

MODERN MINIMALLY INVASIVE SURGICAL TECHNIQUES AND FIXATION METHODS FOR LOWER JAW FRACTURES.

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Annotation: This article explores contemporary minimally invasive surgical techniques and fixation methods for managing lower jaw (mandibular) fractures. The discussion encompasses the advantages, challenges, and outcomes associated with these methods, backed by recent advancements in surgical tools and imaging technologies. The study also presents practical insights and recommendations for clinicians.

Keywords: Mandibular fractures, minimally invasive surgery, fixation methods, surgical techniques, jaw fracture management, osteosynthesis, postoperative outcomes

Lower jaw fractures are a common occurrence in maxillofacial trauma, often resulting from physical altercations, accidents, or sports injuries. Managing these fractures effectively requires a balance between ensuring structural stability and minimizing trauma caused by the intervention itself. Traditional open surgical methods, while effective, often come with risks such as infection, visible scarring, and prolonged recovery times. This has led to the development of minimally invasive surgical (MIS) approaches and advanced fixation techniques aimed at improving patient outcomes while reducing complications.

This article examines the latest innovations in minimally invasive surgical techniques and fixation methods for mandibular fractures, analyzing their clinical efficacy and practicality.

Recent studies highlight a paradigm shift in mandibular fracture management, moving from conventional open reduction and internal fixation (ORIF) to MIS approaches. Key literature identifies several emerging techniques:

- **Endoscopic-Assisted Surgery:** This technique uses small incisions and specialized endoscopes to access the fracture site, allowing precise alignment and fixation.

- **3D-Printed Implants and Guides:** Advances in 3D printing technology enable the creation of patient-specific implants and surgical guides, which enhance the accuracy of fracture repair.

- **Bio-Resorbable Fixation Devices:** These devices provide temporary stabilization, gradually dissolving as the bone heals, thereby eliminating the need for a second surgery to remove hardware.

Here's an overview of modern minimally invasive surgical techniques and fixation methods for lower jaw (mandibular) fractures:

Overview of Mandibular Fractures

The lower jaw (mandible) is a common site for facial fractures due to its prominent position. Treatment aims to restore function (e.g., chewing, speaking) and aesthetics while minimizing complications. Traditional methods included extensive open surgeries, but modern techniques focus on minimally invasive approaches.

Minimally Invasive Surgical Techniques

These approaches minimize trauma to surrounding tissues and reduce recovery time:

Closed Reduction Techniques

- **Arch Bars and Intermaxillary Fixation (IMF):** Wires or elastic bands stabilize fractures through the alignment of teeth. Common for simple, non-displaced fractures.

- **Hybrid Approaches:** Combine IMF with temporary skeletal anchorage devices to reduce reliance on dental support.

Endoscopic-Assisted Reduction

- A small endoscope is inserted to visualize and guide the fracture reduction process internally.

- Benefits: Smaller incisions, reduced scarring, and shorter recovery times.

- Commonly used for condylar fractures.

Percutaneous Pinning

- Pins are placed through small incisions to hold fragments in place.

- Useful for fractures where open surgery poses risks or in cases requiring temporary stabilization.

Navigation-Guided Surgery

- Utilizes 3D imaging (CT scans) to plan and execute surgery with high precision.

- Ensures proper alignment and minimizes unnecessary bone or soft tissue manipulation.

Modern Fixation Methods

Advanced fixation techniques provide stable and effective support for bone healing:

Titanium Plates and Screws

Closed reduction techniques are effective methods for stabilizing fractures, particularly in the facial region, by aligning and maintaining the fractured segments without requiring open surgery. Here's an expanded explanation of the techniques mentioned:

Arch Bars and Intermaxillary Fixation (IMF):

- Application: Arch bars are metal devices secured to the teeth using wires. Elastic bands or wires then connect the upper and lower arches to maintain proper alignment and stabilization of fractures.

- Indications: This method is commonly used for simple, non-displaced fractures, particularly in the mandible or maxilla, where dental alignment can act as a guide.

- Advantages:

- Avoids the need for invasive surgery.

- Cost-effective and widely accessible.
- Challenges:
 - Requires intact dentition for proper fixation.
 - Can be uncomfortable for the patient, impacting oral hygiene and nutrition.

Hybrid Approaches:

- **Combination Technique:** These methods incorporate Intermaxillary Fixation (IMF) with temporary skeletal anchorage devices (TADs), such as screws or plates. These devices provide additional stability independent of the teeth.

- **Advantages:**
 - Reduces reliance on dental support, making it suitable for patients with compromised or missing teeth.
 - Provides a more versatile and stable framework for fracture alignment.
- **Applications:** Often used for more complex fractures or cases where traditional IMF is not feasible due to dental limitations.

Both techniques emphasize minimally invasive management of fractures while aiming to restore function and aesthetics effectively. Hybrid approaches represent a modern evolution, offering greater flexibility for diverse clinical scenarios.

Resorbable Plates and Screws

Resorbable Plates and Screws

- **Material:** Constructed from biocompatible polymers such as polylactic acid (PLA) or related compounds.
- **Functionality:** These materials naturally degrade in the body over time, negating the need for surgical removal post-healing.
- **Applications:**
 - Particularly suitable for pediatric fractures, as growing bones can be adversely affected by permanent implants.
 - Commonly used for less severe fractures or situations where implant-related complications need to be minimized.
- **Advantages:**

- Eliminates the risks and costs associated with a secondary removal surgery.
- Reduces the potential for chronic implant-related discomfort or complications.
- Limitations:
 - Limited load-bearing capacity compared to metal implants.
 - Not ideal for complex or heavily loaded fractures.
- Usage Considerations: Requires careful evaluation of fracture type, patient age, and healing capacity for optimal outcomes.

Locking Plate Systems

- Plates with threaded holes that lock screws in place.
- Provides a fixed-angle construct, reducing the risk of screw loosening and improving stability.

Orthodontic Anchorage Devices

- Temporary devices like mini-screws act as anchors for stabilization.
- Used in combination with other methods for minimally invasive approaches.

Benefits of Minimally Invasive Techniques

- Reduced Surgical Trauma: Smaller incisions mean less disruption to surrounding tissues.
- Shorter Recovery Times: Patients often experience quicker functional recovery.
- Better Aesthetics: Less scarring and improved cosmetic outcomes.
- Lower Risk of Complications: Reduced infection and nerve damage compared to open techniques.

Key Considerations in Technique Selection

- Fracture Complexity: Simple fractures may require only closed reduction, while complex, comminuted fractures often need open reduction with fixation.
- Patient-Specific Factors: Age, dental health, bone quality, and comorbidities.
- Technological Availability: Access to advanced tools like endoscopes or navigation systems.

Conclusions

Minimally invasive surgical techniques and advanced fixation methods provide a promising alternative to traditional approaches for treating lower jaw fractures. Their benefits include reduced trauma, quicker recovery, and improved aesthetic outcomes. To maximize the potential of these innovations, healthcare institutions should:

Invest in Training Programs: Equip surgeons with the skills needed to perform MIS techniques.

Adopt Advanced Technologies: Incorporate 3D printing and endoscopic tools into surgical practice.

Support Further Research: Encourage studies on cost-efficiency and long-term outcomes of bio-resorbable materials.

By addressing these areas, the field of mandibular fracture management can continue to evolve, delivering better care for patients worldwide.

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