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Original Research

## Use of the locking 2.0-mm fixation system for treating mandibular fractures with the potential for complications



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### ABSTRACT

**Objective:** To describe the evolution after internal fixation using a locking 2.0-mm system plate in the treatment of mandibular fractures that have potential for complications.

**Method:** Among 42 patients with mandibular fractures surgically treated, 10 (23.8%) presented 16 mandibular fractures with the potential for complications, due to drug abuse, smoking and/or dental status – partially or completely edentate. They were treated with the locking 2.0-mm system plates, and the evaluations were performed at 1 week and 1, 3 and 6 months postoperatively. The remaining cases received conventional fixation systems.

**Results:** Most patients were male with a mean age of 41.2 years, presented with a displaced (81.3%) fracture in the body or angle region and were partially edentulous (60%). There was a predominance of alcoholism (50%), which was followed by illicit drug use (30%) and smoking (30%). All patients recovered well. There was a progressive gain in the values of jaw opening ( $p < 0.001$ ), reaching normal values.

**Conclusion:** It was concluded that the treatment of displaced mandibular fractures in patients who are addicted to drugs and are partially edentulous was adequate with the use of the locking 2.0-mm fixation system.

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## 1. Introduction

The main objective of open reduction and rigid internal fixation of mandibular fractures is to achieve proper healing and immediate restoration of form and function without the use of intermaxillary fixation [1]. Rigid fixation is a more cost-effective treatment than non-rigid methods, which is in part because of the decreased probability of postoperative complications that could necessitate further surgery [2]. The consequences of retreatment include greater patient morbidity, additional hospitalization and

hospital costs and a longer period of absence from work, leading to high social costs [3,4].

The primary postoperative complications requiring surgical retreatment are nonunion, soft tissue infection associated with screw loosening, osteomyelitis and malunion [4,5]. Although there is no consensus in the literature, factors including substance abuse, age, dental condition, location of fracture, degree of fragmentation, fracture exposure and time between trauma and treatment should be considered as those that contribute to the occurrence of such complications [5–9]. One way to overcome these described factors in the treatment of mandibular fractures is the use of more rigid systems [10–12], such as locking 2.4 mm plates. On the other hand, some studies have stated that the 2.0-mm locking plates can be used in the cases of fractures with large displacement, mandible reconstruction, and comminuted fractures as well as in the cases of atrophic mandible fracture [13–15].

Some studies have compared standard 2.0-mm monocortical plates to 2.0-mm locking plates in the treatment of mandibular fractures and reported similar short-term complication rates [16–18]. However, the use of a 2.0-mm locking plate system has been considered a viable alternative to conventional miniplates

\* AsianAOMS: Asian Association of Oral and Maxillofacial Surgeons; ASOMP: Asian Society of Oral and Maxillofacial Pathology; JSOP: Japanese Society of Oral Pathology; JSOMS: Japanese Society of Oral and Maxillofacial Surgeons; JSOM: Japanese Society of Oral Medicine; JAMI: Japanese Academy of Maxillofacial Implants.

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in the management of these fractures due to the advantages of increased stability, shorter surgical time and the preservation of bony perfusion [19]. The 2.0-mm locking plates present a stability that is three times higher than conventional miniplates, which is because the fixation method is analogous to external fixation; the screws form together with the plate and cortical bone to construct a frame [14]. An *in vitro* evaluation of miniplate systems for the treatment of mandibular angle fractures demonstrated that 2.0-mm locking systems provided greater resistance to displacement than conventional ones [20]. Additionally, a biomechanical comparison of locking and nonlocking plates showed that the adaptation does not affect the stability of the former systems [21].

The objective of this study was to describe prospectively the evolution after internal fixation using a single locking 2.0-mm system plate in the treatment of mandibular fractures with the potential for complications.

## 2. Methods

Among 42 patients with mandibular fractures treated in 2012, 10 (23.8%) presented with 16 mandibular fractures with the potential for complications, due to drug abuse and/or unsatisfactory dental status, that required internal fixation and were treated with the locking 2.0-mm system plates were included in this prospective study. The remaining cases (76.2%) received 2.0-mm system when they showed favorable or condylar fractures and received 2.4-mm system when there was loss of bone substance. They were treated at the Oral and Maxillofacial Surgery Clinic of the Hospital M. Dr. Arthur R. de Saboya, which is a trauma hospital that provides coverage for the southern area of Sao Paulo, Brazil. All patients signed an informed consent. This study received approval from the local human research ethics committee (Protocol No. 229.0.162.000-10).

Inclusion criteria were patients older than 18 years of age regardless of their race and gender who presented with a history of drug abuse and/or inadequate dental status that could compromise the fracture repair. For this study, fractures that occurred in the following locations were included: symphysis, paramedian, body and angle. Exclusion criteria were patients with fractures involving loss of bone substance, infected fractures, fractures requiring a second plate in a given line of the fracture or postoperative intermaxillary fixation.

The age, gender, medical history, history of drug abuse (alcoholism and illicit drugs), smoking, etiology, fracture type (single, compound or comminuted), location of the mandibular fractures, number of fracture lines, degree of displacement (undisplaced or displaced), teeth in the fracture line which needed to be extracted, associated facial fractures and dental status (dentate, partially edentulous or completely edentulous) were recorded.

To improve the description of fractures, computed tomography features and intraoperative findings were used. All patients were treated under general anesthesia by the same team, and intermaxillary fixation was only performed intraoperatively. A single 2.0-mm locking plate (Synthes GmbH, Oberdorf, Switzerland) was fixed to each stable fragment with at least three bicortical screws at the basilar border of the mandible, i.e. below the mandibular canal (Figs. 1 and 2). The holes for the screws were made with the appropriate sized drill through a standard or threaded drill guide which positioned the hole centered and perpendicular to the plate. The surgical access, type of plate used (straight, angled or hemimandible), the profile of the plate (medium or large, the small profile not being used), postsurgical clinical and imaging findings and complications were registered.

None of the cases had a second plate inserted in the same line of fracture. Extraction of teeth in the fracture line was performed when indicated. All patients received cefazolin intravenously

during the intra- and postoperative periods because anti-biotic is used as standard practice in the hospital in question, and cephalexin orally for one week after hospital discharge due to the potential for complications presented.

Patients were instructed to eat a soft diet for 4 weeks. Postoperative complications were recorded as minor when they did not require surgical intervention, such as transient inferior alveolar nerve dysfunction, surgical site infection resolved with antibiotics, intraoral wound dehiscence treated with local care and minor occlusal disturbances treated with elastics. Major complications would be those requiring a second surgery, such as nonunion, soft tissue infection associated with screw loosening or plate exposure, osteomyelitis and malunion. The active jaw opening as the interincisal distance in millimeters was measured on days 7, 30, 90, and 180 after the surgery.

The data were tabulated, and statistical analyses were performed, involving descriptive statistics. To verify differences in the moments of observation of the values of mouth opening, the Friedman test was applied, and if there was a significant difference, the Wilcoxon Signed Posts test was applied to check the time points that differed among themselves. The level of significance was set at 5% ( $p < 0.050$ ) in all statistical analyses. The Statistical Package for Social Sciences (SPSS) version 19.0 (IBM Software Group, Chicago, USA) was used to conduct the analyses.

## 3. Results

The mean follow-up was 10 months. There was a predominance of male gender (80% of the cases) with a mean age of 41.2 years, ranging from 28 to 66 years old. The predominant etiology was physical assault (30%), which was followed by motorcycle accidents (20%), falls (20%), gunshot injuries (20%) and sports (10%).

Medical conditions were reported in some of the cases (50%), including psychiatric condition (30%) and hypertension (30%). Drug abuse was present in most cases (80%), including alcoholism (50%) and illicit drugs (30%), while smoking was reported in 30% of the cases (Table 1).

The mandibular fractures, in decreasing order, are described as follows. With respect to the type of fracture, 40% were a simple type, 40% a compound type and 20% a comminuted type. With respect to location, 43.8% occurred in the body, 31.2% in the angle, 18.8% were paramedian and 6.2% occurred in the symphysis. With respect to the number of fracture lines, the cases included single fractures (60%), multiple fractures (30%) and bilateral fractures (10%). Regarding the degree of displacement, the majority (81.3%) were displaced. Only 18.8% of the cases had teeth in the fracture line which were extracted (two due to extrusive luxation and one due to dental fracture). Associated fractures occurred in 40% of the cases, including three cases of condylar fractures and one case of zygomatic complex fracture; the former was treated with standard 2.0-mm and the latter with 1.5-mm fixation systems. With respect to dental status, most cases were partially edentulous (60%), and the remaining were dentate (20%) and edentulous (20%) (Table 2).

**Table 1**

Frequency of medical conditions, smoking and drug abuse in the studied group (patients).

	n (%)
<b>Medical conditions</b>	5 (50)
Psychiatric condition	3 (30)
Hypertension	2 (20)
<b>Smoking</b>	3 (30)
<b>Drug abuse</b>	8 (80)
Alcoholism	5 (50)
Illicit drugs	3 (30)

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