

ORIGINAL PAPERS

Percutaneous screw fixation in hand fractures

C. Simón-Pérez*, J.I. Rodríguez-Mateos and M.A. Martín-Ferrero

Department of Orthopedic and Trauma Surgery, Valladolid University Hospital, Valladolid, Spain

Received October 27, 2008; accepted February 3, 2009
Available on the internet from June 26, 2009

KEYWORDS

Fractures;
Hand;
Osteosynthesis
percutaneous

Abstract

Purpose: To expound our experience of percutaneous screw fixation in the treatment of certain hand fractures.

Materials and methods: We carried out a prospective study between November 2002 and November 2006, in which 84 patients with hand fractures were treated by means of closed screw osteosynthesis. The injury was located at the base of the first metacarpal in 12 cases (14.28%) the remainder being phalangeal fractures (85.71%). All fractures were closed, 40 of them intra-articular (47.61%). The most frequent fracture type was the long oblique fracture, which was present in 68 cases (80.95%).

Results: Functional results obtained at the last follow-up visit (6 months) were excellent in 64 patients (76.19%), good in 15 (17.86%) and poor in 5 (5.95%).

Conclusions: Percutaneous screw fixation sharply reduces immobilization time permitting earlier functional recovery without causing any cosmetic defects. It is a highly useful technique for carefully selected fractures and patients.

© 2008 SECOT. Published by Elsevier España, S.L. All rights reserved.

PALABRAS CLAVE

Fracturas;
Mano;
Osteosíntesis
percutánea

Microosteosíntesis con tornillos a cielo cerrado en las fracturas de la mano

Resumen

Objetivo: Exponer la experiencia de los autores en la realización de la técnica de microosteosíntesis percutánea con tornillos para el tratamiento de ciertas fracturas de la mano.

Material y método: Se realizó un estudio prospectivo en el período comprendido entre noviembre de 2002 y noviembre de 2006 en el que 84 pacientes con fracturas en la mano se trataron mediante osteosíntesis a cielo cerrado con tornillos. La localización de la

*Corresponding author.

E-mail: simonclarisa@yahoo.es (C. Simón-Pérez).

lesión fue en la base del primer metacarpiano en 12 (14,28%) ocasiones y el resto fueron fracturas de las falanges (85,71%). Todas las fracturas eran cerradas y 40 fracturas eran intraarticulares (47,61%). El tipo de fractura más frecuente fue la oblicua larga en 68 casos (80,95%).

Resultado: Los resultados funcionales obtenidos tras la última revisión (6 meses) fueron excelentes en 64 pacientes (76,19%), fueron buenos en 15 pacientes (17,86%) y fueron malos en 5 pacientes (5,95%).

Conclusiones: La osteosíntesis percutánea con tornillos disminuye el tiempo de inmovilización de la fractura al máximo, favorece una recuperación funcional más temprana y no deja defectos estéticos. Es una técnica muy útil en fracturas y en pacientes especialmente seleccionados.

© 2008 SECOT. Publicado por Elsevier España, S.L. Todos los derechos reservados.

Introduction

Hand fractures are the most usual fractures in the upper limb, accounting for around 10% of all fractures affecting the human body^{1,2}. These fractures occur mainly in young individuals, which entails serious social, occupational and economic repercussions^{1,2}.

Conservative treatment of most of these fractures usually affords optimal results, provided that joint immobilization is maintained for a short period of time, is performed in a functional position and is followed by early physical therapy^{1,3}.

However, in the last 25 years, surgical treatment of hand fractures has become increasingly popular given the improvements achieved in materials, implant design and instruments, and as a result of the introduction of fluoroscopy^{1,4,5}.

Increase in the frequency of surgical treatment of these fractures can be explained by a desire to address the 2 most prevalent sequelae of conservative treatment: stiffness and deformity. Indeed, surgery achieves better fracture stabilization and permits earlier motion¹.

Fractures amenable to surgical treatment are irreducible fractures, rotational deformities (spiral and oblique fractures), intraarticular and subcapital fractures, open fractures, fractures involving the loss of a bone fragment, multiple fractures in the hand, hand fractures in the context of multiple trauma and soft tissue injury^{1,2}.

Nonetheless, the indication of surgical treatment for these fractures has been overextended, which has led to the secondary appearance of other complications caused by soft-tissue injury, such as tendon adhesions, infections and, on some occasions, the need of revision surgery^{1,3}.

In order to prevent the potential complications derived from conservative treatment, a new percutaneous micro-screw fixation technique has been developed. This technique affords better stabilization and earlier mobilization of fractures, minimizes the complications inherent in open surgery, causes less soft tissue damage, reduces tissue exposure and avoids opening of the fracture site.

Ease of access to the hand bones favors the application of this new technique, although careful patient selection is essential to obtain satisfactory results³.

The purpose of this study is to present the authors' experience in performing the above mentioned percutaneous technique for the treatment of hand fractures.

Materials and methods

A prospective study was carried out between November 2002 and November 2006. Eighty-four patients with hand fractures were treated by means of a percutaneous micro-screw fixation technique.

All patients were operated at the Valladolid University Hospital by the same specialist in orthopedic and trauma surgery.

Patient selection was carried out on the basis on the patients' characteristics and the type of fracture they had sustained. It was essential to recruit collaborative patients. The fractures considered amenable to this type of treatment were unstable fractures where appropriate stability could be achieved with screw fixation, such as condylar phalanx fractures, long spiral or oblique phalanx shaft fractures, phalanx base fractures, intraarticular fractures and some fractures of the base of the first metacarpal (figs. 1, 2, 3 and 4).

All patients were operated under the regime of major outpatient surgery.

The type of anesthesia used was locoregional. No ischemia was required. Antibiotic prophylaxis was administered preoperatively.

We used hand osteosynthesis-specific materials and instruments as well as a low-radiation OEC Miniview 6800 mobile fluoroscopic x-ray system (General Electric).

After closed reduction of the fracture, on some occasions with the help of Kocher forceps to keep the fragment on the opposite site reduced through a minimal incision, an incision is performed in the skin at the dorso-palmar junction, which is the safest area. A blunt dissection is performed so as to prevent entrapment of the lateral slips of the extensor mechanism; the fracture is initially stabilized with Kirschner wires, which are then replaced by self-tapping micro-screws of 1.5-2 mm in caliber. The type of bone present and its location determine the need to observe the fracture site compression criteria; use of an image intensifier may be required.



Figure 1 Long extraarticular oblique fracture of the middle phalanx of the middle finger.

Skin closure is not necessary given that incisions are minute; use of Steri-Strips® (3 m) may be indicated.

Immobilization is performed by means of “buddy-taping” for 3 weeks and, in some cases, with a plaster cast during the first two weeks; rehabilitation should be started immediately.

Post-operative follow-up exams were performed at 2–3 days, at 3–5 weeks, at 3 and 6 months, with serial functional evaluations according to the criteria of the American Society for Surgery of the Hand (ASSH)^{5,6} (table 1) ; radiographic fracture controls were also performed.

Results

We attempted to use this technique in 89 patients. However, in 5 of these patients (5.61%) closed fracture reduction was impossible, which made it necessary to perform the osteosynthesis by opening the fracture site.

Of the 84 remaining patients, 68 (80.95%) were male and 16 female (19.05%) with ages ranking between 15 and 63 years (mean age: 29 years).

The number of days elapsed between trauma and surgery ranged between 0 and 7 (mean: 2.95 days).

The mechanism of injury was an occupational accident in 28 patients (33.33%), a fortuitous fall in 24 patients (28.57%) a sports-related accident in 28 patients (33.3%) and traumatic finger torsion in 4 patients (4.76%).



Figure 2 Fracture of the base of the middle phalanx of the ring finger.



Figure 4 Fracture of the base of the first metacarpal.

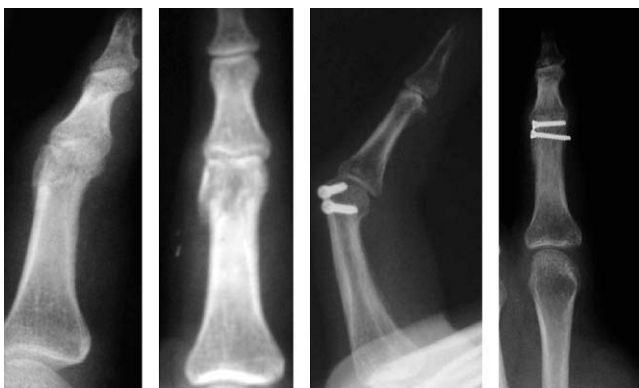


Figure 3 Condylar proximal phalanx fracture of the index finger.

Table 1 Functional results in the hand according to the American Society for Surgery of the Hand^{5,6}

	Range of motion
Results (thumb)	
Excellent	>120°
Good	100°-120°
Poor	<100°
Result (2nd to 5th finger)	
Excellent	>220°
Good	180°-220°
Poor	<180°

The injury was located at the base of the first metacarpal in 12 (14.28%) cases; the rest were all phalangeal fracture: 12 (14.28%) fractures in the proximal phalanx and 8 (9.52%) in the middle phalanx media of the little finger; 8 (9.52%) fractures in the proximal phalanx and 4 (4.76%) in the middle phalanx of the middle finger; 12 (14.28%) fractures in the proximal phalanx and 12 (14.28%) in the middle phalanx of the ring finger; 12 (14.28%) fractures in the proximal phalanx and 4 (4.76%) in the middle phalanx of the little finger.

All fractures were closed. Forty (47.61%) fractures were intraarticular: 16 (19.04%) were at the palangeal base; 12 (14.28%) were condylar and 12 (14.28%) at the base of the first metacarpal.

The most frequent type of fracture were long oblique fractures (68 patients, 80.95%), spiral fractures (8 patients, 9.52%) and comminuted joint fractures (8 patients, 9.52%).

At 6 months excellent results were obtained in 64 (76.19%) patients, good in 15 (17.86%) patients and poor in 5 (5.95%), according to the criteria of the ASSH^{5,6} (table 2).

Radiographic reduction of the fractures was acceptable from the anatomic point of view in 78 (92.85%) cases. In 3 (3.57%) patients with a comminuted joint fracture of the base of the phalanx fracture the joint surface was restored but reduction was suboptimal, in 2 patients (2.38%) the joint surface could not be fully restored because of severe comminution and because the bone fragments were too small (these were considered poor results) and in one (1.19%) patient with a fracture in the proximal phalanx of the fourth finger a slight diastasis persisted at the fracture site (following trauma to the finger the fracture was displaced and a plate and screw fixation was applied; this was also considered a poor result) [fig. 5].

The other 2 patients with a poor functional result were one patient with proximal interphalangeal flexion of 90° and adhesions of the lateral slips of the extensor mechanism, owing to prolonged immobilization; as the patient did not return until the fifth week post-op, we had to perform a tenolysis, which yielded a good result. The other case was a patient who did not cooperate in post-operative mobilization, which resulted in a revision procedure.

There was no infection and all fractures, except for the one mentioned above, healed within 6 weeks.

Discussion

Swanson (1970) stated that "hand fractures may have the following complications: deformity due to lack of treatment,

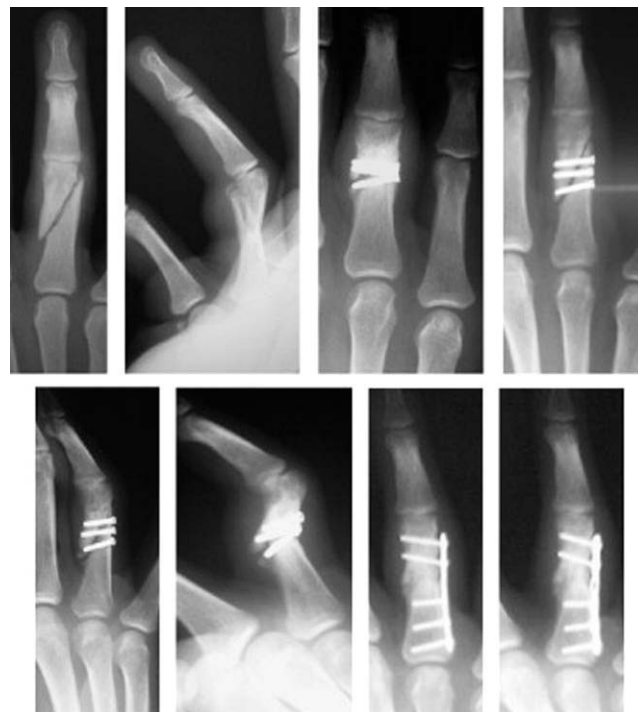


Figure 5 Long oblique fracture of the proximal phalanx of the ring finger of the right hand. Failure of percutaneous fixation. New plate and screw osteosynthesis.

stiffness resulting from excessive treatment and both deformity and stiffness due to deficient treatment”¹.

The development of new micro-osteosynthesis led to an excessive broadening of the indication of surgery for hand fractures and resulted in the appearance of many cases of stiffness derived from soft tissue dissection and the very presence of the hardware, which on occasion takes up a space necessary for the sliding of the different tissues¹⁻⁵.

On the other hand, conservative treatment forces the surgeon to immobilize the finger for long periods, which results in stiffness and, in many patients, cannot prevent post-fracture deformity^{1,2}.

In an attempt to combine the advantages of surgical treatment as regards fracture correction and stability with those of orthopedic treatment in terms of not having to open the fracture site and avoiding tissue dissection (and the subsequent scars) this new technique has been developed, where Kirschner wires are not used as a final stabilizer given their unstable immobilization of the fracture site but rather fixation mini-screws that afford a superior stabilization and compression of the fracture site.

A percutaneous technique involves certain difficulties associated to the treatment of the fracture itself and to the placement of the fixation hardware, especially in spiral fractures, given the complexity inherent in tridimensional reduction. However, the technique was successful in 84 of the 89 cases originally planned. A strict selection of the fractures amenable to this type of treatment must be carried out in order to avoid complications.

The results obtained in this series are superior to those published in the literature, both in the series treated

Table 2 Functional results obtained following the last follow-up visit

	Thumb	2 nd finger	3 rd finger	4 th finger	5 th finger
Excellent	12	16	4	20	12
Good		4	6	3	2
Poor			2	1	2

conservatively and in patients treated with open surgery.

Complications attributed to this technique were only observed in 3 patients. In one of them the fracture could not be sufficiently stabilized and, as a result of direct trauma, the finger was displaced and the screws loosened, which resulted in a new plate and screw fixation surgery, with good subsequent results (fig. 5). In 2 patients appropriate joint reduction was not achieved, although if open reduction had been attempted the result would probably have been the same or even worse given the small size and comminution of the bone fragments.

The other 2 patients with poor functional results were one patient with a long oblique fracture of the proximal phalanx of the middle finger that was treated with 3 percutaneous screws; the fracture healed properly but a lengthy 5-week immobilization resulted in stiffness with a flexion deformity of the interphalangeal joint caused by adhesion of the lateral slips of the extensor mechanism, which was corrected by means of a tenolysis; the other patient presented with a fracture of the base of the proximal phalanx of the little finger treated with 2 percutaneous screws; failure to mobilize the patient early because of poor cooperation resulted in a new surgical procedure in order to release adhesions and achieve greater mobility.

Conclusions

- Percutaneous osteosynthesis is a very useful technique in carefully selected fractures.
- It requires special skills and specific materials.

—Percutaneous osteosynthesis minimizes immobilization time, favors earlier functional recovery and does not produce cosmetic defects.

—Patient cooperation is fundamental to obtain an optimal functional result.

Conflict of interests

The authors have declared that they have no conflict of interests.

References

1. Stern PJ. Fracturas de los metacarpianos y falanges. En: Green S. Cirugía de la mano. 5.ª ed. Tomo I. Madrid: Marban; 2007. p. 277-341.
2. Pun WK, Chow SP, Luvestuk DK. A prospective study on 284 digital fracture of the hand. *J Hand Surg.* 1989;14A:474-81.
3. Klein DM, Belsone RJ. Percutaneous treatment of carpal, metacarpal and phalanges injuries. *Clin Orthop Rel Res.* 2000;375:116-25.
4. Le Systeme VB. Un nouveau matériel d'ostéosynthese modulaire á la fois vis et broche. *Chir Main.* 2002;21:23-7.
5. Bosscha K, Snellen JP. Internal fixation of metacarpal and phalangeal fractures with AO minifragment screw and plates: A prospective study. *J Hand Surg.* 1993;21A:166-8.
6. Freeland A. Outcome measurements. Hand fractures. Repair, reconstruction and rehabilitation. Philadelphia: Churchill Livingstone; 2000. p. 12-13.