Anterior fracture displacement in Colles' fractures after Kapandji wiring in women over 59 years

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Abstract The aim of this study was to assess the radiological results of Colles' fractures treated with Kapandji wiring and to determine the frequency of postoperative anterior fracture displacement. The X-rays of 89 fractures in women over 59 years of age were evaluated. Five weeks after injury, palmar shift of the distal fracture fragments and/or palmar tilt of more than 20° were observed in 26 patients. In ten wrists dorsal tilt was not sufficiently corrected and measured more than 10°. Increase in ulnar variance was more than 2 mm in 37 wrists and more than 5 mm in six wrists; this was more pronounced when the palmar tilt was not corrected properly or when anterior fracture displacement was present. We conclude that Kapandji wiring may not be able to prevent anterior fracture displacement in almost one-third of Colles' fractures in osteoporotic elderly patients.

Résumé Le but de cette étude était d'apprécier le résultat radiologique du traitement par le brochage de Kapandji des fractures de Pouteau-Colles et de déterminer la fréquence des déplacements antérieurs secondaires. Les radiographies de 89 fractures chez des femmes de plus de 59 ans ont été évaluées. 5 semaines après le traumatisme un décalage antérieur et/ou une bascule palmaire de plus de 20 degrés était observé dans 26 cas. Dans 10 cas la bascule postérieure était insuffisamment corrigée et mesurait plus de 10 degrés. L'augmentation de l'index cubital était de plus de 2 mm dans 37 poignets et de plus de 5 mm dans 6 poignets, ceci étant plus prononcé quand la bascule

palmaire n'était pas corrigée correctement ou quand un déplacement antérieur de la fracture était présent. Nous concluons que le brochage de Kapandji ne prévient pas le déplacement antérieur dans environ un tiers des fractures de Pouteau-Colles chez la patiente âgée et ostéoporotique.

Introduction

Distal radius fractures are common in postmenopausal women and are often associated with osteoporosis [13]. In displaced distal radius fractures, cortical bone density is lower than in non-displaced fractures [24], and the severity of the fracture increases with advancing osteopaenia [12]. It may be more difficult to obtain and maintain a good reduction of osteoporotic fractures. With manipulation and plaster cast immobilisation reduction is lost in the majority of elderly patients [8]. The advantage of percutaneous pinning is its minimal invasiveness. In elderly patients with intra-articular fractures, Board et al. obtained better radiological results with Kapandji wiring than with closed reduction and plaster cast immobilisation [2]. Azzopardi et al., on the other hand, concluded that, in elderly patients with extra-articular fractures, crossed K-wires do not gain sufficient purchase to maintain anatomical reduction and improve function [1]. A possible disadvantage of the Kapandji technique is that an anterior shift of initially dorsally displaced fracture fragments may occur. A few cases of over-reduction have been reported [11, 16, 17].

Although the correlation between anatomical and functional outcome in distal radius fractures is controversial and complete anatomical restoration does not seem to be necessary in elderly low-demand patients [8, 25], we have always tried to obtain good anatomical results, regardless of patient age. The purpose of our study was to determine if

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the treatment of displaced Colles' fractures with percutaneous K-wires in elderly, mainly osteoporotic, patients gave acceptable radiological results and how frequently anterior fracture displacement occurred. We paid special attention to increase in ulnar variance, because we consider this an important radiological parameter.

Patients and methods

Between 2000 and 2004, 138 displaced Colles' type fractures in women over 59 years of age were treated with closed reduction and percutaneous K-wire fixation in our hospital. Forty-nine wrists could not be examined, because the patients did not come to our outpatient clinic for further treatment. X-rays of 89 Colles' fractures in 86 women (three women had bilateral fractures) were available for evaluation. Mean patient age was 74 years (range 60–87 years).

The fractures were reduced under general anaesthesia. Two K-wires were used in 41 wrists, three K-wires in 46 wrists and four K-wires in one wrist. The method described by Kapandji was used: insertion of the K-wire perpendicularly into the fracture, distal tilting of the K-wire and fixation in the opposite cortex [7]. The K-wires were 1.6 mm to 2 mm in diameter. A small stab wound was made through the skin, and the soft tissues were retracted with a small haemostatic forceps before the K-wires were inserted. No additional procedures such as bone grafting, plating or external fixation were performed. The K-wires were left outside the skin to facilitate their removal after 5 weeks. The protruding end of the K-wires was bent to avoid anterior or ulnar migration. Plaster immobilisation was applied for 5 weeks, consisting of a splint during the first postoperative week followed by a short arm cast for 4 weeks.

We studied X-rays taken at the time of fracture healing (5 weeks postoperatively directly after removal of the K-wires). The X-rays of the fractured wrists were compared with those of the contralateral uninjured wrist. In 23 cases the contralateral wrist could not be used for comparison, either because it had been fractured before (11 cases) or the X-rays were unavailable (12 cases).

According to the AO classification [15] 22 cases were A2, 15 A3, 12 C1, 17 C2 and 23 C3 fractures. According to the Frykman classification [4] there were nine type 1, 21 type 2, six type 5, four type 6, 17 type 7 and 31 type 8 fractures.

On the anteroposterior X-rays we measured the ulnar variance using the method of perpendicular lines to the central axis [9] (Fig. 1). Ulnar variance is the difference in length between the medial articular surface of the distal radius and the distal articular surface of the ulnar head. It can be negative if the ulna is situated more proximally than the radius or positive when the ulna is situated more

Fig. 1 Measurement of ulnar variance in millimetres

distally. We determined the increase in ulnar variance by calculating the difference in ulnar variance from the uninjured contralateral wrist. In the 23 cases in which the contralateral wrist could not be used for comparison, the normal ulnar variance for the individual patient was estimated from peroperative images during reduction or from X-rays taken immediately postoperatively, because in most cases ulnar variance is restored on the first postoperative day and loss of reduction occurs afterwards [11].

On the lateral X-rays we measured palmar tilt [9] (Fig. 2). The normal variation in palmar tilt is between 3° and 20° in females [14]. A negative palmar tilt, as occurs in dorsally displaced distal radius fractures, was referred to as a dorsal tilt. A dorsal tilt of more than 10° was considered undercorrection, and a palmar tilt of more than 20° overcorrection. Over-reduction is also present if an anterior shift of the distal fracture fragment has occurred. We measured the anterior shift of the fracture fragment in millimetres as the distance between the palmar cortex of the fracture fragment and the cortex just proximal to the fracture (Fig. 2).

We also looked for intra-articular steps of more than 2 mm on the X-rays taken at the time of fracture healing.

Statistical analysis was performed using non-parametric tests, because the distribution of the parameters was not

Fig. 2 A wrist with anterior fracture displacement and increased palmar tilt after the pinning of a Colles' fracture

normal. The difference in ulnar variance between intra- and extra-articular fractures and between fractures with and without articular steps was determined with the Mann–Whitney U-test. The difference in ulnar variance between wrists with a normal palmar tilt, with anterior fracture displacement and with a dorsal tilt exceeding 10° , was determined with the Kruskal–Wallis test. We used the chi-square test to find out if anterior fracture displacement was more frequent in extra- or intra-articular fractures.

Results

Mean increase in ulnar variance was 3 mm (range 0 to 10 mm). Ulnar variance increased more than 2 mm in 37 wrists and more than 5 mm in six wrists. The distribution of increase in ulnar variance is presented in Fig. 3.

On lateral X-rays ten wrists had a dorsal tilt of more than 10° and eight had a palmar tilt of more than 20° . In 26 wrists an anterior shift of the distal fracture fragments was present (mean 6 mm, range 2 mm to 13 mm). All fractures with more than 20° of palmar tilt had an additional anterior shift, but not all cases with anterior fracture displacement had a palmar tilt exceeding 20° . Of the 26 wrists with an anterior shift, 14 were type C fractures. Overcorrection was not significantly more common in intra-articular fractures than in extra-articular fractures ($P=0.24$).

Increase in ulnar variance was higher when palmar tilt was not sufficiently restored. In the 53 wrists with an

acceptable palmar tilt and without anterior shift of the distal fracture fragments, mean increase in ulnar variance was 2 mm. In the 26 wrists with too much palmar tilt and/or palmar shift of the distal fracture fragments, mean increase in ulnar variance was 3 mm. In the wrists with a dorsal tilt of more than 10° , mean increase in ulnar variance was 4 mm. The difference was statistically significant ($P<0.001$) (Fig. 4).

There were 52 intra-articular fractures. Mean increase in ulnar variance was 2 mm in extra-articular fractures and 3 mm in intra-articular fractures. The difference was not significant ($P=0.71$).

In 14 of 52 intra-articular fractures there was an intra-articular step of more than 2 mm. Increase in ulnar variance was 2 mm when a step was absent and 4 mm when present. The difference was significant ($P=0.04$).

Discussion

The criteria for an acceptable radiological result when one is treating distal radius fractures are not clearly established. Increase in ulnar variance can lead to ulnocarpal abutment and may be associated with a subluxed and incongruent distal radio-ulnar joint. The difference in ulnar variance from the contralateral uninjured wrist should be measured, because of the wide variation in the normal population. Ulnar variance can range between -8 mm to $+6$ mm in normal wrists [19]. In studies measuring the difference in

Fig. 3 Distribution of the increase in ulnar variance in Colles' fractures treated with Kapandji pinning

ulnar variance from the contralateral wrist, increase in ulnar variance was found to be an important radiological parameter affecting the functional result. [6, 20, 21, 23]. Inadequate correction of palmar tilt will be reflected in an increased ulnar variance. One of the reasons why, in some studies, no correlation was found between anatomical and functional results may be that the difference in ulnar variance from the contralateral wrist was not measured [18, 22, 25] or that, in elderly low-demand patients, the correlation between radiological and anatomical results is less pronounced [6, 25]. In young adults Fernandez advised acceptance of no more than 2 mm of radial shortening and no more than 10° of dorsal tilt [3]. In elderly patients Kelly et al. [8] suggested that up to 5 mm increase in ulnar variance and 30° of dorsal tilt can be accepted. We chose 10° of dorsal tilt as the limit, because, in our series, we had only one patient with more than 30° residual dorsal tilt.

Over-reduction or anterior displacement of the distal fracture fragments after Kapandji pinning in distal radius fractures is associated with an increase in ulnar variance and

can lead to worse functional results. Anterior fracture displacement can be expected to be more frequent in osteoporotic patients, because the severity of the fracture type increases with advancing osteopenia [12]. We observed in our study that anterior shift was more common in intra-articular fractures than in extra-articular fractures, but the difference was not significant. Anterior displacement may also be caused by an incorrect technique. Kapandji wrote in 1987 that overcorrection is an exaggerated problem and is caused when posterior pins are positioned too vertically [7]. According to Nonnenmacher and Kempf overcorrection might be caused by palmar comminution or by forcible reduction during manipulation [16]. We are not able to say if the anterior displacement in our study was mainly caused by an incorrect technique or by the fracture pattern.

We observed various degrees of anterior shift in 29% of the fractures. This percentage is higher than in other studies in which distal radius fractures were treated with Kapandji wiring. Peyroux et al. [17] observed anterior fracture displacement in 5%, but their study included old and young patients with mainly extra-articular fractures. Lenoble et al.

Fig. 4 Increase in ulnar variance (in millimetres) in wrists with anterior fracture displacement, normal palmar tilt and residual dorsal tilt

[11] observed anterior displacement in six of 60 fractures treated with Kapandji wiring, of which five had converted to a posterior tilt at the time of bone healing. Comminuted fractures were excluded, as were fractures with more than two intra-articular fragments. Nonnenmacher and Kempf [16] found 28% malunions, of which 8% were over-corrections. Their series comprised young and old patients, and malunions were less frequent in younger patients.

Distal radius fractures with anterior comminution or secondary anterior displacement can be treated with a palmar plate [16]. If necessary, a palmar plate can be combined with dorsal K-wires. This combination may not be necessary if plates with angle stable screws are used.

Mean postoperative increase of 3 mm in ulnar variance in our series has also been reported in other studies in which elderly patients with distal radius fractures were treated with Kapandji wiring [5, 21]. Trumble et al. found that increase in ulnar variance was more pronounced in comminuted fractures and that results were better when intrafocal pinning was combined with an external fixator. They concluded that intrafocal pinning alone cannot maintain radial length in elderly patients [21]. A mean

increase of 3 mm has been reported by Azzopardi et al. in patients older than 60 years after percutaneous pinning of extra-articular fractures. No difference in ulnar variance was found between closed reduction and percutaneous pinning, but the mean preoperative increase in ulnar variance of the fractures treated with closed reduction was less than that of the fractures treated with pinning [1].

Apart from increase in ulnar variance, intra-articular steps are also important, because they can lead to postoperative osteoarthritis [10]. In our series steps of more than 2 mm were present in one-quarter of the intra-articular fractures. In elderly low-demand patients this may no longer be an important factor [8, 25].

Conclusion

In the majority of our patients an acceptable reduction could be obtained with percutaneous pinning and plaster cast immobilisation. Kapandji wiring of Colles' fractures in elderly, mainly osteoporotic, patients may not be able to prevent anterior fracture displacement in almost one-third

of the cases. As anterior displacement is associated with an increase in ulnar variance and, thus, incongruity of the distal radio-ulnar joint, functional results may be worse in patients that are still active.

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