Surgical Management of Anterior Mandibular Fractures: A Systematic Review and Meta-Analysis

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Purpose: The aims of this study were to *1)* determine which fixation method has the fewest complications in the treatment of anterior mandibular fractures (AMFs) and *2)* provide scientific data to enable surgeons to make evidence-based decisions regarding the best technique.

Materials and Methods: A comprehensive electronic search without date and language restrictions was performed in March 2014. Studies in humans, including randomized or quasi-randomized controlled trials, controlled clinical trials, and retrospective studies, were included with the aim of comparing fixation techniques (lag screws, 3-dimensional plates, 1 plate, and 2 miniplates) in the management of AMFs. The incidence of postoperative complications was evaluated.

Results: Thirteen publications were included: 8 randomized controlled trials, 3 controlled clinical trials, and 2 retrospective studies. Seven studies showed a low risk for bias, 3 studies showed a moderate risk for bias, and 3 studies showed a high risk for bias. There were statistically significant advantages for lag screws and 1 plate plus an arch bar. There was no statistically significant difference between 3-dimensional plates and 2 miniplates. The cumulative odds ratio was 0.29, meaning that the use of lag screws in the fixation of AMFs decreases the risk for postoperative complications by 71% over the use of 2 miniplates. The cumulative odds ratio for 1 plate plus an arch bar was 0.28, showing that the use of 1 plate plus an arch bar in the fixation of AMFs decreases the risk for postoperative complications by 72% over the use of 2 plates.

Conclusions: The results of this meta-analysis revealed that the use of both lag screws and 1 plate plus an arch bar were superior to 2 miniplates in reducing the incidence of postoperative complications in the management of AMFs. Also, there were significantly shorter operating times with lag screws and 3-dimensional miniplates over 2 miniplates in the fixation of AMFs.

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The mandible is the second most commonly fractured bone of the maxillofacial skeleton because of its position and prominence. Although there is wide variance in the reported percentage of fractures of the mandible that occur in the anterior mandible, aggregate analysis places this at approximately 17% of all mandibular fractures.[1,2]

Anterior mandibular fractures (AMFs) are defined as mandibular fractures that involve a region bounded bilaterally by vertical lines just distal to the canine teeth (the parasymphysis) or linear fractures that run in the midline of the mandible (symphysis).[3] The lag-screw technique in maxillofacial surgery was first advocated by Brons and Boering[4] in 1970 and was later reintroduced by Niederdellmann et al,[5] who stated that at least 2 screws were necessary to prevent rotational movement of the fragments in oblique fractures of the mandible. In North America, its use for the management of anterior mandible fractures became popular through the work of Ellis.[6]

Internal fixation of mandibular fractures with miniplates (in conformity with the tension band principle)

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was first introduced by Michelet in 1973 and was later modified by Champy et al.[7] Champy et al advised the use of 2 miniplates in the anterior region, one at the inferior border and the second 5 mm above the lower plate. Champy's principle is still followed, but the need for 2 miniplates in the parasymphysis region is questioned when a mandibular arch bar is additionally placed simultaneously for intra- or postoperative intermaxillary fixation (IMF). The arch bar placed for intraoperative or postoperative IMF itself acts as a tension band, and the subapical plate (tension band plate) can be eliminated. Because a single miniplate is used instead of 2 plates, the approach is economical, will reduce the incidence of infection, will reduce the incidence of mental nerve injury,[8] may reduce injury to the roots of the anterior teeth,[9] and will diminish wound dehiscence.[10]

The use of 3-dimensional (3D) strut plates has been one of the methods of fixation to challenge the Champy technique for the fixation of mandibular fractures, with a growing number of clinical studies.[11] The 3D plates can be considered a 2-plate system, with 2 miniplates joined by interconnecting crossbars.[12] Their shape is based on the principle of a quadrilateral as a geometrically stable configuration for support.[13] Because the screws are arranged in the configuration of a box on both sides of the fracture, a broadband platform is created, increasing the resistance to twisting and bending of the long axis of the plate.[14] There is a simultaneous stabilization of the tension and compression zones, making 3D plates a time-saving alternative to conventional miniplates.[14] Moreover, this system is simple to apply because of its malleability, low profile (reduced palpability), and ease of application (requiring little or no additional contouring).[14]

The treatment of AMFs has evolved during the past several decades, especially with the application of open reduction and internal fixation techniques. This area has been studied extensively, and debate continues regarding the ideal treatment method.[15] Thus, the aim of this study was to answer the following question: what fixation method has the fewest complications in the treatment of AMFs? The study also provides scientific data to enable surgeons to make evidence-based decisions regarding the best technique.

Materials and Methods

SEARCH METHODS FOR IDENTIFICATION OF STUDIES

This systematic review and meta-analysis was conducted according to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses Equity 2012 Extension checklist.[16] A comprehensive electronic search without date and language restrictions was performed in March 2014 using the following electronic databases: PubMed, the Cochrane Database of Systematic Reviews, the Cochrane Central Register of Controlled Trials, Embase, MEDLINE, the Cumulative Index to Nursing and Allied Health Literature, and the Electronic Journal Center. One or a combination of the following search terms was used: "lag screw versus miniplate in anterior mandibular fractures" AND/OR "three dimensional versus standard miniplate" AND "one miniplate," "internal rigid fixation in symphyseal AND parasymphyseal fractures," "Champy technique," "bone plate," "osteosynthesis of anterior mandibular fractures."

A manual search of oral and maxillofacial surgery–related journals, including the *International Journal of Oral and Maxillofacial Surgery*, the *British Journal of Oral and Maxillofacial Surgery*, the *Journal of Oral and Maxillofacial Surgery*, *Oral Surgery*, *Oral Medicine*, *Oral Pathology*, *Oral Radiology and Endodontology*, the *Journal of Cranio-Maxillofacial Surgery*, the *Journal of Craniofacial Surgery*, and the *Journal of Maxillofacial and Oral Surgery*, was also performed.

The reference lists of the identified studies and relevant reviews on the subject were also evaluated for possible additional studies. Moreover, online databases providing information about clinical trials in progress were checked (http://clinicaltrials.gov, http://www.centerwatch.com/clinicaltrials, and http://www.clinicalconnection.com).

Any randomized or quasi-randomized controlled trials, controlled clinical trials, or retrospective studies whose aim was the comparison of postoperative complications between or among fixation techniques (eg, lag screws, 3D plates, standard miniplates) in the management of AMFs were included.

Case reports, technical reports, animal studies, in vitro studies, review papers, and studies that included infected and/or comminuted AMFs, fractures in edentulous mandibles, and pediatric AMFs were excluded.

DATA COLLECTION PROCESS

We carefully assessed the eligibility of all studies retrieved from the databases. From the included studies in the final analysis, the following data were extracted (when available): authors, year of publication, study design, number of patients, gender, mean age in years, follow-up period, AMF fixation methods, postoperative IMF, mean length of operation (in minutes), and associated fractures. Authors were contacted to obtain possible missing data.

RISK FOR BIAS IN INDIVIDUAL STUDIES

A methodologic quality rating was performed by combining the proposed criteria of the Meta-Analysis of Observational Studies in Epidemiology statement,[17]