

# Patient Discomfort: A Comparison between Lingual and Labial Fixed Appliances

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**Abstract:** This study was undertaken to determine the discomfort differences between patients treated with lingual and labial orthodontic brackets. The study sample consisted of two groups of 30 adolescent patients. Group LI was treated with lingual appliances, and group LA was treated with labial appliances. After three months of treatment, each patient completed a seven-part survey with 12 questions, evaluating intraoral discomfort; tongue-lip-cheek soreness; eating, speech, and oral care difficulties; adaptation period; and general problems. In the LI group, tongue soreness and speech difficulties were significantly greater ( $P < .001$ ) than in the LA group, whereas cheek ( $P < .001$ ) and lip ( $P < .05$ ) soreness were greater in group LA than in group LI. No statistically significant differences were found between the groups in reported intraoral discomfort and eating and oral care difficulties, but adhering of food particles was greater ( $P < .05$ ) in the LI group. In this study, speech difficulty was the most severe problem for the lingual group. All patients in the LA group and 76.7% of the patients in the LI group reported that the problem was solved at the end of 30 days. However, 23.3% of the LI group claimed that at the end of three months they were still having a problem while speaking. Even the maximum adaptation period was longer in the LI group (90 days) than in the LA group (30 days). General evaluation of this study suggested that after the initial discomfort period, only a small percentage (10%) of lingual orthodontic patients reported some hindrance because of their treatment. (*Angle Orthod* 2004;75:86–91.)

**Key Words:** Lingual orthodontics; Discomfort

## INTRODUCTION

Recent years have seen a marked increase in the number of adult patients desiring orthodontic treatment. It is well known that adults have a negative reaction toward the esthetics of conventional fixed orthodontic appliances and do not want them to show. Even though brackets made of plastic and porcelain and coated archwires have appeared in the market for the reason stated above, the only solution that provides the ultimate in esthetics during the treatment is to attach the appliances to the lingual surfaces of the teeth. However, several questions arise in this context, and the lingual appliance may be considered impractical because of discomfort from orthodontic treatment, inherent with speech, irritation of the tongue, difficulty of hygiene, and inherent problems in design and construction.

Since the introduction of the lingual appliance in the late

1970s, research workers have dealt with the technical-clinical aspects of the technique.<sup>1–9</sup> However, only a few publications have appeared dealing with patient characteristics, acceptance, and motivation.<sup>10–14</sup> Lingual orthodontic patients are usually informed that there may be some tongue discomfort and speech difficulty associated with the insertion of the appliance. However, the intensity and duration of the problems are not yet entirely clear, and orthodontists are still dubious of the patient's ability to adapt to lingual brackets.

This study was undertaken to determine the discomfort differences between the patients treated with lingual and labial orthodontic appliances.

## MATERIALS AND METHODS

The study sample consisted of 60 adolescent patients (39 females, 21 males) treated at the Department of Orthodontics, Istanbul University School of Dentistry, Istanbul University. These patients were divided into two groups. The LI group consisted of 30 patients (19 females, 11 males) with a mean age of 17 years and seven months. The LI group was treated with lingual brackets (Ormco 7th generation, Glendora, Calif.) indirectly bonded on both arches during the same appointment using the TARG+TR System© (torque angulation reference guide + thickness &

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rotation).<sup>15</sup> A 0.017 × 0.017 inch copper NiTi was used as the initial archwire on the upper and lower arches.

The LA group consisted of 30 patients (20 females and 10 males) with a mean age of 18 years and three months. The LA group was treated with a straight wire appliance (Roth prescription). They were directly bonded on both arches during the same appointment, and the initial archwires were 0.017 × 0.017 copper NiTi.

After insertion of the appliance, all patients were asked to record every day any kind of problems that occurred including intraoral irritation in the tongue, cheek, and lip areas; mastication problems; oral hygiene; and changes in speech patterns and articulation induced by lingual or labial brackets.

After three months of treatment, each patient completed a seven-part survey with 12 questions designed to evaluate intraoral discomfort; tongue-lip-cheek soreness; eating, speech, and oral care difficulties; adaptation period; and general problems. Patients were asked to refer to their diary while they were completing the questionnaire if they had any uncertainties regarding intensity, duration, or severity of the problem.

**Statistical analysis**

All questionnaire responses were stored, coded, and analyzed. Chi-square tests were carried out to determine whether there were any significant differences between LI and LA groups in the amount of intraoral discomfort; tongue-lip-cheek soreness; eating, speech, and oral care difficulties; as well as adaptation period reported as a function of time after placement of lingual and labial brackets. The levels of statistical significance used in all tests were: *P* < .05, statistically significant; *P* < .01, statistically highly significant; and *P* < .001, statistically very highly significant.

**RESULTS**

The results of this study are shown in Tables 1–6. Intraoral discomfort reported by the patients in LA and LI groups is shown in Table 1. Twenty-nine of 30 patients in the LA group (96.7%) recorded some discomfort in the mouth after placement of the brackets, as did 30 patients in the LI group (100%). The difference between these proportions does not approach statistical significance. Similarly, the location and the intensity of the discomfort between the two groups were found to be insignificant.

As part of the questionnaire, the patients in the study were asked to report any discomfort or soreness in the tongue, cheek, and lip areas after bracket placement (Table 2). In the LI group, 27 of 30 patients (90%) had a sore tongue compared with eight of 30 patients (26.7%) in LA group. The difference between the proportions was very highly significant (*P* < .001). The intensity of tongue irritation was reported to be mild to moderate by all patients in the LA group, whereas in the LI group, 16 patients

**TABLE 1.** Prevalence (%) of Intraoral Discomfort in the LA and LI Groups

	Group LA <sup>a</sup>		Group LI		Test <i>P</i>
	n = 30	%	n = 30	%	
Discomfort					
Yes	29	96.7	30	100	NS
No	1	3.3	0	0	NS
Discomfort					
Generalized	4	16.7	6	20	NS
Localized	25	83.3	24	80	NS
Intensity					
Low-middle	23	79.3	17	56.7	NS
High	6	20.7	13	43.3	NS

<sup>a</sup> LA, labial appliances; LI, lingual appliances; NS, nonsignificance.  
 \* *P* < .05.  
 \*\* *P* < .01.  
 \*\*\* *P* < .001.

(59.3%) classified the problem as severe. This difference was also statistically highly significant (*P* < .01) (Table 2). In the LA group, 86.7% (n = 26) and 46.7% (n = 14) of the patients claimed that they had some discomfort in their cheeks and lips, respectively. These proportions were statistically higher when compared with 36.7% (n = 11) reporting cheek discomfort (*P* < .001) and 16.7% (n = 5) claiming lip soreness in the LI group (*P* < .05) (Table 2).

To examine speech disturbance after bracket placement, Table 3 illustrates the level of difficulty in speaking as well as intensity and duration of the problem in the LA and LI groups. Speech disturbances were reported by 19 of 30 patients (63.3%) in the LA group, whereas all the patients (100%) in the LI group reported some discomfort in speaking. The difference between the percentages was statistically very highly significant (*P* < .001). All patients having speech problem in the LA group (n = 19) classified the problem as mild to moderate, whereas eight of 30 patients (26.7%) questioned in the LI group reported severe impairment. The difference was statistically significant (*P* < .05). The time needed for recovery of speech was reported to be between one and 30 days by all patients (100%) having speech problem in the LA group. However, seven of 23 patients (23.3%) with speech disturbances in the LI group claimed that the problem lasted for 90 days. The difference between these proportions was statistically significant (*P* < .05).

No statistical difference was found between the percentage of the patients in the two groups concerning eating difficulties or intensity and duration of the problem (Table 4). Data concerning problems in eating hard or soft food among the patients in the LA and LI groups were also statistically insignificant (Table 4). Similarly, the difference among the proportions of the patients in the LA and LI groups concerning oral hygiene and problems relating to bleeding gums and bad taste in the mouth did not approach

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**TABLE 2.** Prevalence (%) of Soft Tissues Discomfort in the LA and LI Groups

	Group LA <sup>a</sup>		Group LI		Test <i>P</i>
	n = 30	%	n = 30	%	
<b>Tongue</b>					
Discomfort					
Yes	8	26.7	27	90	***
No	22	73.3	3	10	***
Intensity					
Low-middle	8	100	11	40.7	NS
High	0	0	16	59.3	**
Duration					
0–30 d	8	100	26	96.3	NS
3 mo	0	0	1	3.7	NS
<b>Cheeks</b>					
Discomfort					
Yes	26	86.7	11	36.7	***
No	4	13.3	19	63.3	***
Intensity					
Low-middle	23	88.2	10	90.9	NS
High	3	11.5	1	9.1	NS
Duration					
0–30 d	22	84.6	11	100	NS
3 mo	4	15.4	0	0	NS
<b>Lips</b>					
Discomfort					
Yes	14	46.7	5	16.7	*
No	16	53.3	25	83.3	*
Intensity					
Low-middle	14	100	4	80	NS
High	0	0	1	20	NS
Duration					
0–30 d	14	100	5	100	NS
3 mo	0	0	0	0	NS

<sup>a</sup> LA, labial appliances; LI, lingual appliances; NS, nonsignificance.  
\*  $P < .05$ .  
\*\*  $P < .01$ .  
\*\*\*  $P < .001$ .

statistical significance (Table 5). However, compared with 24 of 30 patients in the LA group (80%), all patients ( $n = 30$ ) in the LI group (100%) reported adhering of food particles between the braces, and the difference was statistically significant ( $P < .05$ ) (Table 5).

The time needed for adaptation to the appliance was stated to be between zero and 30 days for all patients ( $n = 30$ , 100%) in the LA group and for 27 of 30 patients (90%) in the LI group. Only three patients (10%) with lingual appliances still had difficulties at the end of three months. However, the difference between the proportions did not approach statistical significance (Table 6). Similarly, only 20% of the patients ( $n = 20$ ) in both groups claimed that handling of the orthodontic appliances was very difficult, and the difference was statistically insignificant (Table 6).

Regarding the patients' perception of the appearance of

**TABLE 3.** Prevalence (%) of Speech Disturbance in the LA and LI Groups

	Group LA <sup>a</sup>		Group LI		Test <i>P</i>
	n = 30	%	n = 30	%	
<b>Discomfort</b>					
Yes	19	63.3	30	100	***
No	11	36.7	0	0	***
<b>Intensity</b>					
Low-middle	19	100	22	73.3	NS
High	0	0	8	26.7	*
<b>Duration</b>					
0–30 d	19	100	23	76.7	NS
3 mo	0	0	7	23.3	*

<sup>a</sup> LA, labial appliances; LI, lingual appliances; NS, nonsignificance.  
\*  $P < .05$ .  
\*\*  $P < .01$ .  
\*\*\*  $P < .001$ .

**TABLE 4.** Prevalence (%) of Eating Problems in the LA and LI Groups

	Group LA <sup>a</sup>		Group LI		Test <i>P</i>
	n = 30	%	n = 30	%	
<b>Eating problems in general</b>					
Discomfort					
Yes	27	90	29	96.7	NS
No	3	10	1	3.3	NS
Intensity					
Low-middle	18	66.7	16	55.2	NS
High	9	33.3	13	44.8	NS
Duration					
0–30 d	26	96.3	25	86.2	NS
3 mo	1	3.7	4	13.8	NS
<b>Problems in eating hard food</b>					
Discomfort					
Yes	24	80	28	93.3	NS
No	6	20	2	6.7	NS
Intensity					
Low-middle	16	66.7	16	57.2	NS
High	8	33.3	12	42.9	NS
<b>Problems in eating soft food</b>					
Discomfort					
Yes	7	23.3	14	46.7	NS
No	23	76.7	16	53.3	NS
Intensity					
Low-middle	7	100	14	100	NS
High	0	0	0	0	NS

<sup>a</sup> LA, labial appliances; LI, lingual appliances; NS, nonsignificance.  
\*  $P < .05$ .  
\*\*  $P < .01$ .  
\*\*\*  $P < .001$ .

**TABLE 5.** Prevalence (%) of in Oral Hygiene in the LA and LI Groups

	Group LA <sup>a</sup>		Group LI		Test P
	n = 30	%	n = 30	%	
<b>Problems</b>					
Yes	15	50	21	70	NS
No	15	50	9	30	NS
<b>Intensity</b>					
Low-middle	14	93.3	21	100	NS
High	1	6.7	0	0	NS
<b>Food impaction</b>					
Yes	24	80	30	100	*
No	6	20	0	0	*
<b>Bleeding gum</b>					
Yes	8	26.17	11	36.7	NS
No	22	73.3	19	63.3	NS
<b>Bad taste</b>					
Yes	5	16.7	7	23.3	NS
No	25	83.3	23	76.7	NS

<sup>a</sup> LA, labial appliances; LI, lingual appliances; NS, nonsignificance.  
 \*  $P < .05$ .  
 \*\*  $P < .01$ .  
 \*\*\*  $P < .001$ .

**TABLE 6.** Prevalence (%) of the General Problems with the Appliance in the LA and LI Groups

	Group LA <sup>a</sup>		Group LI		Test P
	n = 30	%	n = 30	%	
<b>Adaptation period</b>					
0–30 d	30	100	27	90	NS
3 mo	0	0	3	10	NS
<b>Handling</b>					
Easy	24	80	24	80	NS
Very difficult	6	20	6	20	NS
<b>Noticibility</b>					
Yes	30	100	9	30	***
No	0	0	21	70	***

<sup>a</sup> LA, labial appliances; LI, lingual appliances; NS, nonsignificance.  
 \*  $P < .05$ .  
 \*\*  $P < .01$ .  
 \*\*\*  $P < .001$ .

their appliances, more patients in the labial group (n = 30, 100%) reported that the appliances were more noticeable compared with the patients in the lingual group (n = 9, 30%). The difference between the percentages was statistically highly significant ( $P < .001$ ) (Table 6).

**DISCUSSION**

Patients may experience a considerable amount of discomfort from orthodontic treatment including feelings of tension, pressure, soreness of teeth, and even pain.<sup>16</sup> Pain and discomfort during labial orthodontic treatment<sup>16–24</sup> and

during lingual orthodontic treatment were investigated separately.<sup>11–14</sup> Only the study by Fujita<sup>10</sup> has compared patient discomfort between cases treated with lingual and labial appliances. The results of our comparative study showed that both labial and lingual orthodontic treatment patients feel some discomfort at the beginning of their treatment. However, in both groups, patients generally do not feel any discomfort after four weeks of appliance wear. These results are generally consistent with the data reported by Fujita.<sup>10</sup> It should be noted that in this investigation lingual brackets were bonded on both arches during the same appointment. However, placing the lingual appliance in the upper and the lower jaw during two different sessions would enhance patient comfort, as suggested by Fillion.<sup>13</sup>

The main difference between the study groups was in the localization of the discomfort. This can be summarized as: tongue soreness was higher in the lingual group, whereas the amount of discomfort experienced in the cheek and the lip areas was greater in the labial group (Table 2). These results are generally consistent with previous studies.<sup>11,13,14</sup>

Soreness or irritation of the tongue in the LI group may be partially due to the restricted functional space in the mouth caused by the lingual appliance. Ormco 7th generation premolar brackets, which were used in this study, are quite wide in the labiolingual direction. Therefore, using a low-profile bracket only in the posterior area would be a good way to increase patient comfort during lingual mechano-therapy. (Ormco anterior brackets have the advantage of a built-in bite plane that prevents them from being sheared off because of the bite forces.)

In this investigation, transpalatal bars and Nance appliances were used in some patients in the LI group to reinforce anchorage. The nature of the lingual technique is uncomfortable for patients. Therefore, one should avoid the use of auxiliaries such as transpalatal bars and Nance appliances along with lingual brackets as far as possible. Mini screws and implants should be considered more often to reinforce anchorage when using this technique.<sup>25,26</sup>

Interestingly, in this study, the incidence of tongue discomfort in the LA group was 26.7% (n = 8) (Table 2). This may be due to cleats and buttons used on the lingual side, to the Nance appliances, or to the transpalatal bars (or all) used in these patients. On the other hand, 36.7% (n = 11) and 16.7% (n = 5) of the patients in the lingual group claimed some discomfort in their cheeks and lips, respectively. This may be because of molar tubes on the labial sides or because of the removable lip bumpers (or both) used in these cases.

Patients in both groups had trouble eating, especially firm or fibrous food. However, this problem was solved after one month in 96.3% of the patients (n = 26) in the labial group and in 86.2% of the patients (n = 25) in the lingual group (Table 4). This finding is generally in agreement with the results of Fujita.<sup>10</sup> In our study, only four patients (13.8%) in the lingual group (Table 4) with severe deep bite at the

beginning of treatment still complained of difficulties in eating at the end of three months because of posterior disocclusion caused by the bite planes on maxillary anterior lingual brackets.

A significant difference between the groups was found at the level of speech difficulty, with LI patients bothered more compared with LA patients. Speech problems disappeared within four weeks after appliance placement in all patients in the LA group and in the majority of the subjects in the LI group. Of the patients with lingual brackets, 23.3% (n = 7) (Table 3) had longer-lasting speech problems (three months). This finding is generally in agreement with the studies of Sinclair et al<sup>11</sup> and Årtun.<sup>12</sup> However, the patient's assessment for speech disturbance in this study appears more negative compared with that in the studies by Fujita,<sup>10</sup> Fillion,<sup>13</sup> Fritz et al,<sup>14</sup> and Mariotti.<sup>27</sup> Pronunciation of different languages may be the reason for this difference.

One of the interesting findings of our study was that 63.3% (n = 19) of the patients in the LA group reported some problems in speaking. This may be due to the Nance appliances and transpalatal arches used in combination with labial orthodontic appliances. This finding confirms the results of the studies by Haydar et al,<sup>28</sup> Erb,<sup>29</sup> and Strutton and Burkland.<sup>30</sup> They all reported that dental appliances (orthodontic or prosthetic) can cause articulation disorders. Patients with these appliances experienced articulation problems at the beginning of treatment, which gradually decreased with time.

The results of this study showed that speech difficulty was the most severe problem induced by the lingual appliance. This finding does not agree with those of Fillion<sup>13</sup> and of Fritz et al,<sup>14</sup> who reported tongue discomfort as the most common and serious problem in their lingual patients. This may be due to the difference between the populations used in the studies. Psychological studies have shown that pain and discomfort is influenced by personal values and expectations.<sup>31,32</sup> Age may be another factor for this difference. Jones and Chan<sup>22</sup> have shown that during orthodontic therapy adult patients experience more pain and discomfort than do younger patients.

The most important and indispensable factor in orthodontic treatment is brushing and the maintenance of adequate oral hygiene.<sup>33,34</sup> In this investigation, no significant difference was noted between the groups in the achievement of proper oral hygiene. This finding is generally in agreement with the results of the study by Sinclair et al<sup>11</sup>; however, it should be approached with caution because plaque accumulation around the brackets has not been evaluated by quantitative methods in this study. Further investigations are needed to see whether there is a difference between labial and lingual cases in terms of plaque accumulation, caries, and decalcifications. In this investigation, all LI patients complained more about adherence of food particles between the brackets compared with the patients in the LA group. This may be due to the interbracket dis-

tance, which is smaller than in the labial technique.<sup>35</sup> A brushing method for this purpose is proposed by Fujita.<sup>36</sup> The WaterPick flosser is also recommended to improve oral hygiene in lingual orthodontic patients.<sup>37</sup>

According to the findings of this study, LI patients do not have more difficulty than LA patients during the adaptation period, which was generally no longer than four weeks. In this study, the LI patients refused the offer to change to labial orthodontic treatment because of the esthetic advantage of their appliance. In accordance with our findings, retrospective surveys suggested that the patient's discomfort with lingual brackets tends to disappear gradually within one month of starting treatment.<sup>10-14</sup> In this investigation, nine of 30 patients (30%) in the LI group reported that their appliances were noticed by the people around them (Table 6). This may be due to the speech difficulty during the adaptation period to the lingual brackets. On the other hand, all patients in the LA group complained that the braces were a source of annoyance from an esthetic point of view because they were noticeable by the people around them. This finding is consistent with the results reported by Fujita<sup>10</sup> and shows that one of the most important advantages of the LI appliance is its esthetic nature, which results in braces not having to be removed before treatment is completed.

## CONCLUSIONS

The results of this study can be summarized as follows.

- Both labial and lingual patients feel some discomfort at the beginning of treatment, which gradually disappears during a one month period.
- The localization of discomfort due to the orthodontic appliances is different: tongue soreness was higher in the lingual group, whereas the amount of discomfort in the cheek and the lip areas was greater in the labial group.
- Speech was the most severe problem in patients treated with lingual appliances.
- No significant difference in eating and in achieving proper oral hygiene was noted between the groups, but food sticking was higher in the lingual group.
- The adaptation period to both lingual and labial appliances was approximately the same (four weeks).

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