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

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A B S T R A C T

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

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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 observation 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).

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

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

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].

Since unreasonable second surgery for plate removal may lead to psychological, financial,

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

		Reasons for mini-plate removal surgeries (N)								
		Infection	Plate Exposure	Third molar	Plate palpabilit	Growth disturban	Plate fracture	Pain	Patient's Desire	Total
Maxillofacial anatomic sites	**Mandible**	21	9	14	0	7	3	1	1	56
	Maxilla	11	13	0	0	0	1	0	0	25
	Zygoma and Orbit	1	0	0	9	0	0	2	1	13
	Total	33	22	14	9	7	4	3	2	94

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

1. Mosbah MR, Oloyede D, Koppel DA, Moos KF, Stenhouse D. Miniplate removal in trauma and orthognathic surgery—a retrospective study. Int J Oral Maxillofac Surg. 2003 Apr;32(2):148-51.
2. Islamoglu K, Coskunfirat OK, Tetik G, Ozgentas HE. Complications and removal rates of miniplates and screws used for maxillofacial fractures. Ann Plast Surg. 2002 Mar;48(3):265-8.
3. Park HC, Kim SG, Oh JS, You JS, Kim WG. Mini-plate removal in maxillofacial trauma patients during a five-year retrospective study. J Korean Assoc Oral Maxillofac Surg. 2016 Aug;42(4):182-6.
4. Thorén H, Snäll J, Kormi E, Lindqvist C, Suominen-Taipale L, Törnwall J. Symptomatic plate removal after treatment of facial fractures. J Craniomaxillofac Surg. 2010 Oct;38(7):505-10.
5. Bhatt V, Chhabra P, Dover MS. Removal of miniplates in maxillofacial surgery: A follow-up study. J Oral Maxillofac Surg. 2005 Jun;63(6):756-60.
6. Rallis G, Mourouzis C, Papakosta V, Papanastasiou G, Zachariades N. Reasons for miniplate removal following maxillofacial trauma: a 4-year study. J Craniomaxillofac Surg. 2006 Oct;34(7):435-9.
7. Bhatt V, Langford RJ. Removal of miniplates in maxillofacial surgery: University Hospital Birmingham experience. J Oral Maxillofac Surg. 2003 May;61(5):553-6.
8. Rauso R, Tartaro G, Stea S, Tozzi U, Biondi P. Plates removal in orthognathic surgery and facial fractures: When and why. J Craniofac Surg. 2011 Jan;22(1):252-4.
9. Thorén H, Snäll J, Hallermann W, Kormi E, Törnwall J. Policy of routine titanium miniplate removal after maxillofacial trauma. J Oral Maxillofac Surg. 2008 Sep;66(9):1901-4.
10. Champy M, Loddé JP, Schmitt R, Jaeger JH, Muster D. Mandibular osteosynthesis by miniature screwed plates via a buccal approach. J Maxillofac Surg. 1978 Feb;6(1):14-21.
11. Kent SJW, Al-Izzi T, Herbert C, Ryan M. A Retrospective Review of Metal Plate Removal in an Oral and Maxillofacial Surgery Department. Int J Dent Sci Res. 2017;5(1):5-8.
12. Pan Z, Patil PM. Titanium osteosynthesis hardware in maxillofacial trauma surgery: to remove or remain? A retrospective study. Eur J Trauma Emerg Surg. 2014 Oct;40(5):587-91.
13. Rana ZA, Khoso NA, Siddiqi KM, Arshad O, Farooq MU. The incidence and indications for removal of osteosynthesis devices in adult Trauma patients: A retrospective study. Ann Pak Inst Med Sci. 2012;8(3):184-7.
14. Little M, Langford RJ, Bhanji A, Farr D. Plate removal following orthognathic surgery. J Craniomaxillofac Surg. 2015 Nov;43(9):1705-9.
15. Manor Y, Chaushu G, Taicher S. Risk factors contributing to symptomatic plate removal in orthognathic surgery patients. J Oral Maxillofac Surg. 1999 Jun;57(6):679-82.
16. Matthew IR, Frame JW. Policy of consultant oral and maxillofacial surgeons towards

removal of miniplate components after jaw fracture fixation: pilot study. Br J Oral Maxillofac Surg. 1999 Apr;37(2):110-2.
17. Nagase DY, Courtemanche DJ, Peters DA. Plate removal in traumatic facial fractures: 13-year practice review. Ann Plast Surg. 2005 Dec;55(6):608-11.
18. Haraji A, Motamedi MH, Moharamnejad N. Causes and incidence of miniplate removal following Le Fort I osteotomy. Eplasty. 2009 Oct 12;9:e45.
19. Samieirad S, Aboutorabzade MR, Tohidi E, Shaban B, Khalife H, Hashemipour MA, et al. Maxillofacial fracture epidemiology and treatment plans in the Northeast of Iran: A retrospective study. Med Oral Patol Oral Cir Bucal. 2017 Sep 1;22(5):e616-e624.
20. Kuhlefelt M, Laine P, Suominen-Taipale L, Ingman T, Lindqvist C, Thorén H. Risk factors contributing to symptomatic miniplate removal: a retrospective study of 153 bilateral sagittal split osteotomy patients. Int J Oral Maxillofac Surg. 2010 May;39(5):430-5.
21. Bakathir AA, Margasahayam MV, Al-Ismaily MI. Removal of bone plates in patients with maxillofacial trauma: a retrospective study. Oral Surg Oral Med Oral Pathol Oral Radiol Endod. 2008 May;105(5):e32-7.
22. Yamamoto K, Matsusue Y, Horita S, Murakami K, Sugiura T, Kirita T. Routine removal of the plate after surgical treatment for mandibular angle fracture with a third molar in relation to the fracture line. Ann Maxillofac Surg. 2015 Jan-Jun;5(1):77-81.