Comparison of oral impacts experienced by patients treated with labial or customized lingual fixed orthodontic appliances

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Introduction: Our objective was to compare the oral impacts experienced by patients treated with labial or customized lingual fixed orthodontic appliances. Methods: This was an age- and sex-matched prospective longitudinal study of 60 adult patients treated with either labial or customized lingual fixed orthodontic appliances over a 3-month period. Ratings of oral impacts experienced and satisfaction were made on visual analog scales at 3 time points after appliance fixation. Variations in oral impacts and satisfaction over the trajectory of treatment were assessed. Area-under-the-curve analyses were conducted to assess variations in oral impacts and satisfaction between the groups. Results: All patients experienced oral impact disturbances, although these disturbances decreased over time (P < 0.001). Patients treated with customized lingual appliances reported more oral discomfort (P < 0.001), dietary changes (P < 0.001), swallowing difficulty (P < 0.001), speech disturbances (P < 0.001), and social problems (P < 0.001) than did those in the other group. There was no significant difference between the groups regarding ratings of oral self-care, mastication, and satisfaction level of treatment (P > 0.05). Conclusions: The findings indicate that oral impacts are commonly experienced during both labial and customized lingual fixed orthodontic therapies. However, the oral impacts decreased over the observational period. Patients treated with customized lingual appliances experienced more oral impacts. Both groups had similar levels of treatment satisfaction. (Am J Orthod Dentofacial Orthop 2011;139:784-90)

There has been a paradigm shift in orthodontics to the use of lingual fixed appliances as opposed to conventional labial fixed appliances in the treatment of malocclusion.1 Lingual fixed appliances can produce comparable treatment outcomes as labial fixed appliances over similar treatment time periods and therefore are an alternative treatment modality for patients to consider.2,3 Nevertheless, orthodontic treatment leads to a number of consequences, which also are important to consider in evaluating treatment modalities. Pain, for example, is a well-documented sequela encountered during therapy.4-6 In more recent years, there has been growing interest in understanding not just the symptoms experienced during treatment (eg, pain), but also the oral impacts of orthodontic treatment, such as the influence on quality of life.7-9 To this end, many oral health-related quality of life measures have been used to assess oral impacts.8,10,11 The measures differ in their underlying theoretic framework, number of items, and scoring methods; there is no single measure that is the gold standard. All measures assess key oral impacts: oral discomfort, oral self-care, mastication, speech disturbances, and social activities.8,12,13

Different orthodontic treatment modalities function in dissimilar ways, making it imperative to assess the oral impacts of each treatment.12 In this study, we aimed to compare the oral impacts experienced and the satisfaction of patients treated with conventional labial fixed orthodontic appliances and customized lingual fixed orthodontic appliances during treatment.

MATERIAL AND METHODS

This study was approved by the ethics committee of the University of Hong Kong.
An age- and sex-matched prospective longitudinal study of 60 adults treated in the Department of Orthodontics, Prince Philip Dental Hospital in Hong Kong, over a 3-month period was undertaken. It consisted of 30 patients (20 women, 10 men; mean age, 21.6 years; SD, ± 2.24 years) treated with customized lingual appliances (Incognito, 3M Unitek, Bad Essen, Germany), and 30 patients (18 women, 12 men; mean age, 20.3 years; SD, ± 4.21 years) treated with labial appliances (Mini-Diamond,Ormco, Glendora, Calif.).

The patients rated their oral impacts experienced (oral discomfort, mastication, speech disturbances, and social functioning) and treatment satisfaction on a 100-mm long visual analog scale at 3 time points during treatment: 1 week, 1 month, and 3 months after the brackets were placed. Variations in oral impacts over the study period were assessed by using Friedman 1-way analysis of variance (ANOVA). Oral impacts experienced over the study period were assessed by area-under-the-curve analyses (AUC):

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\text{AUC} = \frac{1}{2} \sum_{i=0}^{n-1} (t_{i+1} - t_i) (y_i + y_{i+1})
\]

where \( n \) is the number of measurements, \( t \) is the timing of measurement, and \( y \) is the mean pain score.

Differences in the AUC values of oral impacts experienced by those wearing labial and customized lingual appliances were compared by using a \( t \) test for independent samples.

The hypothesis was that there would be differences in oral discomfort, mastication, speech disturbances, social functioning, and treatment satisfaction between patients treated with labial and lingual appliances.

**RESULTS**

Differences of oral impacts experienced by those treated with labial appliances compared with those treated with customized lingual appliances varied with respect to orthodontic appliances; these are summarized in Figure 1. Those treated with customized lingual appliances consistently reported more oral impact disturbances than those treated with labial appliances.

In the “oral discomfort” category, there were significant differences in pain experiences attributed to change in tongue position (\( P <0.001 \)) and reduction in tongue space (\( P <0.001 \)). Variations in mastication were apparent in terms of dietary change (\( P <0.001 \)) and swallowing (\( P <0.05 \)). Differences in speech disturbances were also observed in terms of self-perceived speech disturbance (\( P <0.001 \)) and speech disturbances noticed by others (\( P <0.001 \)). In terms of social functioning, differences were found in terms of avoidance of conversation (\( P <0.001 \)), avoidance of eating out (\( P <0.001 \)), and impact on leisure activities (\( P <0.001 \)).

Oral impact disturbances across all domains decreased over time (\( P <0.05 \)), except for swallowing in patients treated with labial appliances (\( P >0.05 \)), as shown in Figure 2. Oral impact disturbances were most common in the early phase of treatment. By the end of 3 months, oral impacts were comparable for those treated with both labial and customized lingual appliances (\( P >0.05 \)) (Fig 2). The exceptions were oral discomfort, dietary changes, and speech activities, which were reported to be more severely affected in patients treated with customized lingual appliances. There were no reported social disturbances and difficulty in swallowing by 3 months after placement of the fixed appliances in both groups.

Both labial and customized lingual patients rated similarly their satisfaction with the treatment modalities (\( P >0.05 \)) and their readiness to recommend treatment to other patients (\( P >0.05 \)), as shown in Figure 3. As an overall observation, the satisfaction level gradually increased from initial treatment to the end of the 3-month observation period to similar levels.

**DISCUSSION**

Increasingly, it is accepted that patients’ perceptions of experiences of treatment and outcomes from orthodontic treatment are of paramount importance to consider in informing evidence-based orthodontic practice.\textsuperscript{14-16} To this end, there has been increasing research in assessing, documenting, and comparing the effects of wearing different orthodontic appliances.\textsuperscript{1,12,17,18}

In this study, it was apparent that oral impact disturbances were commonly encountered during orthodontic treatment and across a range of activities. This concurs with previously reported observations suggesting that orthodontic treatment impacts on oral health-related quality of life. Therefore, it is important to consider oral impact disturbances, in both managing the patient during treatment and assessing the overall benefits of orthodontic treatment in light of what patients encounter, to achieve the desired outcome.\textsuperscript{13,19}

Differences in oral impacts experienced were found between those treated with customized lingual and labial appliances across a range of activities such as oral discomfort, speech disturbances, social activities, and aspects of mastication, but not in oral self-care. Previously, it has been reported that patients treated with lingual appliances encounter much tongue discomfort as a result of the change in tongue position and the restriction of tongue space.\textsuperscript{1} Oral discomfort is to be expected as a result of the placement of lingual brackets, which can infringe on the tongue space or irritate the tongue, leading to discomfort.\textsuperscript{20,21} Identification of sites of oral discomfort
associated with different orthodontic treatment modalities is important in determining appropriate pain management approaches, including prevention of discomfort and pain. Currently, modifications to the design of lingual fixed orthodontic appliances such as different bracket sizes, flattening the brackets, and using customized brackets (eg, Incognito) have been suggested to reduce oral discomfort.²²

Both treatment groups experienced impacts on oral self-care (oral hygiene), particularly during the early phases of treatment. This highlights the need for special oral hygiene instructions and motivation for oral self-care during orthodontic treatment.¹ There was no significant difference in the self-perceived impact of oral self-care between those treated with labial and lingual appliances; this concurred with a previous study.¹ Nevertheless, self-perceived oral self-care and actual clinical assessments of oral hygiene did differ, and thus it is worthwhile to supplement self-reports of oral self-care with clinical assessments to provide a comprehensive assessment of the effects of orthodontic appliances on oral self-care.²³

As expected, patients treated with customized lingual appliances experienced more speech disturbances than those treated with labial appliances. The study also showed that speech disturbances were the most severe oral impact experienced by lingual patients; this was consistent with a previous report.¹ Several studies have highlighted that

Fig 1. A comparison of different oral impacts experienced between those treated with labial or customized lingual appliances over the whole study period. *statistically significant; ns, not significant.
the placement of brackets near the tongue influences phonetics, and impacts on speech were common.\textsuperscript{20,21} Of note, speech disturbance reduction over time was most likely a result of adaptation to the appliances; this also concurred with a previous finding.\textsuperscript{24}

Unexpectedly, patients treated with customized lingual appliances reported more adverse social impacts than those treated with labial appliances. It has been suggested that lingual appliances are the ultimate esthetic appliances and are of special importance to patients' physical appearances, as well as their physical and social lives.\textsuperscript{25,26} However, observing that those treated with customized lingual appliances also encountered more masticatory and speech disturbances, it can be expected that these functional disturbances will have social effects, such as impacts on conversation with others and social activities such as eating out.

In terms of impact on mastication, there was no significant difference reported in biting or chewing between patients treated with labial and customized lingual orthodontic appliances; this agreed with a previous study.\textsuperscript{1} This is in contrast to another finding that suggested that lingual appliances cause difficulty in eating because of the increase in occlusal vertical height.\textsuperscript{20} However, patients treated with customized lingual appliances did experience more difficulties swallowing and reported more dietary changes while wearing the appliances than those treated with labial fixed appliances. The close proximity of the tongue to the lingual brackets and the movement of the tongue during swallowing are likely to explain the greater swallowing difficulties reported by those treated with customized lingual appliances, particularly during the early phases of treatment until the reflex of swallowing was relearned.

The smaller the appliance, the less pronounced the impairment. The overall minor difference in oral impacts between the 2 appliances might be a result of the low profile and the reduced labiolingual dimension of the customized lingual appliance; by using prefabricated brackets or straight-wire laboratory procedures, the rate

**Fig 2.** A comparison of different oral impacts experienced between those treated with labial or customized lingual appliances at each time point. \textbf{A,} Oral Discomfort and Oral Self-care; \textbf{B,} Mastication and Speech Disturbances; \textbf{C,} Social Activities.
of discomfort might be higher. Therefore, these results are valid only if a fully customized lingual bracket-archwire system is used. This type of lingual bracket system can significantly enhance patient comfort and reduce negative oral impacts in comparison with prefabricated lingual brackets with larger dimensions.27

There was no significant difference in the ratings of satisfaction between the 2 treatment groups, suggesting that customized lingual appliances were as acceptable as labial appliances to patients. Interestingly, ratings of satisfaction improved over time—presumably because alignment of the teeth improved. Further long-term studies of different orthodontic therapies and with various appliance designs are warranted. They should also include the effects of wearing the appliance to provide a true estimate of the benefits of particular orthodontic interventions.

There were a number of limitations in this study. The assessments of oral impacts were the patients’ subjective opinions and thus might have been influenced by their...
emotional states. We matched the subjects for age and sex but not treatment complexity, which might have influenced the results. The oral impacts were those considered in the literature as the most common attributes experienced. However, since this was not a standardized assessment tool, it would require other studies with a similar methodology to validate our claims. Patients’ expectations of oral impacts were not investigated in this study. However, expectations can influence patients’ reports of experience, and this is worth exploration in other studies. Although assessment of oral impacts was feasible in this research, it might be more difficult to do such assessments.
in the clinical setting to determine patients’ experiences so as to adopt appropriate management approaches.

CONCLUSIONS

Oral impacts were commonly experienced during the early treatment phases of both labial and customized lingual fixed orthodontic therapies. However, the oral impacts decreased over the observational treatment period. Patients treated with customized lingual appliances experienced more oral impacts compared with those treated with labial appliances. Both groups had similar levels of satisfaction with treatment.

These findings have implications in informing patients’ treatment decision-making processes with different treatment modalities and for minimizing unpleasant sequelae of orthodontic therapy.

REFERENCES