



LOCAL EXPERIENCE IN TREATMENT OF SCAPHOID NONUNION WITH AND WITHOUT AVASCULAR NECROSIS

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ABSTRACT

Early detection and proper adequate treatment of scaphoid fractures are essential to avoid complications of malunion, delayed union, nonunion and the avascular necrosis, with their disabling sequelae. The aim of this study is to assess prospectively the clinical and radiological results using the modified Matti-Russe technique, for the treatment of scaphoid nonunion with and without questionable viability of the proximal fragment. With our experience of the numerous procedures and techniques proposed for the treatment of this complex problem, we are reporting our results in 23 cases, 8 of which were associated with avascular necrosis of their proximal fragments. Although the data were limited for cases of nonunion scaphoid fracture, with proximal pole avascular necrosis, we noticed that increased bone density is a reliable sign of avascularity. Our success rate in cases without avascular necrosis was (93%), while it was (75%) in the presence of avascular necrosis. Hence the conclusion was: The modified free bone grafting technique of Matti-Russe, which was originally recommended for the treatment of scaphoid nonunion, is yet effective even in presence of avascular necrosis; and with this technique fixation seems unnecessary.

Key Words: Scaphoid fracture, Nonunion, Avascular-necrosis

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INTRODUCTION

The scaphoid bone fractures are a major hand surgery and orthopaedics problem, account about 7% of the whole skeletal fractures, and are the most common among the carpal bones (60-70%). [1,2] Its unique anatomical positioning, bridging the two carpal rows; Its structural property, of appendant articular surfaces (80%); Lacking of ligamentous attachments; and Its unusual retrograde blood supply, made the scaphoid fractures more exposed to complications such as malunion, delayed union, nonunion and the avascular necrosis, with their serious debilitating functional sequelae of progressive osteoarthritis and the disabling carpal collapse. [3,4,5] It has been reported that nonunion may follow 5% of scaphoid fractures even with the adequately given primary conservative treatment, that may reach up to 10%, or more if were unstable, and up to 12% if missed and not treated. While the avascular necrosis particularly of its proximal pole, has been recorded in up to 50% of the scaphoid fractures. [6] Several different surgical procedures and many techniques, have been suggested for the treatment of nonunion and avascular necrosis of the scaphoid car-

pal bone, out of these the modified Matti-Russe technique of free bone grafting harvested from the iliac crest has been reported with high successful results in treatment of scaphoid fracture nonunion. [7] However its use in the presence of avascular necrosis reported ineffective in many literatures. [8,9,10,11,12,13,14,15] In this study we are reporting our results using this modified technique of Matti-Russe, in 23 diagnosed cases of scaphoid nonunion, with and without avascular necrosis that were operated by the hand surgery units at Al-Jala teaching trauma hospital, Benghazi Private Hospital and Ebn-Sina Private Hospital / Benghazi, between 2009 and 2017.

METHODS

A prospective study describing the results of our experience in, 23 right handed adult male patients, with past history of trauma, who were referred to our hand clinics, between 2009 and 2017, with clinical and radiological evidence of ununited fracture scaphoid nonunion of more than eight months duration. In eight patients, the scaphoid nonunion was associated with avascular necrosis, involving the proximal fragments. The cases were

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Figures 1a-1e: The modified Matti-Russe free bone grafting for the scaphoid fracture nonunion (a) anterior exposure of the scaphoid, (b) wedging of the harvested corticocancellous bone grafts, (c) the K. wires fixation (d) filling of the residual defects by cancellous bone grafts, (e) closure of the capsule.

assessed regarding the mechanisms of causative trauma; their complaints and physical findings; as well as types and duration of the initial treatments. Radiological assessment included postero-anterior (PA), lateral, lateral in mid-pronation and mid-supination, as well as the scaphoid views looking for: loss of the normal bone trabeculation, fragments displacement, edges sclerosis, bone density; and osteoarthritic changes. CT scanning was requested for eleven doubtful cases to exclude or determine the extent of displacement, the existence of osteoarthritis, and other carpal involvement. All patients were surgically treated by the modified Matti-Russe free bone grafting technique, where the two fragments were meticulously excavated by curettes, preserving the thin outer frames. Then two strips of corticocancellous bone grafts were harvested from the iliac crest, and wedged into the created cavities with their cancellous surfaces opposed to bridge the fragments. They were fixed in place by two parallel Kirschner (K) wires inserted from distal to proximal along axis of the scaphoid, and the remaining defects, were then filled snugly by cancellous grafts. (Figures 1) In five cases (21.7%) we felt that the two fragments were stable enough, moving in all directions as one piece, so we repaired the ligaments and closed the capsule with no wires fixation. A below elbow volar slab was applied for 6 weeks and then night splinting for an additional two weeks. The fixation was removed eight weeks post operatively. Skin sutures were removed by the second week of the operation. The patients then subjected to regular follow up. Follow-up management: Patients were followed up every second week for two months when the fixation was removed, and then thereafter monthly for six months. Bony union was confirmed by CT scanning. Further visits thereafter were according to the patients' need for one to five years with an average of three years. Postoperatively pain, range of movement and grip strength were assessed. The pain was rated in three grades. Grade 1: pain free, Grade 2: pain not interfering with activities, and Grade 3: pain interfering with activities, based on the verbal rating method, [16] depending on the patient self-evaluation. The range of movement was measured in degrees compared with the normal wrist. Grip strength was assessed according to the muscle power grading scale 0-5. Osseous union was evaluated both clinically and by absence of tenderness, and radiologically using simple X-ray views, throughout the follow up period visits of an average duration of three years. During the final visits, we further evaluated our results with CT scan images whenever available, and the patient's satisfaction, considering their own assessment of pain, their return to previous or new lighter jobs and their modification or restriction of activities. Patients with a combination of scaphoid nonunion and radiocarpal osteoarthritis were excluded.

Results:

All the patients were adult males, between 17 to 45 years of age with an average of 31 years. The involvement was of the right in 18 (78%) and left in 5 wrist regions. The scaphoid fractures were diagnosed following a classic history of a fall on an out-stretched hand and radial deviation in 14 cases, while the mechanisms were not clear in 9 cases, (six sport injuries, two during altercation and one in road traffic accident). All patients attended the emergency department and received



Figure 2 The Fragment sclerotic edges

conservative treatment of below elbow (short) volar slab initially, that was changed to a complete cast within one week. Nineteen cases were managed as out patients, and only four admitted for 2-4 days for observation for reasons other than their scaphoid fractures. In seventeen patients the cast continued for 2 - 3 months, 4 - 5 months in four patients and for 5- 6 months in two patients. Painful restriction of wrist movements, was the chief complaint in 17 patients Grade 2, and in only 6 cases it was Grade 3. The grip power was Grade 4/5 in 19 patients and Grade 5/5 in 4 patients (17.3%) The average restriction of wrist movements was up to 40 degrees extension, 60 degrees Flexion, 20 degrees adduction, and 10 degrees abduction. Positive local tenderness at the radial snuffbox and over the scaphoid tubercle was observed in 16 patients (69.5%), the scaphoid shift test was positive in the 23 cases. Radiologically: sclerosis of the fracture edges was seen in 6 cases (Figure 2), scaphoid shortening in 10 (Figure 3) and



Figure 3 The scaphoid shortening

increased scapholunate angle of >60 degrees in 4 cases (Figure 4). Increased proximal pole density; as a sign of avascular necrosis; was observed in 8 cases, and this preoperative finding was confirmed intraoperatively by cutting bloodless hard ivory-like osseous tissue from the proximal fragments in all 8 cases, (Figure 5). Our intervention times were ranging between 8 months to 2 years post initial trauma, with an average of 16 months. There was sclerotic nonunion in nine, and it was fibrous in fourteen cases. No early complications were reported. We found that all but three cases united, including the 4 cases where we did not use wires fixation. The failed three cases were as follows; one nonunion without avascular necrosis; and two cases with associated avascular necrosis. Five patients were pain free (Grade 1), fifteen were perceiving pain only with strenuous use (Grade 2), and three cases the pain was severe (Grade 3) There was much improvement in the range of movements compared with the recorded preoperative ranges, (Figure 7). There was some improvement noted of the grip strength, in sixteen cases (65%), with a power grading score of between 4-5/5. Residual proximal pole bone density remained up to nearly one year, in five cases, (Figure 8).



Figure 4 Increased Scapholunate angle. >60 degrees

DISCUSSION

In his classification of the scaphoid fractures,[17] Ru suggested that vertical fractures are mostly displaced, because of the applied shearing force, and according to the Herbert and Fisher classification, all the scaphoid fractures except the tubercle and incomplete fractures are potentially unstable. (Figures 9 and 10) Fractures of the lunate key-bone are the most frequent carpal fractures, accounting for nearly 60%. Nonunion may occur in up to 12 of patients if the scaphoid fractures are missed and not treated.[1,18,19] and avascular necrosis of its proximal pole may follow 13% to 50% of the scaphoid fractures, especially the unstable. Therefore, early detection and appropriate primary treatment of all scaphoid fractures is essential to avoid complications such as malunion, delayed union, nonunion and avascular necrosis. However, there is no fixed model or standard treatment for these lesions and it is mostly agreed that whenever clinically expected even if not obvious on X-ray views, thumb spica cast immobilization is recommended.[20] There are many controversial views about the level of the cast if decided, whether to be below (short) or (long) above elbow, and whether it should include the thumb, and the proximal phalanx



Figure 5 Increased bone density of the proximal fragment, a sign of avascular necrosis.



Figure 6 CT. Fracture scaphoid waist



Figure 7a

Figure 7b

of the index and long fingers or not. Moreover, opinions now vary regarding freshly undisplaced stable fractures, where the thumb spica cast immobilization was and is still advised by some for eight to twelve weeks. Many others now recommend the primary percutaneous K. wires or screw fixation.[21,22]. The acutely displaced and unstable scaphoid fractures are candidates for open reduction and K. wires or screw fixation. However some surgeons prefer to approach such fractures by arthroscopic reduction and percutaneous fixation.[23] Avascular necrosis as a complication of scaphoid fracture is reported in as much as 13% to 50% of cases.[1, 18,19] Such a high rate is due to the scaphoid bone's structural and configurational peculiarities that is Jacking in ligamentous attachments, as most of the scaphoid bony mass is covered by articular cartilage, and also because of its unusual retrograde blood supply from the radial artery and its volar carpal branch. Numerous procedures and various techniques have been postulated for the treatment of this serious complication, aiming for the avoidance of its debilitating sequelae. These include the original Hermann Matt procedure and modified Matti-Russe free bone grafting procedure [17]; Stark procedure, using cancellous grafts and temporary wiring [24]; Fisk procedure [25], and Fernandez technique by wedged graft.[26] In addition there are several methods of local vascularized bone graft [27,28,29] from the scaphoid tubercle and the pisiform based on the palmar carpal artery and the first dorsal metacarpal artery,[30,31,32] The pronator quadratus and radial styloid pedicled bone grafts.[33] Some other distant free vascularized bone grafts from the iliac crest,[34] and medial femoral supracondylar area have also been used.[35,36] Such huge diversity confirms that no ideal grafting procedure is suited to all types of nonunion whether associated with avascular necrosis or not. Out of these, the modified Matti-Russe technique offered for the treatment of scaphoid nonunion, and reported with (90%) successful results.[6,7] But it has been claimed that it is not recommended for the treatment of scaphoid nonunion with associated avascular necrosis. [36] In this study we are reporting our results using this technique, in 23 patients, operated for the treatment of scaphoid fractures nonunion, in 8 of our patients (34.7%) the scaphoid nonunion was associated with avascular necrosis involving the proximal pole. According to our results, adult males were the most frequently involved and the fracture affecting the wrist joints of the dominant hands more, which is simply explained by their frequent exposure to trauma. There was no delay in receiving the initial primary management as all the 23 patients were attended to, diagnosed, and primarily treated within 24 hours of the trauma. Painful restriction of movements is the chief presenting symptom in scaphoid nonunion, while grip weakness may not be the main problem in some cases. In addition, local tenderness at the radial snuffbox is not a fixed sign, but the scaphoid shift test is usually helpful. Although the increased proximal pole density (Figure 11) as a sign of avascular necrosis has been disputed by Perlik and Guildford, who stated that the increased density on the preoperative radiographs has only 40%



Figure 9a



Figure 9b



Figure 10a



Figure 10b



Figure 11a



Figure 11b



Figure 12a



Figure 12b



Figure 12c



Figure 12d

accuracy,[37] correlating the intraoperative confirmatory findings of the proximal poles avascularity in our 8 cases, with the preoperative finding of avascular necrosis based on this radiological observation, indicated that it was a fixed universally frequent finding and may be relied upon as a sign of scaphoid proximal pole avascular necrosis. We depended on regular X-ray findings whereas CT was employed only for doubtful cases. MRI was not used as a diagnostic tool in our cases for a number of reasons. These included its higher cost and lesser availability, as well as its relatively low sensitivity and specificity (64% & 88%, respectively).[38] In addition, some professionals hold the opinion that "MRI is not useful in the evaluation of healing" [39,40] and some reported an accuracy in assessing proximal pole vascularity of just 68%. [41] Although the data are limited for cases of scaphoid nonunion fracture with proximal pole avascular necrosis, our success rate was 93%, in the treatment of cases without avascular necrosis (14 out of 15 cases), compared with the reported results of Krimmer H. (67%),[42] and Russe (90%),[6,7] and it was 75% in the presence of avascular necrosis (6 out of 8 cases), compared with (71%) reported by Russe. (Figures 12 and 13) In terms of patients' satisfaction, 15 patients (65%) were happy with our results and returned back to their previous work and modified activities within nine months following surgery, 6 patients (26%) were satisfied with new lighter jobs and controlled activities, but 2 (8%) were not happy and appeared likely to progress to radiocarpal arthritis.

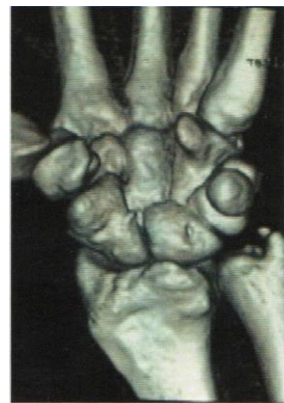


Figure 13a



Figure 13b

CONCLUSION

Increased bone density is a reliable sign of avascular necrosis. The modified free bone grafting technique of Matti-Russe, which was recommended for the treatment of scaphoid nonunion, is effective even in the presence of avascular necrosis. In this technique, fixation seems unnecessary.

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