



What is the Optimal Treatment of Atrophic Scaphoid Non-Union?

Skafoid Kaynamamalarında Optimal Tedavi Nedir?

Atrophic Scaphoid Treatment

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Özet

Amaç: Skafoid kaynamamalarında vida ile tespit yapılan olgularda iliak kemik otogrefti ya da radius otogrefti kullanımının etkinliğini araştırmak. **Gereç ve Yöntem:** Ocak 2000-Ocak2014 yılları arasında skafoid kaynamaması nedeni ile opere edilen 89 hasta retrospektif olarak değerlendirildi. Postoperatif ölçümler el bileği hem fleksiyonda hem de ekstansiyonda iken yapıldı, ulnar ve radial deviasyon dereceleri gonyometre ile, kas gücü ise dinamometre ile ölçüldü. Kırıklar radyolojik olarak Herbert-Fisher sistemine göre, fonksiyonel sonuçlar ise Herbert-Fisher sınıflandırması ve Mayo klinik modifiye el bileği skorlama sistemine göre değerlendirildi. **Bulgular:** 89 skafoid kaynamama vakasınının 47'si sağ, 42'si ise sol el bileği yerleşimliydi ve bunların 52'si dominant eldi. Kırık oluşmasından cerrahiye kadar geçen süre ortalama 17.8 aydı (3-300). Kırıkların 60'ı (67.5%) bel bölgesinde, 27'si (30.3%) skafoidin proksimal 1/3'ünde, 2'si (2.2%) ise distal 1/3'ündeydi. 54 hastada (60.6%) iliak kanat grefti, 35 hastada (39.4%) radius distal grefti kullanıldı. Ortalama takip süresi 16.4 aydı (5-72). 71 hastada kaynama görüldü. Kaynama süresi ortalama 14.9 haftaydı (8-40). Ortalama skafolunat açısı operasyon öncesi 74.3° (62° - 87°) ve operasyon sonrası 43.8° (31°-72°) idi. Kavrama gücü operasyon sonrası ortalama 35.7 kg dı (15-63). **Tartışma:** Otogreft alımı invaziv bir yöntemdir fakat skafoid açık cerrahisinin skafoidin beslenmesini negatif yönde etkilediği göz önünde bulundurulursa atrofik skafoid kaynamamalarının tedavisinde otogreftleme ile birlikte vida fiksasyonu güvenli ve başarılı bir yöntemdir. İliak kanattan alınan greft sonrası oluşan ağrı nedeniyle radius distal grefti kullanımının daha uygun olduğu düşünülebilir.

Anahtar Kelimeler

Skafoid; Kaynamama; Cerrahi Tedavi; Otogreftleme

Abstract

Aim: To evaluate the efficacy of the treatment method of autogenous iliac wing or radius bone graft and fixation with screw applied to cases of scaphoid non-union. **Material and Method:** A retrospective evaluation was made of 89 cases between 2000 and 2014. Postoperative measurements were taken of both wrists' movement with a goniometer and muscle strength was assessed with a dynamometer. Fractures were evaluated radiologically according to the Herbert-Fisher System and the functional results according to the Herbert-Fisher Classification System and the Mayo Clinic Modified Wrist Scoring System. The data were input to the SPSS system and evaluated with the Shapiro-Wilk test. **Results:** Non-union were on the right side in 47 and the left side in 42 cases. The fracture was seen to be in the waist in 60 cases (67.5%), in the proximal third in 27 cases (30.3%) and in the distal third in two cases (2.2%). The mean follow-up period was 16.4 months (range, 5-72 months). Definitive findings of union were observed in 71 cases. The mean time to union was 14.9 weeks (range, 8-40 weeks). **Discussion:** The grafting procedure applied is an invasive technique but if it is considered that there are negative effects of open surgery on the feeding of the scaphoid bone, then in the treatment of scaphoid non-union which is atrophic non-union, ultimately autogenous bone grafting and screw fixation is a safe and successful method and because of the pain created by an iliac wing graft, radius distal bone graft can be considered more appropriate.

Keywords

Scaphoid; Non-Union; Surgical Treatment; Autografting

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Introduction

Scaphoid bone fractures are the second most common wrist trauma after distal radius fractures. Of the carpal bone fractures, they are the most frequently seen fractures [1,2]. Due to biological, mechanical and blood supply properties, the healing of scaphoid bone fractures is difficult [3]. When there are no signs of union despite 3 and 6 months of treatment in scaphoid bone fractures, it is classified respectively as delayed union and non-union [4].

Many different surgical techniques have been described in the treatment of scaphoid non-unions [5]. Bone grafting, internal fixation with various fixation materials, and vascularised bone grafts with combinations of bone grafting and internal fixation methods are applied in surgical treatment [6]. The aim of all these methods is to achieve a pain-free, functional wrist by removing the problem in the scaphoid bone, which plays a significant role in the stabilisation of the wrist and all wrist movements, and to prevent potential loss of working days [7].

In this paper an evaluation is made of cases of scaphoid non-union treated with autogenous iliac wing or radius bone graft and screw fixation.

Material and Method

The study included 89 cases who were diagnosed with scaphoid non-union and treated with autogenous iliac wing or radius distal bone grafting and screw fixation and had sufficient follow-up at two different clinics between January 2000 and January 2014. Approval for the study was granted by the Local Ethics Committee.

Postoperatively, both wrists were measured with a goniometer for flexion, extension and the degree of radial and ulnar deviation. With the patient in a sitting position, the elbow in 90° flexion and the forearm in a neutral position, the muscle strength of both wrists was measured with a hand dynamometer (Hydraulic Hand Dynamometer, Model SH5001, Saehan Corporation, Masan, Korea). The mean value of 3 measurements was used in the evaluation. Radiological evaluation was made using standard anteroposterior and lateral wrist radiographs. Computed tomography (CT), magnetic resonance imaging (MRI) and scintigraphy were not routinely used.

The fractures were classified radiologically according to the Herbert-Fisher system and the results were evaluated according to the Herbert-Fisher Classification System and the Mayo Clinic Modified Wrist Scoring System. The reason for using two systems in the evaluation of the results was that radiological evaluation cannot be made with the Mayo Clinic Modified Wrist Scoring System.

Statistical analysis

Statistical analysis were made using SPSS v. 15.0 (SPSS Inc., Chicago, IL, USA) software and conformity to normal distribution was evaluated with the Shapiro-Wilk test.

Results

The 89 cases of non-union comprised 81 males and seven females with a mean age of 30.2 years (range, 15-61 years). The non-union was on the right side in 47 and the left side in 42 cases and the dominant hand in 52 cases. The mechanism of

the fracture was a sports injury in 43 cases (48.3%), a fall in 38 (42.6%), and a traffic accident in eight (9.1%).

The fracture was seen to be in the waist of the scaphoid in 60 cases (67.5%), in the proximal third in 27 cases (30.3%), and in the distal third in two cases (2.2%). All the cases were consistent with Herbert-Fisher Type D2 (sclerotic non-union pseudarthrosis) (Fig. 1). The fixation material was Acutrak screw in

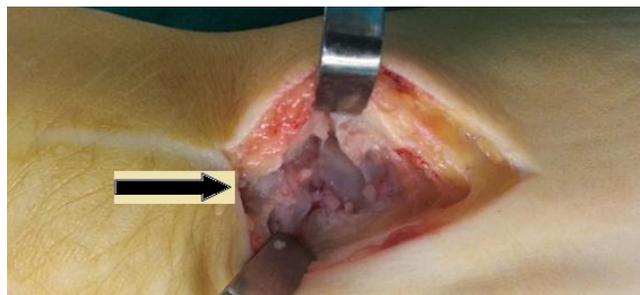


Figure 1. Image of the non-union line (arrow).

60 cases (67.4%) and Herbert screw in 29 cases (32.6%). In 54 cases (60.6%) iliac wing graft was taken and in 35 cases (39.4%) radius distal graft was taken. The form of graft used was spongy in 46 cases (51.6%) and corticospongy in 43 cases (48.4%). The mean time from fracture to surgery was 17.8 months (range, 3-300 months).

Clinical and radiological follow-up examinations were made every 3-4 weeks until union was achieved. The time to union was accepted as the period until the first radiograph was obtained on which the fracture line was seen to have disappeared and a trabecular appearance was observed in the location of the fracture line. Definitive findings of union were observed in 71 cases. The mean time to union was 14.9 weeks (range, 8-40 weeks). The mean period of fixation was 6.4 weeks (range, 4-12 weeks), and the mean follow-up period was 16.4 months (range, 5-72 months) (Fig. 2).



Figure 2. Non-union in the scaphoid bone waist area. A 26-year old male was treated with plaster cast for 4 months following a sports injury. (a) Direct radiograph taken on presentation at our clinic 6 months after the trauma. Direct radiographs (b) 3 months (c) 12 months (d) 40 months after surgery.

Postoperatively compared to the contralateral healthy hand, >10% function loss was observed in the wrist movements. The

scapholunate angle was mean 74.3° (range, 62° - 87°) preoperatively and 43.8° (range, 31°-72°) postoperatively. Grip strength postoperatively was mean 35.7 kg (range, 15-63 kg).

According to the Herbert-Fisher classification, the results were found to be excellent or good in 79% and poor in 21%; the Mayo Score was determined as mean 78.1 (range, 40-100).

No vascular or nerve complications developed during surgery. No scar tissue that limited joint movement developed in any patient. No major or minor complication was encountered in the graft donor site. In three patients, the screw was determined to be in an inappropriate position on the postoperative radiographs and in one patient, wound site infection was observed on postoperative day three. These patients were informed and second surgery was necessary. No problems developed in the follow-up period of any of these four patients.

Of the 18 cases where union was not observed, the fracture was in the proximal in 12 cases, in the scaphoid bone waist in five, and in the distal in one. Screw loosening was observed in one of the 18 cases and the screw was seen not to have passed the non-union line in two cases. Avascular necrosis was observed in the proximal fragment in two cases during follow-up and in both cases the screw was removed and the proximal fragment was excised. In three patients with persistent pain, a radical styloidectomy was applied.

Apart from these 18 cases, union was achieved in all other cases and outcomes were evaluated as successful. In one case where union was achieved, the screw was observed to have advanced to the lunatum. Non-union in the distal region is not frequently observed and two cases were operated on for distal region non-union.

Discussion

Scaphoid fractures are seen in the young, active population at a mean age of approximately 25 years at the rate of 13-43 per 100,000 per year [1,2]. Difficulty in determining the fracture line on direct radiographs taken early, fractures that remain untreated, or delay of treatment may result in non-union because of the biological, mechanical and vascular properties of the bone. These situations can cause post-traumatic arthritis and the development of carpal instability in patients [4].

For success in cases of scaphoid non-union, even if treatment is applied later in cases of non-treatment or delayed treatment, effective treatment must be applied before the permanent complication develops of a wrist with painful and limited movement because of the delay. Union in the scaphoid bone only is not sufficient; restoring bone anatomy and obtaining functional recovery must be considered essential [7].

Scaphoid non-unions display the general features of atrophic (avascular) non-union. The treatment principles of atrophic non-unions are cleaning the scar tissue, decortication and bone graft, and stable fixation for fracture healing [8]. These treatment principles are equally valid for scaphoid non-union as for atrophic non-union.

In scaphoid non-unions there are advantages to placing grafts in the spaces between fragments after cleaning and smoothing the surfaces. When autogenous bone grafts are successfully applied, fracture stability is increased, fracture healing is accelerated, and the period of immobilisation is shortened [9,10].

Spongy graft provides a larger contact surface and more rapid union due to cellularity and vascularity. Cortical graft provides protection and restoration of the scaphoid bone length because of the dense structure and prevents carpal instability from a united but smaller scaphoid bone. Berris et al. [11] reported that corticospongyous grafts were more effective than spongyous grafts in reducing deformity and obtaining initial stabilisation. Rates of union with bone graft were reported as 61-93% by Russe and as 75-100% by Fernandez [12,13]. Even though filling bone defects with autogenous bone grafts is seen as the gold standard, there are risks. The development of fracture, vascular and nerve damage, infection, haematoma, and chronic pain have been reported in 6-25% of cases [14,15]. In the current series, bone restoration was achieved using corticospongyous graft in cases that had lost scaphoid height and spongyous grafts in those that had not, and no complications developed in any patient in the donor site.

Various studies have been made on the subject of graft donor site. Many studies have compared the sites that were used in this study as donor sites--the iliac wing and the distal radius. A study based on postoperative pain reported that the clinical scores were better when the distal radius was used as the donor site rather than the iliac wing [16]. Aguilera and Garcia [17] stated that the anterolateral corner of the distal radius metaphysis could be used as a donor site and provided some advantages compared to other methods. These advantages include providing good quality bone graft, reaching the donor site with the same incision used for scaphoid surgery, no requirement for general anaesthesia, and less morbidity compared to the use of the iliac wing. In the current series, negative effects were observed in patient satisfaction and mobilisation due to pain in cases where iliac graft was used. Complaints of much greater postoperative pain in the wrist have been reported with the use of iliac wing.

The most important of the factors affecting the rate of union in scaphoid fractures is the fracture location; studies have shown lower rates of union in proximal fractures [18]. In the current study, of the 18 cases that were not successful, 12 were non-union with a proximal location. Inoue et al. [19] described avascular necrosis criteria in the proximal fragment as loss of trabeculation, advanced sclerosis, and deformation in the proximal fragment. Surgery is contra-indicated in these kinds of cases. In the current study, of the 27 cases with proximal location of the fracture, avascular necrosis was observed postoperatively in the proximal fragment in two. In one case, the screw was removed and the proximal fragment was excised and the other case refused surgery.

The development of non-union in scaphoid fractures is more evident in proximal pole fractures in particular, due to less blood supply of proximal scaphoid [20]. In uncomplicated stable non-unions, success rates of bone graft and screw fixation have been reported as 70-90% [21]. With bone graft and screw fixation in proximal scaphoid non-union, Megerle et al. [22] obtained union rates of 61%, Inoue et al. [19] 81% and DeMaagd and Engber [23] 92%. In contrast, again in cases of scaphoid non-union that developed avascular necrosis in the proximal pole, success rates with bone graft and internal fixation have been reported to have only reached 50% [12]. On the other hand, Matsuki et al. [24]

obtained 100% union with Herbert screw and grafting in 11 cases of proximal pole non-union and this result was reported to be independent of the vascularity of the proximal fragment. In addition, Gereli et al. [25] reported union in 15 of 17 cases where non-vascularised grafting and Acutrak screw were applied for proximal non-union and in 11 of 12 cases where fixation was made with Herbert screw. Thus it can be seen that with rates varying between 50 and 100% for non-vascularised grafting and screw fixation for scaphoid proximal pole fractures, it is possible to talk of both success and failure. The most important factor affecting this result is whether or not there is avascular necrosis. It is thought that in some of the current series cases there could have been proximal region avascular necrosis which could not be determined on direct radiograph. In addition, the open surgery method can be considered as contributing to the unsuccessful results with the effect of impairing the vascularity in the scaphoid bone proximal region in particular [26,27].

Limitations of this study can be said to be that because it was retrospective, there was no evaluation of differences in the types of cannulated screw applied and no MRI of the proximal fragment in proximal region non-unions.

In conclusion, generally rapid union is obtained with autogenous iliac wing or radius bone graft and screw fixation in the treatment of scaphoid atrophic non-union. This method with the appropriate surgical technique and under scopy guidance is safe and successful. Due to the pain caused in iliac wing grafting, distal radius bone graft can be considered more suitable. Thus, by providing rigid internal fixation, early active movement is possible, the immobilisation period is shortened, and workdays lost are reduced.

Competing interests

The authors declare that they have no competing interests.

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