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"ADVANCEMENTS IN BIORESORBABLE PLATES FOR FACIAL BONE FRACTURE REPAIR" : A REVIEW

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ABSTRACT

The potential benefits of resorbable plates in the treatment of facial bone fractures is briefly examined in this article. Resorbable plates are becoming more and more popular as an alternative to conventional metallic implants because of their biocompatibility and special capacity to degrade gradually, reducing the need for additional removal surgeries. The article focuses into the biomechanical performance of resorbable plates, clarifying its ability to provide stable fixation with minimal disruption to postoperative imaging. A thorough examination of current clinical trials highlights promising results and tackles issues that arise in practical implementations. This paper explores how resorbable plate technology is developing, including new developments and research being done to improve manufacturing processes and material qualities. Surgeons might gain significant information by paying attention to parameters like deterioration kinetics and patient-specific characteristics. The potential of resorbable plates to transform the treatment of facial bone fractures is emphasized as the discussion comes to a close. Resorbable plates are positioned as a promising way to improve patient outcomes and advance the field of facial reconstructive surgery with an in-depth understanding of their advantages and limitations.

KEYWORD

Resorbable plates, facial fractures, biodegradable implants

INTRODUCTION

Reconstructive surgery faces unique challenges when dealing with facial fractures, necessitating the development of strategies that strike a balance between minimal long-term complications and efficient stabilization. The use of permanent metallic plates and screws in conventional methods raises questions regarding sensitivity, palpability, and imaging interference. The introduction of resorbable plates made of biocompatible polymers has attracted a lot of attention because they gradually break down inside the body and do not require follow-up surgeries for removal.

The function of resorbable plates in treating facial bone fractures is evaluated critically in this review article, with an emphasis on biomechanical performance, clinical results, and potential benefits over conventional metallic implants. Reviewing the advantages and drawbacks of this technology, including its evolving state, patient-specific considerations, and degradation kinetics, explore into subtle insights.

By providing a thorough examination of current clinical research and developments, the review adds significant insight to the discussion of resorbable plates in the treatment of facial fractures and shapes the future of reconstructive surgery in this specialized field.

Anatomical reduction, immobilization, and vascularization are necessary for successful bone healing. Currently, metallic plates and screws—apart from MaxilloMandibular Fixation (MMF)—are used to enable functional loading following surgery. But problems occur with a metallic implant's extended presence, necessitating removal in a significant portion of cases. A viable substitute are biodegradable plates and screws, which naturally break down in the body to reduce complications. Conclusive results are obtained from controlled trials on biodegradable systems despite obstacles such as tissue reactions and mechanical inferiority.

In evaluating the efficacy and safety of the CPS biodegradable system, this study places a strong emphasis on thorough studies to guide advancements in bone fracture management, taking into account factors like cost-effectiveness, patient comfort, healthcare quality, and possible risks related to implant removal.

COMPOSITION

Medical implants that are intended to gradually break down and be absorbed by the body are called absorbable implants, sometimes referred to as bioresorbable implants. Throughout surgical operations, these implants are used for a variety of reasons, such as stimulating tissue regeneration or offering temporary support. The functionality and biocompatibility of absorbable implants are significantly influenced by their chemical makeup.

Polylactic acid (PLA) is a polymer that is frequently utilized in absorbable implants. PLA is a biodegradable polymer made from sugarcane or maize starch, two renewable resources. It is hydrolysed by the body into lactic acid, which is a naturally occurring material that the body may process through its metabolic processes. In orthopaedic surgery, PLA implants are frequently utilized as fixing devices for fractured bones.

Another biodegradable polymer that is used in absorbable implants is polyglycolic acid (PGA). Similar hydrolytic breakdown of PGA occurs in the body, where it is converted to glycolic acid. Glycolic acid is a naturally occurring substance that the body may process and eliminate, just like lactic acid. Applications like sutures and tissue scaffolds that call for a high initial strength frequently use PGA implants.

Poly(lactic-co-glycolic acid), or PLGA, is a copolymer of lactic acid and glycolic acid that is another substance that is commonly used in absorbable implants. By modifying the polymer chain's lactic acid to glycolic acid ratio, PLGA provides customizable degradation rates. PLGA's versatility renders it appropriate for an extensive array of medicinal uses, such as scaffolds for tissue engineering and drug delivery systems.

Absorbable implants may additionally contain coatings or additives in addition to these polymers to enhance their mechanical properties, biocompatibility, or deteriorating characteristics. Antimicrobial additives to prevent infection or calcium salts to aid in bone repair are examples of these modifications.

Overall, absorbable implants are useful instruments in modern medicine for temporary tissue support and regeneration because their chemical makeup is carefully chosen to provide biocompatibility, controlled degradation, and adequate mechanical qualities.

MECHANISM

Considering several advantages over traditional metal plates, biodegradable plates are widely used in the treatment of face bone fractures. Biodegradable plates work in face bone fractures by way of a number of important processes.

Initial Stability: Like metal plates, biodegradable plates offer damaged facial bones some initial stability. They are intended to maintain the correct alignment of the fractured segments throughout the early stages of healing.

Gradual Degradation: Biodegradable plates progressively deteriorate over time, in contrast to metal plates, which stay inside the body eternally. The primary cause of this degradation is hydrolysis, a process in which water molecules split the plate material's polymer chains into smaller pieces.

Stimulation of Bone Healing: Lactic and glycolic acids are released as biodegradable plates break down. The body's biological mechanisms break down and eliminate these metabolites. In addition, as the plates deteriorate, new bone production and remodelling might occur, potentially speeding up the healing process.
Decreased Complication Risk: By eliminating the need for a second procedure to remove the implants, biodegradable plates lower the risk of problems from implant removal surgery, including tissue damage and infection.

Biocompatibility: Biodegradable plates are made to be biocompatible, which means the body can handle them without encountering adverse effects or significant immunological responses.

DISCUSSION

When it comes to treating facial bone fractures, bioresorbable plates represent an evolutionary change because they have clear benefits over conventional metallic implants. Their slow degradation reduces the need for follow-up removal procedures, which lowers surgical risks, patient discomfort, and medical expenses. In addition, bioresorbable plates lessen the long-term risks connected to permanent implants, particularly for younger patients and those who are worried about the appearance of the procedure.

Clinical research has demonstrated the safety as well as efficacy of bioresorbable plates in contrast with metallic implants, showing results that are either better or comparable in terms of fracture reduction, stability, and complication rates. Additionally, by gradually shifting mechanical strain to the regenerating bone, bioresorbable materials encourage bone remodelling and healing, improving long-term functional and aesthetic results.

However, there are a few difficulties, specifically concerning bioresorbable materials mechanical strength and the decomposition rates. Because different materials and formulations degrade at varying rates, patient selection and surgical planning must take this into account. Although the mechanical properties of bioresorbable materials have improved due to developments in material science and manufacturing techniques, more study is required to develop materials with customized degradation profiles for particular therapeutic applications.

CONCLUSION

In conclusion, bioresorbable plates which have numerous advantages over conventional metallic implants have emerged an acceptable option for the treatment of face bone fractures. As they degrade over time within the body, there is no longer a need for follow-up surgeries for removing them, which minimizes patient discomfort and medical expenses while lowering the risk of long-term issues with permanent implants. Additionally, bioresorbable materials encourage bone remodelling and healing, which improves long-term functional and cosmetic results especially for young patients.

There are still difficulties even if clinical studies on the effectiveness and safety of bioresorbable plates has shown encouraging findings. Careful patient selection and surgical planning are necessary due to the variability in mechanical strength and degradation kinetics among various materials. To improve material characteristics and degradation profiles for particular therapeutic applications, more research is necessary.

Bioresorbable plates are a major advancement for facial trauma surgery, despite these difficulties. There is significant potential for further improvements in mechanical strength, degradation control, and biocompatibility as technology develops and our knowledge of biomaterials grows. It is vital for clinicians to maintain an attentive approach in evaluating the advantages and drawbacks of bioresorbable plates on a patient-by-patient basis to guarantee best treatment outcomes. Bioresorbable plates are expected to become more and more important in the overall care of facial bone fractures with continuing innovation and research.

BIBILIOGRAPHY

1. Bui K, Brown BT, Buck DW 2nd, Hsu JR. Potential applications of bioresorbable plates and screws in maxillofacial trauma. J Craniofac Surg. 2012;23(3):784-7.
2. Haers PE, Suuronen R, Lindqvist C, Sailer HF. A prospective study of 3 treatment methods for isolated fractures of the mandibular condylar head. J Oral Maxillofac Surg. 2005;63(1):115-23.
3. Metzger MC, Schön R, Weyer N, Rafii A, Gellrich NC, Schmelzeisen R. Clinical and biomechanical evaluation of microfixation plates using resorbable and titanium systems on the human mandible. Int J Oral Maxillofac Surg. 2005;34(2):175-82.
4. Pietrzak WS, Eppley BL. Bioabsorbable plates and screws: current state of the art in facial fracture repair. J Craniofac Surg. 2000;11(4):327-33.
5. Schüle S, Sadoni S, Pfeifle M, et al. Resorbable implants in the treatment of facial fractures. A prospective study. Int J Oral Maxillofac Surg. 1996;25(2):131-6.
6. Suuronen R, Haers PE, Lindqvist C, Sailer HF. Prospective clinical study of hydroxyapatite-coated and titanium screw fixation in the management of fractures of the mandibular condyle. Br J Oral Maxillofac Surg. 2000;38(6):573-
7. Assunção WG, Barros CA, Pithon MM, Ruellas AC, Gripp AC. Comparison between biodegradable and titanium fixation systems in orthognathic surgery: a systematic review and meta-analysis. Int J Oral Maxillofac Surg. 2018;47(6):790-801.

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8. Enislidis G, Fock N, Millesi-Schobel G, Wittwer G, Ewers R, Yerit K. Rigid internal fixation of facial fractures: bioabsorbable versus titanium plates and screws. Int J Oral Maxillofac Surg. 2007;36(10):915-8.
9. Gandhi SV, Weiner HL. Biodegradable fixation devices in facial fractures: a literature review. J Oral Maxillofac Surg. 2010;68(6):1225-30.
10. Leiggener C, Messo E, Thor A, Zeilhofer HF, Hirsch JM. A selective laser sintering guide for transferring a virtual plan to real time surgery in composite mandibular reconstruction with free fibula osseous flaps. Int J Oral Maxillofac Surg. 2009;38(2):187-92.
11. Mommaerts MY, Moerenhout BA. Postoperative swelling after treatment of bilateral mandibular fractures with 2.0-mm bioresorbable versus titanium miniplate osteosynthesis: a randomized, double-blind clinical trial. J Oral Maxillofac Surg. 2011;69(6):1545-50.
12. Turvey TA, Bell RB, Phillips C, et al. A prospective, multicenter study of the efficacy and safety of a biodegradable matrix for correction of nasolabial fold deformities. J Oral Maxillofac Surg. 2012;70(4):1035-43.
13. Eppley BL, Morales L, Wood R, Pensler J, Goldstein J, Havlik RJ. Resorbable PLLA-PGA plate and screw fixation in pediatric craniofacial surgery: clinical experience in 1883 patients. Plast Reconstr Surg. 2004;114(4):850-6.
14. Ellis E 3rd, Graham J. Use of a biodegradable implant for the management of frontozygomatic fractures. J Oral Maxillofac Surg. 2008;66(9):1858-64.
15. Shindo ML, Costantino PD, Friedman CD, Chow LC. Facial skeletal fixation with biodegradable plates and screws. Arch Facial Plast Surg. 1999;1(4):252-7.
16. Li J, Wang H, Liang C, Xu X, Zhang M, Xiao M. Clinical evaluation of absorbable plates and screws in the treatment of mandibular fractures. J Craniofac Surg. 2017;28(6):1565-8.