Plating Options for Fixation of Condylar Neck and Base Fractures

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KEYWORDS

• Condylar neck • Base fracture • Subcondylar fracture

KEY POINTS

- There are multiple plating options to consider when performing an open reduction of a condylar neck or base fracture.
- The literature shows that bite force is reduced significantly after a subcondylar fracture during the healing period, returning to only 60% of normal bite force at 6 weeks.
- This raises the question as to how much is enough when considering fixation of subcondylar fractures.
- All plating options presented in this article have been shown in the literature to successfully treat subcondylar fractures.

Introduction

The mandibular condyle or subcondylar region is one of the most common sites of mandibular fracture encountered, occurring between 25% and 35% of all mandibular fractures.[1,2] There is some trend evidence to support the benefits of open surgical management over that of closed treatment of mandibular condylar neck and base fractures. A recent systematic review and meta-analysis by Al-Moraissi and Ellis[3] confirmed that open reduction and internal fixation provide superior functional clinical outcomes compared with closed reduction in the management of adult condylar fractures. Several different surgical approaches as well as plating options are available to oral and maxillofacial surgeons once a decision to treat the condylar fracture open has been made.

Surgical approach

The common approaches to this area typically include the retromandibular, transparotid, and submandibular. The various surgical approaches to the condylar neck and base fractures are discussed. (See Hany A. Emam and colleagues' article, "Matching Surgical Approach to Condylar Fracture Type," in this issue). An important consideration when determining a plating scheme for this type of fracture is an appreciation for the limited visibility and challenges of surgical access to this particular area.[4]

Biomechanics of the condylar neck and base

The mandible can be considered a class III lever, with the fulcrum of rotation the condyle; the load occurs at the dentition and the force exerted largely comes from the muscles of mastication.[5,6] Several muscles are responsible for the movement of the mandible and thus for the forces exerted on the mandible. The masseter and medial pterygoid combine to generate a vector that is directed superior and anterior direction from the angle of the mandible. The temporalis generates a force vector originating from the coronoid process and directed superior and slightly posterior. The lateral pterygoid exerts a vector from the condyle anterior and medial direction.[7] Others muscles also contribute to the movement and force generated on the mandible; however, those listed are the most pertinent to a discussion of fractures of the mandibular condylar neck and base.

Normal physiologic movement and the force vectors generated create lines of compression and tension within the mandible. The lines of tension at the condylar neck and base run approximately perpendicular to the posterior aspect of the ascending ramus following the curvature of the sigmoid notch and extending superiorly through the coronoid process. The lines of compression run approximately perpendicular to the lines of tension. They run parallel to the posterior aspect of the ascending ramus and then curve along the angle to continue parallel to the inferior border of the mandible.[4] Ultimately, this results in a tension band at the anterior/superior (sigmoid notch) aspect of a condylar neck and base fractures and a compression band at the posterior aspect.

Fractures of the condylar neck and base typically occur as a result of forces far greater than those that exist in the normal physiologic range.[8] The goal of reduction of these fractures is a restoration of the ability to withstand a functional load in a normal physiologic range or the ability to tolerate the normal tension band and compression band that exist in the condylar neck. The literature shows that the functional force applied to the mandible after a subcondylar fracture is significantly

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reduced. There are also significant neuromuscular adaptations that alter the forces exerted on the condylar neck during the healing phase after a fracture.[9]

Plating options

There are several different plating options available for internal fixation of the condyle and subcondylar fracture, none of which has been extensively studied clinically. A single plate, dual plates, specially designed geometric condylar plates (trapezoid, rhomboid, and so forth), lag screws, and resorbable fixation systems have all been described. Titanium plates and screws are considered the most reliable materials if proper site selection, sufficient quantity or rigidity, and handling and placement techniques are used; however, titanium hardware still poses risk of future failure, which may require re-entry operation with its own added esthetic, functional, and financial risks.[10] Resorbable materials may be able to alleviate or overcome some of the disadvantages that titanium plates potentially pose.

Single Plate

There is little debate regarding the functional stability gained with a 2-plate fixation scheme when treating a subcondylar fracture in comparison to a single straight plate. This has been illustrated over the years with biomechanical analyses using finite element analysis and in vitro studies as well as clinical retrospective review.[11–15] Commonly a single plate may be the only feasible option in fixating a mandibular condyle fracture due to the often limited exposure and bony architecture available for plates and screws. Screw length also becomes important in the search to gain added stability if only a single plate is used. A comparative biomechanical evaluation by Asprino and colleagues[13] demonstrated superior performance in peak load and peak displacement of a single plate with 8-mm screws compared with 6-mm screws. Complications of subcondylar fracture repair seem to differ depending on the fixation scheme used and may be seen more frequently when a single plate design is used as displayed by Hammer and colleagues.[16] They demonstrated in a series of 30 patients that plate fracture, screw loosening, infection, or malposition occurred in 35% of the fractures stabilized with a single miniplate, whereas no hardware failure was identified in other plating schemes used. In vitro strain measurements at the condylar process have shown that the highest levels of tensile strain occur on the anterior and lateral surfaces whereas the medial surface had the lowest level of tensile strain. The highest compressive strain levels occurred on the posterior surface, and lateral surface had the lowest levels of compressive strain.[17] As previously described by Champy and colleagues[18] and now widely accepted, an appreciation of the areas of tension and compression can be applied to provide a functionally stable fixation. To apply Champy and colleagues' principles with fixation along the lines of tension at the subcondylar region suggests fixation anteriorly along the lines of tension as opposed to the common method of a single posteriorly aligned plate. As also noted by Meyer and colleagues,[19] placement here may be more difficult because the bone is often very thin further anteriorly. Therefore, if only a single plate is used, at least 2 screws should be engaged on each side of the fracture, with use of longer screws with bicortical engagement. Additionally, a larger profile plate, such as a 2.0, 2.4, or minidynamic compression plate, should be used and applied along the lines of tension if accessible (Fig. 1).

Two Plates

As previously discussed, a biomechanical advantage is evident when 2 plates are used compared to 1 single straight plate in evaluating fixation schemes for subcondylar fractures. This allows stabilization at the anterior and posterior aspects of the condylar neck and seemingly has the favorable effect of repairing tension and compression paths of the subcondylar region as well as resisting any torsional forces that may not be opposed with a single plate (Fig. 2). One of

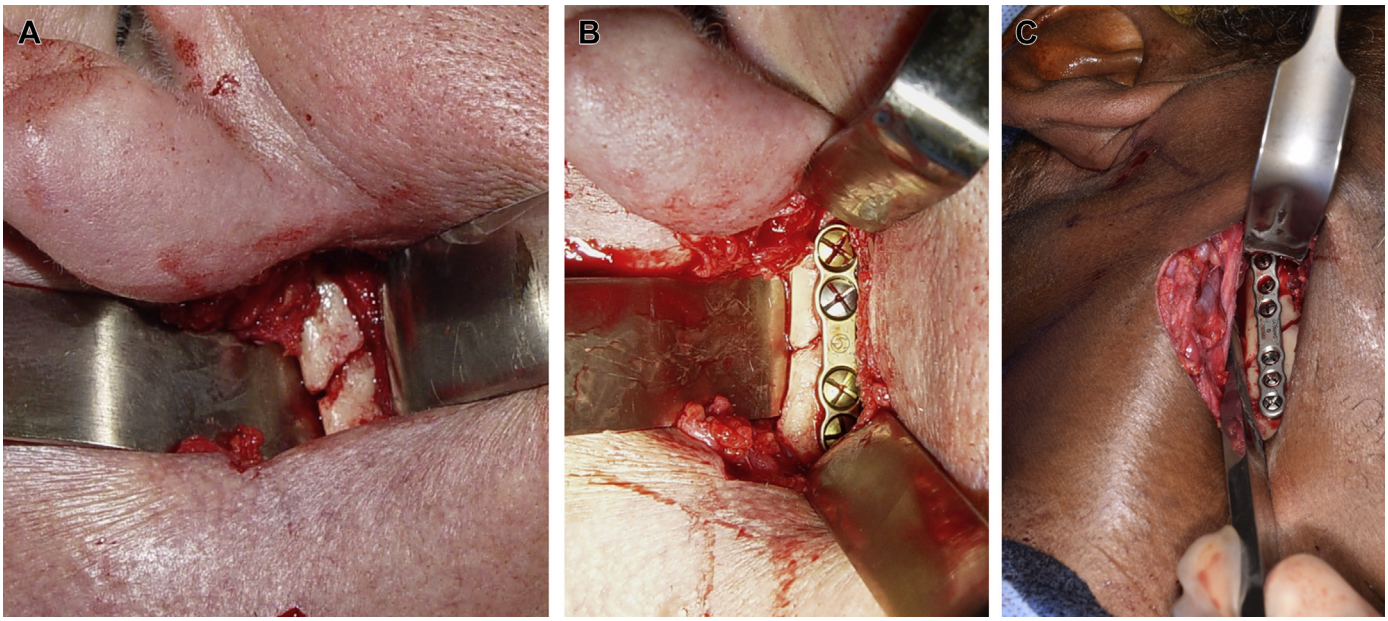

Fig. 1 Fixation of subcondyle fracture (*A*) with rigid single plates with 2 (*B*) and 3 (*C*) bicortical screws on each side.