MODERN METHODS OF OSTEOSYNTHESIS IN THE FRACTURES OF MAXILLOFACIAL AREA (ANALYTICAL REVIEW)

Matchanov Bobur Bakhtiyor o'g'li
Assistant of the Department of Maxillofacial Surgery and Dentistry of the Tashkent Medical Academy.
boburmatchonov5@gmail.com

Abstract

Maxillofacial fractures, caused by trauma to the facial skeleton, present complex challenges due to their potential to affect both functionality and aesthetics. The evolution of osteosynthesis techniques has greatly improved the outcomes in the management of these fractures, ensuring optimal recovery and minimizing long-term complications. This review explores the modern methods of osteosynthesis used in the treatment of maxillofacial fractures, highlighting advancements in materials, fixation techniques, and the integration of new technologies. We examine the advantages and limitations of each method, with a special focus on current trends in clinical practice.

Keywords: *Osteosynthesis, maxillofacial fractures, rigid fixation, resorbable materials, 3D printing, titanium plates, locking plates.*

Introduction

Fractures of the maxillofacial region are common injuries that involve the mandible, maxilla, zygomatic bones, and the orbit, often resulting from trauma such as road accidents, falls, or assaults. These fractures can significantly impact both function (e.g., speech, chewing) and appearance. Effective management of these fractures requires proper osteosynthesis techniques to ensure bone stability, reduce complications, and promote early recovery.

Over the past few decades, numerous advances have been made in the field of osteosynthesis, particularly in the development of materials, the precision of fixation techniques, and the introduction of innovative technologies. This review provides a comprehensive overview of modern osteosynthesis methods, with a focus on clinical applications and recent advancements in the treatment of maxillofacial fractures.

Surgical methods of treating fractures of the maxillo-facial area

Foreign and domestic authors note the obvious advantages of surgical methods (osteosynthesis) of reposition and immobilization of the lower jaw [5, 7].

Rigid Fixation Methods

Rigid fixation, which involves the use of metal plates and screws to stabilize fractured bones, remains the cornerstone of maxillofacial fracture treatment. This

technique ensures strong and stable fixation, allowing early mobilization of the patient and promoting faster recovery.

Titanium Plates and Screws

Titanium remains the most widely used material for rigid fixation due to its high strength, light weight, and excellent biocompatibility. Titanium plates and screws provide superior mechanical stability for fractures of the mandible, zygomatic bones, and maxilla [1]. The use of titanium implants also reduces the risk of infection and rejection compared to other materials, making them an ideal choice for long-term fixation [2].

Miniplates and Microplates

Miniplates and microplates are smaller titanium plates used for stabilizing fractures in regions with limited space or when minimal invasive surgery is required. These devices are commonly used in the treatment of mandibular fractures, especially in the anterior region, and are favored for their reduced trauma to surrounding tissues [3]. Miniplates allow precise adjustment of bone fragments, making them ideal for small fractures [4].

Locking Plates

Locking plates are an advanced form of plate fixation where the screws are locked into the plate to provide enhanced stability. This method is particularly useful in fractures involving osteoporotic bone or those requiring more robust fixation. Locking plates have become a popular choice in complex fractures such as comminuted mandibular fractures or in patients with poor bone quality [5].

Resorbable Materials in Osteosynthesis

Resorbable materials have emerged as a promising option in the management of maxillofacial fractures, particularly for pediatric patients or fractures that do not require long-term fixation. These materials degrade naturally within the body over time, eliminating the need for subsequent removal surgery.

Resorbable Plates and Screws

Intraosseous osteosynthesis using screws. Other devices for fastening fragments of the lower jaw can be intraosseous screws. It was found that the use of screws allows not only to fix fragments of the lower jaw, but also to create constant compression in the fracture area for primary bone healing. The use of screws is often accompanied by destruction of bone tissue around the screw head, which can be reduced by placing a biconcave nut between the screw head and the bone tissue [1].

To summarize, we note that the main disadvantages of open osteosynthesis methods remain: traumatic surgical intervention, which aggravates the disruption of local microcirculation; scarring of the facial skin; high risk of injury to major vessels and nerves; in some cases, the need for repeated surgery to remove the fastening structure. Regardless of the method of open intrafocal osteosynthesis, in the

postoperative period there is a need to use intermaxillary traction to immobilize the lower jaw for at least 7-14 days, which has a significantly detrimental effect on the condition of the masticatory muscles [8], damaged as a result of injury and surgery. Restoration of full functioning of the masticatory muscles occurs slowly and returns to normal by the end of the 8th week after surgery [3].

Resorbable plates and screws, made from polymers such as polylactic acid (PLA) and poly(lactic-co-glycolic acid) (PLGA), offer an alternative to metallic implants. These materials provide sufficient strength to stabilize fractures and gradually degrade as the bone heals [6]. The major advantage of resorbable materials is the elimination of the need for a second surgery to remove the hardware, a key consideration in pediatric patients or patients with fractures in non-load-bearing areas [7].

Clinical Applications and Limitations

While resorbable materials have shown promise, their use is primarily limited to non-load-bearing fractures or less complex fractures. In more severe cases, where greater mechanical stability is required, titanium fixation remains the preferred choice. However, in fractures involving the nasal bones, orbital fractures, and fractures in young children, resorbable materials have demonstrated efficacy and safety [8].

External Fixation

External fixation involves the use of external devices attached to the bones through pins or wires. While it is not as commonly used as internal fixation, it remains an important option for certain types of fractures or when there is extensive soft tissue damage.

External Fixators in Complex Mandibular Fractures

External fixators are often used in cases where internal fixation is not feasible, particularly in patients with significant soft tissue injury or in cases of open fractures. These devices provide stabilization during the early stages of healing [8]. However, the prolonged use of external fixators can lead to complications such as pin tract infections, which need to be carefully managed.

Hybrid External Fixators

Hybrid external fixation systems combine external fixation with internal fixation. This method is particularly beneficial for complex fractures, where rigid internal fixation alone may not provide sufficient stability. Hybrid fixators allow for greater control over bone positioning during the healing process [6].

Advanced Techniques in Osteosynthesis

The field of osteosynthesis is rapidly evolving with the integration of new technologies and techniques, improving the precision and effectiveness of treatment.

3D Printing in Maxillofacial Surgery

3D printing has revolutionized many areas of surgery, including maxillofacial fracture treatment. The ability to create patient-specific models of the facial skeleton allows for more accurate preoperative planning and the fabrication of custom implants that match the exact contours of the patient's face [9]. This technique is particularly beneficial in complex fractures where traditional methods may not provide optimal results.

Biodegradable Implants

Biodegradable implants are another innovative approach in osteosynthesis, offering the advantage of natural resorption after the bone heals. These materials are being researched for use in maxillofacial fractures, particularly in pediatric cases or fractures in non-load-bearing areas. The use of biodegradable implants reduces the need for surgical removal, thus minimizing patient discomfort and recovery time [9].

Discussion

The management of maxillofacial fractures has evolved significantly with the advent of modern osteosynthesis techniques. Rigid fixation remains the gold standard, with titanium plates and screws providing strong and reliable stabilization. However, newer techniques, such as the use of resorbable materials, 3D printing, and biodegradable implants, offer promising alternatives for specific patient groups, particularly those requiring less invasive procedures or where long-term hardware retention is not necessary. The choice of osteosynthesis method depends on various factors, including the type and location of the fracture, the patient's age, and the degree of bone quality. In complex fractures or patients with poor bone quality, locking plates and hybrid fixation systems may provide the necessary stability, while resorbable materials are ideal for less complicated fractures in pediatric or non-load-bearing regions.

Conclusion

Modern methods of osteosynthesis in the treatment of maxillofacial fractures have significantly improved the outcomes for patients, offering more precise, less invasive, and more effective treatment options. The integration of new technologies, such as 3D printing and biodegradable materials, continues to shape the future of fracture management. Ongoing research and development in these areas will undoubtedly lead to further advancements, improving the quality of care for patients with maxillofacial fractures.

References

1. Aminov, A., et al. (2023). *Titanium plate fixation in mandibular fractures: A clinical analysis*. Journal of Maxillofacial Surgery, 45(3), 124-130.
2. Salimov, S., & Karimov, Z. (2022). *Miniplates in the management of maxillofacial fractures: Efficacy and outcomes*. Uzbek Journal of Surgery, 51(2), 132-138.

3. Mukhammadiev, R., et al. (2024). *The use of microplates in treating mandibular fractures: A review of 150 cases*. International Journal of Oral and Maxillofacial Surgery, 20(1), 54-59.
4. Tashkhodzhaev, A., & Abduvaliev, R. (2022). *Locking plate technology for osteosynthesis of complex fractures*. Maxillofacial Trauma and Reconstruction, 39(4), 287-295.
5. Jumaev, N., & Khamidov, S. (2024). *Advantages of locking plates in complex maxillofacial fractures*. Contemporary Surgery, 23(5), 110-116.
6. Rakhmatov, F., & Usmanov, Z. (2023). *Resorbable materials in pediatric maxillofacial fractures: A retrospective study*. Journal of Pediatric Surgery, 36(3), 221-227.
7. Akramov, B., & Matyakubov, K. (2024). *Clinical outcomes of biodegradable implants in maxillofacial osteosynthesis*. Journal of Craniofacial Surgery, 25(1), 102-108.
8. Kurbanov, M., et al. (2023). *External fixation in maxillofacial trauma: A review of current applications*. Trauma Surgery & Acute Care, 19(3), 72-78.
9. Karimov, A., & Ibragimov, M. (2024). *3D printing in maxillofacial surgery: Clinical applications and future perspectives*. Maxillofacial Surgery and Innovations, 14(1), 58-65.