

Treatment of pediatric scaphoid nonunion with the ipsilateral radius graft and headless screw

Kerim Oner¹, Ahmet Emre Paksoy², Mehmet Yildiz³

ABSTRACT

This study concerns pediatric scaphoid non-union, a very rare entity, for which surgical treatment remains controversial. This injury is rare, but several therapeutic methods have been described. Despite these reports, confusion persists due to the variety of methods of harvesting the autologous graft and the type of osteosynthesis. This case series concerns ipsilateral autologous radius graft and headless compression screw fixation in three children diagnosed with pediatric scaphoid non-union. This method appears to be useful and sufficient with both graft harvest and fixation through a single incision. The patient is thus protected against secondary morbidities deriving from iliac crest grafting.

Key words: Scaphoid, nonunion, pediatric

Introduction

Scaphoid fractures are infrequent childhood injuries. They represent 0.39 % of all pediatric fractures and only 0.45 % of pediatric upper extremity fractures [1]. Scaphoid non-union is more seldom to see. Although scaphoid non-union generally results from missed diagnosis or delayed treatment, it can also occur in fractures that are early diagnosed and correctly treated. Fabre et al. reported a non-union incidence of 0.8% after plaster cast therapy initiated early and applied for a sufficient period

of time [2]. Since scaphoid non-union is rare, opinions concerning the optimal treatment differ. Methods including plaster cast immobilization, grafting, graft-Kirshner wire fixation, graft-screw fixation, and percutaneous fixation with or without graft have been described.

The purpose of this study is to contribute to the limited literature concerning the treatment of this rare injury by reporting the surgical results of autologous radial graft-screw fixation in three pediatric cases of scaphoid non-union.

Author affiliations : Department of Orthopedics and Traumatology, ¹Sorgun State Hospital, Yozgat, Turkey ²Yozgat Bozok University, Yozgat, Turkey ³Division of Hand Surgery, Karadeniz Technical University Faculty of Medicine, Trabzon, Turkey

Correspondence : Ahmet Emre Paksoy, MD, Department of Orthopedics and Traumatology, Yozgat Bozok University, Yozgat, Turkey
e-mail: ahmetemrepaksoy@gmail.com

Received / Accepted : December 13, 2018 / June 25, 2019



Figure 1. (A) Pre-operative x-ray of 16-year-old male patient (case 1) (B) Posterior-anterior x-ray at 6 months postoperatively.

Case Reports

Case 1

A 16-year-old male patient presented due to pain commencing after a fall eight months previously and worsening subsequently. He had not sought medical assistance and had not received any treatment. Distal scaphoid non-union was diagnosed using radiography, and the patient was operated with radial graft and screw fixation as described below (Figure 1). Union was achieved on the second month postoperatively. Dynamometric measurement at 15-months follow-up was 32 kg on the healthy side and 28 kg on the operated side. Mild pain was present with heavy activity, and the patient's Modified Mayo Wrist score was "good" [3].

Case 2

A 12-year-old male patient reported pain commencing following a fall two years previously. He had not received any previous medical treatment. Scaphoid non-union was determined at the waist at radiographs and the patient has been operated with radial graft and screw fixation. Union was achieved on the third month postoperatively. Dynamometric measurement after 12-months follow-up was 46 kg on the healthy side and 42 kg on the operated side. The patient reported pain

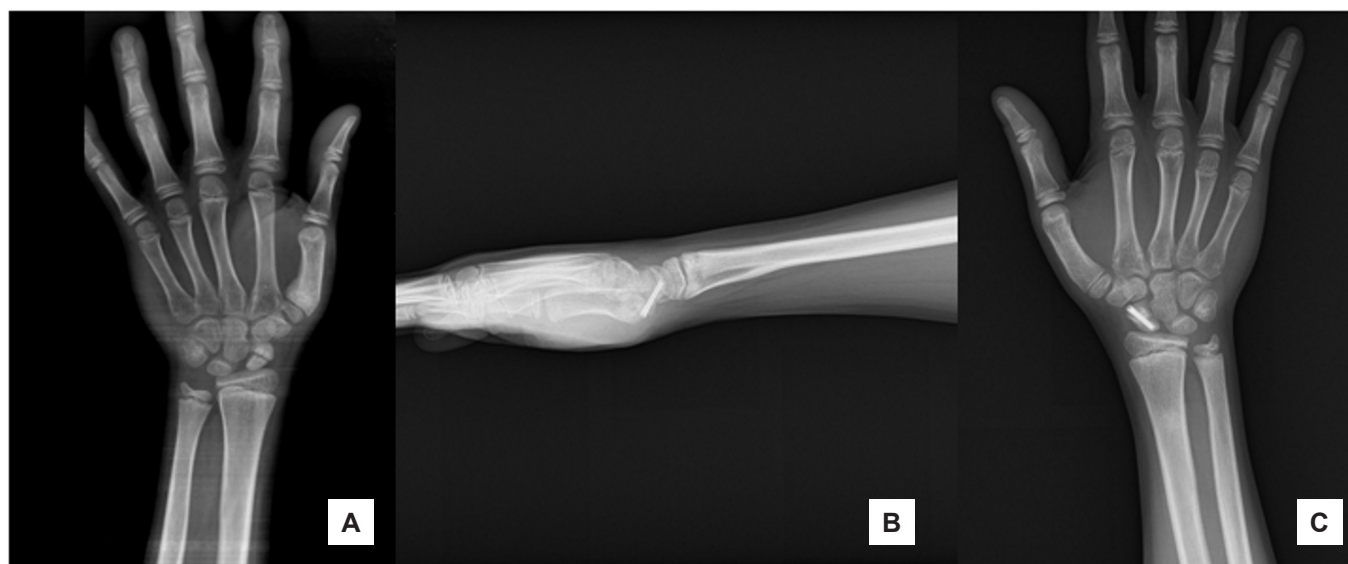


Figure 2. (A) Pre-operative x-ray of a 12-year-old male patient (Case 2) (B) Lateral x-ray at 1 year postoperatively (C) Posterior-anterior x-ray at 1 year postoperatively.

associated with changes in the weather, and his Modified Mayo Wrist Score was “good”. (Figure 2)

Case 3

A 12-year-old male patient had presented to several different centers due to pain commencing one year after a fall, but have not received any treatment other than splint therapy. Distal scaphoid non-union was diagnosed using radiography, and the patient was operated with radial graft and screw fixation (Figure 3). Union was achieved at the 10th month postoperatively. No pain was present after 12-months follow-up, and dynamometric measurement was 26 kg on the healthy side and 24 kg on the operated side. His Modified Mayo Wrist Score was “excellent”.

In all three cases, Acutrax 2,5 mm headless (Acumed, Hillsboro, OR) screw fixation was performed with cancellous grafts from the distal part of the ipsilateral radius. For graft retrieval, a 1x0.5 cm rectangular cortical osteotomy was performed 2 cm proximal to the physeal line at the volar aspect of the radius, and the cortical cap was elevated. Following the harvesting of the cancellous graft, the cortical cap has been closed. Short arm circular casts were applied for six weeks, followed by splints for two weeks routinely. There were no clinical or radiological reasons to prolong the immobilisation. Assessment of union was based on radiographs. No implant removal was performed in any case. No neurovascular complications have been encountered during surgery. No wound site infections or cast-associated local complications occurred. Three measurements were taken using a dynamometer at final follow-up, and the mean values were taken.

Discussion

Pediatric scaphoid fractures have a greater healing capacity than those in adults [4]. In contrast to adults, they are most common in the distal region. Christodoulou et al. reported fracture sites of 60% distal, 37% waist, and 3% proximal [1]. This greater healing capacity and predominantly distal location may be regarded as resulting in a low probability of non-union. Indeed,

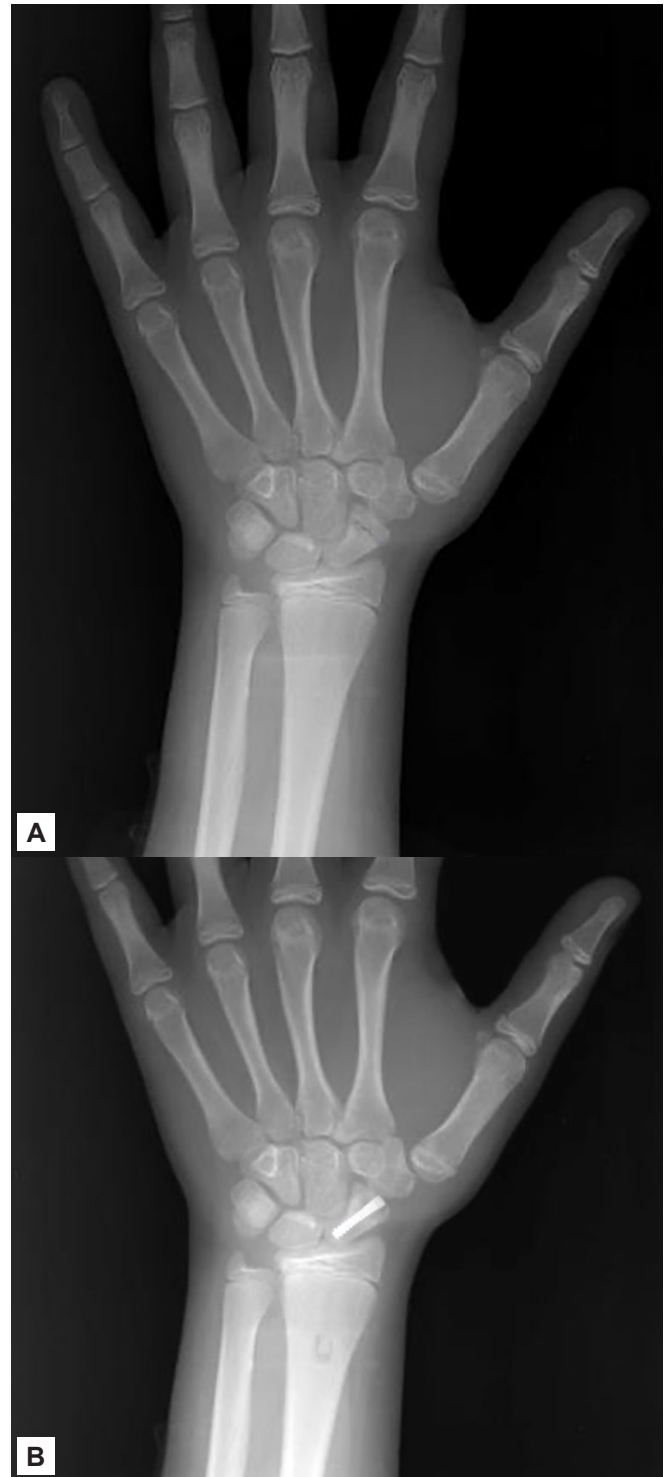


Figure 3. (A) Pre-operative x-ray of a 12-year-old male patient (Case 3) (B) Posterior-anterior x-ray at 1 year postoperatively.

similarly to injuries in adults, the incidence of fractures in the waist region have been reported to increase in series involving causes such as throwing punches, and

a high incidence of non-union has been observed [5].

Pediatric scaphoid non-union is a rare condition, the optimal treatment of which remains controversial. A wide spectrum of treatment methods have been discussed, ranging from cast immobilization to graft-screw fixation. Good results have been reported with almost every method applied in the treatment of this rare injury. This makes the decision regarding treatment more difficult.

Weber et al. achieved union with prolonged cast therapy in a six-case series with a mean age of 12.8 years [6]. Although shortening occurred in the scaphoid in three cases, they reported excellent Modified Mayo Wrist scores in all six patients. Since the time elapsing between trauma and non-union treatment was less than seven months in this series, it was limited to non-displaced cases.

Garcia-Mata et al. reported scaphoid fixation using grafts alone in four children with non-union. They reported cast therapy of 2-5 months after surgery when fixation was performed with graft alone [4,7]. Not using fixation material is known to result in loss of reduction in the early postoperative period [8].

The use of small-diameter Herbert screws has been shown to produce rigid fixation and not to cause growth impairment in several series [9-11]. When combined with the advantages posed by grafting, screw-graft fixation appears to represent a good therapeutic option.

The iliac crest graft has frequently been used in non-union scaphoid surgery. Taking a graft from the iliac crest offers advantages such as the ability to harvest a high volume graft, while advantages of the distal radius graft include no requirement for an additional incision and its facilitation of preparation for surgery [12]. Harvesting a graft from the iliac crest may also involve complications such as abdominal herniation and lateral femoral cutaneous nerve damage [13].

The volume of the defect that occurs in pediatric scaphoid non-union can be easily filled with a cancellous graft obtained from the distal radius. Once

alignment has been established with k-wires used as joysticks, the guidewire is propelled forward, and the defect is filled with cancellous graft from the dorsal to the volar aspects; after the graft filling, the headless screw is inserted [14].

The mechanical advantages provided by headless compression screws at this stage eradicate the need for a cortical graft in most cases. In the light of the fact that a large volume is not required and that a cortical graft is not needed, the distal radius graft appears sufficient for this surgical procedure. Morbidities resulting from an additional incision can be avoided using distal radius grafting in pediatric scaphoid non-union.

The autologous radial cancellous graft gives good results in pediatric scaphoid non-union when applied together with headless compression screws. The single surgical approach involving graft harvesting and treatment of non-union appears to be a useful method in the treatment of this rare injury.

Conflict of interest statement

The authors have no conflicts of interest to declare.

References

1. Christodoulou A, Colton C. Scaphoid fractures in children. *J Pediatr Orthop* 1986;6:37-9.
2. Fabre O, De Boeck H, Haentjens P. Fractures and nonunions of the carpal scaphoid in children. *Acta Orthop Belg* 2001;67:121-5.
3. Herzberg G, Comtet J, Linscheid R, Amadio PC, Cooney W, Stalder J. Perilunate dislocations and fracture-dislocations: a multicenter study. *J Hand Surg Am* 1993;18:768-79.
4. García-Mata S. Carpal scaphoid fracture nonunion in children. *J Pediatr Orthop* 2002;22:448-51.
5. Toh S, Miura H, Arai K, Yasumura M, Wada M, Tsubo K. Scaphoid fractures in children: problems and treatment. *J Pediatr Orthop* 2003;23:216-21.
6. Weber D, Fricker R, Ramseier L. Conservative treatment of scaphoid nonunion in children and adolescents. *J Bone Joint Surg Br* 2009;91:1213-6.
7. Dooley B. Inlay bone grafting for non-union of the

- scaphoid bone by the anterior approach. *J Bone Joint Surg Br* 1968;50:102-9.
8. Mintzer CM, Waters PM. Surgical treatment of pediatric scaphoid fracture nonunions. *J Pediatr Orthop* 1999;19:236-9.
9. Mintzer CM, Waters PM, Simmons BP. Nonunion of the scaphoid in children treated by Herbert screw fixation and bone grafting. A report of five cases. *J Bone Joint Surg Br* 1995;77:98-100.
10. Herbert TJ, Fisher WE. Management of the fractured scaphoid using a new bone screw. *J Bone Joint Surg Br* 1984;66:114-23.
11. Filan S, Herbert T. Herbert screw fixation of scaphoid fractures. *J Bone Joint Surg Br* 1996;78:519-29.
12. Russe O. Fracture of the carpal navicular: diagnosis, non-operative treatment, and operative treatment. *J Bone Joint Surg Am* 1960;42:759-68.
13. Myeroff C, Archdeacon M. Autogenous bone graft: donor sites and techniques. *J Bone Joint Surg Am* 2011;93:2227-36.
14. Cohen MS, Jupiter JB, Fallahi K, Shukla SK. Scaphoid waist nonunion with humpback deformity treated without structural bone graft. *J Hand Surg Am* 2013;38:701-5.

© 2019 Turkish Society for Surgery of the Hand and Upper Extremity. This is an open access article licensed under the terms of the Creative Commons Attribution NonCommercial ShareAlike 4.0 (<https://creativecommons.org/licenses/by-nc-sa/4.0/>) which permits unrestricted, noncommercial use, distribution and reproduction in any medium, provided the work is properly cited.