

THE RESULTS OF OPERATIVE TREATMENT OF FRACTURES OF THE THUMB METACARPAL BASE

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The results of operative treatment of 21 patients with intraarticular fractures of the thumb metacarpal bone are presented. In 14 patients closed reduction was performed followed by percutaneous fixation with one or two K-wires through the metacarpal shaft to the trapezium. In five delayed cases, in which closed reduction was unsuccessful, open reduction and K-wire pinning was performed. After operation the hand and wrist were immobilized for four weeks. In two patients with Rolando-type fractures, an external fixator was used after closed reduction. Patients were followed-up for six months to three years (mean 1.5 years). Consolidation of fractures was achieved in all cases. Fourteen patients had no pain in the hand at final assessment, two complained of mild pain after activity, and another five complained of pain related to the weather. Grip strength of the affected hand ranged from 72% to 85% (mean 80%) of the expected standard value, matched for gender, age and dominant side. Full opposition of the thumb was achieved in all patients. Self-evaluation of the function of the hand expressed on an analogue scale, from 1 (normal hand function) to 5 (total disability), was from 1.1 to 1.5 (mean 1.2). Abduction of the affected thumb measured on xray ranged from 30° to 50° and it was 5°-12° less than in the unaffected hand. Secondary degenerative changes seen as narrowing of the trapeziometacarpal joint were observed in 16 patients. All patients returned to their previous occupations, among them five to hard manual work. None reported problems in daily activities. Our results suggest that closed reduction followed by percutaneous K-wire pinning is a valuable method of treatment for acute fractures. When treatment has been delayed an open operative approach should be considered.

Keywords : metacarpal ; fracture ; Bennett.
Mots-clés : métacarpien ; fracture ; Bennett.

INTRODUCTION

Intraarticular fractures of the thumb metacarpal base were first described by Bennett and Rolando (1, 17). In the Bennett-type fracture, the thumb metacarpal base is broken and subluxated (fig. 1) ; it occurs when an injury acts on the slightly flexed thumb and a small triangular fragment of the metacarpal base is cracked out on the ulnar side ; the trapezium bone acts as a wedge against the thumb. When the applied force is strong enough, T- or Y-shaped multifragmental fractures (Rolando-type) can occur. The broken proximal part remains in its position held by ligaments of the trapeziometacarpal joint. The distal part, the metacarpal shaft, subluxes proximally and ulnarly, pulled by the tendon of the abductor pollicis longus and by thenar muscles.

Treatment of these fractures can be either conservative or operative. The former consists of reduction and immobilization in a well-fitted circular cast holding the thumb in abduction and

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Fig. 1. — An example of the thumb metacarpal base fracture (Bennett type).



Fig. 2. — Bennett-type fracture reduced and stabilized by percutaneous K-wire pinning.

opposition. In the case of a comminuted fracture, direct traction on the first metacarpal bone may be applied to maintain reduction (2, 19). There are several options for operative management, such as closed reduction and percutaneous pinning with K-wires, external fixation, open reduction and internal fixation of various types (6, 7, 8, 9, 11, 20, 21, 22).

The objective of this study was to evaluate the long-term results of operative treatment in 21 patients with intraarticular fractures of the thumb metacarpal base.

MATERIAL AND METHODS

From 1994 to 1997, 21 patients with intraarticular thumb metacarpal fractures were treated in the department, which makes up 0.65% of all hand injuries identi-

fied in that period. The patients included 19 men and two women with ages ranging from 23 to 58 years (average 42). The right hand (dominant) was injured in 18 cases and the left (nondominant) in three. The mechanism of injury was a fall on the hand in nine patients, a street brawl in five, a sports accident in four, and a direct injury to the hand in three. The operations were performed within a period from several hours to 15 days after the accident. In seven cases patients were referred to our department because of unsuccessful conservative treatment in another hospital.

All operations were performed under brachial plexus anesthesia (axillary or supraclavicular access). In 14 patients closed reduction under fluoroscopic control was performed followed by percutaneous fixation with one or two K-wires through the thumb metacarpal shaft into the trapezium (fig. 2). In seven patients anatomical restoration of the articular surface was not achieved. In five delayed cases in which closed reduction was

unsuccessful, open reduction and K-wire pinning were performed. After operation the hand was immobilized with four fingers free for four weeks ; subsequently K-wires were removed and rehabilitation was promptly started. In two patients with Rolando fractures, external fixation was applied after closed reduction (fig. 3).

Final assessment was performed from six months to three years after the treatment (mean : 1.5 years). Intensity of pain, total grip strength and thumb opposition (thumb to little finger pinch grip) were evaluated. Total grip strength was measured with a Jamar dynamometer ; the results were compared with standard values matched for gender, age and dominant side and were finally presented as a percentage of the expected standard value (16). Patients' subjective estimation of hand function was expressed on an analogue scale from 1 (normal hand function) to 5 (total disability) (13). On xray, the angle between thumb- and second metacarpal bones was measured, and the appearance of the trapeziometacarpal joint was evaluated.



Fig. 3. — Rolando-type fracture reduced and stabilized by external fixation.

RESULTS

Healing of the fracture was achieved in all patients at final assessment. Of 21 patients who completed the study, 14 had no pain, two complained of mild pain following activity, and the other five complained of pain related to the weather. Grip strength of the affected hand ranged from 72% to 85% (mean 80%) of the expected standard value. Self-evaluation of the function of the hand expressed on an analogue scale was from 1.1 to 1.5 (mean 1.2). All patients achieved full range of thumb opposition of the affected hand. Abduction of the affected thumb measured on xray ranged from 30° to 50° ; this was 5° to 12° less than in the unaffected hand. A compensatory mechanism involving hyperextension in the thumb metacarpophalangeal joint was observed in four cases. There were no differences in final functional outcomes between 5 patients treated by open reduction and K-wire pinning and 16 patients who underwent closed reduction and K-wire pinning or external fixation. The normal shape of the trapeziometacarpal joint at final xray examination was noted in five patients. Secondary degenerative changes seen as narrowing of the trapeziometacarpal joint were observed in 16 patients, of whom seven had an articular step-off or loss of joint surface ; this, however, did not significantly influence the final functional result. There was no relationship between the presence of a small articular step-off and the presence of pain at final assessment ; the follow-up was however relatively short (mean 1.5 years). No infectious complications were noted. All patients returned to their previous occupations, among them five to hard manual work. None reported problems in daily activity.

DISCUSSION

Intraarticular fractures of the thumb metacarpal base are considered to be relatively rare ; their incidence is estimated to be 1.4% of all fractures within the hand (10). Proper reduction of these fractures appears necessary for the normal function and power grip of the hand (3, 12). Except in delayed cases, anatomical reduction of the base of the thumb

metacarpal base is relatively easy, but it is more difficult to maintain this position as long as healing is not sufficient. To maintain anatomical position after reduction Iselin *et al.* used K-wire fixation of the first to second metacarpal bone (11). Secondary displacements are frequently observed during conservative treatment, which results in consolidation of the fracture in a nonanatomic position. This may lead to secondary degenerative changes and subluxations in the trapeziometacarpal joint, and eventually pain and diminished range of motion of the thumb (14, 15, 20). After a mean follow-up of 7 years, Kijaer-Petersen *et al.* observed arthritic changes in the trapeziometacarpal joints significantly more frequently in patients in whom restoration of the articular surface had not been achieved; they also complained more frequently of pain in the hand. The authors suggest that operative treatment of these fractures results in better functional outcomes (12). Timmenga *et al.* reported results of surgical management of 18 Bennett fractures with percutaneous and open K-wire fixation. At the final assessment at 11 years, xrays showed degenerative changes in all patients; however they were less severe in anatomically reduced cases (20).

The necessity of anatomic restoration of the articular surface was challenged by Cannon *et al.* and Cullen *et al.* (4,5). They reported that 2-mm displacement of the metacarpal base fragment did not significantly affect the joint biomechanics, provided the rest of the articular surface was congruous. These findings did not contradict the principle of accurate reposition in articular fractures. In cases of delayed fractures when accurate reduction is unlikely, acceptable results can be achieved by precise joint ligaments restitution and consolidation of the trapeziometacarpal joint (4).

In our study seven patients reported periodical pain without limitation of occupational activity. Reduction of thumb abduction was noted in all cases at final assessment, but it did not significantly impair hand function. Decrease of global grip strength was noted in all patients, which is in agreement with results of other authors (15, 20); this, however, did not influence significantly daily and occupational activity. Dein and Ansorg reported satisfactory results of percutaneous pinning in

Bennett fractures in 20 of 22 patients (6). Van Niekerk and Ouwens considered this method equally good as open reduction, but less traumatic and easier to perform (21).

Satisfactory results of treatment of Bennett fractures are less likely to be achieved by conservative treatment. Livesley reported results of conservative treatment of 17 patients, after a mean follow-up of 26 years. All patients complained of pain in the wrist, reduction of range of motion of the thumb, and reduced global grip strength; radiological studies revealed in all patients subluxation and degenerative changes in the trapeziometacarpal joint (15). In our study, seven patients had primary conservative treatment elsewhere with poor results and finally required open reduction and internal fixation.

Our satisfactory results suggest that closed reduction and percutaneous pinning is a valuable method of treatment for these fractures. Immediately after injury this technique is relatively easy and should guarantee the maintainance of repositioning until fracture healing. Nevertheless in delayed cases closed reduction is more difficult, and an open operative approach is necessary. In comminuted Rolando fractures external fixation with the use of small fixators is beneficial. In conclusion we suggest that operative treatment of intraarticular fractures of the thumb metacarpal base should be considered in the majority of the cases.

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SAMENVATTING

J. BRÜSKE, M. BEDNARSKI, Z. NIEDŹWIEDŹ, A. ŹYLUK, S. GRZESZEWSKI. Resultaten van de heelkundige behandeling van fracturen van de basis van de eerste metacarpaal.

De resultaten worden beschreven van de heelkundige behandeling van intra-articulaire fracturen van de basis van metacarpaal één bij 21 patiënten. In 14 gevallen werd de gesloten reductie gevolgd van een enkelvoudige of dubbele kirchnerpinning vanuit de diaphyse van metacarpaal I naar het multangulum majus. In 5 laatijdige gevallen kon gesloten reductie niet worden bekomen, en moest ze heelkundig worden bereikt, waarna tevens pinning. Telkens werden postoperatief de hand en de pols gedurende 4 weken geïmmobiliseerd. Twee patiënten vertoonden een Rolando fractuur: hier werd na gesloten reductie, uitwendige fixatie verkozen. De follow-up periode bedroeg gemiddeld 1.5 jaar (van 6 maand tot 3 jaar). Telkens werd consolidatie bereikt. Bij de finale evaluatie vermeldden 14 patiënten de afwezigheid van pijn, 2 hadden lichte hinder bij inspanning en 5 hadden "weer" pijn. De grijpkracht lag tussen 72% en 85% (gemiddeld 80%) van de normale waarde, rekening houdend met geslacht, ouderdom, en dominante zijde. Bij allen was de oppositie van de duim volledig hersteld. De handfunctie gemeten volgens een analoge, visuele schaal behaalde gemiddeld 1.2 (gaande van 1.1 tot 1.5), waarbij schaal 1 staat voor normale handfunctie en schaal 5 voor volledige machteloosheid. De radiologische duimabductie ging tot 30° à 50°, dit is 5° tot 12° min dan de gezonde zijde. Zestien patiënten hadden een lichte zadelgewrichtsvernauwing. Allen hernamen hun normaal werk, wat zware manuele arbeid betekende voor 5. Geen enkel had problemen bij de activiteiten van het dagelijkse leven. De resultaten suggereren dat acute Bennett fracturen wel degelijk kunnen worden behandeld met gesloten reductie en percutane pinning. Laatijdig behandelde fracturen vragen open reductie.

RÉSUMÉ

J. BRÜSKE, M. BEDNARSKI, Z. NIEDŹWIEDŹ, A. ŹYLUK, S. GRZESZEWSKI. Résultats du traitement chirurgical des fractures de la base du premier métacarpien.

Les auteurs rapportent les résultats obtenus par traitement chirurgical chez 21 patients qui présentaient des

fractures intra-articulaires de la base du premier métacarpien. Dans 14 cas, la réduction à foyer fermé a été suivie d'une fixation percutanée par une ou deux broches de Kirschner introduites dans le trapèze à partir de la diaphyse du métacarpien. Dans 5 cas reçus tardivement, la réduction n'a pu être obtenue à foyer fermé ; elle a été faite à foyer ouvert, suivie d'un embrochage. La main et le poignet ont été immobilisés pendant 4 semaines en post-opératoire. Chez deux patients qui présentaient une fracture de type Rolando, la réduction a été obtenue à foyer fermé et la contention a été assurée par un fixateur externe. Les patients ont été suivis pendant une période de six mois à trois ans (moyenne : 1,5 an). La consolidation de la fracture a été obtenue dans tous les cas. Lors de l'évaluation finale, 14 patients n'avaient aucune douleur locale, 2 signalaient une douleur légère lors des activités, et 5 autres signalaient des douleurs barométriques. La force de préhension atteignait entre 72% et 85% (moyenne : 80%) de la

valeur normale, compte tenu du sexe, de l'âge et du côté dominant. L'opposition complète du pouce a été rétablie chez tous les patients. Ceux-ci ont également évalué la fonction de la main, sur une échelle visuelle analogique allant de 1 (fonction normale de la main) à 5 (impotence complète) ; les valeurs allaient de 1,1 à 1,5 (moyenne de 1,2). L'abduction du pouce, mesurée sur radiographie, allait de 30 à 50°, soit 5 à 12° de moins que du côté sain. Des signes radiologiques d'arthrose secondaire étaient notés chez 16 patients, avec un pincement de l'interligne trapézo-métacarpien. Tous les patients ont repris leur métier antérieur, qui était un travail manuel lourd pour 5 d'entre eux. Aucun ne signalait de problème dans les activités de la vie quotidienne. Ces résultats suggèrent que les fractures de Bennett vues au stades aigu peuvent être valablement traitées par réduction à foyer fermé suivi d'embrochage percutané. Cependant, la réduction doit se faire à foyer ouvert dans les cas traités tardivement.