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Customized mini-plate for scaphoid fractures and nonunions

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SUMMARY: **Customized mini-plate for scaphoid fractures and nonunions.**

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Scaphoid fractures detected in the subacute stage require a more meticulous and prompt approach to prevent chronicity and regain wrist function. Oblique-type scaphoid fractures are potentially unstable and may result in detrimental sequelae. Aim of this study is to suggest an easy surgical approach to restoration of the oblique-type scaphoid fractures or nonunions by using of a customized mini-plate, italic-S shaped. This surgical intervention is associated with promising outcomes and at long-term follow-up showed to avoid the development of a carpal collapse with concomitant arthritis of the radiocarpal joint.

RIASSUNTO: **Mini-placca personalizzata per il trattamento di fratture e non-unioni scafoidee.**

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Le fratture scafoidee nello stadio subacuto richiedono un approccio molto meticoloso e sollecito, al fine di prevenirne la cronicizzazione e recuperare pienamente la funzione del polso. Le fratture di tipo obliquo sono potenzialmente instabili e possono avere esiti sfavorevoli. Lo scopo del presente studio è suggerire un semplice approccio chirurgico per la ricostruzione di fratture e non-unioni scafoidee di tipo obliquo che si fonda sull'impiego di una mini-placca modellata ad S-italica. Tale tecnica chirurgica ha mostrato risultati promettenti, specie nel prevenire a lungo termine lo sviluppo di un collasso carpale con concomitante artrite a carico dell'articolazione radiocarpale.

KEY WORDS: Scaphoid fractures - Scaphoid nonunions - Mini-plate.
Fratture scafoidee - Non-unioni scafoidee - Mini-placca.

Introduction

Scaphoid fractures are among the most common types of carpal bone injury; but they can be easily overlooked in the acute stage. Scaphoid fractures detected in the subacute stage require a more meticulous and prompt approach to prevent chronicity and regain wrist function. Oblique-type scaphoid fractures are potentially unstable and may result in detrimental sequelae if overlooked in the acute stage. Accurate diagnosis is possible through critical skepticism and the meticulous scrutiny of radiographs (1). Diagnosis and treatment of scaphoid fractures has been fraught with uncertainty and fear for ages (2). When a fracture is missed in the acute stage and the patient presents with an existing nonunion, such as in our patient, the treatment becomes more challenging. A variety of surgical techniques have been described for treating scaphoid fractures (3).

We describe a case of scaphoid fracture which had occurred with less common injury mechanisms, leading to delayed treatment. We report the fracture patterns and locations, as determined from radiographs, as well as the surgical methods used. Aim of this study is to suggest a surgical approach to restoration of the oblique-type scaphoid fractures/nonunions by using a customized mini-plate, in order to avoid the development of a carpal collapse with concomitant arthritis of the radiocarpal joint.

Case report

A 19 year-old right-handed Caucasian male presented to clinic approximately 6 month after injuring his right wrist. While playing

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soccer he was hit on the right hand with the ball, causing a forced palmar-flexion of the wrist. He had immediate pain, but was told his radiograph at the time was negative. He wore a removable splint for few weeks with some initial improvement in symptoms. Subsequently, he had intermittent radial wrist pain, which worsened over time. His motion was restricted in both flexion and extension.

Despite symptomatic treatment, he continued to have diffuse radial-sided wrist pain. Because of pain the patient came to our department. Examination revealed a mild swelling over the mid-dorsal and volar regions of the wrist. The wrist was tender along the dorsoradial side, including the waist of the scaphoid. His range-of-motion was close to the opposite wrist with only mild discomfort at the extreme ranges. The DASH Score (Disability of the Arm, Shoulder and Hand) was 12 points, the PRWE Score (Patient-Related Wrist Evaluation) 24 points, respectively. The Mayo Wrist Score amounted to 81.5 points. Active range of wrist motion was reduced by one third compared with the opposite side. Grip strength was reduced by 15-20%.

An X-ray was repeated to understand the causes of his chronic pain. X-ray showed a scaphoid fracture oblique-type without evidence of avascular necrosis (Fig.1 A). So, our planning are substantially between internal fixation and placement of a plate. In accordance with the patient, we decide inserting a customized mini-plate.

First we performed a palmar incision on radial side to expose involved bony that was realigned and squared (Fig. 1 B). Scaphoid fracture was stabilized by a customized plate, shaped on operating table, modelled as an Italic S (Fig. 1 C). Thus bony are fixed tight and the solicitation were distributed on the 4 points of anchorage.

Fig. 1 - A) Radiograph: right scaphoid fracture occurring 6 months previously; no avascular necrosis is evident. B) Intraoperative: palmar incision on radial side to expose the scaphoid that is realigned and squared. C) Intraoperative: stabilization by a customized plate, shaped on operating table, modelled as an Italic S; distribution of the solicitation on the 4 points of anchorage.

Discussion

Carpal scaphoid fractures occur fairly frequently. The most commonly described mechanism of injury is a fall on an extended wrist, which creates an axial as well as extension force to the scaphoid bone (2). Scaphoid nonunions can notoriously progress to carpal collapse and degenerative arthritis (4). The prime cause of delayed union or nonunion is a delay in diagnosis or displacement of the fracture. (5). Non-operative treatment for nondisplaced scaphoid non-unions can involve very prolonged periods of cast immobilization (4 to 6 months) with or without electrical or ultrasound bone stimulation, which can negatively impact quality of life and the result is often not the one expected. In cases of progressive arthrosis salvage procedures like intercarpal fusion, proximal row carpectomy, scaphoid excision with four corner arthrodesis, total wrist arthroplasty, or total carpal fusion may be necessary. Most surgical series have reported union rates of about 90% with various procedures (6). The most commonly cited reason for failed surgical union has been avascular necrosis of the proximal pole with reported union rates from 40 to 67% with non-vascularised bone grafts. There are at least two different types of vascularized bone graft, a distal radial pedicle graft and a free vascularized medial femoral condyle graft for the surgical treatment of scaphoid waist nonunion with avascularity of the proximal pole and carpal collapse (7) .

Minimally invasive operative techniques includes screw osteosynthesis. Fracture reduction and screw insertion can be guided by wrist fluoroscopy, arthroscopy, or specially designed guiding jigs. Operative fixation of these fractures remains a challenging problem in hand surgery (8). Despite the advent of newly developed fixation techniques, including open and percutaneous fixation, the nonunion rate for scaphoid fractures remains as high as 10% after surgical treatment (6). We suggest that this high rate of nonunion is due to the use of internal fixations that aren't the gold standard. The problem is related to the small bone dimension, that needs a treatment with small devices such as mini-plate. In fact, the scaphoid had a mean length of 26 mm (range, 22.3-30.7 mm), and men had a longer (P<001) scaphoid than women (27.861.6 mm vs 24.561.6 mm, respectively). The mean volume of 3389.5 mm^3. Men had a larger (P<.001) scaphoid volume than women (4057.86740.7 mm^3 vs 2846.56617.5 mm^3, respectively) (9).

Our surgical technique is not previously reported in literature. It is based on the placement of a mini-device. We placed a customized plate, shaped on the operatory table to italic-S and, this way, we stabilized the fracture. This intervention is minimally invasive and join two different positive aspects: the less morbidity caused by intervention and the good stability thanks to the plate placed. The bony is fixed tight and the solicitation were distributed on the 4 points of anchorage. The plate is in titanium with high elasticity; his placement is easy and the fixation is safe. Long-term follow-up showed an optimum outcome. Patient did not show the development of a carpal collapse with concomitant arthritis of the radiocarpal joint. Thanks to these outcomes we suggest a successful correlation between scaphoid size and type of fixation.

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