PRINCIPLES OF STABILIZATION IN CRANIOMAXILLOFACIAL OSTEOSYNTHESIS: FROM SPLINTING TO COMPRESSION

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ABSTRACT

This article explores the fundamental biomechanical principles governing the internal and external stabilization of craniomaxillofacial fractures. It details the mechanisms of splinting, adaptation, and compression, with a specific focus on the technical application of dynamic compression plates (DCP) and lag screw techniques. The objective is to provide a clear understanding of how different fixation methods influence interfragmentary movement and primary bone healing.

Keywords: Maxillofacial Fractures, Osteosynthesis, Lag Screw Principle, Compression Plating, Interfragmentary Compression, Mandibular Stabilization.

Introduction

Stabilization in maxillofacial surgery is not merely about holding bone fragments together; it is about creating a biomechanical environment conducive to healing. The choice between flexible and rigid fixation depends on the anatomical site, the nature of the fracture (simple vs. comminuted), and the functional loads expected during the healing period.

1. Stabilization Modalities

1.1 Splinting: External and Internal

Splinting reduces the mobility of bone fragments.

• External Splinting: Often referred to as indirect management, this involves devices like arch bars or Gunning splints. While non-invasive, it is frequently an unreliable method for maintaining absolute alignment.

• Internal Splinting: Involves the fixation of implants directly to the fracture fragments. While it allows for some interfragmentary motion, it is significantly more stable than external methods.

1.2 Adaptation Osteosynthesis

Adaptation plates (e.g., miniplates) are used to hold fragments in close approximation without applying active pressure. This is a "load-sharing" situation where the bone and the plate share the functional load. It is the gold standard for midface fractures and simple mandibular fractures where central screw placement is essential for stability.

1.3 The Principle of Compression

Compression increases interfragmentary friction and preloads the fracture, preventing movement even under functional stress.

• Primary Bone Healing: By eliminating the fracture gap, compression allows osteons to cross the fracture line directly, facilitating faster and stronger union.

• Indications: Linear fractures of the mandible, zygomaticofrontal sutures, and bone graft fixation.

2. Advanced Fixation Techniques

2.1 Compression with a Plate

Compression plates utilize elliptical, oval-shaped holes. When a screw is inserted eccentrically (away from the fracture line), the screw head slides down the inclined plane of the hole, moving the bone fragment toward the fracture and creating interfragmentary pressure. Note: Overbending the plate is a crucial maneuver in mandibular body fractures to prevent the lingual gap from opening when the buccal side is compressed.

2.2 Lag Screw Fixation

The lag screw is arguably the most efficient way to achieve maximum interfragmentary compression.

• The Gliding Hole: The proximal cortex is drilled to a diameter equal to or wider than the screw threads, ensuring the screw "glides" through.

• The Threaded Hole: The distal cortex is drilled to a smaller diameter so the threads can grip.

• Result: As the screw is tightened, the head pulls the proximal fragment against the distal one, squeezing them together.

2.3 Position Screws vs. Lag Screws

Unlike lag screws, position screws engage threads in both cortices. They are used when compression is undesirable, such as in sagittal split osteotomies where compression might damage the inferior alveolar nerve.

Summary

The success of craniomaxillofacial osteosynthesis relies on selecting the appropriate mechanical principle for the specific clinical scenario. While adaptation is sufficient for the midface, the mandible often requires the more robust stabilization provided by compression plates or lag screws. Proper technique—such as overbending plates or correctly drilling gliding holes—is mandatory to avoid complications like bone necrosis or malocclusion.

References

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