

## Mini-plate removal in maxillofacial trauma patients during a five-year retrospective study

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**Abstract** (J Korean Assoc Oral Maxillofac Surg 2016;42:182-186)

**Objectives:** The purpose of this study was to analyze the incidence of indications for the removal of mini-plates over a five-year period in maxillofacial trauma patients.

**Materials and Methods:** The medical records of 530 patients who underwent treatment with mini-plate fixation after maxillofacial trauma were reviewed for a five-year period (May 2007 to May 2012). Patients were evaluated concerning the number of mini-plates removed, age and gender distributions, time between insertion and removal, indication for removal, and site of removal.

**Results:** The plates of 120 patients were removed (26 females and 94 males). The removal rate was 22.6%. The most frequent indication for removal was patient demand (81.7%), followed by tooth extraction (7.5%), and pain (3.3%). The most frequent removal site was the mandible (95.0%).

**Conclusion:** The number of mini-plates removed was small, and the most common indication for removal was patient demand. There is no evidence to support a recommendation for the routine removal of titanium mini-plates.

**Key words:** Fracture, Internal fixation, Trauma

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### I. Introduction

Since fixation surgery with the use of mini-plates in the oral and maxillofacial area was introduced in the 19th century, there has been an increase in the use of mini-plates<sup>1</sup>. In 1978, Champy et al.<sup>2</sup> introduced a surgical technique in which mini-plates were used in the oral and maxillofacial area, and the mini-plate gained utility for the treatment of maxillofacial trauma and orthognathic surgery. Mini-plates have commonly been composed of titanium, as it possesses a higher biocompatibility and better physical properties than other metals. The use of mini-plates has increased in recent years<sup>3</sup>. However, there have been various reports of complications, such as metal toxicity and allergy, stress shielding, metal-

losis, migration, palpability, and thermal sensitivity, caused by the use of mini-plates, and the appropriate removal of mini-plates remains controversial. Some researchers recommend removal in general<sup>4-6</sup>, while others do not recommend removal unless clinical symptoms occur<sup>7-9</sup>. Clear evidence for such a recommendation has not yet been established, and recent studies have been controversial. Studies have reported various values for the removal rate of mini-plates, ranging from 7% to 33.8%<sup>10-12</sup>.

Against this background, the present retrospective study examined the removal rate over a period of five years of mini-plates and various reasons for removal among patients who underwent open reduction and internal fixation (ORIF) due to trauma. In addition, this study investigated factors that influenced removal by additionally examining the sex and age of patients, as well as the fracture site.

### II. Materials and Methods

We received approval from the Clinical Trial Center Institutional Review Board (IRB No. CDMDIRB-1320-103) of Chosun University Dental Hospital (Gwangju, Korea). Electronic medical records (EMRs) were examined to col-

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lect information on patients who underwent ORIF with mini-plates due to trauma in the Department of Oral and Maxillofacial Surgery of the Chosun University Dental Hospital from May 2007 to May 2012. Among the trauma patients, 530 total patients underwent ORIF with the use of mini-plates. Of these, approximately 120 patients were confirmed to have had the mini-plates removed. The EMRs of the 120 patients were investigated to collect information on removal rate, reason for removal, age, sex, site of removal, and the length of time between ORIF surgery and removal of the mini-plate. The reasons for removal were classified into the following categories: cases in which the patient made a request for removal; cases in which the patient exhibited infection; cases in which the mini-plate was exposed without any symptoms of infection; cases in which there were no symptoms, but the mini-plate was exposed in the process of tooth extraction, necessitating immediate removal; cases in which the mini-plate was removed to recover an implant prosthesis; cases in which a screw was loosened; and cases in which the patient experienced pain without signs of infection.

### III. Results

Over five years, a total of 530 patients underwent ORIF

**Table 1.** Age distribution

Age (yr)	Case (n)	%
10-19	39	32.5
20-29	33	27.5
30-39	21	17.5
40-49	14	11.7
50-59	8	6.7
≥60	5	4.2
Total	120	100.0

The sum of the percentages does not equal 100% because of rounding.  
Hyun-Chun Park et al: Mini-plate removal in maxillofacial trauma patients during a five-year retrospective study. *J Korean Assoc Oral Maxillofac Surg* 2016



**Fig. 1.** Mini-plates were fixed at the right parasymphysis and left angle.

Hyun-Chun Park et al: Mini-plate removal in maxillofacial trauma patients during a five-year retrospective study. *J Korean Assoc Oral Maxillofac Surg* 2016

with mini-plates due to trauma in the oral and maxillofacial area. Younger patients with tooth buds were excluded from this study because ORIF with resorbable plate was performed in these cases. Of the total subjects, 120 patients had their mini-plates removed, indicating a removal rate of approximately 22.6%.

The 120 patients included 94 men (78.3%) and 26 women (21.7%), with an average age of approximately 29.2 years (range, 13-79 years). They included 39 patients (32.5%) aged 10 to 19 years, followed by 33 patients (27.5%) aged 20 to 29 years. As age increased, the removal rate was found to decrease. (Table 1)

According to the analysis of the fracture site (Fig. 1, 2), there were 110 cases (91.7%) in which patients had an isolated fracture on the mandibular bone. There were four cases (3.3%) of fractures on both the maxillary bone and mandibular bone, and there were three cases (2.5%) in which patients had isolated fractures on the maxillary bone. (Table 2) Among the 120 patients who had their mini-plates removed, 23 cases (19.2%) underwent removal under general anesthesia, while 97 cases (80.8%) underwent removal under local anesthesia.

According to the analysis of the reason for removal, there were 98 cases (81.7%) in which patients made a request for removal, and there were nine cases (7.5%) in which the mini-plate was exposed in the process of tooth extraction, which led to its removal. There were four cases (3.3%) in which the

**Table 2.** Fracture site in plate removal

Site	Case (n)	%
Mandible	110	91.7
Maxilla	3	2.5
Mandible and maxilla	4	3.3
Zygomaticomaxillary complex	3	2.5
Total	120	100.0

Hyun-Chun Park et al: Mini-plate removal in maxillofacial trauma patients during a five-year retrospective study. *J Korean Assoc Oral Maxillofac Surg* 2016



**Fig. 2.** Mini-plates were removed and left 3rd molar was extracted.

Hyun-Chun Park et al: Mini-plate removal in maxillofacial trauma patients during a five-year retrospective study. *J Korean Assoc Oral Maxillofac Surg* 2016

mini-plate was removed due to pain without any symptoms of infection. Lastly, there was one case (0.8%) in which the mini-plate was removed due to infection.(Table 3) The main reason for removal of the mini-plate in patients aged 10 to 19 years was patient request, including the possibility of issues with growth (32 of 98 cases) and extraction (7 of 98 cases). According to the analysis of each part that was removed in the mandibular bone, there were 45 cases (39.5%) in which only the mandibular angle was removed. There were 24 cases (21.1%) in which only the parasymphysis was removed. Lastly, there were 17 cases (14.9%) in which both the parasymphysis and the mandibular angle were removed.(Table 4)

According to the analysis of the length of time from ORIF surgery to mini-plate removal, there were 96 cases (80.0%) in which removal was performed within 12 months (Table 5), 95 cases in which removal was performed within 6 to 12 months, and one case in which removal was performed just after two months because of infection.

#### IV. Discussion

In many studies, the removal of mini-plates has remained controversial. Evidence has not yet supported a general consensus for the removal of mini-plates. Some researchers argue that an ordinary mini-plate should be removed<sup>13</sup>, whereas others maintain that mini-plates should not be removed until the appearance of clinical symptoms<sup>14</sup>. Those who oppose removal of an ordinary mini-plate argue that its biocompatibility, low incidence of complications, the risks of general anesthesia during removal, possible damage to adjacent anatomical structures, and the expense of removal<sup>15</sup>. On the contrary, researchers who favor removal argue that the mini-plate could possibly act as a foreign object with the potential to cause complications, and that mini-plates generate growth restrictions among pediatric patients<sup>16,17</sup>.

In a study by Matthew and Frame<sup>9</sup>, the removal rate of

**Table 3.** Reason for plate removal among adult trauma patients

Reason for removal	Case (n)	%
Patient's demand	98	81.7
Extraction of tooth	9	7.5
Pain	4	3.3
Prosthetic rehabilitation	3	2.5
Exposure	3	2.5
Screw loosening	2	1.7
Infection	1	0.8
Total	120	100.0

Hyun-Chun Park et al: Mini-plate removal in maxillofacial trauma patients during a five-year retrospective study. J Korean Assoc Oral Maxillofac Surg 2016

mini-plates was reported to be approximately 5% to 40%. The present study also reported a specific removal rate of 22.6%, which lies within the reported range.

A previous study recommended that pediatric patients have mini-plates removed within two to three months after fracture surgery due to the potential of growth restriction<sup>18</sup>. Additional study was conducted with pediatric patients, but it did not separately consider pediatric patients in its focus on adult patients, because the number of pediatric patients was small. With regard to age distribution, most patients in the present study were between 16 to 30 years old. Our study reported a higher removal rate among patients aged 30 or younger. This contrasts with the results of a previous study, which found that the removal rate of mini-plates increased among patients aged 30 or older<sup>14</sup>.

With regard to the length of time from ORIF surgery to mini-plate removal, most cases (80.0%) involved removal within one year. Another study also reported that the highest removal rate was found within one year<sup>14</sup>. This could be attributable to the fact that it may be easier to remove the mini-plate within one year. In particular, younger patients tend to have a higher capability for bone healing. Therefore, if removal is performed after one year, it is likely that the mini-plate would be covered with bone due to the formation of a significant bone mass, thus prompting its earlier removal.

Removal of the mini-plate from the mandible was most often performed at the mandibular angle, followed the mandib-

**Table 4.** Site of removal from the mandible in trauma patients

Site	Case (n)	%
Symphysis	7	6.1
Parasymphysis	24	21.1
Body	6	5.3
Angle	45	39.5
Symphysis and angle	8	7.0
Parasymphysis and angle	17	14.9
Body and angle	1	0.9
Subcondyle	3	2.6
Parasymphysis and subcondyle	3	2.6
Total	114	100.0

Hyun-Chun Park et al: Mini-plate removal in maxillofacial trauma patients during a five-year retrospective study. J Korean Assoc Oral Maxillofac Surg 2016

**Table 5.** Time between plate insertion and removal

Time (yr)	Case (n)	%
<1	96	80.0
1-2	17	14.2
>2	7	5.8
Total	120	100.0

Hyun-Chun Park et al: Mini-plate removal in maxillofacial trauma patients during a five-year retrospective study. J Korean Assoc Oral Maxillofac Surg 2016

ular body<sup>19</sup>. This demonstrates that fracture occurs frequently in the mandibular angle and mandibular body, where the incidence rate of complications can be high. In the present study, the removal rate at the mandibular angle was approximately 39.5%, followed by 21.1% for removal at the parasymphysis. The removal rate for both the mandibular angle and the parasymphysis was approximately 14.9%, indicating that most patients had surgery for removal at the mandibular angle or the parasymphysis only. It was also determined that most of the trauma cases occurred in the mandibular angle and parasymphysis.

The main reason for the removal of the mini-plate in the previous study was infection at the surgical site or exposure of the mini-plate<sup>14</sup>. According to this previous study, infection occurred mostly in mini-plates that were located in the anterior part of the mandibular bone or maxillary bone. Mini-plates are often located in thin submucous membrane, which results in their exposure to dentures or other traumatic environmental effects. Furthermore, according to the previous study, the anterior part of the maxillary bone is highly likely to have thin bone near the maxillary sinus, which leads to the loosening of screws, bone resorption, and the proliferation of inflammatory granulation tissue, increasing the possibility of infection<sup>10</sup>. However, even though most of the cases in the present study showed that removal was performed in the mandibular bone, there were not many cases in which the mini-plate was removed due to inflammation or exposure of the mini-plate (4.2%). Among young adults, most cases involved removal at the request of patients (81.7%), which conflicts with results of previous studies. Unexpectedly, in the mandibular angle, 7.5% of cases of mini-plate removal resulted from extraction of the mandibular third molar, which caused exposure of the mini-plate. The removal of mini-plates in the present study was significantly influenced by patient request, and such requests were believed to be based on psychological factors. Additionally, the inflammation rate attributable to mini-plates was not high in the oral and maxillofacial area. Removal of mini-plates was generally performed under local anesthesia, but mini-plates were removed under general anesthesia in approximately 19.2% of cases. There is a risk and expense associated with general anesthesia that cannot be taken lightly. As detailed above, in most cases, mini-plates were removed at the request of the patient, rather than due to complications. Consequently, the clinical necessity of mini-plate removal is still unknown, leading to potential economical and physical burden.

In the present study, there was insufficient follow-up sur-

vey after ORIF was performed due to trauma. Therefore, the removal rate was not precisely calculated, and it was difficult to accurately examine the reasons for removal. An additional limitation to this study was that removal of only part of the mini-plate, incidence rate of complications, and cases of mini-plate removal among pediatric patients were not included. As a result, further studies are needed to address these shortcomings.

## V. Conclusion

In conclusion, the removal rate in the present study was similar to that reported in a previous study. However, the removal rates due to inflammation or mini-plate exposure were not higher than those previously reported. This indicates that complications due to the presence of a mini-plate are unlikely. In addition, mini-plate removal generally occurred within one year after placement and was mostly influenced by patient psychological factors. Thus, mini-plates may not generally require removal, as various complicating factors must be considered when the mini-plate is removed.

## Conflict of Interest

No potential conflict of interest relevant to this article was reported.

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