

Polydioxanone suture fixation for the repair of pediatric maxillofacial fractures

Hakan Cinal¹, Osman Enver Aydin², Onder Tan³, Said Algan⁴, Murat Kara⁵, Kerem Yilmaz⁵, Harun Karaduman⁶

¹Zonguldak Bulent Ecevit University, Faculty of Medicine, Department of Plastic Reconstructive and Aesthetic Surgery, Zonguldak, Turkey

²Adnan Menderes University, Faculty of Medicine, Department of Plastic Reconstructive and Aesthetic Surgery, Aydin, Turkey

³Private practice, Tanes Aesthetic and Plastic Surgery Clinic, Istanbul, Turkey

⁴Private practice, Linemed Aesthetic and Plastic Surgery Clinic, Istanbul, Turkey

⁵Ataturk University, Faculty of Medicine, Department of Plastic Reconstructive and Aesthetic Surgery, Erzurum, Turkey

⁶Yildirim Beyazit University, Ankara City Hospital, Department of Plastic Reconstructive and Aesthetic Surgery, Ankara, Turkey

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Abstract

Aim: Unique pattern of the pediatric facial skeleton and its fractures confers a special issue to take into account. Conservative management, occlusal splints and wiring techniques are popular among pediatric facial fractures. As titanium plates require plate removal after the fracture healing, resorbable plates have gained popularity. However, they are expensive and it may not be possible to obtain resorbable plates in some medical facilities. This led us to question the mechanical stability and functional outcome after fracture fixation using polydioxanone (PDS) sutures.

Material and Methods: Seven children with maxillofacial fractures were included in this study. After limited sufficient dissection and periosteal stripping the fracture lines were reduced and four holes were made with a drill on preoperatively planned sites where no tooth buds were projected. After that a number 2 PDS loop suture was passed through these holes in a figure of eight fashion and tied to stitches after sufficient stability and anatomic reduction.

Results: No complication occurred, except for two cases that had tooth extractions.

Conclusion: To sum up, PDS suture fixation in a figure of eight fashion is a feasible and cheap alternative to titanium and resorbable plate systems.

Keywords: Pediatric maxillofacial fractures; polydioxanone; resorbable mini plates; titanium mini plates

INTRODUCTION

Maxillofacial trauma is one of the most common causes of morbidity that a trauma surgeon faces. While internal reduction and rigid fixation with titanium mini plates is the most prominent method of management in adults, that is not the case in pediatric group.

Many studies have shown that the mandible is a predilection site for pediatric facial fractures (1,2). In young children, the deciduous dentition and tooth buds restrict the placement of the plates. Furthermore, the titanium plates require removal. Conservative management, splints and wiring techniques are popular among pediatric facial fractures. As titanium plates require plate removal after the fracture healing, resorbable plates have gained popularity. Resorbable plates have some disadvantages like chronic inflammatory reaction,

high cost and incomplete resorption. Furthermore, the latter disadvantages of titanium and resorbable plates have led authors to search for better options. Dumbach and Rasse et al., have used polydioxanone (PDS) material for fixation of mandibular fractures (3,4).

Unique properties of pediatric facial fractures have led us to question the functional outcome after fracture fixation using PDS sutures. This paper focuses on our series of maxillofacial fractures that we treated using a figure of eight technique with PDS sutures.

MATERIAL and METHODS

Patient selection

Seven consecutive pediatric facial fracture cases who were admitted to hospital without condylar fractures were included in this study. This study was approved

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Corresponding Author: Hakan Cinal, Zonguldak Bulent Ecevit University, Faculty of Medicine, Department of Plastic Reconstructive and Aesthetic Surgery, Zonguldak, Turkey E-mail: mdcinal@gmail.com

by the Institutional Ethics Committee and conducted in compliance with the ethical principles according to the Declaration of Helsinki.

Operative technique

After endotracheal intubation, vasoconstrictor solution was injected to the operation site. Appropriate incisions were made to expose the fractures. After limited and sufficient dissection and periosteal stripping the fracture lines were reduced and four holes were made with a drill on preoperatively planned sites where no tooth buds were projected. After that a number 2 PDS loop suture (PDSII, Ethicon Johnson and Johnson Medical Ltd., Simpson Parkway, Livingston, UK) was passed through these holes in a figure of eight fashion and tied to stitches after sufficient stability and anatomic reduction. Next, semi-rigid fixation of the incision was closed primarily with 4/0 polyglactin 910 (Vicryl Rapide, Ethicon Johnson and Johnson Medical Ltd., Simpson Parkway, Livingston, UK).

Case 1

Nine years old girl fell over a high wall. She had a history of orthodontic treatment for malocclusion. Lateral cephalogram showed maxillary retrusion. Radiological evaluation revealed she had Le Forte 1 fracture. PDS sutures were used for fixation of the pterygoid and nasomaxillary buttresses. Anterior posterior incisor relation was deformed; however, this was developmental in origin. Midline relation was normal (Figure 1, 2, 3).

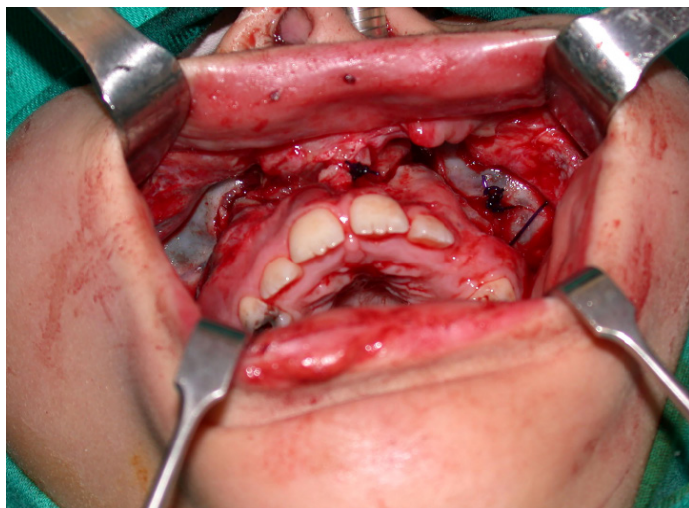


Figure 1. Le Forte 1 fracture. Left side fixated with PDS sutures

Case 2

Five years old boy fell from a tree. He had malocclusion in the emergency room. X-ray and physical examination revealed symphyseal fracture. Two separate PDS sutures combined with steel interdental wiring were used to fixate the fracture. 7 Months later his permanent incisors erupted. (Figure 4, 5)

Case 3

Three years old boy suffered facial trauma in a car crash. He had a symphyseal fracture. PDS fixation combined with steel wire was used for fixation. He had no malocclusion

or any complication at the end of the 12th month. X-ray revealed developing tooth buds (Figure 6, 7, 8, 9).

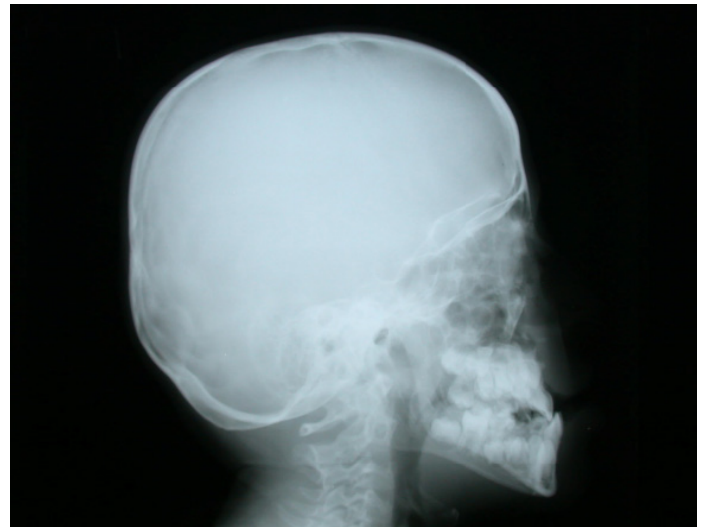


Figure 2. Preoperative view of the patient. Note maxillary retrusion on lateral cephalogram



Figure 3. Postoperative view, note incisive overbite. Maxillary and mandibular midlines overlap

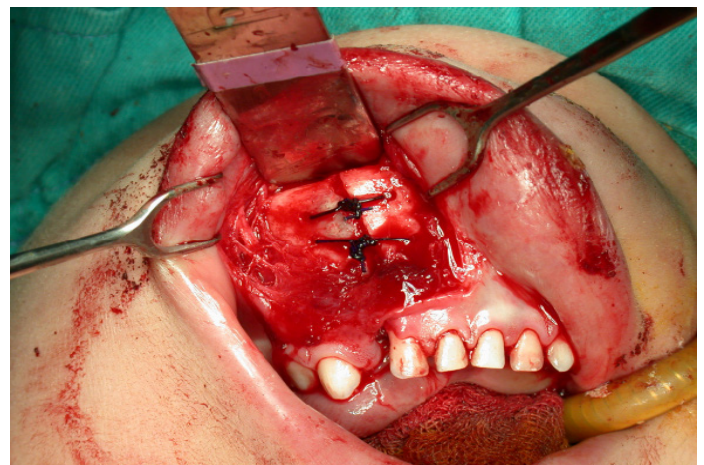


Figure 4. The fracture was reduced and fixated with two interrupted PDS sutures. Note fracture line just medial to the canine tooth.



Figure 5. Postoperative 7th month. Note erupting incisive teeth on the fracture line

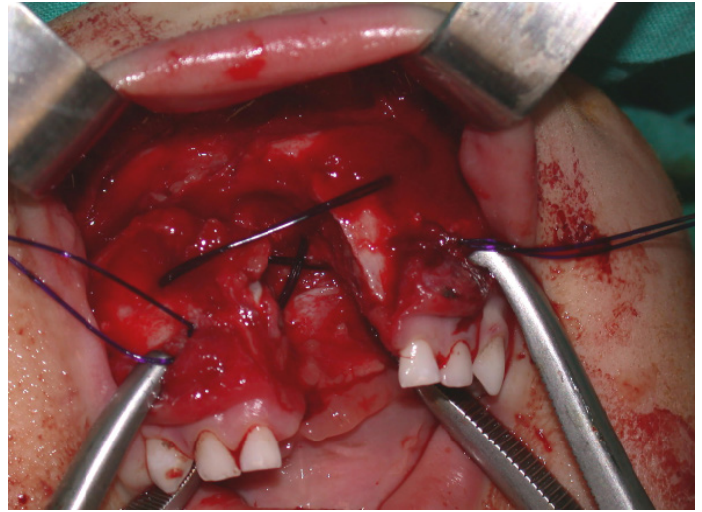


Figure 6. A-Perioperative view of a symphyseal fracture. Double strand PDS suture was passed through the holes on both sides of the fracture line

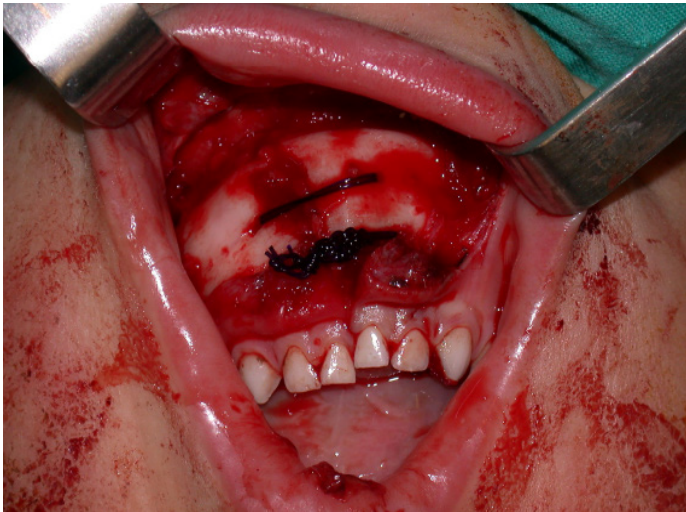


Figure 7. The fracture was reduced and fixed with PDS suture in figure of eight fashion. Note incisor level discrepancy

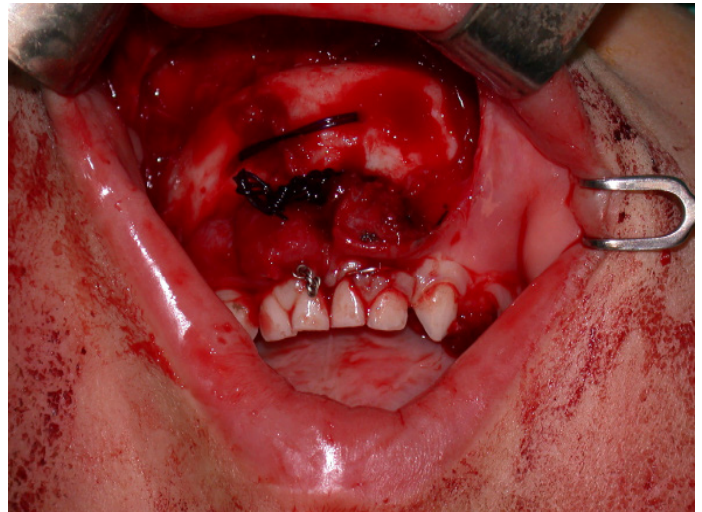


Figure 8. Steel wire was then used



Figure 9. Postoperative 12th month. Note unerupted tooth buds are developing

RESULTS

There were 7 patients and 8 fracture lines treated with this technique. Average age was 6.4 (3-9 years) and 6 were male. Horse kick was mostly seen in the etiology. Five of the cases had fracture of the mandible; one had a maxillary fracture and one zygomatic fracture. While three cases were managed using separate PDS sutures, 4 cases were fixed using one or more figure of eight sutures. Interdental wiring was done when needed. Steel wires were removed 4 weeks later. Mean follow-up duration was 15.2 months (8-30 months). Two of the cases had 2 teeth, which were on the fracture line, extracted eventually. No other complication was evident. The patient group is summarized in the table (Table 1).

Table 1. Summary of the results

Patient no	Age (Years)	Sex	Etiology	Location of fracture (s)	Number of PDS-sutures	Complication	Follow-up time (Months)
1	9	F	Falling	Maxilla-Le Forte I	3 (separate)	None	9
2	5	M	Falling	Mandibula-symphysis	2 (separate)	None	13
3	3	M	Traffic accident	Mandibula-symphysis	1 (figure of 8)	None	8
4	4	M	Falling	Mandibula- left parasymphysis	1 (figure of 8)	2 teeth extraction	23
5	8	M	Horse Kick	Mandibula- bilateral parasymphysis	2 (figure of 8)	None	30
6	8	M	Horse Kick	Mandibula- left parasymphysis- communitied	2(figure of 8)	2 teeth extraction	16
7	8	M	Horse Kick	Zygoma	2 (Separate)	None	8

DISCUSSION

Childhood maxillofacial fractures are not very often seen. However, when it happens, mandible is mostly affected (1,2). Pediatric mandibular fractures differ from adult mandibular fractures. Pediatric mandible mandates minimal dissection of the fracture line. It has been suggested that soft tissue dissection of the facial bones disrupt facial growth (5). Furthermore, an alternative treatment modality that is often used in adults, intermaxillary fixation (IMF) cannot provide enough stability as the pediatric dentition has shallow roots that can even avulse under the stress exerted by IMF. The youngest age suggested for IMF is 9 years (6). Unerupted tooth buds also limit the use of mini plates in children. If they are to be used in children younger than 9 years old, the most inferior margin is suitable. Monocortical placement of mini screws can also be recommended for upper level plate fixation if mandatory. Some authors suggest that the plates should be removed after the fracture heals (6).

Advances in polymer science have led to the development of resorbable mini plate systems. Lately, the use of resorbable mini plates has gained popularity after the clinical data obtained from adults. Mechanical durability and the degradation rate of resorbable plating systems suggest them as an ideal option for the fixation of childhood fractures and also craniofacial osteotomy lines (7,8). However, large series in which pediatric fractures were treated using resorbable plates and screws have not been published yet. Conversely, although it depends on the polymer composition in different brands, delayed biodegradation of resorbable plates that need plate removal has been reported even at 36th month postoperatively in a pediatric craniofacial patient group (9). This needs elucidation before claiming resorbable plate systems to be ideal for pediatric bony fixation. Although resorbable plates gain popularity, they have some disadvantages. Incomplete material resorption,

chronic inflammatory reactions around partially degraded devices, or the large sizes of the fabricated plate and screws have been reported (10,11).

Dumbach used the PDS screws for fixation of ramus fractures (3). Rasse et al., have used PDS material for reduction of condylar fractures (4). PDS sutures have been used in other clinical sites too. Ikävalko and Lehto have published their result they observed in rheumatic elbow fractures. They used PDS in 4 of 26 cases alone or in combination with other fixation procedures and obtained satisfactory results (12). Obwegeser used PDS sutures to stabilize Le Fort I osteotomy lines and reported satisfactory results (13). In contrast, van Sterkenburg et al. used PDS sutures for sternotomy fixation and discovered a 20% sternal dehiscence (14). In our clinical practice with phalanx and metacarpal fractures, we perform cerclage sutures for fracture fixation.

PDS sutures are absorbable monofilament sutures. However, it retains its tensile strength long enough for the fracture to stabilize itself. It has been shown that the tensile strength of PDS is 65-80 days (15). This duration is long enough to stabilize a mandibular fracture in the pediatric group. Pihlajamäki et al. compared PDS, polyglycolide (PGA), polylevolactide (PLLA) and stainless steel pins in a rabbit femur model. During the course of degradation, PDS showed less inflammation and less fibrosis. At 52 weeks, PDS was completely resorbed and replaced by bone marrow and connective tissue (15). These features make PDS an ideal material for bone fixation.

In our series the postoperative results were satisfactory. No case developed occlusion problems. There was no need for a revision surgery. Extraction of the 2 teeth is thought to be related to their location on the fracture line in the 4 years old patient. On the other hand, the two extracted teeth in the 8 years old patient might have been due to eruption of the permanent teeth.

Furthermore, Landes and Ballon reported that resorbable plates cost \$650 and titanium plates cost \$65 (16). This

difference between the two systems favors titanium. However, if plate removal is taken in to account, \$650 may seem cost effective. The PDS suture is much cheaper than either plate system. There is no need for removal surgery and it is easy to place the sutures. PDS sutures can be a good and feasible alternative to expensive titanium and resorbable mini plates in low & middle income countries.

Disadvantages of PDS are low suture security, which we overcame with 8 knots. Mechanical stability is presumably less than other rigid or semi rigid fixation materials. Therefore, dietary restrictions should last longer than other techniques. On the other hand, figure of eight increases the stability of the fracture line providing sufficient immobilization for fracture healing.

CONCLUSION

To sum up, PDS suture fixation of pediatric facial fractures can be a good and cheap alternative to titanium and resorbable miniplate systems. What is more, to our knowledge, adult fractures have not been fixated with PDS sutures and it may be worthy to see the results of adult fractures with PDS sutures. We suggest that figure of eight PDS sutures can be used for the repair of pediatric maxillofacial fractures especially in the low and middle income countries. Larger studies are needed to appraise the value of this technique.

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Hakan Cinal ORCID: 0000-0002-9797-5730

Osman Enver Aydın ORCID: 0000-0002-5823-2774

Onder Tan ORCID: 0000-0002-5706-0069

Said Algan ORCID: 0000-0001-8516-0318

Murat Kara ORCID: 0000-0002-1742-3742

Kerem Yılmaz ORCID: 0000-0002-7844-6761

Harun Karaduman ORCID: 0000-0003-2696-7255

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