Is Mini-Plate Removal Necessary for Oral and Maxillofacial Surgery Patients? A Five-Year Case-Control Study

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ABSTRACT

Objectives: The purpose of this study was to determine the mini-plate and screw removal rate and reasons in maxillofacial surgery patients under previous semi-rigid fixation treatment in the past five years at the main trauma center of Mashhad.

Materials and Methods: This was a census-based retrospective study. All the candidates who admitted to our department for maxillofacial plate removal due to symptomatic or infected mini-plates were included in this study. The patients' age and gender, plate removal etiologies, and the time between plate insertion and removal were analyzed.

Results: Mini-plates were inserted for 1026 patients. However, only 94 patients with a mean age of 29.4±11.1 years were candidates for plate removal. The plate removal rate was 9.16%. Infection and exposure were the most common causes of plate removal. The most prevalent removal site was the mandible (angle and body). The interval between mini-plate insertion and removal was an average of 12.9±5.6 months. It is noteworthy that the shortest lasting duration was when plate removal was secondary to pain (6.67 months) and infection (11.45 months).

Conclusion: This research showed that the routine removal of plates does not appear to be generally indicated in healthy subjects unless there is an obvious and definitive clinical indication.

Keywords: Maxillofacial Injuries; Bone Plates; Fracture Fixation

INTRODUCTION

Nowadays, rigid fixation is considered the gold standard protocol for craniomaxillofacial, orthognathic, and reconstructive surgeries [1-9]. Since 1987, with the introduction of the Champy technique, mini-plates have become popular in maxillofacial fields for semi-rigid fixation procedures [1-3,10,11]. To the best of our knowledge, the necessity for mini-plate removal is still a subject of controversy [3,6,8,11-13]. Some surgeons advocate plate removal in general, whereas
others do not suggest removal unless clinical 
symptoms manifest [1-9,11].
Some reports show various removal rates at 
different treatment centers in several 
countries across the world [1-4,6,8,11-17].
Different mini-plate removal rates (mostly 
ranging from 6% to 40%) have been reported 
after oral and maxillofacial surgeries [1-
4,6,8,11-14,17]. It should be noted that the 
controversy in plate removal is related to the 
causes and techniques of plating procedures 
as well as treatment concepts. However, there 
is no consensus on the routine removal of 
mini-plates in healthy subjects at the Iranian 
treatment centers and universities [2,3,6,12-
14].
Considering the mentioned controversies and 
insufficient information about the etiology and 
epidemiology of plate removal [18], we 
decided to accomplish a retrospective study to 
identify the trends of plate removal after oral 
and maxillofacial surgeries in healthy subjects 
at our trauma hospital.

MATERIALS AND METHODS
This study was planned as a retrospective case-
control research (ethical code: 
IR.mums.sd.REC.1394.219). This research has 
been approved by the Institutional Human 
Research and Ethics Committee of our 
department.
This census-based study evaluated the rate, 
prevalence, and etiologies of mini-plate removal 
in maxillofacial surgery patients. This study was 
conducted at the oral and maxillofacial 
department of Shahid Kamyab Trauma Hospital, 
Mashhad, Iran, which is the main trauma 
hospital in Khorasan province. Therefore, all of 
the healthy candidates for maxillofacial plate 
removal due to symptomatic, sensitive, or 
infected mini-plates and screws related to 
previous rigid fixation procedures, who 
admitted to our maxillofacial surgery 
department from 2013 to 2018, were included 
in this study.
The authors did not include patients who 
underwent maxillofacial plate insertion or plate 
removal surgeries at other less equipped 
departments to eliminate confounding factors.

Individuals with incomplete medical records or 
repetitive information were excluded from the 
research. The authors excluded patients who 
had risk factors such as smoking, diabetes, and 
immunosuppression, to eliminate confounding 
factors.
Ethical considerations were taken into account 
throughout the study, and the patients' names 
and medical information remained confidential. 
According to the admission office information 
and considering the above-mentioned inclusion 
and exclusion criteria, 1026 healthy subjects 
that underwent mini-plate insertion were 
analyzed in this research. However, only 94 
cases were candidates for plate removal 
surgeries. Data collection tools included 
observer sampling and census sampling of medical 
records, documents, PACS (picture archiving 
and communicating system), and archived 
radiology reports. All demographic data (e.g. 
patients' age and gender) were collected and 
registered. The patients’ medical records were 
examined to extract information related to the 
date and cause of plate insertion for semi-rigid 
fixation (the primary surgery), as well as the 
date, anatomic site, and cause of plate removal 
(the secondary surgery). In addition, the method 
of removal (local versus general anesthesia) and 
the lasting duration of the plate (the period 
between insertion and removal) were evaluated 
in this study.
We used descriptive statistics, such as 
distribution and continuity [means and 
standard deviations (SD)], for representing the 
data collected.

RESULTS
During the past five years, 1026 healthy 
subjects underwent procedures involving 
mini-plate insertion. However, only 94 cases 
with an average age of 29.6±11.1 years 
ranging from 10 to 63 years] were candidates 
for plate removal surgeries. Therefore, in this 
research, the plate removal rate for healthy 
subjects was 9.16%.
These subjects included 37 females and 57 
males. Plate removal was 1.54 times more 
frequent among males. In these 94 cases of 
plate removal, the most common reason for
the primary surgery involving plate insertion was trauma (57 cases) followed by reconstruction of pathological lesions (18 cases) and orthognathic surgeries (7 cases). The most frequent causes of plate removal procedures were plate site infection (33 cases) and plate exposure (22 cases).

The mandible was the most prevalent maxillofacial site for plate removal in 56 patients followed by the maxilla (25 subjects) and the zygomatico-orbital area (13 cases). As shown in Table 1, the highest prevalence of plate removal in the mandible was related to the mandibular angle and body, respectively. Table 2 shows that the most common causes of plate removal in the mandible were infection, a necessity for wisdom tooth surgery, and plate exposure, respectively. In the maxilla, plate exposure and infection were noted as the most common reasons. Plate removal in the zygomatic and orbital areas was mostly due to plate palpability (Table 2). It should be noted that 83 cases of plate removal surgeries were performed under general anesthesia and 11 ones under local anesthesia. The interval between mini-plate insertion and removal (the lasting duration) was an average of 12.9±5.6 months. It is noteworthy that the shortest lasting duration of the plate was when plate removal was secondary to pain (6.67 months) and infection (11.45 months).

**DISCUSSION**

Currently, there is no agreement or universal guideline for the routine and definitive removal of titanium mini-plates [2,3,6,12-14,17].

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**Table 1.** The frequency of plate removal in different maxillofacial anatomic sites

<table>
<thead>
<tr>
<th>Maxillofacial anatomic sites</th>
<th>Number</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Mandible</strong> (N=56)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mandibular Angle</td>
<td>25</td>
<td>26.6</td>
</tr>
<tr>
<td>Mandibular Body</td>
<td>13</td>
<td>13.8</td>
</tr>
<tr>
<td>Mandibular Para-symphysis</td>
<td>6</td>
<td>6.4</td>
</tr>
<tr>
<td>Mandibular symphysis</td>
<td>12</td>
<td>12.8</td>
</tr>
<tr>
<td><strong>Maxilla</strong> (N=25)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Piriform rim</td>
<td>12</td>
<td>12.8</td>
</tr>
<tr>
<td>Anterolateral wall of the maxillary sinus and buttress</td>
<td>13</td>
<td>13.8</td>
</tr>
<tr>
<td><strong>Zygoma &amp; Orbit</strong> (N=13)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Inferior orbital rim</td>
<td>4</td>
<td>4.3</td>
</tr>
<tr>
<td>Lateral orbital rim</td>
<td>9</td>
<td>9.6</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>94</td>
<td>100.0</td>
</tr>
</tbody>
</table>

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**Table 2.** The frequency of and reasons for plate removal in different maxillofacial anatomic sites

<table>
<thead>
<tr>
<th>Reasons for mini-plate removal surgeries (N)</th>
<th>Infected</th>
<th>Plate Exposure</th>
<th>Third molar</th>
<th>Plate palpability</th>
<th>Growth disturbance</th>
<th>Plate fracture</th>
<th>Pain</th>
<th>Patient’s Desire</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Mandible</strong></td>
<td>21</td>
<td>9</td>
<td>14</td>
<td>0</td>
<td>7</td>
<td>3</td>
<td>1</td>
<td>1</td>
<td>56</td>
</tr>
<tr>
<td><strong>Maxilla</strong></td>
<td>11</td>
<td>13</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>25</td>
</tr>
<tr>
<td><strong>Zygoma and Orbit</strong></td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>9</td>
<td>0</td>
<td>0</td>
<td>2</td>
<td>1</td>
<td>13</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>33</td>
<td>22</td>
<td>14</td>
<td>9</td>
<td>7</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>94</td>
</tr>
</tbody>
</table>
Since unreasonable second surgery for plate removal may lead to psychological, financial, and social costs for the people and the society [18,19], it is therefore very important to identify the etiology and epidemiology of maxillofacial plate removals [5,9,18].

This research demonstrates a 9.16% removal rate for titanium mini-plates. Considered a low rate, this was close to the removal rates reported in studies by Little et al (10.4%) [14], Haraji et al (10.6%) [18], Rallis et al (9.6%) [6], and Mosbah et al (10%) [1]. Thorén et al [9] suppose that the diversity of plate removal rates among different studies might be due to the difference in the concepts of mini-plate removal as some would perform removal after subjective symptoms manifest while others would wait until the manifestation of the objective symptoms. It should be noted that plate removal does not necessarily indicate treatment failure [3,6,8,11-13]. The average age of patients who underwent plate removal surgeries during our research was close to the averages reported in recent studies [2,3,12]. Plate removal was more frequent in males [1-3,6,8,11-13].

The highest rates of plate removal were related to patients undergoing primary semi-rigid fixation due to trauma followed by reconstruction of pathological lesions and orthognathic surgeries. This descending order was in line with studies by Mosbah et al [1], Bhatt et al [5], and Bhatt and Langford [7]. Plate site infection and exposure due to wound dehiscence were considered two important causes of removals in the present study. This finding is in agreement with the results of most previous studies [1,2,5,6,13,14,18,20]. Plate removal due to growth disturbances in pediatric patients in the current study was in agreement with studies by Sameirad et al [19], Pan and Patil [12], and Bakathir et al [21]. The most common maxillofacial sites for plate removal were the mandible followed by the maxilla, zygoma, and orbit; this descending order can also be seen in a study by Park et al [3]. Furthermore, the highest rate of plate removal in the mandible was in line with the results of several previous studies [1-5,9,11-14,20,21].

The present study demonstrates that plate removal was most frequently performed at the mandibular angle, followed by the mandibular body, the anterolateral wall of the maxillary sinus, and the zygomatic buttress. This result was in agreement with most previous studies [2-6,9,12,15].

As stated by Rallis et al [6], plate exposure and infection in the mandible most frequently occur in the body, angle, and external oblique ridge, whereas in the maxilla, the most susceptible site is the anterolateral wall of the maxillary sinus. The anterior wall of the maxillary sinus is composed of a thin bone, which may cause screw entrance into the maxillary sinus mucosa followed by inflammation, granulation tissue formation, infection, bone resorption, and screw loosening [6]. In addition, in the body and angle of the mandible, mini-plates are directly placed on the mucoperiosteum, bearing recurrent traumatic forces, such as occlusion, chewing, and denture contact. This can explain the higher rates of infection and plate exposure in these regions.

Pathological problems, such as pericoronitis and infection, may occur after plate insertion in the mandibular angle, especially if the third molar is exposed to the osteotomy or fracture line. In this case, there is a significantly higher chance for infection and periodontal or mucogingival complications, leading to wound dehiscence and plate exposure and infection [22]. According to a study by Islamoglu et al [2], the main causes of plate removal are plate infection and exposure in the mandible and plate sensitivity and palpability in the zygoma [2]. This result is also in agreement with our study.

This research demonstrated a mean of 12.9+5.6 months for the lasting duration of the plate (the interval between plate insertion and removal). A higher prevalence of plate removal within the first postoperative year has also been detected in most previous studies [1,3-6,12-14,20,21]. It is noteworthy that the shortest lasting
duration of the plate was when plate removal was secondary to pain (6.67 months) and infection (11.45 months). Taking into account that pain and infection are highly subjective symptoms and are noticed sooner by patients, compared to plate fracture or screw loosening, as expected, plate removal was performed sooner in these circumstances; the research by Rallis et al [6] confirms this finding. Our study had some limitations. This was a retrospective case-control study; therefore, the patients were not checked through a regular follow-up. Moreover, the systemic conditions of patients, such as smoking, alcohol consumption, immunosuppression, or diabetes, which are considered as risk factors for plate infection and removal [3,6], were not included in this research to eliminate confounding factors.

CONCLUSION
According to the results of the present study, the plate removal rate was low (9.16%); therefore, this retrospective analysis demonstrated that the routine removal of plates does not appear to be generally indicated in healthy subjects unless there is an obvious and definitive clinical indication. Moreover, in this research, the most common indications for plate removal were infection and plate exposure.

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CONFLICT OF INTEREST STATEMENT
None declared.

REFERENCES


