Fractures of the scaphoid, diagnosis and management— a review

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INTRODUCTION

The scaphoid is vitally important for the proper mechanics of wrist function. Fracture of the scaphoid bone is the most common carpal fracture. Among all wrist injuries the incidence of scaphoid fracture is second only to fractures of the distal radius. Scaphoid fractures are significant because a delay in diagnosis can lead to a variety of adverse outcomes that include nonunion, delayed union, decreased grips strength, range of motion and osteoarthritis of the radiocarpal joint. To avoid missing this diagnosis, a high index of suspicion and a thorough history and physical examination are necessary, because initial radiographs are often negative. Regardless of the technique of bone grafting, there will almost always be some loss of motion even if the fracture unites.

Key words: scaphoid fractures, occult scaphoid fracture, pedicle vascularized bone graft

DIAGNOSIS

We should expect a scaphoid fracture, if in front of us there is a young person that fell on the palm of his hand, with the wrist placed in dorsiflexion, and who has pain in the region of the anatomic snuffbox or volarly, above the scaphoid bone. The initial radiography is often negative and a very common mistake is to declare that injury as a distortion of the wrist. The other diagnose methods used in the early detection of scaphoid fractures are the bone scintigraphy and the magnetic resonance (MRI). Some researches try to establish whether one method is better than the other, as well as the economic advantages of the MRI diagnose, compared to carrying an immobilization device and not being able to work. It is considered that MRI is
an excellent method to detect hidden fractures of the scaphoid, as well as associated injuries in the wrist area. Thanks to this method, it was established that the incidence of occult scaphoid fractures amounts to $19\%$. It was also established that scintigraphy is a sensitive method, but due to its bad specificity, it produces false positive results in $25\%$ of cases. In the same research it was established that computerized tomography (CT) has a low sensitivity in these cases and cannot identify fractures in $21\%$ of cases.

**CLASSIFICATION OF FRACTURES**

Fractures are most frequently classified according to the anatomic location of the fracture line, which usually has an influence on the healing rate and on the prognosis. They can be divided into:

1. Tuberositas fracture, where the expected time for the fusion of the bones is four weeks
2. osteochondral fractures of the distal articular surface
3. fractures of the distal part of the bone, also with good prognosis
4. fractures in the middle of the bone or "waist" fractures, in which there can be fusion problems in a third of cases
5. fracture of the proximal pole, in which healing problems can appear almost in $100\%$ of cases, according to some authors.

**NON-SURGICAL TREATMENT**

Non-surgical treatment is indicated in those cases, in which the fracture gap is not greater than 1 mm in the anteroposterior and oblique images, the lunate-capitate angle not greater than $15^\circ$ and the scaphoid-lunate angle is not greater than $45^\circ$ in the lateral image. There are different opinions regarding the type of immobilization: above-the-elbow or below-the-elbow, with incorporating the thumb or without. In the works of Gellman and his collaborators, there were not observed healing delays or unhealed fractures, in the case of non-dislocated fractures, when above-elbow devices were used, while there were two cases of unhealed fractures and six cases of healing delay, when below-the-elbow plaster splints with thumb inclusion were used. Their conclusion is that in the case of fractures of the proximal and middle third of the scaphoid bone, one should use long thumb spica cast, but that fractures of the distal third of the scaphoid bone heal well, no matter what kind of immobilization is used. Conventionally, in the case of scaphoid fractures, there are applied plaster immobilization devices, which incorporate the thumb. In the work of Clay and collaborators, two kinds of immobilization devices are applied in 392 cases of scaphoid fracture: the first one is an immobilization device that includes the thumb, while the second one is similar to the immobilization device used in the Colles fractures of the distal radius. The incidence of non-healed fractures did not depend on the kind of plaster cast used. Bond and collaborators compared the non-surgical treatment with the percutaneous fixation of non-dislocated fractures of the scaphoid bone with Acutrack screws. It was established that healing was faster and absence from work was shorter in the group of patients that were treated by means of percutaneous fixation with cannulated screws. Surgical treatment of non-dislocated fractures of the scaphoid bone is indicated also by Ring and collaborators, because it shortens the period of immobilization and fastens the return to sports.

**SURGICAL TREATMENT**

All angulated fractures or fractures with dislocation, in which an adequate position cannot be obtained by manual reposition and the use of a splint, shall be treated surgically, by applying Kirschner wires (K) or screws (Picture 1, Picture 2). If there is no comminution, bone grafting is not absolutely necessary in these cases. Surgical treatment is also indicated in the case of slow healing or when there is no healing at all. The procedure of choice depends on the experience of the surgeon, the type of fracture, the age...
of the patient and the presence or absence of arthrosis. The following are some of the most usual techniques.

Techniques with bone graft

Back in 1937 Matti demonstrated that healing can be obtained by using cancellous bone with dorsal approach. This technique was modified by Russe, who used volar access. Fisk proposed lateral approach for this operation, with radial styloidectomy. Fernandez modified Fisk’s technique by using a precisely measured iliac cortical bone graft, with palmar access and internal fixation. However, these procedures can hardly be efficient in case of a completely avascular proximal pole. The ossification material used in these procedures can be K wires, Herbert’s screws, Acutrack screws, interfering screws etc.

Immobilization devices can be used for a period between 10 and 12 weeks (Picture 3).

Radial styloidectomy

This procedure can be carried out subperiosteally, through the snuffbox, paying special attention to the sensitive branch of the radial nerve. It is rarely used isolated, but it is indicated in cases of arthrosis between the scaphoid and the styloid of the radius.

Proximal row carpectomy

According to Hill, this operation is indicated for the treatment of pseudoarthrosis of the scaphoid bone, in the case of patients that have symptomatic pseudoarthrosis, do not wish to be submitted to long period of immobilization, do not suffer from a pronounced radiocarpal arthrosis and do not carry out heavy physical activities. In this procedure the lunate bone and the triquetral bone are removed, while the scaphoid can be completely excided or its distal part can be left, which is joined to the trapezium and the trapezoid. The proximal pole of the capitate bone is placed in the lunate fossa on the articular surface of the radius.

Partial fusions of the carpus

This procedure is used when there are changes in small individual joints inside the carpus, when there are changes in the capitate and/or lunate bone or after the failure of previous operations, in order to prevent the midcarpal collapse. The most usual indication is related to the existence of a SLAC deformity (Scapholunate Advanced Collapse), triscaphe degenerative modifications (arthritic changes between the trapezium, the trapezoid and the distal scaphoid) or the combination of them. Usually it is necessary to carry out the fusion of the capitate and the lunate, but it may also be necessary to carry out the fusion between the hamate and the triquetral bone (four corner arthrodesis). Sometimes, this procedure can be combined with the excision of the scaphoid and the implantation of a silicon prosthesis in its place. One of the options of partial fusions is the triscaphe arthrodesis, i.e. the arthrodesis between the scaphoid, the trapezium and the trapezoid. The complete arthrodesis of the wrist is carried out only in case of advanced destruction of the radiocarpal articulation, in the dominant hand of young people, who make heavy physical work.

Vascularized bone grafts

These pedicle grafts are used in the case of pseudoarthrosis of the scaphoid bones with osteonecrosis of the proximal pole and/or after an unsuccessful osteoplastic procedure. The choice of the adequate graft depends on the characteristics of the pseudoarthrosis and the presence or absence of deformities, which will also determine the surgical approach. Mund and Larsen said that, after applying vascularized grafts, the obtained a 91% fusion in the case of patients that had been unsuccessfully treated with conventional grafts and/or suffered from necrosis of the proximal pole. These results are significant if we com-
pare then to the 64% fusion achieved by using non-vascularized grafts\(^\text{19}\). Numerous pedicle and free vascularized grafts have been described with variable, but generally favorable, outcomes. Understanding the indications for different grafts is critical to the successful application to these techniques\(^\text{20}\) (Picture 4).

**SUMMARY**

**PRELOMI SKAFOIDNE KOSTI - DIJAGNOSTIKA I LEČENJE**

Skafoid je od vitalnog značaja za pravilno funkcionisanje ručnog zgloba. Od svih preloma karpalnih kostiju najčešći su prelomi skafoidne kosti. Kod povreda ručnog zgloba, po učestalosti dolaze odmah nakon preloma distalnog radiusa. Ovi prelomi su važni jer kašnjenje u dijagnozi vodi velikom broju komplikacija, kao što su nesrećanje, usporeno srastanje, smanjenje snage stiska i opsega pokreta, kao i razvoja osteoartritisa ručnog zgloba. Da se dijagnoza ne bi propustila, potrebno je sumnjati na ovu povredu, uzimajući u obzir anamnesu i klinički pregled, jer su inicijalne radiografije često negativne. Bez obzira na operativnu tehniku, skoro uvek se očekivati neki stepen ograničenja pokreta i u slučajevima kada se fuzija postigne.

Ključne reči: prelomi skafoida, okultni prelomi skafoida, vaskularizovani peteljkasti grafovi

**BIBLIOGRAPHY**