

Journal of Hand Surgery (British and European Volume)

<http://jhs.sagepub.com/>

Closed Reduction Transarticular Kirschner Wire Fixation Versus Open Reduction Internal Fixation in the Treatment of Bennett's Fracture Dislocation

M. SAILER, R. LUTZ, R. ZIMMERMANN, M. GABL, H. ULMER and S. PECHLANER

J Hand Surg [Br] 2003 28: 142

DOI: 10.1016/S0266-7681(02)00307-8

The online version of this article can be found at:

<http://jhs.sagepub.com/content/28/2/142>

Published by:



<http://www.sagepublications.com>

On behalf of:

[British Society for Surgery of the Hand](#)



[Federation of the European Societies for Surgery of the Hand](#)



Additional services and information for *Journal of Hand Surgery (British and European Volume)* can be found at:

Email Alerts: <http://jhs.sagepub.com/cgi/alerts>

Subscriptions: <http://jhs.sagepub.com/subscriptions>

Reprints: <http://www.sagepub.com/journalsReprints.nav>

Permissions: <http://www.sagepub.com/journalsPermissions.nav>

CLOSED REDUCTION TRANSARTICULAR KIRSCHNER WIRE FIXATION VERSUS OPEN REDUCTION INTERNAL FIXATION IN THE TREATMENT OF BENNETT'S FRACTURE DISLOCATION

M. LUTZ R. SAILER, R. ZIMMERMANN, M. GABL, H. ULMER and S. PECHLANER

From the Department of Trauma Surgery, University of Innsbruck, Austria and Department of Biostatistics, University of Innsbruck, Austria

Thirty two patients with fracture dislocations of the base of the thumb metacarpal with a single large fracture fragment (Bennett's fracture) were either treated by open reduction and internal fixation or closed reduction and percutaneous transarticular Kirschner wiring. All were assessed at a mean follow up of 7 (range 3–18) years. Patients with an articular step off more than 1 mm were excluded. The type of treatment did not influence the clinical outcome or the prevalence of radiological post-traumatic arthritis. The percutaneous group had a significantly higher incidence of adduction deformity of the first metacarpal. This was attributed to Kirschner wire placement near the fracture line or in the compression zone of the fracture, resulting in loss of reduction. This however did not result in an inferior outcome.

Journal of Hand Surgery (British and European Volume, 2003) 28B: 2: 142–147

INTRODUCTION

Post-traumatic arthritis of the trapezometacarpal joint of the thumb is a frequent sequel to a Bennett's type fracture-dislocation of the thumb metacarpal. Gedda classified these fractures: Type 1 – a large single fragment and subluxation of the thumb metacarpal base; Type 2 – an impaction fracture without subluxation of the thumb metacarpal; Type 3 – fractures – a small avulsion fragment and thumb metacarpal dislocation (Gedda, 1954). Gedda and Moberg (1953) considered open reduction and internal fixation superior to closed reduction and plaster splintage (Gedda and Moberg, 1953), but other treatment techniques are also available. (Iselin et al., 1956; Sälgeback et al., 1971; Spanberg and Thoren, 1963; Wagner, 1950). It is difficult to compare the results of different procedures as most studies do not differentiate between the three fracture subtypes (Stern, 1993). This study compares open reduction and internal fixation with closed reduction and transarticular Kirschner wire fixation (Wagner's technique) for the treatment of Type 1 Bennett's fracture-dislocation (Wagner, 1950).

PATIENTS AND METHOD

Between 1983 and 1998, 46 Bennett's fractures with a large fracture fragment (Gedda Type 1) were treated at our department. Thirty-two of these 46 patients were available for follow-up examination (Fig 1).

Operative treatment was either by closed reduction and percutaneous pinning (Wagner technique: group A), or open reduction and lag screw fixation (group B). The Wagner technique was abandoned if an anatomical

closed reduction with an intra-articular step of no more than 1 mm could not be achieved. Open reduction and lag screw fixation was then performed, without any attempt at percutaneous Kirschner wire fixation.

Of the 25 patients in group A, 17 (four women and 13 men: mean age 37 years) were available for follow-up. Their fractures were treated using the technique described by Wagner. Traction was applied to the thumb and additional pressure was applied to the base of its metacarpal. The reduction was checked with an image intensifier and, if satisfactory, a Kirschner wire was passed from the base of the thumb metacarpal into the trapezium. Postoperatively a thumb spica cast was worn for 6 weeks, but the transarticular Kirschner wire was removed after 4 weeks (Wagner, 1950).

Of the 21 patients in group B, 15 (two women and 13 men: mean age 28 years) were available for follow-up. They were treated by open reduction and internal fixation through a dorsoradial approach. The fracture dislocation was reduced and the fragment stabilized with a lag screw. The thumb was then immobilized for 4 weeks in a thumb spica cast.

At the follow-up assessment pain (no pain; mild pain, occasionally or during and after strenuous work; moderate pain with daily activities which restricted employment; severe pain causing inability to work), the active range of motion of the trapezometacarpal joint (neutral zero method: Russe et al., 1982) and grip and pinch strength (balloon dynamometer) were measured and compared to the uninjured side. X-rays (anteroposterior and lateral view of the trapezometacarpal joint) were taken on the day of injury, postoperatively and at follow-up and were assessed for arthritis and adduction deformity of the first metacarpal. Arthritis of the trapezometacarpal joint was classified according to van

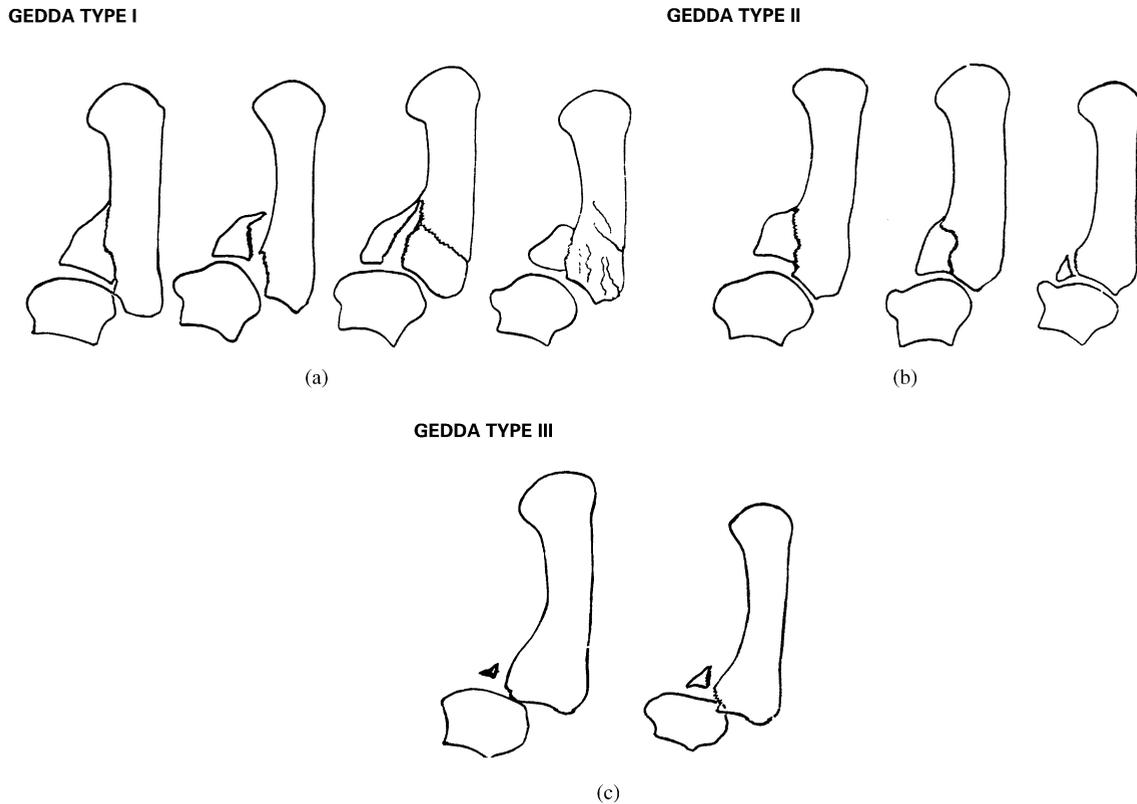


Fig 1 Gedda classification: (a) Type 1 fractures are intraarticular and there is subluxation of the metacarpal, with or without additional basal fractures; (b) Type 2 fractures are through the palmar tip and are impacted, but there is no dislocation or subluxation of the metacarpal; (c) Type 3 fractures have small avulsion fragments and the trapeziometacarpal joint is dislocated.

Niekerck and Owens modification of the Eaton and Littler system (van Niekerck and Owens, 1989; Eaton and Littler, 1969): stage 1: no arthritis; stage 2: osteophytes smaller than 2 mm; stage 3: osteophytes larger than 2 mm or joint narrowing; stage 4: joint space more or less absent. The angle between the long axis of the shaft and the line of the joint surface of the thumb metacarpal was measured postoperatively and at follow-up on the lateral X-ray. The metacarpal adduction deformity was then determined by subtraction of each of these angles from the normal shaft-joint angle (see Fig 2).

The chi-square and *t*-tests were used to detect differences between both groups. Associations between the clinical and radiologic variables were assessed using Pearson's correlation coefficient.

RESULTS

At the final follow-up, 26 of the 32 patients were pain free, five had mild pain during strenuous work and only one reported moderate pain during daily activities. There was no difference between the pain levels in the two treatment groups ($P = 0.4$). There was also no difference between the groups regarding active range of

trapeziometacarpal motion ($P = 0.3$), grip strength ($P = 0.8$) or pinch strength ($P = 0.1$) (Table 1).

At follow-up nine patients had no arthritic changes, 19 had stage 2 changes and three had stage 3 disease. There was no significant difference between the two groups regarding arthritic change ($P = 0.2$) but adduction deformity was more common in group A than in group B ($P = 0.01$). A mean of 6° of adduction deformity developed after operative treatment, 9° in group A and 4° in group B. There was a significant correlation between adduction deformity and the development of arthritis ($r = 0.385$; $P = 0.03$) but there was no correlation between arthritis and clinical symptoms, or between adduction deformity and active range of motion.

DISCUSSION

Redislocation and fracture redisplacement are common following conservative treatment of Bennett's fracture dislocation. In a late follow-up (26 years) study, Livesley observed osteoarthritis in 14 and subluxation of the trapeziometacarpal joint in 13 out of 17 patients

(Livesley, 1990). Active range of motion at the trapeziometacarpal joint was decreased in all patients and ten were symptomatic. Gedda and Moberg reported that open reduction and internal fixation of Bennett's fracture dislocation was superior to closed reduction and plaster fixation (Gedda and Moberg, 1953): Only nine of their 53 conservatively treated fractures united in anatomic alignment. The relationship between mal-

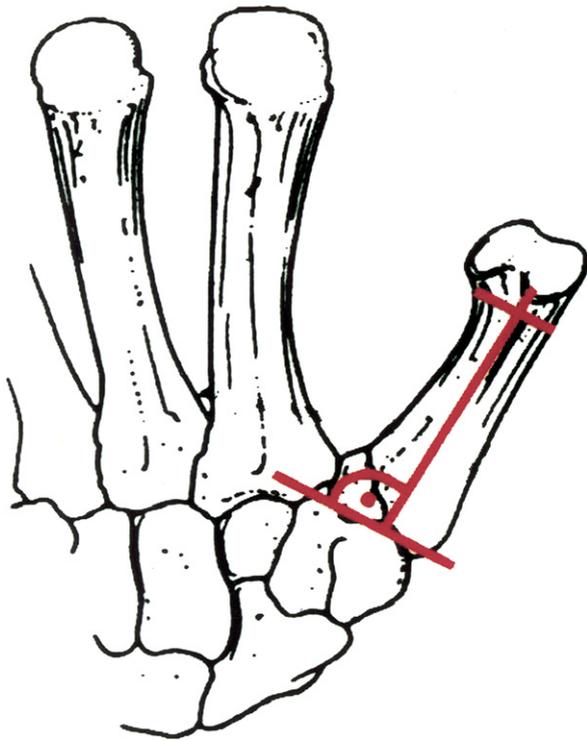


Fig 2 Measurement of the shaft-joint angle of the thumb metacarpal on the lateral X-ray.

union and the development of degenerative arthritis was emphasized, but only five patients were symptomatic at their 7.5 year follow-up (Gedda, 1954) (see Figs 3 and 4).

Bennett's fracture dislocations are now usually treated surgically, though it is still debated whether a closed or an open reduction is preferable (Fosler and Hastings, 1987; Howard, 1978). After open reduction and internal fixation, the reduction is maintained in 60–70% of patients, with failures occurring due to failed osteosynthesis or the multifragmentary nature of the fractures (Badger, 1956; Gedda, 1954; Kjaer-Petersen et al., 1990). Gedda and Moberg maintained their anatomic reductions in 17 of 29 fractures treated by open reduction and internal fixation, but redislocation occurred in about a third of cases. Eleven developed radiological degenerative osteoarthritis, but without clinical symptoms (Gedda and Moberg, 1953). Furthermore Badger observed redislocation in a quarter of his 17 patients treated by open reduction and screw fixation (Badger, 1956) and Kjaer-Petersen et al. (1990) achieved union in anatomical alignment in 18 of 26 fractures. The latter authors also reported a correlation between the quality of reduction and the development of degenerative changes and, in contrast to many other investigations, a positive association between arthritis and clinical symptoms (Kjaer-Petersen et al., 1990).

In contrast Wagner reported uniformly good results in 38 cases treated by closed reduction and transarticular Kirschner wire fixation of the trapeziometacarpal joint (Wagner, 1950). However Salgeback et al. (1971), using a modified Wagner technique, observed the development of deformity at the thumb metacarpal's base despite adequate closed reductions. Although arthritis occurred in 63% of their cases, it was only symptomatic in 13% (Salgeback et al., 1971).

In a comparison of closed reduction and transmetacarpal pinning and open reduction and internal fixation

Table 1—Results

	Group A (Wagner technique)	Group B (open reduction and internal fixation)
Pain		
No pain	15	11
Mild pain, occasionally or during/after strenuous work	2	3
Moderate pain with daily activities which restricted employment	0	1
Severe pain, causing inability to work	0	0
Arthritis		
Stage 1	4	5
Stage 2	9	10
Stage 3	3	0
Stage 4	0	0
Mean adduction deformity (SD)	9°(6)	4°(4)
Mean loss of reduction (SD)	9°(6)	4°(4)
Mean active abduction (SD)	33°(8)	29°(8)
Mean active adduction (SD)	22°(4)	20°(5)
Mean active opposition (SD)	45°(9)	43°(10)
Mean pinch power (kPa) (SD)	42 (13)	40 (11)
Mean grip power (kPa) (SD)	89 (22)	87 (20)



Fig 3 (a) Type 1 Bennett's fracture; (b) following closed reduction and percutaneous Kirschner wire insertion into the uninjured portion of the thumb metacarpal; (c) 9 years after fracture, healing in anatomical alignment. There is no osteoarthritis.

of 18 patients, Timmenga et al. (1994) found no correlation between the method of treatment and the development of arthritis or between the method of treatment and joint deformity. This investigation was not restricted to Bennett's fractures, and also included comminuted fractures of the thumb metacarpal.

In a biomechanical investigation Cullen et al. (1997) examined the contact pressures within the trapeziometacarpal joint following a simulated Bennett's fracture and fixation of the beak fragment with a 2 mm articular step-off. Pathological concentration of contact pressure was not seen at the fracture site and, despite articular incongruity, the contact area increased with unloading of the palmar articular surface.

Contemporary principles for treating intraarticular fractures demands open reduction and internal fixation, though the disadvantage of this concept is an extensive dissection with the risk of further damage to the ligaments of the trapeziometacarpal joint. Furthermore, despite direct visualization of the fracture fragments, loss of reduction has been observed in about 30% of

cases by several authors (Badger, 1956; Gedda, 1954; Kjaer-Petersen et al., 1990). The percutaneous Wagner technique is easier than open reduction and internal fixation and has far fewer associated risks. However, it is criticized because residual intra-articular steps and joint deformity may occur (Sälgeback et al., 1971).

Comparison of the results in the literature is difficult because different techniques are used to treat different types of fractures, and osteoarthritis is a slowly progressive condition. This study aimed to ascertain whether open reduction and internal fixation is superior to closed reduction and transmetacarpal pinning of type 1 Bennett's fractures. As the development of symptomatic osteoarthritis following intra-articular malunion was observed by Kjaer-Petersen et al. (1990), open operative fixation was performed in cases in which an accurate closed reduction could not be achieved. Our data suggest a significantly higher rate of adduction deformity with the Wagner technique, but no correlation was found between the method of treatment and the development of osteoarthritis, and grip strength,



Fig 4 (a) Type 1 Bennett's fracture; (b) following open reduction and fixation; (c) 4 years after operation, there is no loss of reduction or obvious osteoarthritis.

residual clinical symptoms and range of motion were not influenced by the choice of treatment.

Loss of fracture reduction with the Wagner technique was only observed if the Kirschner wire was positioned near the fracture line, or in its compression zone, and these patients had a higher incidence of radiological osteoarthritis. However, as reported by others, there was no correlation between clinical symptoms and radiological osteoarthritis (Gedda, 1954; Griffiths, 1964; Salgeback et al., 1971). Slight losses of reduction were observed with the Wagner technique, even if the Kirschner wire was placed in the uninjured portion of the base of the thumb metacarpal. However, the results of other studies suggest that this should not lead to post-traumatic osteoarthritis. It is not known whether the mild symptoms of osteoarthritis found in our investigation will progress with longer follow-up.

Based on our findings we recommend the Wagner technique for the treatment of Bennett's fracture

dislocations with a large beak fragment. Open reduction internal fixation should be reserved for irreducible fractures and cases when a Kirschner wire cannot be placed in the uninjured bone at the base of the thumb metacarpal.

References

- Badger FC (1956). Internal fixation in the treatment of Bennett's fracture. *Journal of Bone and Joint Surgery*, 38-B: 771.
- Cullen JP, Parentis MA, Chinchilli VM, Pellegrini VD (1997). Simulated Bennett fracture treated with closed reduction and percutaneous pinning. *Journal of Bone and Joint Surgery*, 79-A: 413-420.
- Eaton RG, Littler JW (1969). Ligament reconstruction for the painful thumb carpometacarpal joint. *Journal of Bone and Joint Surgery*, 51-A: 1655-1666.
- Foster RJ, Hastings H (1987). Treatment of Bennett, Rolando, and vertical intraarticular trapezial fractures. *Clinical Orthopaedics and Related Research*, 214: 121-129.
- Gedda KO, Moberg E (1953). Open reduction and osteosynthesis of so called Bennett's fracture in the carpometacarpal joint of the thumb. *Acta Orthopaedica Scandinavica*, 22: 249-257.

- Gedda KO (1954). Studies on Bennett's fracture: anatomy, roentgenology, and therapy. *Acta Chirurgica Scandinavica (Suppl)*, 193: 1–114.
- Griffiths JC (1964). Fractures at the base of the first metacarpal bone. *Journal of Bone and Joint Surgery*, 46-B: 712–719.
- Howard F (1978). Fractures of the basal joint of the thumb. *Clinical Orthopaedics and Related Research*, 220: 46–51.
- Iselin M, Blanguernon S, Benoist D (1956). Fractures de la base du 1^{er} metacarpien. *Memoires de L' Academie de chirurgie*, 82: 771–774.
- Kjaer-Petersen K, Langhoff O, Andersen K (1990). Bennett's Fracture. *Journal of Hand Surgery*, 15B: 58–61.
- Livesley PJ (1990). The conservative management of Bennett's fracture dislocation: a 26-year follow-up. *Journal of Hand Surgery*, 15B: 291–294.
- Russe OA, Gerhardt JJ, Russe OJ (1982). *Taschenbuch der Gelenkmessung*, 2nd edn. Bern, Huber.
- Salgeback S, Eiken O, Carstam N, Ohlsson NM (1971). A study of Bennett's fracture. *Scandinavian Journal of Plastic Reconstructive Surgery*, 5: 142–148.
- Spangberg O, Thoren L (1963). Bennett's fracture. A method of treatment with oblique traction. *Journal of Bone and Joint Surgery*, 45-B: 732–736.
- Stern PJ (1993). Fractures of the metacarpals and phalanges. In: Green DP (Ed.) *Operative Hand Surgery*, 3rd edn., New York, Edinburgh: Churchill Livingstone, 1993, 745–752.
- Timmenga EJJ, Blokhuis TJ, Maas M, Raaijmakers ELFB (1994). Long term evaluation of Bennett's fracture. A comparison between open and closed reduction. *Journal of Hand Surgery*, 19B: 373–377.
- van Niekerk JLM, Ouwens R (1989). Fractures of the base of the first metacarpal bone: results of surgical treatment. *Injury*, 20: 359–362.
- Wagner C (1950). Method of treatment of Bennett's fracture dislocation. *American Journal of Surgery*, 80: 230–231.

Received: 13 May 2002

Accepted after revision: 22 October 2002

Dr Martin Lutz, Univ. Klinik für Unfallchirurgie Innsbruck, Anichstr. 35, 6020 Innsbruck, Austria. E-mail: martin.lutz@uklibk.ac.at

© 2003 The British Society for Surgery of the Hand. Published by Elsevier Science Ltd. All rights reserved.

doi:10.1016/S0266-7681(02)00307-8/jhsb.2003.0880, available online at <http://www.science-direct.com>