Article

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Hammond, Douglas and Parmar, Sat (2013) A Review of the Use of Resorbable Plateing Systems in Cranio-Maxillofacial Surgery. Tropical Medicine & Surgery, 1 (6). p. 151. ISSN 2329-9088

It is advisable to refer to the publisher's version if you intend to cite from the work.
http://dx.doi.org/10.4172/2329-9088.1000151

Hammond and Parmar, Trop Med Surg 2013, 1:6
http://dx.doi.org/10.4172/2329-9088.1000151

Tropical Medicine & Surgery

Mini Review Open Access

A Review of the Use of Resorbable Plateing Systems in Cranio-Maxillofacial Surgery

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Abstract

Resorbable materials have been used for many different procedures in cranio-maxillofacial surgery. However, they have had varying rates of success. The use of resorbable for oncological reconstruction is a relatively new area, compared with paediatric trauma and orthognathic surgery.

Keywords: Resorbable plating system; Cranio-Maxillofacial Surgery

Resorbable materials have been used as fixation materials in cranio-maxillofacial surgery [1]. In contrast to titanium plating systems, resorbable plating systems have not been used on a large scale for the fixation of mandibular fractures or for bony free flap fixation.

Nevertheless, the onset and popularity of the combination of polylactic and polyglycolic acids has shown these new materials are being frequently used. There is no doubt left about the usefulness in paediatric applications, but there is still controversy on its use in maxillofacial surgery of adult patients [2]. When using titanium plates, sometimes it is necessary to perform a second operation for the removal of these screws. All the disadvantages inherent to metallic materials such as palpation, sensitivity, migration, possible bone resorption, allergies, and growth delays in children have led to the development of resorbable materials [3]. However, biodegradable materials cause inflammation, it is then necessary to allow for a phase that will enable resorption without causing toxic reactions. Resorbable bicortical screws have been used in craniofacial surgeries, and several studies prove the security and effectiveness reached when using these materials in mandibular osteotomies [4].

Yerit et al. [5] in 2005 performed the largest single trial of poly-L/D-lactide resorbable plates in sixty-six consecutive patients with mandibular fractures (22 female, 44 male; mean age, 23.9 years). A total of 89 fractures at various sites of the mandible were included in the study. It was found that the self-reinforcement technique provided sufficient mechanical stability of the implants for primary healing of these high-load mandibular bone areas. Postoperative complications were transient and limited to wound dehiscence and localized wound infection (two patients). In some patients, hyperaesthesia (three patients) or slight pain (10 patients) was reported at the 1-year recall examination, but implant-related serious adverse tissue reactions were not observed during the follow-up (mean, 24.4 months; range 6.4 to 44.3 months). This suggested that resorbable plates have a place in the mainstream of mandibular fractures.

There have been two high quality review articles with regard to the use of biodegradable/ resorbable paltes. The first article [6], reviewed twenty-two articles detailing 19 studies, including 1 randomized controlled trial. These studies included fixation of mandibular fractures at various locations or fixation of bilateral sagittal split osteotomies. Overall, a total of 326 patients treated with resorbable plates and screws and 112 patients treated with resorbable screws alone were analysed. Analysis of these studies indicates that several material types are used in resorbable mandibular implants, including poly-L-lactic acid (PLLA) and 70% poly-L-lactic acid/30% poly-D,L-lactic acid (PLLA 70/PDLLA 30), coming from at least 10 different manufacturers. Mean follow-up ranged from 3 to 348 weeks. Based on the reported data, of 14 to 15 infections, 2 foreign body reactions, 7 malocclusions, 8 malunions, and 8 to 10 premature removals in the plate group and 1 foreign body reaction and 2 malocclusions in the screws-only group were found. This systematic review concluded the need for further randomized controlled trials in this area.

The Cochrane Review [7], reviewed 53 potentially eligible studies. The review illustrated that there are no published randomised controlled clinical trials relevant to this review question. It concluded that there is currently insufficient evidence for the effectiveness of resorbable fixation systems compared with conventional titanium systems for facial fractures. The review found that, based on the results of the aborted trials, do not suggest that resorbable plates are as effective as titanium plates. It was suggested that, in the future, the results of ongoing clinical trials may provide high level reliable evidence for assisting clinicians and patients for decision making.

There are complications with titanium plate and screw fixation of vascularised free bone graft/ bony free flap reconstruction of the mandible. Knott et al. [8] reviewed 290 titanium plates used to fixate free flap defects of the mandible. They found that 14.8% of all plates needed removal because of hardware related complications. Fourteen of these plates required removal because of plate extrusion or osteoradionecrosis. Predictors of success or failure associated with plate removal were previous treatment with hyperbaric oxygen ($P<.001$), radiation therapy ($P<.001$), and cancer recurrence ($P=.03$) were statistically significant predictors of Locking Mandibular Reconstruction Plate (LMRP) related complications at univariate analysis. At multivariate analysis, previous treatment with hyperbaric oxygen ($P<.046$) remained a statistically significant predictor of LMRP-related complications. LMRPs are highly effective for fixation of vascularized bone grafts, with a high incidence of bone-graft healing and a low incidence of complications

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Received August 17, 2013; **Accepted** October 15, 2013; **Published** October 20, 2013

Citation: Hammond D, Parmar S (2013) A Review of the Use of Resorbable Plateing Systems in Cranio-Maxillofacial Surgery. Trop Med Surg 1: 151. doi:10.4172/2329-9088.1000151

related to lose screws. Nevertheless, there remains a 15% incidence of hardware-related complications, most related to hardware extrusion. Whilst previous treatment with hyperbaric oxygen is a statistically significant predictor of LMRP-related complications, treatment with hyperbaric oxygen is time consuming, expensive and can be difficult for patients with multiple co-morbidities.

Bayram et al. [9] compared the fixation reliability and stability of titanium and resorbable plates and screws by simulating chewing forces. Sheep hemimandibles were mounted with a fixation device in a servohydraulic testing unit for compressive testing. Displacement values under 20, 60, 100, 120, 150, and 200 N; maximum displacements; and maximum forces that the model could resist before breakage were noted. Significant differences were found between resorbable and titanium plates and screws at all forces ($P<.05$). However no statistically significant differences in the breaking force and maximum displacement values (displacement values at the breaking forces) between the groups. This is interesting as it suggests that until there is osseo integration, it is the functional use of the mandible that leads to the failure of the resorbable plate.

A study of 54 patients with a mean postoperative follow up of 63 months were reviewed retrospectively [10]. In addition, each patient completed a 12-item scaled questionnaire to assess perception of pain, speech, mastication and deglutition on recipient site. This showed that Mastication Functional scores on mastication were low for both sexes.

In oncological reconstruction of the mandible, patients are frequently fed via a Percutaneous Endoscopic Gastrostomy or with Nasogastric tube. Initially this is to allow the soft tissue element of the reconstruction to heal, however if the soft tissue reconstruction involves the swallowing mechanism, it may be to prevent aspiration. It may be continued or commenced, due to the complications of post operative radiotherapy, to allow the patient to undertake appropriate calorific intake. Most commonly patients are managing with a pureed diet which requires little mastication. This shows that in the healing period of the reconstruction, very few patients are eating a normal diet compared to patients with a fractured mandible. Post operative radiotherapy takes place normally 4 to 6 weeks after surgery and lasts normally for 6 weeks. This means that when function is being fully restored, the mandible will have fully osseointegrated with the free flap.

Therefore in oncological reconstruction of the mandible, the significant differences between resorbable and titanium plates in compression [9,10] are irrelevant as the mandible is not placed under the same functional stresses.

The biomechanics of mandibular free flap reconstruction are different to that of a fractured mandible.

When choosing a plate to achieve rigid fixation of a mandibular fracture, we recommend the following

important characteristics:-

1. The plate should be simple to place.
2. The plating system should require minimum specialized training for the surgeon to use it proficiently.
3. The plate should have appropriate strength to meet the mechanical demands during fracture healing.
4. A resorbable plate should be biocompatible and degrade in a predictable fashion, maintaining sufficient strength until the bone has healed.
5. A resorbable plate should resorb completely within a reasonable period of time with minimal inflammation.

We also understand the significant problems with titanium fixation [8], such as a 15% rate of hardware extrusion and osteordionecrosis. We are confident that by using resorbable plates this will prevent this happening; however a randomised controlled trial is required to prove this.

References

1. Turvey TA, Bell RB, Tejera TJ, Proffit WR (2002) The use of self-reinforced biodegradable bone plates and screws in orthognathic surgery. J Oral Maxillofac Surg 60: 59-65.
2. Suuronen R, Kallela I, Lindqvist C (2000) Bioabsorbable plates and screws: Current state of the art in facial fracture repair. J Craniomaxillofac Trauma 6: 19-27.
3. Yerit KC, Enislidis G, Schopper C, Turhani D, Wanschitz F, et al. (2002) Fixation of mandibular fractures with biodegradable plates and screws. Oral Surg Oral Med Oral Pathol Oral Radiol Endod 94: 294-300.
4. Shand JM, Heggie AA (2000) Use of a resorbable fixation system in orthognathic surgery. Br J Oral Maxillofac Surg 38: 335-337.
5. Yerit KC, Hainich S, Turhani D, Klug C, Wittwer G, et al. (2005) Stability of biodegradable implants in treatment of mandibular fractures. Plast Reconstr Surg 115: 1863-1870.
6. Agarwal S, Gupta A, Grevious M, Reid RR (2009) Use of resorbable implants for mandibular fixation: a systematic review. J Craniofac Surg 20: 331-339.
7. Dorri M, Nasser M, Oliver R (2009) Resorbable versus titanium plates for facial fractures. Cochrane Database Syst Rev: CD007158.
8. Knott PD, Suh JD, Nabili V, Sercarz JA, Head C, et al. (2007) Evaluation of hardware-related complications in vascularized bone grafts with locking mandibular reconstruction plate fixation. Arch Otolaryngol Head Neck Surg 133: 1302-1306.
9. Bayram B, Araz K, Uckan S, Balcik C (2009) Comparison of fixation stability of resorbable versus titanium plate and screws in mandibular angle fractures. J Oral Maxillofac Surg 67: 1644-1648.
10. Hölzle F, Kesting MR, Hölzle G, Watola A, Loeffelbein DJ, et al. (2007) Clinical outcome and patient satisfaction after mandibular reconstruction with free fibula flaps. Int J Oral Maxillofac Surg 36: 802-806.

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