Original Investigation

Postoperative Maxillomandibular Fixation After Open Reduction of Mandible Fractures

Masoud Saman, MD; Sameep Kadakia, MD; Yadranko Ducic, MD

IMPORTANCE Patients are placed in maxillomandibular fixation (MMF) to restore premorbid occlusion prior to open reduction–internal fixation (ORIF) of mandibular fractures. Maintaining MMF for these patients for several weeks postoperatively is a widely accepted dictum.

OBJECTIVE We compare postoperative ORIF outcomes in dentate patients with noncomminuted symphyseal, parasymphyseal, or angle fractures of the mandible between those who underwent postoperative MMF and those who did not.

DESIGN, SETTING, AND PARTICIPANTS Retrospective review of medical records for 311 patients with 413 mandibular fractures treated at a level 1 public trauma center in the Fort Worth, Texas, metropolitan area. All patients were treated from August 1997 to August 2012 and had a minimum follow-up of 6 weeks.

INTERVENTIONS Of the 413 symphyseal, parasymphyseal, and angle fractures, 78, 63, and 83 patients were treated with postoperative MMF respectively. The group without postoperative MMF included 56 symphyseal fractures, 49 parasymphyseal fractures, and 84 angle fractures.

MAIN OUTCOMES AND MEASURES Rates of wound dehiscence, infection, plate removal, nonunion, malunion, and malocclusion were compared.

RESULTS Using an unpaired *t* test and α value of .05 for significance, the difference between the 2 groups' outcomes was not statistically significant for any of the complications evaluated. In the groups with vs without postoperative MMF, the mean numbers of complications were as follows: wound dehiscence, 4.7 vs 2.5 (95% CI, −1.7 to 6.0) (P = .16); infection, 6.7 vs 4.0 (95% CI, −1.7 to 7.0) (P = .14); plate removal, 2.3 vs 2.5 (95% CI, −7.9 to 7.6) (P = .94); nonunion, 1.0 vs 0.5 (95% CI, −2.2 to 3.2) (P = .59); malunion, 0.7 vs 1.0 (95% CI, −3.1 to 2.4) (P = .72); and malocclusion, 1.3 vs 1.0 (95% CI, −4.0 to 4.7) (P = .82).

CONCLUSIONS AND RELEVANCE The surgical dictum of maintaining postoperative MMF for all trauma patients after ORIF of the mandible may not be of advantage in the treatment of dentate patients with noncomminuted symphyseal, parasymphyseal, or angle fractures.

LEVEL OF EVIDENCE 3.

Author Affiliations: Otolaryngology and Facial Plastic Surgery Associates, Fort Worth, Texas (Saman, Ducic); New York Eye and Ear Infirmary, Mount Sinai Health System, New York (Kadakia).

Corresponding Author: Yadranko Ducic, MD, Otolaryngology and Facial Plastic Surgery Associates, 923 Pennsylvania Ave, Ste 100, Fort Worth, TX 76104 (yducic@sbcglobal.net).

JAMA Facial Plast Surg. 2014;16(6):410-413. doi:10.1001/jamafacial.2014.543
Published online September 18, 2014.

The state of mandibular fracture treatment has undergone constant evolution since the first writings on the topic found in Ancient Egypt, nearly 3 millennia ago. However, as reported by Spina and Marciani,[1] Guglielmo Salicetti was the first to introduce the importance of maxillomandibular fixation (MMF), in 1492, whereby the surgeon would "tie the teeth of the uninjured jaw to the teeth of the injured jaw"[1(p85)] to restore premorbid occlusion in patients with mandible fractures. This technique was later popularized by Gilmer[2] in 1887. Buck[3] was the first to describe open reduction-internal fixation (ORIF) of the mandible using iron loops, a technique that Gilmer[4] and Luhr[5] also adopted. The currently used plating concepts were subsequently described by Champy et al[6] in 1978.

Fractures of the mandible are the second most common facial fractures after the nasal bones, making up 55.9% of all facial fractures.[7] In addition to correct bone healing, restoration of premorbid occlusion is one of the primary goals of treatment. During ORIF, the fracture is directly visualized and reduced after correct occlusion is reestablished by MMF. The fracture is then plated and held in reduction. Many surgeons recommend maintaining postoperative MMF to hold the mandible in correct position against occlusal forces. The advantages of postoperative MMF include the possibility of using guiding elastics in cases of minor malocclusion and also enforcement of liquid diet, thus enforcing patient compliance. For several years, the senior author (Y.D.) routinely kept patients in MMF for 6 to 8 weeks after ORIF.

Despite this trend, MMF is also fraught with disadvantages for both the surgeon and the patient. Since a return to the operating room is required to remove MMF, there is an increased risk for needlestick and glove puncture for the operator, and increased risk of anesthesia complications for the patient. Other disadvantages for the patient include aspiration, gingival trauma, difficulty with oral hygiene, delayed temporomandibular joint (TMJ) mobility, and discomfort. Since 2007, the senior author has abandoned the practice of routine postoperative MMF in noncomminuted fractures of the symphyseal, parasymphyseal, and angle regions in dentate patients. The present study is a comparison of complications and outcomes in patients with and without MMF.

Methods

This retrospective study was approved by the John Peter Smith Hospital institutional review board, which waived patient informed consent. It aims to compare outcomes in dentate patients with noncomminuted symphyseal, parasymphyseal, and angle fractures of the mandible who underwent ORIF with postoperative MMF with those without postoperative MMF. Rates of wound dehiscence, plate removal, nonunion, malunion, and malocclusion were compared. All patients treated by the senior author (Y.D.) from August 1997 to August 2012 with a minimum follow-up length of 6 weeks were included in the study. Preoperative computed tomography and panorex studies were obtained in all patients. Patients routinely received 8 mg of intravenous (IV) dexamethasone and 1 gm of IV cephazolin (clindamycin if penicillin allergic) intraoperatively. All patients were discharged with a prescription for oral clindamycin for 7 to 10 days. In patients with no postoperative MMF, no other method of mandibular immobilization, including elastic bands, was used. The cases were unselected to prevent selection bias from skewing any results in this study.

Excluded from the study were cases involving edentulous patients; mandible fractures secondary to gunshot wounds; atrophic fractures requiring grafting (Luhr classes 2 and 3); comminuted fractures; infected or defective-mandible fractures; concomitant midfacial fractures; fractures with severe loss of overlying soft tissue necessitating local, regional, or free flap coverage; and displaced condylar fractures.

Results

A comprehensive medical record review revealed 413 fractures in 311 patients that met the study criteria. Of the patients, 243 were men (mean age, 34.8 years; age range, 18-69 years), and 68 were women (mean age, 27.4 years; age range, 18-59 years). The fractured regions were categorized as follows: symphyseal, n = 134 (32.4% of all fractures); parasymphyseal, n = 112 (27.1% of all fractures); and angle, n = 167 (40.4% of all fractures) (**Table 1**). A total of 58.2% of symphyseal fractures (n = 78), 56.2% of parasymphyseal fractures (n = 63), and 49.7% of angle fractures (n = 83) were treated with postoperative MMF. The group treated without postoperative MMF included 41.8% of symphyseal fractures (n = 56), 43.8% of parasymphyseal fractures (n = 49), and 50.3% of angle fractures (n = 84) (Table 1).

Of the complications studied, in the group with postoperative MMF, wound dehiscence was found in 3 (4%), 5 (8%), and 6 (7%), respectively, for the symphyseal, parasymphyseal, and angle fractures. Infection was detected in 7 (9%) of the symphyseal fractures, 5 (8%) of the parasymphyseal fractures, and 8 (10%) of the angle fractures. Plate removal occurred in 1 symphyseal (1%) and 6 angle (7%) fractures, with none being found in the parasymphyseal group. Nonunion was found in 1 parasymphyseal (2%), and 2 angle (2%) fractures; none was found in the symphyseal fracture group. Malunion

Table 1. Fractures by Location in Each Treatment Arm[a]

Location of Fracture	MMF (n = 224)	No MMF (n = 189)	Total (n = 413)
Symphyseal	78 (58.2)	56 (41.8)	**134** (32.4)
Parasymphyseal	63 (56.2)	49 (43.8)	**112** (27.1)
Angle	83 (49.7)	84 (50.3)	**167** (40.4)

Abbreviation: MMF, maxillomandibular fixation.

[a] Data are reported as number (percentage) of fractures.

Table 2. Complications Associated With Fracture Location for Each Treatment Arm[a]

	MMF			No MMF		
Complication	Symphyseal	Parasymphyseal	Angle	Symphyseal	Parasymphyseal	Angle
Wound dehiscence	3 (4)	5 (8)	6 (7)	2 (4)	3 (6)	1 (1)
Infection	7 (9)	5 (8)	8 (10)	5 (9)	3 (6)	4 (5)
Implant removal	1 (1)	0	6 (7)	2 (4)	3 (6)	5 (6)
Nonunion	0	1 (2)	2 (2)	1 (2)	0	0
Malunion	1 (1)	0	1 (1)	0	2 (4)	2 (2)
Gross malocclusion	0	1 (2)	3 (4)	0	2 (4)	3 (4)

Abbreviation: MMF, maxillomandibular fixation.

[a] Data are reported as number (percentage) of complications.

Table 3. Statistical Analysis of Complications

	Fractures, Mean No.			
Complication	MMF	No MMF	95% CI	*P* Value[a]
Wound dehiscence	4.7	2.5	-1.7 to 6.0	.16
Infection	6.7	4.0	-1.7 to 7.0	.14
Plate removal	2.3	2.5	-7.9 to 7.6	.94
Nonunion	1.0	0.5	-2.2 to 3.2	.59
Malunion	0.7	1.0	-3.1 to 2.4	.72
Malocclusion	1.3	1.0	-4.0 to 4.7	.82

Abbreviation: MMF, maxillomandibular fixation.

[a] Using unpaired *t* test and α = .05.

Table 4. Statistical Analysis of Complications by Fracture Location

	Fractures, Mean No.			
Fracture Location	MMF	No MMF	95% CI	*P* Value
Symphyseal	2.0	1.7	-2.6 to 3.3	.81
Parasymphyseal	2.0	2.2	-2.9 to 2.5	.87
Angle	4.3	2.5	-1.2 to 4.9	.20

Abbreviation: MMF, maxillomandibular fixation.

was found in 1 symphyseal fracture (1%), 0 parasymphyseal fractures, and 1 angle fracture (1%). Finally, gross malocclusion was seen in 1 parasymphyseal fracture (2%), 3 angle fractures (4%), and 0 symphyseal fractures.

In patients treated without postoperative MMF, wound dehiscence was found in 2 fractures (4%), 3 fractures (6%), and 1 fracture (1%), respectively, for the symphyseal, parasymphyseal, and angle groups. Infection was detected in 5 (9%), 3 (6%), and 4 fractures (5%), respectively, for the symphyseal, parasymphyseal, and angle groups. Plate removal was needed in 2 symphyseal fractures (4%), 3 parasymphyseal fractures (6%), and 5 angle fractures (6%). Nonunion was seen in only 1 symphyseal fracture (2%) and not at all in either the parasymphyseal or angle group. Malunion was found in 0 symphyseal fractures, 2 parasymphyseal fractures (4%), and 2 angle fractures (2%). Finally, gross malocclusion was seen in 0 symphyseal fractures, 2 parasymphyseal fractures (4%), and 3 angle fractures (4%) (**Table 2**).

Using an unpaired *t* test and α value of 0.05 for significance, the patients with and without postoperative MMF were compared for complication rates. The fracture location was not taken into account; rather, the total number of complications within each subsection for the first arm of the study was compared with the similar group in the opposite arm. Compared against each complication, the difference between groups was not statistically significant for any complication noted (**Table 3**). Furthermore, complications by location were compared in each study arm and the differences lacked statistical significance (**Table 4**).

Discussion

Before the advent of rigid titanium plating systems, interosseous wire fixation was used for internal fixation of bone fragments. Given the high rate of malunion and infection, presumably due to the lack of sufficient rigidity of the interosseous wires, postoperative MMF was crucial for a successful repair.[8] With the advent of newer plating systems, a better understanding of fracture biomechanics, and improved techniques (partly owing to the Champy and Lodde[9] concept of ideal lines of osteosynthesis), the use of current plating systems provides sufficient stability to counteract the stresses of the masticatory muscles.

In the repair of mandible fractures, most surgeons keep patients in postoperative MMF to ensure that occlusal forces do not disrupt the repair and that the reestablished occlusion is maintained.[10] Although certain complicated fractures may yield better outcomes with postoperative MMF (including high subcondylar, displaced condylar, and comminuted frac-

tures), the routine use of postoperative MMF in all mandible fracture repairs is debatable. The proponents of postoperative MMF cite forced adherence to a liquid diet, the possibility of using guide elastics to adjust minor malocclusions, and improved bony healing as rationale for its use.

However, postoperative MMF is not without risks and problems. These include gingival trauma, difficulty with oral hygiene, patient discomfort, aspiration risk, and delayed TMJ mobility. The need to return to the operating room for removal of the arch bars exposes the patient to the risk of anesthesia, and the procedure itself carries significant health care cost and is time-consuming. In addition, removal of the arch bars exposes the operator to the risk of needlestick type injuries.

Herein, we examine the utility and safety of maintaining patients in postoperative MMF after they undergo ORIF of symphyseal, parasymphyseal, or angle fractures. Of the 413 fractures identified in 311 patients, 224 fractures were treated with postoperative MMF for 6 to 8 weeks. In the remaining 189 fractures, MMF was removed prior to the patient leaving the operating room. With follow-up of at least 6 weeks, the number of fractures with complications in each treatment arm was identified and recorded (Table 2) and statistical analysis (Tables 3 and 4) was performed. Based on our results, no statistically significant difference in any of the complications between the 2 treatment arms was observed.

Our results were consistent with a previous retrospective study by Valentino and Marentette,[11] who also found no difference in complication rates between patients with postoperative MMF and those without. In a more recent retrospective study by Kumar et al[12] comparing outcomes between patients with postoperative MMF (n = 73) and those without (n = 45), it was shown that there was no statistically significant difference.

There are numerous disadvantages of postoperative MMF. Issues involving patient discomfort, gingival trauma, weight loss, and oral hygiene are intuitive. In addition, delayed TMJ mobility may increase the incidence of TMJ ankylosis.[13] Bone healing may also be a complication secondary to osteopenia and changes in local venous pH.[14] Furthermore, prolonged fixation may lead to weakness and atrophy of the masseter and temporalis.[15]

While this study had a large sample size (n = 413 fractures), it was limited by its retrospective nature. It is important to note, however, that selection bias was not present because the cases were unselected. A prospective randomized clinical trial could be useful in corroborating our results and accounting for certain confounding variables such as patient compliance. In our study, while patients were advised to use postoperative antibiotics and maintain strict dietary guidelines, their compliance could not be evaluated.

Conclusions

The findings of the current study suggest that maintaining patients in MMF after ORIF of symphyseal, parasymphyseal, or angle fractures does not confer an advantage and may not be necessary in the repair of these mandible fractures. Furthermore, immediate release of MMF may lead to improved patient comfort and significant health care cost savings, among other benefits.

ARTICLE INFORMATION

Accepted for Publication: May 31, 2014.

Published Online: September 18, 2014. doi:10.1001/jamafacial.2014.543.

Author Contributions: Dr Ducic had full access to all of the data in the study and takes responsibility for the integrity of the data and the accuracy of the data analysis.
Study concept and design: Saman, Ducic.
Acquisition, analysis, or interpretation of data: Kadakia, Ducic.
Drafting of the manuscript: Saman, Kadakia.
Critical revision of the manuscript for important intellectual content: All authors.
Statistical analysis: Saman, Kadakia.
Study supervision: Saman, Ducic.

Conflict of Interest Disclosures: None reported.

REFERENCES

1. Spina AM, Marciani RD. *Maxillofacial Surgery: Trauma.* Philadelphia, PA: WB Saunders; 2000;85-86.

2. Gilmer TL. A case of fractures of lower jaw with remarks on treatment. *Arch Dent.* 1887;4:388.

3. Buck G. Fracture of the lower jaw with replacement and interlocking of the fragments. *Annalist NY.* 1846;1:245.

4. Gilmer TL. Fractures of the inferior maxilla. *J Dent Sci.* 1881;1:309.

5. Luhr HG. On the stable osteosynthesis in mandibular fractures [in German]. *Dtsch Zahnarztl Z.* 1968;23(7):754.

6. Champy M, Loddé JP, Schmitt R, Jaeger JH, Muster D. Mandibular osteosynthesis by miniature screwed plates via a buccal approach. *J Maxillofac Surg.* 1978;6(1):14-21.

7. Hanson J, Lovald S, Cowgill I, Erdman M, Diamond B. National hardware removal rate associated with internal fixation of facial fractures. *J Oral Maxillofac Surg.* 2011;69(4):1152-1158.

8. Kellman RM. Repair of mandibular fractures via compression plating and more traditional techniques: a comparison of results. *Laryngoscope.* 1984;94(12, pt 1):1560-1567.

9. Champy M, Lodde JP. Mandibular synthesis: placement of the synthesis as a function of mandibular stress [in French]. *Rev Stomatol Chir Maxillofac.* 1976;77(8):971-976.

10. Shenoy NA, Shah N, Shah J. A questionnaire survey on postoperative intermaxillary fixation in mandibular trauma: Is its use based on evidence? *Natl J Maxillofac Surg.* 2011;2(2):141-146.

11. Valentino J, Marentette LJ. Supplemental maxillomandibular fixation with miniplate osteosynthesis. *Otolaryngol Head Neck Surg.* 1995;112(2):215-220.

12. Kumar I, Singh V, Bhagol A, Goel M, Gandhi S. Supplemental maxillomandibular fixation with miniplate osteosynthesis-required or not? *Oral Maxillofac Surg.* 2011;15(1):27-30.

13. Glineburg RW, Laskin DM, Blaustein DI. The effects of immobilization on the primate temporomandibular joint: a histologic and histochemical study. *J Oral Maxillofac Surg.* 1982;40(1):3-8.

14. Hardt AB. Early metabolic responses of bone to immobilization. *J Bone Joint Surg Am.* 1972;54(1):119-124.

15. Mayo KH, Ellis E III, Carlson DS. Histochemical characteristics of masseter and temporalis muscles after 5 weeks of maxillomandibular fixation: an investigation in Macaca mulatta. *Oral Surg Oral Med Oral Pathol.* 1988;66(4):421-426.