

Use of Resorbable Plate and Screws in Pediatric Craniofacial Reconstructive Surgery

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Background: To evaluate two pediatric patients with syndromic craniofacial anomaly that underwent craniofacial reconstructive surgery using resorbable plate-screw systems which have been claimed as biodegradable fixation materials and used in craniofacial reconstructive procedures owing to their advantages such as adequate biomechanical resistance, longer dwelling time, elimination through physiological routes without causing any foreign body reaction and/or significant sequale.

Patient and Method: Resorbable plate-screw systems used in 2 patients for craniofacial reconstructive procedures such as bilateral fronto-orbital advancement and segmental right orbita (four wall box) osteotomy were evaluated as for their efficacy.

Result: Adequate fixation was obtained in both patient, but Infection complication was seen in segmental right orbita osteotomy patient that appear localized abscess formation on subciliary incision and fronto medial insicision. After drainage insicision and antibiotic administration for 1 week, the infection was relieved.

Summary: Owing to resorbable copolymer which contain a polyester derivate of L- lactide and glycolic acid are ideal fixation materials used favourably in pediatric craniofacial reconstructive surgery and have further advantages such as adequate biomechanical resistance against distraction and compression forces in the early postoperative period, longer dwelling time and elimination from the body through physiological routes without causing any foreign body reaction.

Keywords: Craniofacial surgery, resorbable plate screw

Latar Belakang: Mengevaluasi dua pasien anak dengan sindrom kelainan kraniofasial yang menjalani operasi rekonstruksi kraniofasial dengan menggunakan sistem resorbable plate-screw, yang telah diklaim sebagai material fiksasi biodegradabel dan keuntungan mereka seperti resistensi biomekanik yang memadai, waktu tinggal lebih lama, eliminasi melalui rute fisiologis tanpa menimbulkan reaksi benda asing dan/ atau sekuel signifikan.

Pasien dan Metode: Sistem resorbable plate-screw digunakan pada dua pasien anak yang menjalani prosedur rekonstruksi kraniofasial yaitu bilateral fronto-orbital advancement dan segmental right orbita (four wall box) osteotomy, dievaluasi keberhasilannya.

Hasil: Pada kedua pasien didapatkan hasil fiksasi yang memadai, tetapi komplikasi infeksi terjadi pada pasien yang menjalani segmental right orbita osteotomy yaitu timbul lokal abses pada insisi frontomedial dan subsilier. Setelah dilakukan insisi drainase dan pemberian antibiotik selama tujuh hari didapatkan infeksi mereda.

Ringkasan: Kopolimer resorbabel berisi derivat poliester dari L-lactid dan asam glikolat merupakan materi fiksasi yang ideal digunakan pada operasi rekonstruksi kraniofasial pada anak dan memiliki keunggulan seperti resistensi biomekanik yang memadai melawan tarikan dan tekanan pada awal periode pasca operasi, waktu tinggal lebih lama dan eliminasi dari tubuh melalui rute fisiologis tanpa menimbulkan reaksi benda asing.

Kata kunci : Craniofacial surgery, resorbable plate screw

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Various bone fixation materials have been used in maxillofacial surgery. In addition to conventional techniques

such as fixation with suture materials and wires, metal-plating systems have been widely used. Recently, "resorbable platescrew systems" have attracted attention as an

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efficient fixation system, and started to be used more commonly for various indications.¹

Resorbable plating systems are polymers consisting of varying compositions of polylactic acid and polyglycolic acid copolymers. In the early period of their evolution, many problems were encountered such as foreign body reactions, and persistence in the body for longer periods than desired as they contained high molecular weight polylactic acids.^{2,3} Through the rapid development of polymer technology and regulation of polylactic acid/polyglycolic acid ratios, almost ideal fixation materials have been obtained at present. Current materials are completely biocompatible, and have adequate biomechanical resistance and can be eliminated from the body without causing any foreign body reaction.^{4,5,6,7} The alterations in the polylactic acid/polyglycolic acid ratio also changed the dwelling time in the body and the rate of biomechanical resistance.⁸

Resorbable plate-screw systems can be completely excreted through physiological routes. Since the material is composed of essentially aliphatic hydroxy acid polymers, breakdown occurs through hydrolyzation and end products are carbon dioxide and water.^{9,10} The degradation of polylactic acid polymers is quite slow owing to their hydrophobic semicrystalline structure. Conversely, polyglycolic acid polymers have a rapid degradation process due to their highly amorphous structure and increased hydrolytic activities.¹¹ Here we present a congenital cranio-maxillofacial reconstructive procedures.

PATIENT AND METHOD

In our hospital, resorbable plate-screw systems (Lactosorb FL) were used for the reconstruction of two patients with congenital craniofacial anomalies. Resorbable plate screw systems consist of plates of various shape, length and thickness and screws at corresponding sizes and weights. Plates at varying sizes according to the application site and the indication offer rich reconstruction alternatives. First of all the plates at the form and size suitable for the reconstruction planned

are selected. Afterwards appropriate plate and screw is chosen and an indicated hole size is opened with a drill and screwing it to the system with special screw drivers. During this procedure, care should be taken in manipulating the material, as they are more sensitive and fragile than metal plate and screws.

Two cases that reconstructed by means of resorbable plate screw systems in our clinic are presented:

Case 1

An eighteen month-old boy was referred to our hospital with calvarial deformities and facial anomalies include hypertelorism, exophthalmos, strabismus, beaked nose, short upper lip, hypoplastic maxilla, and relative mandibular prognathism. Multiple sutural synostoses frequently extend to premature fusion of the skull base sutures, causing these clinical features named Crouzon syndrome.

A fronto-orbital craniotomy extended to the fused coronal sutures was performed. Following fronto-orbital advancement of the orbital bar and frontal bone, the bony segments were fixated with biodegradable plate-screws. The customized helmet was used post-operatively.

Case 2

A three years old boy was referred to our hospital with amniotic band sequence syndrome. A segmental right orbital osteotomy was performed. Following orbital advancement of the orbital bar to the medial, the bony segments were fixated with biodegradable plate-screws.

RESULT

No infection, local-systemic allergic reaction or inadequate fixation were observed in first patients. Postoperative shape of the cranial vault was satisfactory and no early or late postoperative complications were seen.

In second patient, post-operative infection complication was seen that appeared as localized abscess formation on subciliary

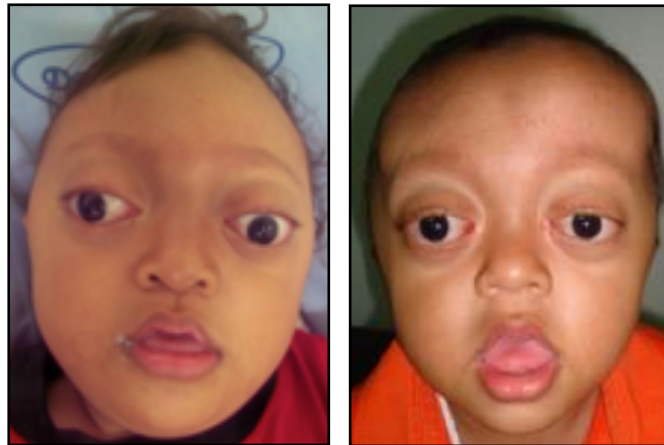


Figure 3. Case 1, A 18-month-old baby presents with calvarial deformities and facial anomalies. A fronto orbita advancement was performed. **Left** : Before surgery. **Right** : At 4-month follow-up, reduce of hypertelorism is demonstrated.



Figure 1. Case 1. **Upper Left and Right** :Three-dimensional computed tomographic scan reconstruction of the skull shown the fused of coronal sutures. **Lower Left and Right** :Lateral orbital shaped and stabilized with long-spanning single-row resorbable plates (1.5 mm).



Figure 4. Case 2, a 3-years-old kid presents cleft lip and palate that already performed cleft lip repair and facial dismorfic. A segmental right orbita osteotomy was performed. **Left :** Before surgery. **Right :** At 1-week follow-up, the infection on subciliary incision and fronto medial insicion was relieved.

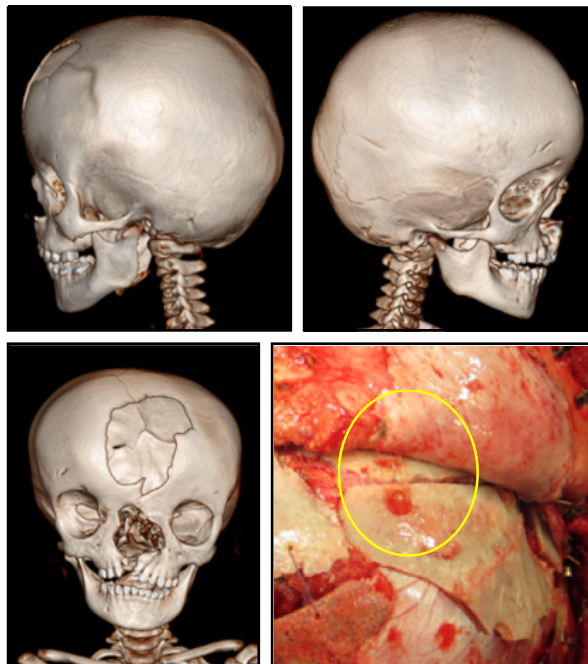


Figure 2. Case 2. **Upper Left and Right, Lower Left :**Three-dimensional computed tomographic scan reconstruction of the skull shown cleft palate and a long distance between orbital bone. **Lower Right :** Supraorbital, medial orbita and lateral orbita shaped stabilized with long-spanning single-row resorbable plates. (1.5 mm).

incision and fronto medial insicion. After drainage insicion and antibiotic administration for 1 week, the infection was relieved. He had no complaints on his postoperative follow up.

DISCUSSION

Metal plate screw systems enable adequate fixation in bone healing process. Yet,

their effects such as limiting bone growth especially in pediatric age group have prompted investigators to look for alternative fixation materials in the reconstruction of trauma and craniofacial anomalies.¹² Ideal fixation materails should have adequate biomechanical resistance against distraction and compression forces in the early postoperative course as well as making bone healing possible

without causing foreign body reaction in the later period.^{9,6,13} Another disadvantage of metal plate-screw systems is that they may undergo "intracranial migration".^{14,15} There are some case reports in the literature, where metal plate-screws progressed as far as dura mater and cause neurological seizures and necessitated their removal with reoperation. Furthermore, metal plate-screws might lead to destruction and osteoporosis in the surrounding bone tissue.¹⁶

Metal plate screws used in regions where dermis and subcutaneous tissue are relatively thin, such as forehead. These regions may be conspicuous and felt by inspection and palpation.¹⁷ Most of the patients present with subjective complaints such as, a sense of cold and pain on their face. These cosmetic problems and discomforting complaints necessitate a second operation for the removal of plate screw systems. In addition, metal plate systems may be displaced or cause artifacts on radiograms, being influenced by the magnetic field produced during MRI.^{9,18} Moreover, they have heating problems during radiotherapy.

Resorbable plate and screw which has resistance against distraction and compression forces is comparable with that of metal plate-screw systems in the early era of the reconstruction. They are completely removed in 12-18 months without producing any foreign body reaction.^{9,19,20} Bone healing was also comparable with metal plate screw in clinical and radiological examinations. Similar results have been obtained in animal studies and their histological examinations^{21,22} Because of their self removal after a period of time, resorbable fixation system is an excellent alternative among pediatric patient group. Complete resorption of the plates and screws at the fracture site by biodegradation let the craniomaxillofacial bones continue their physiological growing. Although successful applications of biodegradable systems on various sites of craniofacial anatomy are well known, fixation of weight bearing bones remains controversial.^{23,24}

At present, the most important problem with resorbable plating systems is their higher cost than their metal counterparts. Compared to metal platescrew systems, plate or screw

systems are much more expensive. However, their advantages such as low infection rates and minimization of the need for secondary operations make them an attractive option.

SUMMARY

Bioresorbable fixation materials are ideal fixation materials used favourably in pediatric craniofacial reconstructive surgery that they make effective fixation and have further advantages such as adequate biomechanical resistance against distraction and compression forces in the early postoperative period, longer dwelling time and elimination from the body through physiological routes without causing any foreign body reaction or significant sequaleae.

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