

BODY AND ANGLE FRACTURES OF THE MANDIBLE

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ABSTRACT: *This article provides a comprehensive analysis of the surgical management of mandibular body and angle fractures, correlating clinical anatomy with biomechanical stabilization principles. It evaluates the regional neurovascular risks—specifically involving the inferior alveolar and mental nerves—and the impact of muscular forces on fracture displacement. The text details various osteosynthesis modalities, ranging from load-sharing miniplates and lag screws to load-bearing reconstruction plates. Key technical requirements, including the application of tension bands to neutralize distracting forces and the use of dynamic compression for primary bone healing, are examined. By synthesizing diagnostic imaging standards, surgical approaches (transoral and transcervical), and perioperative protocols, this review serves as a definitive guide for achieving stable internal fixation and early functional restoration in craniomaxillofacial trauma.*

Keywords: *Mandibular Fractures, Osteosynthesis, Biomechanics, Lag Screw Principle, Surgical Anatomy, Internal Fixation.*

Introduction

Fractures of the mandibular body and angle represent a significant portion of craniomaxillofacial trauma, often resulting from high-impact forces such as vehicular accidents, physical altercations, or falls. Due to its prominent

position in the facial skeleton and its role in essential functions—including mastication, speech, and airway maintenance—the mandible requires precise anatomical reduction and stable fixation to ensure successful recovery.

The management of these fractures is inherently complex due to the unique biomechanical environment of the lower jaw. The mandible acts as a dynamic lever system, where muscular attachments from the masseter, temporalis, and pterygoid muscles create shifting zones of tension and compression during functional loading. Consequently, the surgical approach must not only address the bone's structural integrity but also neutralize these physiological forces to prevent gap formation and malocclusion.

Modern osteosynthesis has shifted the focus toward Stable Internal Fixation (SIF), utilizing a variety of techniques from load-sharing miniplates to load-bearing reconstruction systems. Achieving success in this field necessitates a deep understanding of regional anatomy, particularly the protection of the inferior alveolar and mental nerves, as well as the selection of the appropriate mechanical principle—be it splinting, adaptation, or active compression.

This article explores the integrated surgical workflow for mandibular trauma, starting from the anatomical definitions and diagnostic imaging to the sophisticated biomechanical applications of lag screws and compression plating. By adhering to these established principles, clinicians can minimize postoperative complications and facilitate a rapid return to full functional health for the patient.

1. Anatomy and Clinical Boundaries

The lateral mandibular body is anatomically defined as the segment extending from the distal aspect of the canine (parasymphysis) to the proximal aspect of the third molar. The mandibular angle encompasses the third molar region and the transition point between the body and the ramus.

Structural Composition

The region consists of distinct buccal and lingual cortical plates, alveolar bone supporting the dentition, and the internal mylohyoid and external oblique ridges. Centrally or inferiorly, the bone houses the inferior alveolar canal. Notably, the bone at the angle is thinner inferiorly where the cortices converge, and the antegonial notch serves as a landmark just anterior to the true angle.

Muscular Attachments

Understanding muscle attachments is critical for determining fracture displacement patterns and planning surgical incisions:

- **Masseter & Medial Pterygoid:** Attach to the lateral and medial aspects of the inferior border/angle, respectively.
- **Temporalis:** Attaches to the anterior border of the coronoid process.
- **Buccinator:** Originates along the external oblique ridge.
- **Superior Pharyngeal Constrictor:** Attaches medially at the angle.
- **Mylohyoid:** Runs along the internal mylohyoid ridge.

Neurological Considerations

Surgical intervention must account for several key sensory and motor nerves:

- **Inferior Alveolar Nerve (IAN):** Travels within its canal and exits at the mental foramen. It provides sensation to the teeth, chin, and lower lip.
- **Lingual Nerve:** Positioned roughly 1–2 mm medial to the internal oblique ridge. It is highly vulnerable during superior border stabilization at the angle.
- **Long Buccal Nerve:** Provides sensation to the cheek; it is at risk during transoral incisions as it crosses the anterior ramus.
- **Motor Nerves:** The trigeminal nerve (V3) controls masticatory muscles, while the facial nerve (VII) governs facial expression. The marginal mandibular branch is particularly at risk near the antegonial notch, where injury can cause lip and chin paralysis.

2. Vascular Supply and Healing

Although the mandible generally possesses a robust blood supply via the inferior alveolar artery and the periosteal plexus, this can be severely compromised. In elderly or edentulous patients, the alveolar artery often undergoes atrophy or arteriosclerosis. Trauma and extensive periosteal stripping during surgery can turn bone fragments into "free grafts" devoid of blood supply, significantly increasing the risk of infection and non-union.

3. Diagnostic Imaging

To accurately evaluate fractures, at least two radiographic views at right angles are necessary. Common modalities include:

- Orthopantomogram (OPT/Panorex): The primary screening tool for identifying angle and body fractures.
- Posteroanterior (PA) View: Useful for assessing the obliquity and lateral displacement of fragments.
- Lateral Oblique View: An alternative when a Panorex is unavailable.
- Computed Tomography (CT): The gold standard for 3D reconstruction and detailed anatomical mapping, though it may occasionally miss hairline fractures due to volume averaging.
- Clinical Examination: If imaging is inconclusive, clinical signs (malocclusion, mobility) remain the most reliable indicators of a nondisplaced fracture.

4. Biomechanics and Nerve Management

The mandible functions as a lever system under axial loading. The superior border (dental arch) acts as a tension zone, while the inferior border serves as a compression zone. The neutral zone typically aligns with the inferior alveolar canal in the center of the bone.

Clinical Management of the IAN

A preoperative sensory baseline is essential. While microsurgical repair of a severed nerve is not standard during primary fracture fixation, it remains a secondary option. The transition from the mandibular body to the ramus

represents a complex biomechanical challenge due to the shifting force vectors in the angle region during functional loading.

5. Fracture Classification and Morphology

Fracture patterns in the mandibular body are dictated by the impact's vector and energy levels. These are typically linear but may present with oblique surfaces or basal wedges. High-energy impacts often result in comminution (fragmentation). At the mandibular angle, fractures usually involve the third molar site and extend toward the antegonial notch. These fractures are frequently oblique, typically showing more anterior extension along the external oblique ridge than the internal ridge.

6. Preoperative Strategy

A definitive plan for surgical access and fixation must be established before the procedure.

- **Third Molar Management:** Impacted teeth may be kept or extracted. However, if the tooth is infected, fractured, or excessively loose, it should be removed to prevent complications.

- **Neurological Care:** Preoperative testing of the inferior alveolar nerve is vital to identify existing damage (neurotmesis). While immediate microsurgical repair isn't standard, it remains a viable consideration for some cases.

7. Surgical Access and Approaches

Prior to the incision, Mandibulomaxillary Fixation (MMF) is usually applied to establish proper occlusion.

- **Transoral (Intraoral):** For the angle, a vestibular incision is made lateral to the temporalis muscle. For the body, the incision is beveled at the premolar roots, with careful subperiosteal dissection to protect the mental nerve.

- **Transcervical (Extraoral):** A submandibular approach follows Langer's lines for better aesthetics. Surgeons may use nerve stimulators to identify and protect the marginal mandibular branch of the facial nerve. Ligation of facial vessels is often necessary to improve visibility and nerve safety.

8. Fixation and Osteosynthesis Techniques

After reducing the fracture manually or with forceps, the surgeon chooses between load-sharing or load-bearing techniques based on bone health.

Load-Sharing Techniques

- **Miniplates:** In the mandibular body, a single miniplate is often placed in the "neutral zone" (center) using monocortical screws to avoid root damage. At the angle, a miniplate is typically secured along the superior border (tension zone). If bone support is weak (e.g., after a tooth extraction), two miniplates—one superior and one inferior—may be required.

- **Compression Plating:** Specifically used at the inferior border with bicortical screws. Because compression can cause the superior gap to flare open, a tension band (like an arch bar or a superior plate) must be applied first.

- **Lag Screws:** Ideal for oblique fractures. At least two screws must be placed perpendicular to the fracture to ensure 3D stability and prevent rotation.

Load-Bearing Techniques

Indicated for severe cases like comminuted fractures, bone defects, or atrophic mandibles where the bone cannot assist in weight-bearing. This usually involves heavy reconstruction plates (locking or non-locking).

9. Perioperative and Postoperative Care

- **Antibiotics:** Prophylactic high-dose parenteral antibiotics (Clindamycin or Penicillin/Clavulanic acid) are recommended, especially if surgery is delayed, to cover anaerobic gram-positive bacteria.

- **Recovery Goals:** The objective is a rapid return to normal function (speech, diet, and breathing).

- **MMF Usage:** With stable internal fixation, prolonged MMF is generally unnecessary unless other non-surgically treated fractures (like condylar fractures) are present. A brief period of "soft-tissue rest" in occlusion may be used to assist initial healing.

10. Potential Complications

Common pitfalls include:

1. Incomplete Visualization: Leading to improper plate adaptation.
2. Gap Formation: Opening of the inferior border if superior plating is used alone in poorly buttressed fractures.
3. Ramus Flaring: Caused by poor adaptation of the plate on the lingual side.
4. Iatrogenic Nerve Injury: Direct screw placement into the mandibular canal.

Conclusion

The management of mandibular body and angle fractures remains a cornerstone of maxillofacial surgery, requiring a delicate balance between anatomical preservation and mechanical rigidity. Successful outcomes are predicated on a thorough understanding of the "tension" and "compression" zones of the mandible, as well as the meticulous protection of the inferior alveolar and mental nerves.

While miniplate osteosynthesis offers a reliable load-sharing solution for simple, well-buttressed fractures, complex or comminuted cases necessitate more robust interventions, such as compression plating or load-bearing reconstruction. The technical precision involved—ranging from the correct application of the lag screw principle to the strategic use of tension bands—is essential to prevent common pitfalls such as malocclusion and non-union. Ultimately, the goal of modern internal fixation is to bypass the need for prolonged mandibulomaxillary fixation, allowing the patient to regain full functional movement and nutritional intake as early as the immediate postoperative period.

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