Open Access

Original Article

Reasons for Removal of Titanium Hardware in Postoperative Patients with Maxillofacial Trauma

Zahid Dildar, Muhammad Ishaq, Ali Akhtar Khan, Shafi Ullah Khan, Syed Junaid Hussain Bukhari, Tariq Mahmood

Department of Maxillofacial Surgery, Armed Forces Institute of Dentistry/National University of Medical Sciences (NUMS) Rawalpindi Pakistan

ABSTRACT

Objective: To determine the reasons for removing titanium hardware (mini plates, microplates, and titanium screws) in postoperative patients with maxillofacial trauma.

Study Design: Prospective longitudinal study.

Place and Duration of Study: Armed Forces Institute of Dentistry Rawalpindi, Pakistan from Mar to Dec 2023.

Methodology: A total number of Fifty-one (n=51) patients reported to the Oral Surgery Department of the Armed Forces Institute of Dentistry for hardware removal previously treated with maxillofacial trauma. After following inclusion and exclusion criteria, consecutive sampling was performed. Reasons for hardware removal were evaluated and recorded.

Results: Out of a total of fifty-one individuals, 41(80.3%) were male and 10(19.7%) were females. Of 51 patients, 18(35.2%) reported the complaint of pus discharge as their main reason for seeking expert opinion. In 24(47%) patients, elective hardware removal was performed due to the patient's demands. Meanwhile, 4(7.8%) patients reported the chief complaint of experiencing pain and unpleasant sensations. Hardware palpability was another factor reported by 5(9.8%) of the patients for hardware removal.

Conclusion: The patient's request and infections were the leading causes of the plates and screws removal. The plate removal usually took place 6 to 12 months after initial surgery, and the mandible was the most often region from where these mini plates and screws were removed.

Keywords: Maxillofacial Trauma, Reasons for hardware removal, Titanium hardware.

How to Cite This Article: *Dildar Z, Ishaq M, Khan AA, Khan SU, Bukhari SJH, Mahmood T. Reasons for Removal of Titanium Hardware in Postoperative Patients with Maxillofacial Trauma. Pak Armed Forces Med J 2025; 75(1): 108-111. DOI: https://doi.org/10.51253/pafmj.v75i1.11416*

INTRODUCTION

The open reduction and internal fixation (ORIF) technique is mainly used nowadays to manage fractures in the oral and maxillofacial skeletons.[1] Miniplates, microplates, reconstruction plates, and titanium screws are commonly used for fixation of maxillofacial fractures.[2,3] In comparison to other metals, titanium and its alloy offer the highest levels of biocompatibility, good ductility, tensile strength, nontoxicity, and corrosion resistance. These properties of titanium are due to the formation of an oxide layer at the surface of the metal.[4] The plates and screws used in the maxillofacial region have also changed from being made of thick, less compatible stainless steel or cobalt-chromium to being made of thinner, more flexible, and biocompatible titanium and its alloys.[2] The outcome of oral and maxillofacial surgical procedures depends heavily on bone repair and bone fixation systems. Fundamentally, two types of procedures deal with this area, i.e., orthognathic surgery and maxillofacial trauma.[5] Maxillofacial bone fractures are frequently caused by violence and road traffic accidents.[6] To properly treat craniofacial injuries, the facial skeleton, as well as the surrounding soft tissue envelope, must be both functionally and aesthetically restored. The development of open reduction and rigid internal fixation techniques, however, made it possible for oral surgeons to reconstruct the facial skeleton after trauma.[7] Today, the majority of surgical units throughout the world only remove mini plates when clinically necessary rather than after bony union.[8] Frequently, these issues necessitate additional surgeries to remove the titanium devices. In the presence of this hardware, secondary reconstructive or corrective surgeries such as bone grafting and osteotomies may be affected. At first, it was advised to remove this gear three months after insertion.[9] Resorbable plating systems have the benefit of not requiring a second surgery because they do not require subsequent removal like traditional titanium plating systems do.[10] For more than 20 years, mandibular fractures have been internally rigidly fixed with titanium plates. Numerous benefits, including biocompatibility, stiffness, ease of application, and a low incidence of reported problems, have produced consistent outcomes.[5] Risk factors that can play an important role in deciding the fate of hardware include smoking; therefore, patients having hardware in the maxillofacial region should avoid

Correspondence: Dr Zahid Dildar, Department of Maxillofacial Surgery, Armed Forces Institute of Dentistry, Rawalpindi Pakistan

Received: 11 Jan 2024; revision received: 19 Mar 2024; accepted: 25 Mar 2024

smoking.[5] Regular follow-up for the patients who undergo open reduction and internal fixation is necessary in order to detect any complication associated with hardware. The purpose of this study is to determine the causes for the removal of titanium hardware, including mini plates, microplates, and screws, in postoperative patients presenting in the oral surgery department with oral and maxillofacial trauma.

METHODOLOGY

The study was conducted at Oral Surgery Department of the Armed Forces Institute of Dentistry Rawalpindi, Pakistan, from March and December 2023, after approval from Ethical Committee of the Armed Forces Institute of Dentistry Rawalpindi, Pakistan, (Ethical approval letter Ref No:918/Trg dated 13 May 2020). The sample size was calculated using the WHO sample size calculator, with the prevalence of postoperative complications at 2.5%.[11]

Inclusion Criteria: Patients aged 18 years, of either gender, had undergone open reduction and internal fixation of their fractures for which titanium hardware was used for stabilization of fracture segments. The availability of computed tomographic images or radiographs before and after surgery was also checked prior to selecting the patients for the current study.

Exclusion Criteria: Patients with maxillofacial trauma for which either open reduction and internal fixation were not made, or titanium hardware was not used for the said purpose were excluded from the study. Individuals having dentoalveolar fractures, atrophic mandibular fractures, pathological fractures, malunion, and nonunion were also not included in the study. Patients whose fracture reduction and fixation were postponed for more than one month and orthognathic surgery patients were not considered in data collection.

Patients aged 18 years or above reported to the Oral and Maxillofacial Surgery Department Armed Forces Institute of Dentistry Rawalpindi. Consecutive sampling was performed. In addition, written informed consent was taken from patients and their parents. The demographic data of the patients, such as age, sex, the type of fracture, and the location of the fracture, were taken after obtaining informed consent. The kind of trauma (car crash, interpersonal violence, fall, etc.) and the kind of complication (infection, hardware exposure, pain, screw loosening, etc.) were noted. The reasons for removal can be, on patient request, growth/reconstructive facilitation, plates removed in youngsters during follow-up reconstructive procedures, tooth extraction, prosthodontic interference, when plates prevented the implantation of dental implants, or the creation of detachable dentures .[12]

The data was collected, analyzed, and entered in Statistical Package for Social Sciences (SPSS) version 23.0. For quantitative data, Mean±SD and for qualitative data, frequency and percentage were calculated.

RESULTS

Out of total 41(80.3%) were male and 10(19.7%) were females.Similarly, for age distribution, 12 patients (23.5%) were aged 18-25 years, 27 patients (52.9%) had aged between 26-40 years, and the rest 12(23.9%) had aged> 41 years. Regarding the history of trauma, road traffic accidents (RTA), 45(88.2%) and 6(11.6%) had a history of falls. Regarding the anatomical position, 16(31.3%) had fractures of the symphysis and para symphysis of the mandible, 15(29.4%) had the body of mandible fracture, and 12(23.5%) had angle fractures. In comparison, eight patients (15.6%) had fractures of the zygomaticomaxillary complex. The anatomical location of hardware removal is shown in Table-I.

Table-I: Anatomical Location of Hardware Removal (n=51)

Serial No	Location	n(%)
1	Symphysis/parasymphysis(mandible)	16(31.3%)
2	Body(mandible)	15(29.4%)
3	Angle(mandible)	12(23.5%)
4	Zygomaticomaxillary Complex	8(15.6%)
	Total	51(100%)

A higher number of patients, 26(28.5%)—had their hardware removed within 1 year of initial surgery. The time duration of hardware removal after initial surgery is shown in Table-II. For types of hardware removal, 29(56.8%) had mini plates, 17(33.3%) had microplate removal, and 5(9.8%) had titanium screw removal. The Figure shows the types of hardware removed and their percentages. Out of a total of 51 patients, 18(35.20%) reported pus discharge as their primary complaint. In 24(47%) of patients, elective hardware removal was performed due to patient demand.

Meanwhile, 4(7.80%) reported experiencing pain and unpleasant sensations. Hardware palpability was another factor reported by 5(9.80%) of the patients for hardware removal. The majority of the patients,

24(47%), had hardware removal due to their demand. Reasons for hardware removal are shown in Table-III).

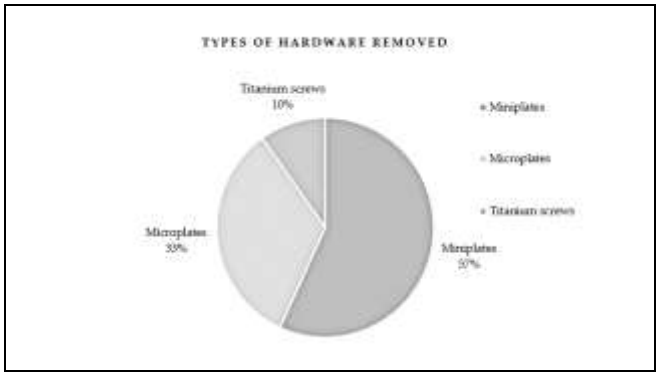

Figure: Types of Hardware Removal (n=51)

Table-II: Duration of Hardware Removal (n=51)

Serial No.	Duration	n (%)
1	8 months	13(25.40%)
2	1 year	26(50.98%)
3	2 year	12(23.50%)
	Total	51(100%)

Table III: Reasons for Hardware Removal (n=51)

Serial No.	Reasons	n (%)
1	Elective removal	24(47.0%)
2	Infection	18(35.2%)
3	Pain	4(7.8%)
4	Palpability	5(9.8%)
	Total	51(100%)

DISCUSSION

This study was carried out on 51 patients, out of which 41 were male. A study conducted by Jaber *et al*., in 2023 also showed a majority of male patients with a male-to-female ratio of 4 1.[13] In our study, 24 patients (47%) had hardware removal due to patients' will or demand. These results are consistent with a study conducted by Mushtaq *et al*., in 2019 and Sukegwa *et al*., in 2020, in which they concluded that the majority of the hardware removed was due to patient request and was not associated with any significant complication.[14,15] Our study concluded that the majority of the patients presented for hardware removal from the mandible, which is consistent with a study conducted by Aramanadka *et al*., in 2021.[3] The present study concluded that 9.8% of the patients had palpable hardware, which is similar to the results of a study conducted by Harsha Gorrela in 2019.[16] The Present study found that 4(7.8%) of patients experience plate removal due to pain and unpleasant sensations. A study conducted by Aramanadka *et al*. 2021 showed similar results.[3] The present study found that 18(35.2%) had plate removal due to infection/pus discharge, favoring the study conducted by Pan *et al*., in which they found that infection was the leading cause of hardware removal in presenting individuals.[17] The Present study found that more than 50% of plate removal was from the mandible area, which favors the study conducted by Capucha *et al*., in 2022 where the majority of the plate removal was from the mandibular area.[18] According to this study, the majority of hardware was removed within two years of initial surgery, which matches the study conducted by Reddy *et al*., in 2021.[1] In this study majority of the hardware removed was titanium mini plates and screws, which is in accordance with a study conducted by Sukegwa *et al*., in 2020.[14] This study concluded that the majority of the hardware was removed between 8 months to 2 years. These results are similar to those of the study conducted by Aramanadka *et al*., 2021, in which a significant number of patients reported hardware removal between 6 months and 2 years of initial surgery.[3] This study reached the conclusion that the majority of the patients who presented for hardware removal suffered from craniofacial trauma, for which open reduction and internal fixation were done in order to reconstruct the maxillofacial skeleton. These findings are similar to those of the study conducted by Piombino *et al*., in 2023, in which they found that the reason for ORIF in these patients was RTA in the majority of the cases.[5] Patients should be counseled to visit for subsequent follow-up and avoid smoking, which is a risk factor for hardware removal. Resorbable mini plates can be used wherever possible in order to avoid additional surgery, which can also reduce the hospital stay of the patient, which will be cost-effective both for the patients and the hospitals.

LIMITATIONS OF STUDY

There are some limitations of this study, including small sample size, observational nature of the study, exclusion of patients with normal results, no control group, and no correlation with risk factors were studied.

CONCLUSION

Our investigations highlight the reasons for removing plates when hardware causes various complications like pain, infection, and physical discomfort/palpability. The patient demand and infections were the leading causes of the removal of the plates. Plate removal usually took place after a period of 6 to 12 months of initial surgery, and the mandible was the most common region for hardware removal.

Conflict of Interest: None.

Funding Source: None.

Authors' Contribution

Following authors have made substantial contributions to the manuscript as under:

ZD & MI: Conception, study design, drafting the manuscript, approval of the final version to be published.

AAK & SUK: Data acquisition, data analysis, data interpretation, critical review, approval of the final version to be published.

SJHB & TM: Conception, data acquisition, drafting the manuscript, approval of the final version to be published.

Authors agree to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

REFERENCES

1. Reddy PA, PU AW, Jagadish V. Incidence of infected hardware removal in oral and maxillofacial region. J Contemp Issues Bus Gov 2021; 27(2): 2544. https://doi.org/10.47750/cibg.2021.27.02.263
2. Kumar MAS, Marimuthu M, Duraisamy R. Osteosynthetic Materials Used in Open Reduction and Internal Fixation of Facial Fractures in University Hospital Setting-A Retrospective Study. Indian J Forensic Med Toxicol 2020; 14(4): 5119–5125. https://doi.org/10.37506/ijfmt.v14i4.12432
3. Aramanadka C, Kamath AT, Srikanth G, Pai D, Singla N, Daundiyal S, et al. Hardware Removal in Maxillofacial Trauma: A Retrospective Study. Sci World J 2021: 9947350. https://doi.org/10.1155/2021/9947350
4. Riviş M, Roi C, Roi A, Nica D, Văleanu A, Rusu LC, et al. The Implications of Titanium Alloys Applied in Maxillofacial Osteosynthesis. Appl Sci 2020; 10(9): 3203. https://doi.org/10.3390/app10093203
5. Piombino P, Sani L, Sandu G, Carraturo E, De Riu G, Vaira LA, et al. Titanium Internal Fixator Removal in Maxillofacial Surgery: Is It Necessary? A Systematic Review and Meta-Analysis. J Craniofac Surg 2023; 34(1): 145–152. https://doi.org/10.1097/SCS.0000000000009006
6. Halim M, Khattak YR, Khan A. Common Nerve Injuries In Oral And Maxillofacial Trauma: A Cross-Sectional Study At Khyber College Of Dentistry Peshawar. J Khyber Coll Dentisrty 2018; 8(02): 7–11. https://doi.org/10.33279/jkcd.v8i02.424
7. Albert D, Muthusekhar M, Selvarasu K. Miniplate Removal Post-Open Reduction Internal Fixation: A Retrospective Analysis. J Contemp Issues Bus Gov 2021; 27(2): 2944. https://doi.org/10.47750/cibg.2021.27.02.302
8. Daniels JS, Albakry I, Braimah RO, Samara MI. Is the Routine Removal of Titanium Plates and Screws Following Miniplate Osteosynthesis of Maxillofacial Bone Fractures Justified? A Fifteen-Year Experience in a Maxillofacial Centre, Saudi Arabia. Craniomaxillofacial Trauma Reconstr Open 2021; 6: 247275122110652. https://doi.org/10.1177/24727512211065268
9. Hernandez Rosa J, Villanueva NL, Sanati-Mehrizy P, Factor SH, Taub PJ. Review of Maxillofacial Hardware Complications and Indications for Salvage. Craniomaxillofacial Trauma Reconstr 2016; 9(2): 134–140. https://doi.org/10.1055/s-0035-1570074
10. Dong QN, Kanno T. Bioresorbable Bone Fixation Devices for Oral and Maxillofacial Surgery. In: Choi AH, Ben-Nissan B, editors. Innovative Bioceramics in Translational Medicine II: Surgical Applications. Singapore: Springer; 2022. https://doi.org/10.1007/978-981-16-7439-6_3
11. Çimen E, Cambazoğlu M, Önder ME. A Comparison of Titanium and Resorbable Miniplate Systems Using Finite Element Analyses with the Orthotropic Mandibular Model in Condyle Fracture. Selcuk Dent J 2021; 8(3): 713–720. https://doi.org/10.15311/selcukdentj.780549
12. Tino T, Pinto Ferreira BS, Ribeiro De Oliveira AR, De-Oliveira Melo LA, CorrêaDe-Faria PA, Neves D, et al. Epidemiology of Maxillofacial Trauma in a Brazilian Emergency Hospital: A Retrospective Study. J Surg Clin Dent 2022; 26(1): 356. http://www.mastereditora.com.br/jscd2358-0356
13. Jaber M, Abouseif N, Ibrahim N, Hassan M, El-Ameen AM. Reasons for Removal of Miniplates Used in Fixation of Maxillofacial Bone Fractures: Systematic Review and Meta-Analysis. Appl Sci 2023; 13(21): 11899. https://doi.org/10.3390/app132111899
14. Sukegawa S, Masui M, Sukegawa-Takahashi Y, Nakano K, Takabatake K, Kawai H, et al. Maxillofacial Trauma Surgery Patients With Titanium Osteosynthesis Miniplates: Remove or Not? J Craniofac Surg 2020; 31(5): 1338–1342. https://doi.org/10.1097/SCS.0000000000006352
15. Mushtaq M, Shah K, Khattak YR, Khan T, Ashraf N. Removal of titanium plates in post-operativepatients with maxillofacial traumaa five years retrospective study. J Khyber Coll Dentisrty 2019; 9(01): 40–43. https://doi.org/10.33279/jkcd.v9i01.336
16. Gorrela H. Policy towards Removal of Mini Plates in Maxillofacial Trauma –A Follow up Study of 234 Patients. J Surg Proce Case Rep 2019; 1-6. https://doi.org/10.17303/jspcr.2019.1.102
17. Pan Z, Patil PM. Titanium osteosynthesis hardware in maxillofacial trauma surgery: to remove or remain? A retrospective study. Eur J Trauma Emerg Surg 2014; 40(5): 587–591. https://doi.org/10.1007/s00068-013-0348-5
18. Capucha T, Shilo D, Abdalla-Aslan R, Blanc O, Ginini JG, Semel G, et al. Is Open Reduction Internal Fixation Using Titanium Plates in the Mandible as Successful as We Think? J Craniofac Surg 2022; 33(4): 1032–1036. https://doi.org/10.1097/SCS.0000000000008258