Pain Perception During Miniplate-assisted Orthodontic Therapy

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Miniplate and screw devices are widely used for fracture repair and fixation of osteotomies. Currently, these miniplate systems are being used as orthodontic treatments for skeletal anchorage. However, despite the widespread use of these treatments, patients are apprehensive when they need to undergo miniplate procedures. Recently, we assessed pain perception using the visual analog scale (VAS) score (0–100 mm) in patients who had undergone miniplate procedures. Thirty miniplates were positioned in the maxilla as skeletal anchors for orthodontic treatment. On the first day after insertion of the fixed orthodontic appliances, the mean VAS score was 36.3 mm. The mean VAS score at 24 hours after insertion of the miniplate was 58 mm. Three months after orthodontic force was applied to the miniplate, the mean VAS scores during eating and speaking gradually decreased to 20 mm and 15 mm, respectively. The mean VAS score at 24 hours after removal of the miniplate was 41.3 mm. Three months after removal of the skeletal anchors, the VAS score decreased to 5 mm. Eighty-eight percent of patients stated that they would be prepared to undergo these new and more efficient treatment modalities in the future. The miniplate system was successfully used in this study as a skeletal anchor, and the patients could endure the pain and discomfort of this orthodontic treatment.

Key Words: miniplate, pain perception, skeletal anchorage, visual analog scale
(*Kaohsiung J Med Sci* 2010;26:603–8)

Miniplate osteosynthesis is a treatment that is commonly used in craniofacial surgery for the repair of bone fractures. Miniplate and screw devices demonstrate biochemical stability; they can be used to achieve reliable fixation of the fractured segments, and achieve good functional results. Recently, many innovations have been introduced in the miniplate and screw system for its use as an orthopedic anchorage unit in orthodontic treatment [1,2]. The use of the miniplate for anchorage has simplified the mechanics of orthodontic treatment, and has shortened the duration of treatment. Sherwood et al used titanium miniplate anchorage to close anterior open bites by intruding molars [3]. Rattanayatikul et al used miniplates and screws in the treatment of skeletal Class III malocclusion with missing posterior teeth [4].

Although miniplate placement is not complicated, patients are still apprehensive about the procedure. There have been cases in which the patient's level of pain perception during miniplate anchorage has been disregarded and that has resulted in the patient experiencing discomfort during the procedure. Therefore, it is important to take into consideration the pain experienced by patients during miniplate osteosynthesis treatment.

Received: Jan 27, 2010 Accepted: Apr 21, 2010
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Table 1. Summary of patients

Variables	
Sex, male:female	3:12
Mean age (range), yr	24.9 (19–39)
Miniplate insertion	
Location	Bilateral zygomatic process of maxilla
Type	4-hole, L-shaped
Number	30
Size of miniscrew (mm)	
Diameter	2
Length	5 or 7

In this study, we evaluated pain perception using the visual analog scale (VAS) and provided practical suggestions for improving communication with patients.

Methods

From May 2004 to June 2007, 15 patients diagnosed with Class II malocclusion underwent comprehensive orthodontic treatment at the Division of Oral and Maxillofacial Surgery, Department of Dentistry, Kaohsiung Medical University Hospital. One surgeon performed all bilateral miniplate anchorage procedures. Approximately 30 minutes was required to insert each miniplate (Table 1). The mean age of the patients was 24.9 years (range, 19–41 years). The patients were fitted with an orthodontic fixed appliance; no medication was administered over the subsequent 3 weeks. Under local anesthesia, a 2-cm-long incision was made in the buccal vestibule, adjacent to the maxillary molars. The cortical bone surface of the zygomatic process of the maxilla was exposed. A 4-hole, L-shaped miniplate (Leibinger, Mühlheim–Stetten, Germany) was fixed by miniscrews (length = 5 mm or 7 mm), and the last loop of the miniplate was allowed to project through the vestibular incision and into the oral cavity (Figure 1). Antibiotics and nonsteroidal anti-inflammatory drugs were prescribed at 8-hour intervals over 3 days. Three weeks later, a force of 100–200 g was loaded onto the miniplate using an elastomeric chain or a nickel titanium coil spring (Figure 2).

The patient's perception of pain at both surgical sites during the treatment was evaluated using a questionnaire, which was subsequently administered by the same orthodontist 3 months after removal of the miniplate. The responses to the questions were measured on a 100-mm VAS. The patients were asked to note down the comparative degree of pain experienced at the indicated time intervals. The questionnaire consisted of the following questions:

(1) How much pain did you experience 24 hours after insertion of the fixed orthodontic appliance?
(2) Prior to surgery, how much pain did you expect from miniplate placement?
(3) How much pain did you experience 24 hours after miniplate placement?
(4) How much pain did you experience 7 days after miniplate placement?

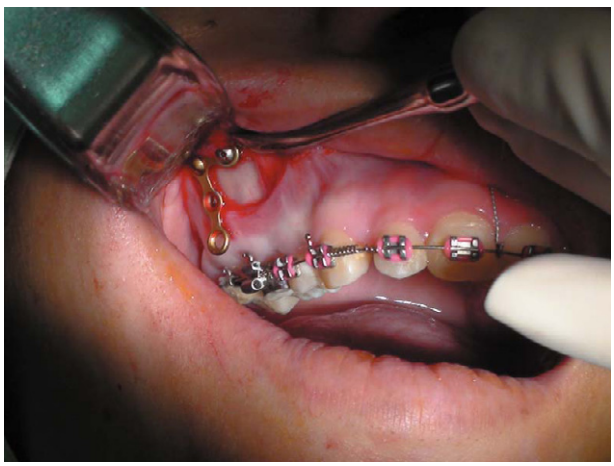

Figure 1. *Fixation of miniplate in the zygomatic process of the maxilla, and its last loop was projected through the incision line into oral cavity.*

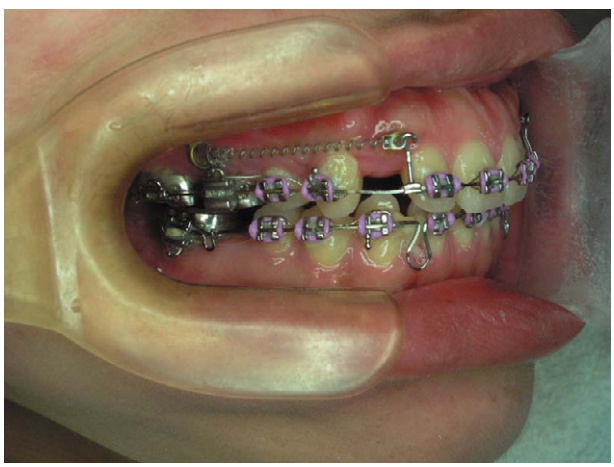

Figure 2. *Retraction of anterior teeth with coil spring onto the miniplate.*

(5) How much pain did you experience while speaking, 3 months after the orthodontic force was applied to the miniplate?
(6) How much pain did you experience while eating, 3 months after the orthodontic force was applied to the miniplate?
(7) How much pain did you expect from the procedure, before miniplate removal surgery?
(8) How much pain did you experience 24 hours after removal of the miniplate?
(9) How much pain did you experience 3 months after removal of the miniplate and during continuation of orthodontic treatment?
(10) How motivated would you be to undergo miniplate treatment in future if it enhanced the final orthodontic results?
(11) How motivated would you be to undergo miniplate treatment if it reduced the orthodontic treatment duration by 6 months?

Calculations were based on the patients' anticipated and actual pain levels as determined by their VAS scores. One sample *t* test was used to determine the sample size that gave 90% power at the 0.05 level of significance (two-sided). The means of the VAS pain intensity scores were calculated 1 day after fixed appliance insertion and 1 day after miniplate placement. The null hypothesis, which stated that there was no difference between mean VAS scores 1 day after fixed appliance insertion and 1 day after miniplate placement, was tested by using a paired *t* test at a significance level of 0.05.

Results

A sample size of 11 patients gave 90% power at the 0.05 level of significance (two-sided). Twenty-four hours after insertion of the orthodontic fixed appliances, the mean VAS score was 36.3 mm (Table 2). As expected, the patients' expectations of pain were aggravated by the fear of surgery. The anticipated VAS score of the miniplate operation was 68.3 mm, which was close to the patient's expectation. The VAS score at 24 hours after the operation was 58 mm. Seven days after miniplate insertion, the VAS score remained high at 26.7 mm. Three weeks after orthodontic force was applied to the miniplate, the VAS scores during eating and speaking gradually decreased to 20 mm and 15 mm, respectively.

Table 2. Pain level during orthodontic treatment

Mean pain intensity	VAS (mean ± SD)
24 hr after fixed orthodontic appliance insertion	36.3 ± 19.1
Expected from miniplate insertion before surgery	68.3 ± 22.2
24 hr after miniplate insertion	58.0 ± 22.3*
7 d after miniplate insertion	26.7 ± 12.3
Speaking at 3 mo after miniplate treatment	15.0 ± 12.4
Eating at 3 mo after miniplate treatment	20.0 ± 18.0
Expected from miniplates before remove surgery	62.3 ± 17.8
24 hr after removal of miniplates	41.3 ± 23.9
3 mo after removal of miniplates	5.0 ± 4.2

*$p < 0.05$. VAS = visual analog scale; SD = standard deviation.

The patients were apprehensive of the miniplate removal procedure because they had experienced pain during initial miniplate placement. The mean expected VAS score before surgery was 62.3 mm, but the 24-hour postoperative VAS score was 41.3 mm. Three months after removal of the miniplate, in the final stage of orthodontic treatment, the mean VAS score was only 5 mm.

The patients were asked to evaluate the miniplate anchorage treatment. Eighty-eight percent of patients said that they would accept the use of this new schema because of increased effectiveness in the results of orthodontic treatment. Seventy-eight percent of the patients agreed to use the miniplate anchorage system because of its ability to reduce the duration of orthodontic treatment by 6 months. A paired *t* test on the data revealed that the VAS score at 1 day after miniplate placement was significantly greater than that at 1 day after attachment of the fixed appliance. The null hypothesis was rejected.

Discussion

Miniplate osteosynthesis has been reported to be useful in biomechanical and biochemical evaluations of the procedure. Miniplate osteosynthesis for skeletal anchorage has been reported to have a high success rate [5–7]. Our previous study reported a 95.5% success rate [7]. The miniplate anchorage system is therefore considered as a valid and successful procedure in orthodontic treatment.

Tissue injury causes considerable pain. Age and sex are not the only parameters that influence the intensity of pain experienced by a patient; the patient's emotional and psychological states also affect his/her pain tolerance level. The anticipation of undergoing new orthodontic treatment modalities that involve surgical placement of a miniplate could intensify a patient's fear of surgery. Therefore, the patient's expectation of pain and the intensity of pain actually experienced are of great importance and should be of interest to the surgeon, orthodontist, and the patient. The VAS is commonly used to measure a patient's perception of pain because it is easy for the patients to understand. In this scale, pain is rated numerically along a 10-cm line, with the intensity of pain ranging from 0 to 10.

Many literature reviews have stated that most patients complain of pain during orthodontic treatment [8–13]. Several researchers have reported that peak pain intensity is observed at 24 hours after insertion of fixed orthodontic appliances [10,12]. The pain intensity gradually reduces to normal levels at 7 days after insertion. The intensity of pain reported varies considerably; the mean VAS score can exceed 40 mm on the day after placement of elastic separators, orthodontic appliances, or archwires [10,13]. In our study, the mean VAS score was similar to those reported in these studies; the score was 36.3 mm on the first day after insertion of fixed orthodontic appliances.

Concern about pain from surgery is very normal, especially when it is associated with an unfamiliar surgical technique. A patient's surgical history might influence his/her pain expectations and responses. Therefore, it is very important that orthodontists provide patients with detailed information about their proposed surgical treatments. Owing to a lack of data on patients' pain perception during miniplate placement, orthodontists are uncertain about the intensity of pain that a patient can expect to experience during such procedures, and there are no convincing scientific data to indicate that orthodontists are communicating the details of surgical procedures to their patients.

The miniplate placement operation involves flap incision, reflection, and closure. Taking into consideration the details of this surgical procedure, it is not surprising that one particular patient's pain expectation was 68.3 mm on the VAS, whereas the actual VAS score at 24 hours post-surgery was as high as 58 mm. Using the paired *t* test, we concluded that the VAS score was significantly greater at 1 day after miniplate placement than it was at 1 day after insertion of a fixed appliance.

Moderate postoperative facial swelling was frequently observed. Generally, the swelling gradually subsided within 1 week. Insertion of the miniplate involved flap surgery and caused a moderate level of pain (VAS = 26.7 mm) on postoperative day 7. Three weeks later, an orthodontic force of 100–200 g was applied to the exposed miniplate via an elastomeric chain or a nickel titanium coil spring. All patients could endure the discomfort and pain of subsequent orthodontic treatments.

Despite having previously undergone similar surgery, the miniplate removal procedure was still a stressful experience for our patients. The VAS score for expectation of miniplate removal was greater than that obtained at 24 hours after miniplate placement. The VAS score at 24 hours after miniplate removal was 41.3 mm. Based on the reported pain perception of patients, the insertion and removal of the miniplate was observed to cause moderate levels of pain. Therefore, it is very important that doctors inform their patients about the intensity of pain that they can expect to experience during miniplate insertion and removal. Despite the patients' fears, the intensity of the pain experienced was not severe, and the VAS score decreased to a normal value of 5 mm at 3 months after the miniplate removal operation.

The role of miniplate anchorage in orthodontic treatment is that of an adjuvant and it improves the efficiency and effectiveness of the treatment [14,15]. Orthodontists and surgeons should communicate the benefits and complications of miniplate insertion and removal to their patients to achieve satisfactory treatment outcomes. Patients are seldom asked about their expectations of orthodontic treatment that involves the use of a miniplate anchorage system. Therefore, our patients were asked to answer the following question: "How motivated are you to undergo miniplate anchorage treatment if it enhances the final outcome and efficiency of orthodontic treatment?" Remarkably, 88% of the patients agreed to undergo the miniplate operation to enhance the efficiency of orthodontic treatment. Seventy-eight percent of the patients were willing to undergo the miniplate anchorage treatment if it would reduce the duration of conventional orthodontic treatment by 6 months. On the basis of

their responses, we concluded that patients would not reject new surgical orthodontic treatments despite the pain experienced during these treatments.

Doctors should not only focus on the efficiency of a treatment, but should also be aware of the discomfort experienced by patients. Effective communication between patients and doctors can help address the concerns that a patient might have with regard to treatment-related pain. We conclude that education and effective communication can help considerably to alleviate a patient's concerns about surgical treatment. Finally, 3 months is a long time for the patients to remember the exact details of pain experienced at hours or days after specific orthodontic procedures. Thus, the corresponding VAS scores might be inaccurate, and reflect over- or underestimation of pain levels in the patients' responses to the questionnaire. In future studies, we suggest that patients should be administered the questionnaires at suitable times to assess and record more accurately the level of pain felt after treatment.

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使用金屬骨板作為骨骼性錨定之疼痛認知

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金屬骨板和骨釘已經被廣泛應用在骨折後的修復和骨切開處固定上，近來，金屬骨板系統已被用來當作牙齒矯正治療的骨骼性錨定，不過，病患仍然對於金屬骨板的手術感到憂慮。本研究選取放置於上顎當做矯正治療的骨錨定，總計 30 個金屬骨板。利用疼痛視覺類比量表（VAS；0–100 mm），來評估接受金屬骨板的手術的病患的疼痛認知。結果在置入這個固定矯正裝置的第 1 天，VAS 的平均值為 36.3 mm，而置入金屬骨板後之 24 小時的 VAS 是 58 mm。當矯正力量應用到這個金屬骨板後的 3 週，病人於吃飯與說話的 VAS 分別降到為 20 mm 與 15 mm。在手術下移除金屬骨板後的 24 小時，VAS 平均值為 41.3 mm；移除金屬骨板 3 個月後的 VAS 平均值降為 5 mm。此外，有 82% 的接受金屬骨板手術的病患，認為他們願意接受這種新形和更為有效治療的方式。

關鍵詞：金屬骨板，疼痛認知，骨骼錨定，視覺類比量表

（高雄醫誌 2010;26:603–8）

收文日期：99 年 1 月 27 日

接受刊載：99 年 4 月 21 日

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