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A comparison of pain experienced by patients treated with labial and lingual orthodontic appliances

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SUMMARY The aim of this prospective longitudinal study was to compare pain experiences among Chinese adult patients treated with labial and lingual orthodontic appliances. Sixty patients, 30 with labial appliances (18 females and 12 males, mean age 20.33 years, SD ± 4.205) and 30 with lingual appliances (22 females and 8 males, mean age 21.63 years, SD ± 2.236), rated their overall pain experience on a 100 mm visual analogue scale (VAS) at three time points: 1 week (T_1), 1 month (T_2), and 3 months (T_3) after bracket placement. In addition, on a separate 100 mm VAS, they rated their pain experience at the locations of the tongue, lips, cheeks, gums, face, and jaw at T_1, T_2, and T_3. Changes in pain VAS were conducted using Friedman analysis of variance, area under the curve (AUC) analysis and the data were compared using a *t*-test.

There was no significant difference in global ratings of pain among those treated with labial or lingual appliances ($P > 0.05$). Among both groups, global ratings of pain decreased over the study period ($P < 0.001$). Patients treated with lingual appliances reported higher ratings of tongue pain ($P < 0.001$), while those treated with labial appliances reported higher ratings of lip ($P < 0.001$) and cheek ($P < 0.001$) pain. The findings indicate that patients treated with labial and lingual appliances rate similarly the level of overall pain they experience during treatment. Ratings of overall pain experienced decreased for both treatment groups with time. However, ratings of pain differed at various sites with respect to the type of orthodontic appliance. These findings have implications in informing patients' treatment decision-making processes regarding labial and lingual appliances and in the management of discomfort associated with different treatment modalities.

Introduction

There has been a paradigm shift within orthodontics to the use of lingual fixed appliances as opposed to conventional labial fixed appliances in the treatment of malocclusions (Caniklioglu and Öztürk, 2005). Lingual appliances can produce a comparable treatment outcome over similar time periods and are thus an alternative treatment modality for patients to consider (Gorman, 1988; Fillion and Leclerc, 1991; Gorman and Smith, 1991; Shum *et al.*, 2004). Although lingual appliance therapy is often more expensive than conventional labial appliance therapy, it has obvious aesthetic advantages during the active treatment phases (Valenci, 1984; Hugo *et al.*, 2000; Hohoff *et al.*, 2003). For example, even colour-matched labial brackets appear to offer no alternative in aesthetics compared with the lingual technique (Fritz *et al.*, 2002; Hohoff *et al.*, 2003).

Poor aesthetics, however, are not the only consequence of orthodontic treatment. Pain has long been recognized as a sequelae of orthodontic treatment and is experienced by the majority of patients (Kluemper *et al.*, 2002; Asham and Southard, 2004; Keim, 2004). Pain is one of the greatest dislikes and a major fear of orthodontic treatment (O'Connor, 2000). Moreover, pain is a common reason why orthodontic treatment is interrupted and even terminated, affecting compliance and treatment times (Haynes, 1974; Oliver and Knapman, 1985; Brown and Moerenhout, 1991; Kluemper *et al.*, 2002). Thus, it is imperative that experience of pain is considered in the orthodontic treatment decision-making process.

The experience of pain from conventional fixed labial appliances has long been reported following the placement of orthodontic separators (Ngan *et al.*, 1989, 1994; Bondemark *et al.*, 2004) to archwire placement and activation, particularly in the early stages of treatment (Jones, 1984; Jones and Chan, 1992; Firestone *et al.*, 1999; Polat and Karaman, 2005). There is conflicting evidence regarding pain experienced by those wearing removable orthodontic appliances compared with those treated with conventional labial appliances (Oliver and Knapman, 1985; Stewart *et al.*, 1997; Sergl *et al.*, 1998). A recent study has suggested that Invisalign® causes less pain during treatment than conventional labial appliances (Miller *et al.*, 2007). There is a paucity of information comparing the experience of pain among those treated with conventional labial compared with those treated with lingual appliances (Caniklioglu and Öztürk, 2005).

The aims of this study were to investigate and compare pain experienced by patients treated with lingual and labial

fixed appliances during the early phase of appliance therapy and to compare the sites of pain experienced by those treated with labial versus lingual appliances.

Subjects and methods

This study was approved by the local ethics committee of the University of Hong Kong.

Sixty adult patients treated in the Orthodontic Department, Prince Philip Dental Hospital, Hong Kong, over a 3 month period were included in this age-matched case–control prospective longitudinal study. It consisted of 30 patients (22 females and 8 males, mean age 21.63 years, SD ± 2.236) treated with lingual appliances (Incognito, Bad Essen, Germany) and 30 patients (18 females and 12 males, mean age 20.33 years, SD ± 4.205) treated with conventional labial appliances (Mini-Diamond, Ormco, Orange, California, USA).

The patients rated their experience of pain at three different time points during treatment: 1 week after the placement of the fixed appliances (T_1) and 1 (T_2) and 3 (T_3) months thereafter. Subjective pain assessment was made on a 100 mm visual analogue scale (VAS) with anchors of '0'—'no pain at all' to '10'—'worst pain imaginable'. Ratings of global overall pain experienced and pain at different oral sites were assessed. In addition, information about the time of onset of pain, pattern of pain, use of analgesia, and sleep disturbances as a result of pain was recorded.

Patients' experience of pain over the study period was assessed using Friedman two-way analysis of variance. The total pain experienced over the study period was assessed by area under the curve (AUC) analyses; $\text{AUC} = (1/2)\sum_{i=0}^{n-1}(t_{i+1}-t_i)(y_i+y_{i+1})$, where n = number of measurements, t = timing of measurement, and y = mean pain score. Differences in the level of pain experienced (AUC) by those wearing labial and lingual appliances were compared using a t-test for independent samples. A comparison of the frequency of pain time, sleep disturbance, and analgesic consumption was assessed using chi-square statistics.

Results

Patients' global rating of pain decreased over the study period for both labial and lingual appliance wearers ($P < 0.001$; Figure 1). There was no significant difference in reported experience of overall pain by those treated with lingual appliances compared with those treated with labial appliances ($P > 0.05$; Figure 1).

Differences in ratings of pain experienced over the study period were observed at various sites with respect to the type of orthodontic appliance used. Those treated with lingual appliances reported significantly greater tongue pain compared with those treated with labial appliances ($P < 0.001$) as calculated by AUC scores (Figures 2 and 3).

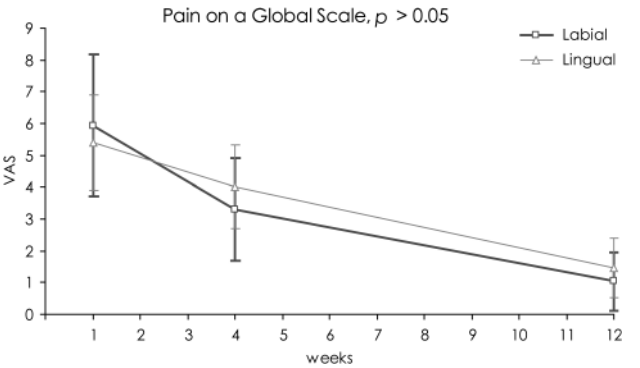

Figure 1 Comparison of overall pain experienced by patients treated with labial compared with lingual appliances at each time point.

However, those treated with labial appliances reported experiencing significantly more lip ($P < 0.001$) and cheek ($P < 0.001$) pain (Figures 2 and 3).

Onset of pain was reported to occur earlier (within 3 hours of the treatment visit) by patients treated with lingual appliances compared with those treated with labial appliances at T_1, T_2, and T_3 ($P < 0.001$; Table 1). There was no significant difference ($P > 0.05$) in reported sleep disturbance during treatment between the two groups (Table 1). Patients more frequently consumed analgesics during the early phase of treatment. However, no significant difference ($P > 0.05$) in consumption of analgesics between the two groups was apparent (Table 1).

Discussion

Within orthodontics there has been increased attention regarding patients' experiences of treatment and outcome from therapy (Jones and Chan, 1992; Sergl *et al.*, 1998; Firestone *et al.*, 1999; Erdinc and Dincer, 2004). Pain is a complex experience for which there is widespread agreement that patients are in the best position to provide reports on their experiences (Melzack, 1975; Jones and Chan, 1992; Simmons, 1994). The use of a VAS has been shown to be valid and reliable in pain assessments and also permits assessment of severity of pain over time since ratings are obtained on a continuous scale (Huskisson, 1974; McGrath, 1990; Linacre, 1998).

Overall pain experiences as calculated by AUC analyses were relatively low compared with the possible range of pain experiences, indicating that pain experienced as a result of orthodontic treatment was not described as 'excruciating'. This concurs with other estimates of pain experienced during treatment with different orthodontic procedures (Oliver and Knapman, 1985; Firestone *et al.*, 1999; O'Connor, 2000; Polat and Karaman, 2005). This should be borne in mind in reassuring patients that pain encountered is likely to be of low intensity but is nevertheless a sequel that occurs throughout treatment.

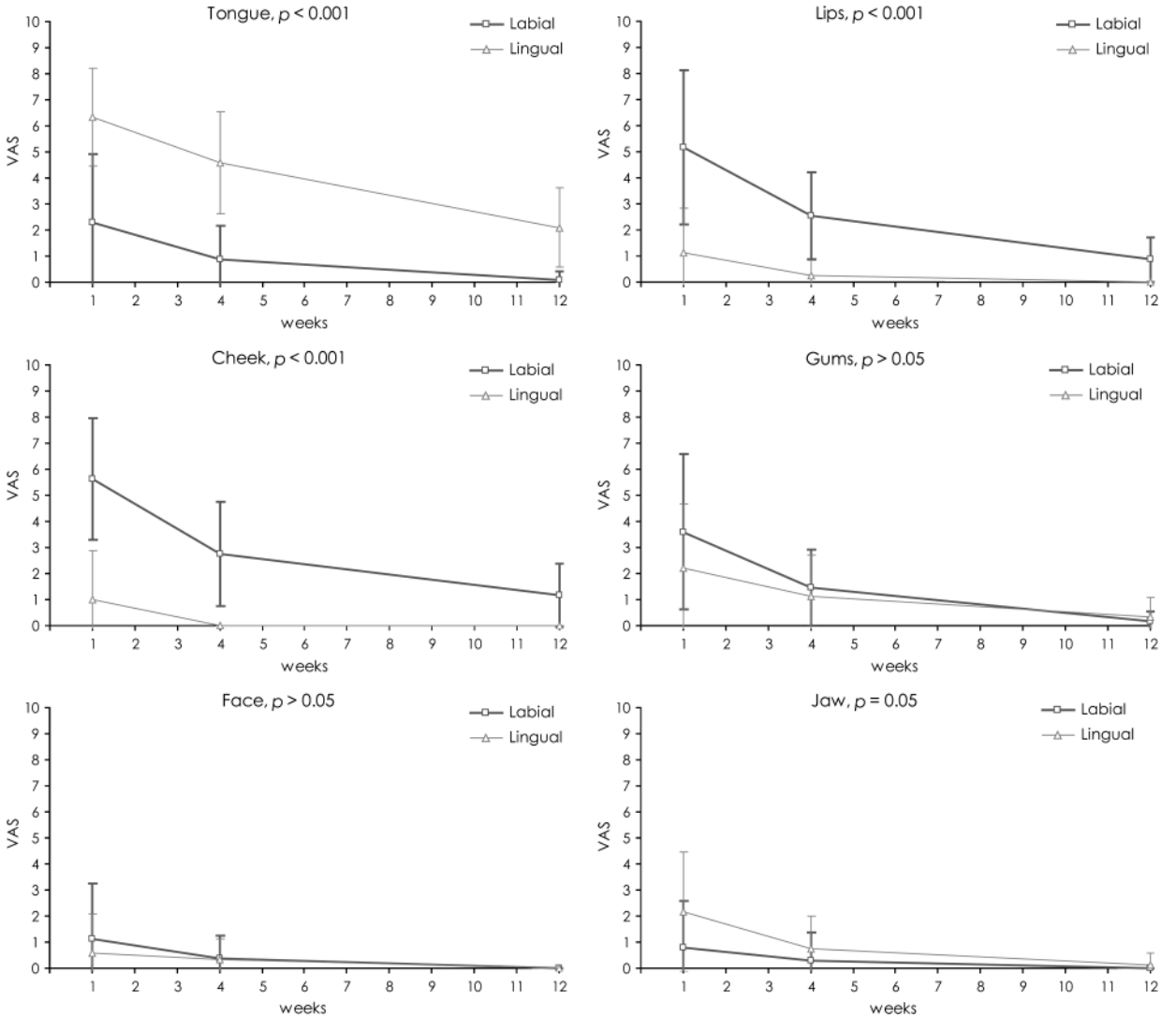

Figure 2 Comparison of pain experienced at different sites by patients treated with labial compared with lingual appliances at each time point.

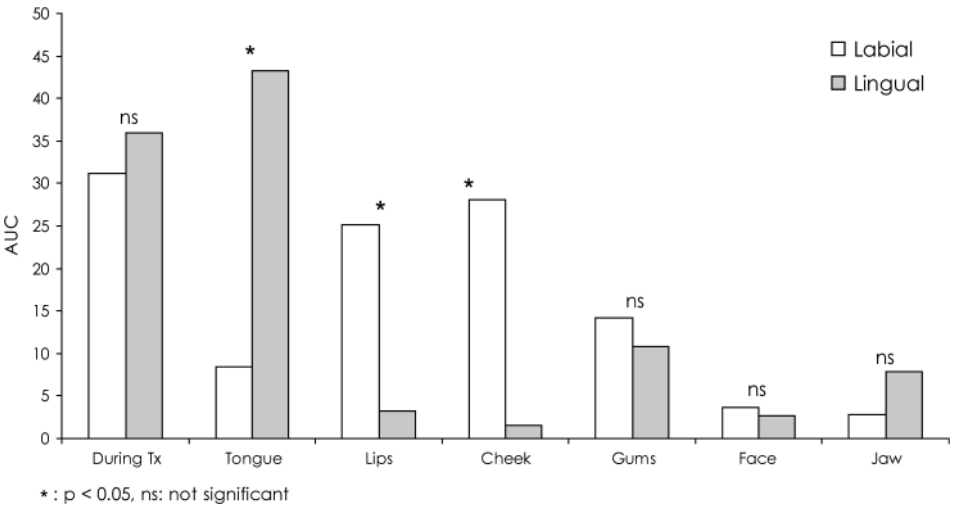

Figure 3 Comparison of pain experienced at different sites between those treated with labial and lingual appliances over the whole study period.

Table 1 Frequency of reported sleep disturbance, analgesic consumption, patients' pain pattern, and onset time of pain by those treated with labial compared with lingual appliances over the study period.

Comparison		1 week		1 month		3 months	
		Labial	Lingual	Labial	Lingual	Labial	Lingual
Reported sleep disturbance	Yes	2 (6.7%)	2 (6.7%)	2 (6.7%)	3 (10.0%)	1 (3.3%)	0 (0.0%)
	No	28 (93.3%)	28 (93.3%)	28 (93.3%)	27 (90.0%)	29 (96.7%)	30 (100%)
	P-value	>0.05		>0.05		>0.05	
Reported analgesic consumption	Yes	1 (3.3%)	4 (13.3%)	0 (0.0%)	2 (6.7%)	0 (0.0%)	0 (0.0%)
	No	29 (96.7%)	26 (86.7%)	30 (100%)	28 (93.3%)	30 (100%)	30 (100%)
	P-value	>0.05		>0.05		>0.05	
Patients' pain pattern	Day	9 (30.0%)	9 (30.0%)	5 (16.7%)	4 (13.3%)	3 (10.0%)	3 (10.0%)
	Night	6 (20.0%)	6 (20.0%)	7 (23.3%)	2 (6.7%)	2 (6.7%)	2 (6.7%)
	Same	15 (50.0%)	15 (50.0%)	18 (60.0%)	24 (80.0%)	25 (83.3%)	25 (83.3%)
	P-value	>0.05		>0.05		>0.05	
Timing of initial pain reported	≤ 3 hour	2 (6.7%)	29 (96.7%)	0 (0.0%)	29 (96.7%)	0 (0.0%)	26 (86.7%)
	> 3 Hour	28 (93.3%)	1 (3.3%)	30 (100%)	1 (3.3%)	30 (100%)	4 (13.3%)
	P-value	<0.001		<0.001		<0.001	

No significant difference in overall pain experience over the study period was observed between those treated with lingual appliances compared with those treated with labial appliances, suggesting that both methods result in similar levels of discomfort. The paucity of research on global ratings of pain experience between labial and lingual modalities of treatment prohibits comparison to be made with other studies in the literature. It would be useful to replicate this study in other settings with other populations to refute or support the findings.

For both patients treated with labial and lingual appliances, their experiences of pain decreased over the observation period. At T_1, both groups reported the highest level of pain but subsequently pain ratings were lower at T_2 and T_3. It has been observed in a number of studies that pain experience diminishes over time (Firestone *et al.*, 1999; Polat and Karaman, 2005; Krishnan, 2007). It is unclear whether this is because the procedure and effect of treatment during later stages are less painful than those of the early treatment phase, or that patients have simply adapted to pain experiences and accepted them as a consequence which they then do not report.

Of note was that pain experience differed with respect to the oral site. Patients treated with lingual appliances experienced more tongue pain, which concurs with findings from a previous study (Caniklioglu and Öztürk, 2005). This is most likely to be as a result of the placement of lingual brackets, which may impinge on the tongue space and/or irritate the tongue, leading to discomfort. Patients treated with labial appliances were found to experience more lip and cheek pain than those treated with lingual appliance, as in the findings of Caniklioglu and Öztürk (2005). Presumably, the placement of brackets close to the labial and buccal mucosa results in the associated discomfort encountered. Identification of the sites of pain associated with different orthodontic treatment modalities is important in determining appropriate pain management approaches, including prevention of discomfort and pain. It would be interesting to determine if the consequences of lingual and buccal (lip and cheek) pain are different in terms of oral function and whether that might influence patients' decision-making process in selecting one treatment modality over another.

Use of analgesics was reported to be low during the study period as found in previous research (Firestone *et al.*, 1999; Bergius *et al.*, 2002). Interestingly, analgesics were used more frequently during the initial treatment phases when pain intensity was reported to be highest, which supports the hypothesis that pain experiences as a consequence of orthodontic treatment are relatively low (Feinmann *et al.*, 1987; Scheurer *et al.*, 1996). There was no significant difference in reported use of analgesics between those treated with labial or lingual appliances. However, the small number of subjects who consumed analgesic during the observation period resulted in a low statistical power to distinguish differences between the two treatment groups.

Conclusions

No significant differences in patients' global ratings of pain experienced during treatment were observed between those treated with labial or lingual appliances. For both groups, pain reduced over the observation period. Subjects with lingual appliances experienced more tongue pain, whereas those treated with labial appliances experienced more lip and cheek pain. Patients treated with lingual appliances reported experiencing pain earlier than those treated with labial appliances.

The present findings provide orthodontists and patients with useful information in relation to the likelihood of pain

when undergoing fixed labial and lingual orthodontic treatment. This information could also be used in educating patients and clinicians concerning what to expect during fixed appliance therapy and help support 'informed consent'.

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