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Clinical outcomes of scaphoid nonunions treated with 1,2 intercompartmental supraretinacular artery pedicled vascularized bone graft and compression screw

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Abstract
Scaphoid fractures are the most common fracture of the carpal bones and account for 60% carpal injuries. Nonunion may occur in 5-12% of scafoid fractures. Aim of this study is to present result of scaphoid nonuinon treated with 1-2 intercompartmental pedicled artery bone graft and canullated screw in our clinic. Between 2009-2012, 19 scaphoid nonunions (18 males, 1 female) were treated with 1-2 intercompartmental pedicled artery bone graft and canullated screw. The average age of patients were 31,2 (range 12-47 years). The average time from initial injury to operation was 40.8 months (range 8 months -20 years). All scaphoid nonunions healed with union at an average of 9,4 weeks(range 6-12 weeks) after surgery. The average Mayo score of patients were 76,6 (range-25-100). We determined that treatment with 1-2 intercompartmental pedicled artery bone graft and canullated screw is good option in scaphoid nonunions regardless of avascular necrosis.

Keywords: Scaphoid nonunion, pedicled vascularized bone graft, compression screw

Introduction

Scaphoid fractures are the most common fracture of carpal bones; account for more than %60 of all carpal fractures and %11 of all hand fractures [1]. Scaphoid nonunion occurs in %5 to %12 of all scaphoid fractures [2,3]. The primary risk factor for nonunion of the scaphoid is displacement/instability, but delayed or missed diagnosis, inadequate treatment, fracture location, and blood supply are also risk factors [4]. Nonunion of scaphoid fractures can cause scaphoid nonuion advanced collapse(SNAC), which can lead degenerative osteoarthritic changes of the wrist [5].

There are diffent treatment options for scaphoid nonunion, including percutaneus fixation, open reduction and internal fixation with vascularized or nonvascularized bone grafts. The 1,2-intercompartmental supraretinacular artery(1,2-IC-SRA) vascularized bone grafting was described by Zaidemberg et al in 1991 [6]. They reported %100 union rate. Other authors reported union rates range from %27 to %100 [6-10]. In this article, we aimed to report our clinical results in scaphoid fractures treated with 1,2- IC-SRA vascularized bone graft between 2009 and 2012.

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Materials and Methods

A retrospective search was performed on all medical records of patients with diagnosis of scaphoid nonunion and treated with 1,2-IC-SRA vascularized bone graft in our clinic. Between January 2009 and March 2012. Consert forms had been taken preopetatively in all cases. All patients informed about vascularized graft would be taken from distal radius. 19 patients (18 males, 1 female) of scaphoid nonunion treated with a 1,2-IC-SRA vascularized graft. One patient was excluded because of lost to follow up. The mean age of patients was 31,2 (range 12-47) years. Mechanism of injury was sport injury in 17 patients, traffic accident in one patient. Dominant hand was affected in ten patients. Nine patients had right scaphoid fracture and nine had left scaphoid fracture. All patients presented with wrist pain to our outpatient clinic and had no prior surgery. All patients had scaphoid fractures more than six months. The diagnosis of scaphoid nonunion was made on plain radiographic assesment. We didn't especially investigated for avascular necrosis (AVN) preoperatively. The delay between initial trauma and operation was 40,8 months(range 8 months to 20 years).

The operation was performed by same experienced hand surgeon. We used surgical technique described by Zaidemberg et al [6]. We used a curvilinear dorsalradial approach, centered the space between first and second extensor tunnels. Dorsal sensory branches of radial nerve identifeied and protected. The extensor retinaculum

divided. Extensor pollicis brevis and abductor pollicis longus are retracted palmarly and extansor carpi radialis brevis and longus tendons retracted ulnarly. The 1,2 IC-SRA is identified overlying distal radius. Then, scaphoid fracture site is visualized and sclerotic bone ends are freshened with a burr drill until healthy bleeding bone seen(Fig. 1b). The required bone graft was harvested with a thin chisel. The pedicle dissected to its origin and with rotation of pedicle the graft is transferred into recipient site(Fig. 1a-1c). Fixation was achivied with a cannulated headless compression screw(standart Acutrak® screw)(Fig. 1d).

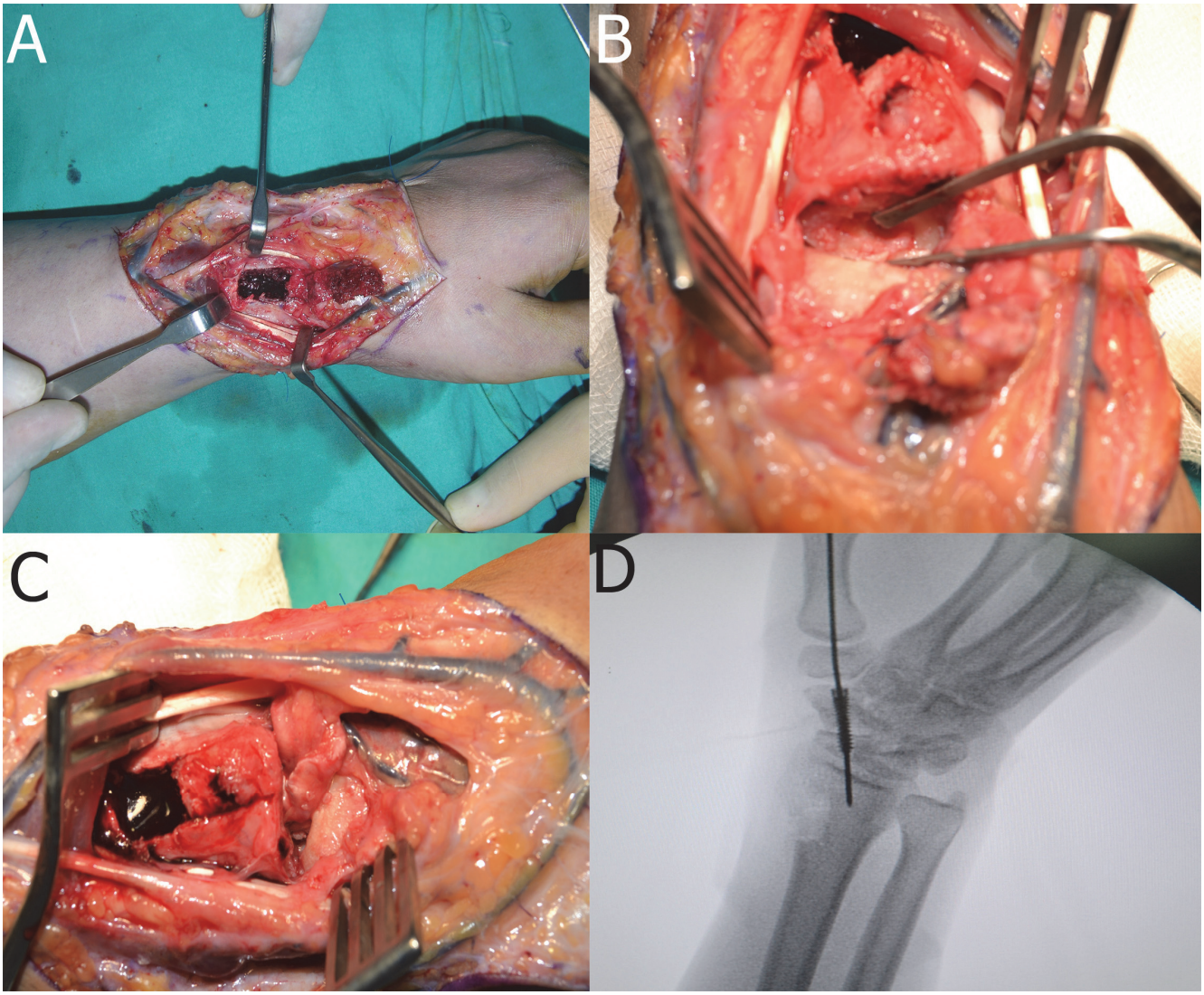

Fig 1a. Harvested 1,2 IC-SRA pedicled graft, **Fig.1b.** Preperarion of nonunion site for grafting **Fig 1c.** Pedicled graft is transferred into recipient site. **Fig 1d.** Fixation of graft with screw.

Postoperatively, all patients were placed into thumb free short arm splint for 6 weeks. Radiological examinations were performed at 4,8,12 and at the latest follow up. Outcome scoring was performed at the end of follow up period by Mayo Wrist Score[11].

Results

Fracture union was achieved in all patients in a mean 9,4 (range 8-12) weeks. The criteria for fracture union was bridging trabeculae crossing the fracture side on plain radiographs or on computed tomography(CT)if plain radiograph was suspicious for union. The mean Mayo Wrist Score was 76,6(25-100). All patients returned their previous occupations. No wound complication(e.g. infection) was seen.

Discussion

The ideal treatment for scaphoid nonunion is still unsolved and controversial. Despite optimal treatment in scaphoid fractures, nonunion and malunion may ocur [2,3]. Despite,

we did not see any SNAC in our series even patient with 20 years history, scaphoid nonunion could cause radiocarpal arthrosis [5], so early diagnosis and treatment is essential. Since described by Zaidemberg in 1991,the vascularized bone graft based on 1,2-IC-SRA was used for scaphoid nonunion by many authors and union rates range from 27% to 100% (Table 1). In our series, we had %100 union at 18 patients.

Table 1. Results of 1,2-IC-SRA for treatment of scaphoid nonunion

Authors	Number of patients	Union Rate(%)	Time to Union	Year
Zaidemberg et al.[6]	11	100	6,2 weeks	1991
Boyer et al.[12]	10	60	18,4 weeks	1998
Uerpairojkit et al.[13]	10	100	6,5 weeks	2000
Malizos et al.[14]	22	100	6-12 weeks	2001
Steinmann et al.[15]	14	100	11,1 weeks	2002
Tsai et al.[7]	5	100	<18 weeks	2002
Straw et al.[8]	22	27	-	2002
Chang et al.[16]	48	70,8	15,6 weeks	2006
Waitayawinyu al.[17]	30	93	5,1 months	2009
Ong et al.[18]	13	77	152 days	2011
Our series	19	100	9,4 weeks	

Other authors reported good results with other vascularized bone bone grafts [19-25]. In these series union rates were between 80% and 100%. In some of these techniques, surgical time is longer than technique we chose due necessity of arterial anastomosis of free vascularized grafts [25,28]. Nonvascularized bone grafts have been also used for treatment of scaphoid nonunions [26-28]. Union rate was 80% to 90%. Braga-Silva et al. compared vascularized and nonvascularized bone graft treatment for scaphoid nonunion and found similar results functionally [29]. Union rate was 100% in non vascularized group, they had 3 nonunions in vascularized group. They had associated these nonunions with technical difficulties.

In treatment of scafoid nonunions, different types of fixation were used (e.g; K-wires or screws or both). Type of fixation did not show difference in union rate in series of Straw et al [8]. In their series, they had %27 union rate, this could be explained by their removal of K-wire regardles of union at 8 weeks. In a cadaveric study, Panchal et al. found better results in terms of strenght of stability and stiffness in screw fixation group than K-wire group [30]. Screws also had advantage of achieving interfragmentary compression. Compression in fracture site has been shown to enhance healing [31]. In an other biomechanical study, Dodds et al. reported no statically significant difference in stability between screw fixation and both screw and K-wire fixation [32].

There is some limitations in our study. First; our study is a retrospective study with limited sample size. Second; we did not classify type of fracture.

In conclusion; we think the vascularized bone graft based on 1,2-IC-SRA for treatment of scaphoid nonunion is a good option and have excellent results. We recommend this procedure for good selected patients with scaphoid nonunion.

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