Odontology (2011) 99:88–91
DOI 10.1007/s10266-010-0152-1

ORIGINAL ARTICLE

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The perception of pain following interdental microimplant treatment for skeletal anchorage: a retrospective study

Received: August 1, 2009 / Accepted: May 27, 2010

Abstract During orthodontic therapy, patients frequently complain about pain and discomfort, especially during insertion of fixed appliances. Skeletal anchorage using an interdental microimplant is a new concept in orthodontic treatment. The purpose of this study was to investigate differences and changes in the level of pain among patients in relation to orthodontic microimplant treatments. Forty microimplants were applied to the maxilla as skeletal anchors in the orthodontic treatment. The visual analog scale (VAS) was used to evaluate the patients' perception of pain during this new modality treatment. The premolar extraction VAS core was used as a baseline for the complete orthodontic procedure. The mean VAS score was 35.8 mm at 24 h after premolar extraction. The mean VAS score for insertion and removal of the microimplant 24 h after the operation was 12.3 and 7.8 mm, respectively. Three months after removal of the skeletal anchors, the VAS score had decreased to 3.2 mm and was the same as with the traditional orthodontic treatment. By using the repeated-measure general linear model (GLM), we found that the score 1 day after microimplant placement was significantly less than that 1 day after first premolar extraction or that 1 day after fixed appliance insertion. This result indicates that interdental microimplant did not generate any greater pain than other orthodontic procedures. Therefore, patients were willing to adopt the new orthodontic treatment.

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Key words Pain · Visual analog scale · Skeletal anchorage · Interdental microimplant

Introduction

Recently, skeletal anchorage using microimplants has gained orthodontists' attention as a means of improving the quality of orthodontic treatment. Even though patients are fully informed before the microimplant operation, they are still anxious and restless about this new treatment. As is well known, patients always encounter some pain from orthodontic treatment, especially in the placement of an elastic separator or fixed appliance. Bergius et al.[1] concluded that pain was common even after a simple procedure such as placement of molar separators. The experience of pain varies substantially among subjects. Erdinç and Dinçer[2] concluded that initial pain is perceived at 2 h and peaks at 24 h during orthodontic treatment with fixed appliances. Kvam et al.[3,4] reported that of the patients they studied, 95% experienced pain and 83% experienced ulceration during orthodontic treatment. Therefore, pain is an inevitable and real unpleasant sensation resulting from orthodontic procedures.

Especially in Asia,[5,6] many orthodontists have been encouraged to use microimplants to assist in orthodontic treatment. Even though orthodontists are very careful about patients' suffering, information is still lacking about pain after microimplant placement. Thus, the aim of this study was to investigate the pain experiences of patients during and after interdental microimplant insertion, and to assess their feedback after treatment. Moreover, our study tested the null hypothesis that there would be no difference in pain score from the first premolar extraction to the removal of the microimplants.

Materials and methods

This was a retrospective study using data that had been recorded by an orthodontist. Twenty patients (15 women

Table 1. Summary of microimplant placement

Sex (*n*)	Male, 5; female, 15
Age (years), mean (range)	24.3 (19–32)
Microimplant	
Length (mm)	8
Diameter (mm)	1.2
Placement location (*n*)	40
Interradicular bone between the bilateral maxillary second premolar and first molar	

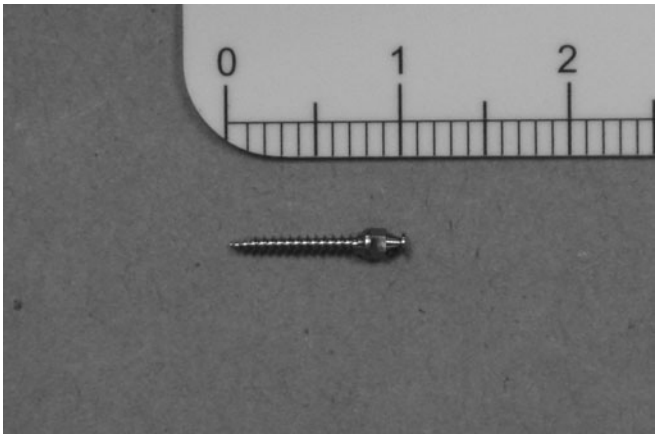

Fig. 1. The microimplant (diameter, 1.2 mm; length, 8 mm)

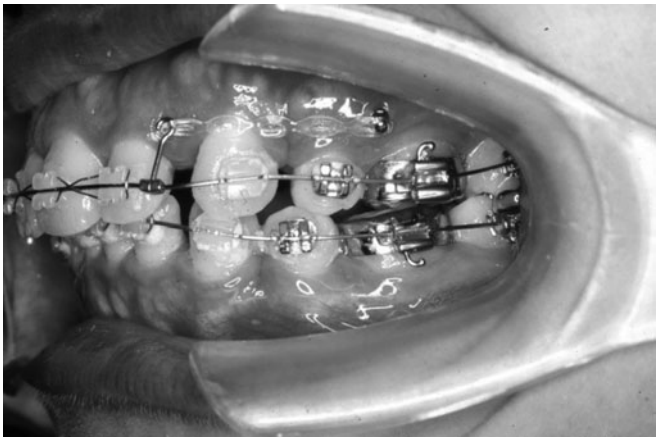

Fig. 2. Retraction of left maxillary anterior teeth with an elastomeric chain

and 5 men) undergoing an interdental microimplant skeletal anchorage procedure participated in comprehensive orthodontic treatment at Chang's orthodontic clinic from July 2004 to June 2007. The inclusion criteria were (1) at least 18 years of age, (2) anterior crowding, diagnosed as class II malocclusion, (3) no previous orthodontic treatment, (4) the procedure involved the extraction of the four first premolars, and (5) microimplant skeletal anchorage was considered necessary. The exclusion criteria were (1) any oral-facial pain prior to treatment, (2) a posterior tooth missing, and (3) severe posterior teeth crowding. The mean age of the patients was 24.3 years, ranging from 19 to 32 years (Table 1). After cephalometric tracing and cast model analysis, microimplant-aided skeletal anchorage was formally suggested to the patients. All patients and parents gave fully informed written consent prior to microimplant insertion. Three weeks before placement of an orthodontic appliance, the four first premolars were extracted and the patient was given antibiotic and nonsteroidal anti-inflammatory drugs (NSAIDs) at 8-h intervals for 1 day. After insertion of the orthodontic fixed appliance, no medication was needed for a further 3 weeks. In this procedure, two microimplants were placed into the interdental bone between the bilateral maxillary second premolar and first molar. The operation was performed under local anesthesia in all patients. The diameter of the microimplant (Absoanchor; Dentos, Daegu City, Korea) was 1.2 mm, and its length was 8 mm (Fig. 1). Microimplants are divided into two main types: (a) self-drilling and (b) non-self-drilling. To avoid fracture, only non-self-drilling microimplants were used, because of their smaller diameters. A low-speed (400–500 rpm) pilot drill handpiece (diameter, 1 mm) was used to penetrate the cortical level of bone only. Once the pilot hole was prepared, the microimplant was introduced into the buccal interdental alveolar bone. All patients were required to take an antibiotic and NSAIDs at 8-h intervals for 1 day. The application of orthodontic force was started 3 weeks after microimplant placement (Fig. 2). A force of 100–200 *g* was loaded onto an elastomeric chain or NiTi coil spring.

Patients were asked to respond to a questionnaire, based on the 100-mm visual analog scale (VAS), which was used to measure their perception of pain during the treatment. Three months after removal of the microimplants, while the patients were still wearing the orthodontic appliance, they were asked to think about an write down the degree of pain they had experienced at the indicated time intervals. The questionnaire consisted of the following ten questions:

1. One day after extraction of the first premolars, how much pain did you have?
2. One day after fixed orthodontic appliance insertion, how much pain did you have?
3. Seven days after fixed orthodontic appliance insertion, how much pain did you have?
4. Before microimplant placement, how much pain did you expect?
5. One day after microimplant placement, how much pain did you have?
6. Three weeks after applying orthodontic force on the microimplants, how much did pain interfere with your speaking?
7. Three weeks after applying orthodontic force on the microimplants, how much did pain interfere with your eating?
8. Before removal of the microimplants, how much pain did you expect?

9. One day after removal of microimplants, how much pain did you have?
10. Three months after removal of microimplants, how much pain did you have?

Following Kuroda et al.,[7] sample-size calculations were based on the VAS scores 1 day after microimplant placement. Two-sample *t* tests were used to determine the sample size giving 90% power at the 0.05 level of significance (two-sided). The sample size required was only eight subjects. The repeated-measure general linear model (GLM) was calculated to assess subjective pain differences between treatments over time. The null hypothesis was that there would be no difference in the pain score from the first premolar extraction to the removal of the microimplant at a significance level of 0.05. Two baseline points were chosen for pairwise comparisons of repeated measurements: the VAS score 1 day after the extraction of the first premolars and the score 1 day after fixed orthodontic appliance insertion. We used SPSS (version 14; SPSS, Chicago, IL, USA) for all analyses. All patients were carefully informed about the use of VAS and repeated measures of a constant attribute. There was no occasion that by affecting the patient's mood would inflate or deflate their answers. Therefore, casual error was reduced to a minimum. All measurements were performed by the same well-trained orthodontist in order to avoid systematic error.

Results

In this study, four first premolar extractions were part of the orthodontic treatment plan. During the whole period of observation, the mean pain score 1 day after first premolar extraction was 35.8 mm (Table 2). This was considered a baseline VAS score for comparison with the different conditions of this study. On the first day after archwire insertion, the VAS score was 21.4 mm, less than the extraction VAS score. Seven days after orthodontic treatment with fixed appliances, the VAS score fell to 10.4 mm. Just as we expected, fear of surgical operation aggravated the perception of pain. The anticipative VAS score for the microimplant operation was 43.7 mm, greater than the extraction VAS score. However, contrary to the patient's expectation, the VAS score was only 12.4 mm 24 h after the operation. Three weeks after the orthodontic force was first applied to the microimplant anchorage, the VAS scores during eating and speaking had decreased to 7.8 and 5.5 mm, respectively.

Even though the patients were informed that there would be just a little discomfort during removal of the microimplants, they were still concerned about pain, and the expected VAS score prior to removal of the microimplants jumped to 37.8 mm. However, the mean VAS score at 24 h after removal of the microimplants was only 7.8 mm. In the final stage of orthodontic archwire treatment, 3 months after removal of the microimplants, the VAS score dropped to 3.2 mm. The results of the repeated-measure GLM indicated a significant VAS effect, Pillai's Trace = 0.000. This result indicated that there were differences in the VAS score compared to the baseline points, so the null hypothesis were rejected (Table 2).

Discussion

Certainly, potential patients have heard about how painful orthodontics can be, but they all go through the treatment anyway. Therefore, pain perception is real, and must be accepted as part of routine orthodontic treatment. Premolar extractions are a common procedure in orthodontic treatment plans, especially for management of dental crowding. The overwhelming majority of premolar extractions involve a routine and simple procedure by the oral surgeon or dental practitioner. Chaushu et al.[8] reported on patients' perceptions of recovery after routine extraction of healthy premolars. They concluded that patients can expect recovery within 2 days after premolar extraction. Moreover, the number of extractions performed at the same appointment has no effect on the posttreatment recovery.

Most orthodontists inform patients about the incidence and intensity of orthodontic pain. Ordinarily, orthodontists neglect to inform patients about the pain after premolar extraction, which is a part of the orthodontic treatment course. For this

Table 2. Pain levels evaluated by the repeated-measure GLM in the integrated orthodontic treatment course

Question no.	Description	VAS score (mm)
1.	1 day after the extraction of the first premolars	35.8**
2.	1 day after fixed orthodontic appliance insertion	21.4*
3.	7 days after fixed orthodontic appliance insertion	10.4*, **
4.	Expected for microimplant placement before surgery	43.7*, **
5.	1 day after microimplant placement	12.4*, **
6.	3 weeks after microimplant treatment while speaking	7.8*, **
7.	3 weeks after microimplants treatment while eating	5.5*, **
8.	Expected for microimplant removal before surgery	37.8*, **
9.	24 h after removal of microimplants	7.8*, **
10.	3 months after removal of microimplants and continuation of the orthodontic treatment	3.2*, **

The VAS score was determined according to a 100-mm scale
VAS, visual analog scale; GLM, general linear model
* $P < 0.05$; compared with question no. 1
** $P < 0.05$; compared with question no. 2

reason, orthodontists need to have a pain score baseline, such as premolar extraction, to use in informing the patient about how much pain to expect. Moreover, premolar extraction can be used as a baseline for pain during orthodontic treatment, especially in the application of skeletal anchorage.

Most patients acknowledge pain during orthodontic treatment. The intensity of pain after orthodontic treatment is reported diversely on the VAS scale. Several researchers[9–11] have concluded that the perception of pain from the orthodontic procedure peaks 1 day after the start of the treatment and reduces to normal levels 7 days later. In these studies, the highest intensity of pain was 40 mm or more in mean VAS score the day after placement of an elastic separator, appliance, or archwire, and fell to less than 10 mm 7 days later. Our results were similar to those of these studies. We recorded the patients' perception of pain from the extraction of the premolars. This was a good baseline for the entire orthodontic treatment. Our patients reported a VAS score on the first day after insertion of the fixed appliance only two-thirds as high as the score they reported 1 day after extraction of the premolars.

When confronted with a new technique for orthodontic therapy, patients and their families hesitate and waver in their opinions about the technique, and fear and anxiety cloud reason and encroach beyond logic. Owing to lack of data about pain perception during interdental microimplant application, orthodontists also sometimes feel uncertainty. Therefore, it is no wonder that patients presuppose that the pain will be greater than that arising from premolar extraction. Fortunately, the pain is merely one-third as high as that from premolar extraction on the first day after insertion of the microimplants, as indicated by the VAS scores. Moreover, the VAS score 1 day after orthodontic force is applied to the microimplants is only one-fifth as high as the score for premolar extraction. Kuroda et al.[7] reported a mean VAS score of 4 to 5 mm 1 day after microimplant placement. Our study and Kuroda's findings[7] indicate that patients can well endure the pain caused during microimplant anchorage.

It is interesting that patient anticipation of pain from the removal of microimplants was greater than the VAS score of premolar extraction, even though the VAS score during the skeletal anchorage period was less than 10 mm. Though patients had previous experience of microimplant placement, the fear of surgery once again impacted the mood and reasoning of patients. Obviously, apprehension and fear of surgery was related to the patients' experiences when faced with the operations earlier. Therefore, it is important to assist patients in relieving anxiety and fear over an upcoming microimplant removal procedure. As we expected, the VAS score was less than 10 mm on day one after removal of the microimplants. Thus, the VAS score gradually decreased to initial orthodontic levels as has been reported in the literature.

We used the VAS score of premolar extraction as a baseline for the whole treatment because it is easily understood by patients because of their previous experience with dental extraction. Moreover, we collected the postoperative VAS scores for insertion and removal of microimplants. Therefore, we can provide realistic data to relieve patient worry and uncertainty about the skeletal anchorage procedure. In the meantime, patients can understand the extent of pain to be expected during the whole treatment by reference to the premolar extraction VAS score. Using the repeated-measures GLM, we concluded that 1 day after microimplant placement the VAS score was significantly less than the scores 1 day after first premolar extraction and 1 day after fixed appliance insertion. Therefore, the null hypothesis of no difference in pain scores was rejected.

The interdental microimplant anchorage is a new technique and treatment option in current orthodontic therapy. Naturally, patients are always concerned about the differences between conventional and new treatment procedures. Therefore, the data collected in this study can contribute to a better outcome by persuading patients and orthodontists alike to willingly trust the new treatment modality and by relieving patient uncertainty regarding the suffering that they might undergo. In light of these positive responses, we can conclude that patients did not reject placement of the skeletal anchorage. The toleration of pain did not cause an enduring problem.

Patients belonging to different cultures may report different pain perception and severity during microimplant treatment, so patients from one culture should be compared with those of another. Finally, 3 months is a long period for patients to remember the exact details of their pain experience hours or days after specific orthodontic procedures. Thus, VAS scores reported retrospectively by patients may have been over- or underestimated. In a future study, patients should be asked at specific time intervals following treatment to accurately record their pain.

References

1. Bergius M, Berggren U, Kiliaridis S. Experience of pain during an orthodontic procedure. Eur J Oral Sci 2002;110:92–8.
2. Erdinç AM, Dinçer B. Perception of pain during orthodontic treatment with fixed appliances. Eur J Orthod 2004;26:79–85.
3. Kvam E, Bondevik O, Gjerdet NR. Traumatic ulcers and pain in adults during orthodontic treatment. Community Dent Oral Epidemiol 1989;17:154–7.
4. Kvam E, Gjerdet NR, Bondevik O. Traumatic ulcers and pain during orthodontic treatment. Community Dent Oral Epidemiol 1987;15:104–7.
5. Chen CH, Chang CS, Hsieh CH, Tseng YC, Shen YS, Huang IY, Yang CF, Chen CM. The use of microimplants in orthodontic anchorage. J Oral Maxillofac Surg 2006;64:1209–13.
6. Kyung HM, Park HS, Bae SM, Sung JH, Kim IB. Development of orthodontic micro-implants for intraoral anchorage. J Clin Orthod 2003;37:321–8.
7. Kuroda S, Sugawara Y, Deguchi T, Kyung HM, Takano-Yamamoto T. Clinical use of miniscrew implants as orthodontic anchorage: success rates and postoperative discomfort. Am J Orthod Dentofacial Orthop 2007;131:9–15.
8. Chaushu G, Becker A, Zeltser R, Vasker N, Branski S, Chaushu S. Patients' perceptions of recovery after routine extraction of healthy premolars. Am J Orthod Dentofacial Orthop 2007;131:170–5.
9. Giannopoulou C, Dudic A, Kiliaridis S. Pain discomfort and crevicular fluid changes induced by orthodontic elastic separators in children. J Pain 2006;7:367–76.
10. Ngan P, Kess B, Wilson S. Perception of discomfort by patients undergoing orthodontic treatment. Am J Orthod Dentofacial Orthop 1989;96:47–53.
11. Scheurer PA, Firestone AR, Bürgin WB. Perception of pain as a result of orthodontic treatment with fixed appliances. Eur J Orthod 1996;18:349–57.