensive compared to prefabricated lingual bracket, however several studies shown that they are more comfortable for patient.

The use of invisible orthodontic technique increases the self-esteem of patient, but there exists a difference between lingual and the conventional buccal appliances, included bonding technique, biomechanical aspect and anchorage considerations.

Recently, lingual orthodontic treatment outcomes have become similar and comparable to those produced by labial orthodontic treatment[25-26]. However, brackets that are positioned at the lingual surfaces of teeth cause a change in the morphology of these surfaces, which may result in speech problems [27], oral

discomfort, difficulty in chewing, and tongue irritation. Masticatory and speech disturbances induced by lingual brackets may lead to social embarrassment [9].

Material and Method

No languages or time restriction has been considered in order to realize this review. Relevant studies have been collected from medical databases, included Pubmed, EMBASE, Cochrane Library and *Dentistry e Oral Sciences source*. Keyword used were "lingual orthodontic", "evidence base", "patient experience", "risks and benefits" and "treatment outcomes". Abstracts, opinion articles, commentaries and editorials has been removed. Following the search, 27 articles were selected.

Discussion

A positive patient experience is the main key to successful orthodontic treatment, Although the use of lingual appliances has been strongly associated with patient discomfort and dysfunction, the available evidence should be carefully considered[6].

Some studies states that pain and discomfort in lingual orthodontic devices has greater intensity and last longer compared to conventional orthodontic appliances [7-8]. According to these studies, pain and discomfort gradually disappears in a month period [8-9].

Clearly the localization of pain regarding the tongue is most likely to be related to a restricted functional tongue space, after the placement of lingual brackets. Anyway the customized appliance result to be less painful than the pre-fabricated bracket.

The smaller angles SNA and SNB seems to be a good predictors for the level of tongue space restriction; statistically, patient with smaller angles appear to suffer greater discomfort [10].

It has been shown that both lingual and labial appliances cause some speech impediment, but there is a higher degree of impairment in the presence of lingual brackets[11]. Lingual appliance bracket induce a substantial change in the lingual morphology of the dentition, albeit it is temporary. The zone behind the upper incisors is altered, resulting in changed articulation, especially the "S" sound. Additionally, patients with lingual appliances were more likely to report a perception of articulation change and avoidance of some types of conversation after 3

months compared with patients with labial appliances.

Eating with lingual appliances could be very difficult since the brackets are positioned against the tongue, causing more difficulty in chewing [12], although custom device has lower levels of discomfort [10]. The adaptation period associated with both lingual and labial appliances is approximately the same, between 0 and 30 days [9].

It is suggested to appropriately identify the patients that are suited to the lingual appliance, with particular regard on morphological and psychological features. In fact, notwithstanding the extreme technological development, it is important to remember that not every case treated with buccal conventional appliance could be treated with lingual appliance. There are cases in which the use of lingual appliance is not recommended e.g.: dolichocephalic skeletal pattern; short, abraded, and irregular lingual tooth surfaces; presence of multiple crowns, bridges, and large restorations; patients with a low level of compliance or trismus and patients with cervical ankylosis or other neck injuries that prevent neck extension [19].

It would also be useful to look at personality types as an indicator of tolerance to the discomfort experienced by patients [6].

Some studies does not identify a difference between lingual or buccal appliance in regard of oral hygiene [9-15], but the lingual surfaces of the teeth appear to be less prone to caries than the buccal surfaces [16], probably due to differences in surface morphology, plaque retention, salivary flow and the mechanical cleaning of surfaces by the tongue. Van del Veen et al. [17] compared the incidence of decay to lingual (fully customized lingual appliance) or labial appliances in patients aged between 12 and 18 years randomly allocated. The results showed that the buccal surfaces are almost five times more prone to decay than the lingual surfaces during orthodontic treatment. Patients treated with lingual appliances were associated with significantly fewer new white-spot lesions compared with patients treated with labial appliances [17-23].

The lingual surfaces of the teeth can be very difficult to clean when fitted with a fixed appliance; though orthodontic appliances promote plaque-associated gingivitis, causing gingival enlargement, an increase in periodontal probing depths and bleeding on probing. More studies are required to evaluate if there are difference between lingual and buccal appliance concerning periodontal disease.

According to Papageorgiou et al. [20] metanalysis, the treatment with lingual appliances was associated with a distinct increase in the intercanine width and a

decrease in the intermolar width. Probably this is related to the prominent premolar offset incorporated in the lingual wire, together with the small interbracket distance in the anterior region[31]. A possible explanation for the decrease in intermolar distance might be lingual appliances causing irritation of the tongue, moving it to a more posterior and inferior position, and thereby affecting the force equilibrium at the posterior teeth [31]. Lingual appliances were associated with significantly less sagittal anchorage loss of the first maxillary molar after retraction to close first premolar extraction spaces compared with patients fitted with labial appliances. Possible explanations for this pertain to smaller arch perimeter, with lingual appliances leading to higher wire rigidity and better anchorage control during retraction [22-20] and increased anchorage value of the posterior teeth as a result of nearness of the lingual brackets to the center of tooth resistance which leads to cortical bone anchorage as a result of buccal root torque and distal rotation of the molar crown [24]. Anyway these aspects need more confirms.

Finally, treatment with lingual appliances was associated with smaller amounts of interproximal enamel reduction needed to create missing arch space compared with labial appliances [20].

Conclusion

Additional research is required to investigate the efficiency of lingual appliance systems. According to the analyzed studies, initial pain and discomfort for the patient appears to be similar in both cases of labial or lingual appliances, although the onset can be earlier with lingual brackets and the location different, with the tongue more frequently being involved. Customized lingual brackets may be associated with less pain than with the pre-fabricated ones. Lingual appliance is related to higher difficulties with speech and mastication. At last there is some evidence that the lingual surfaces of the teeth are more resistant to early demineralization and caries. Little data exist regarding treatment outcome and ease of use for the orthodontist, either between lingual or labial appliances or between different lingual systems.

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