COLLES FRACTURE: DOES THE ANATOMICAL RESULT AFFECT THE FINAL FUNCTION?

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Thirty patients who had sustained a Colles' fracture at least four years previously were examined functionally and radiographically. Seventeen had a good radiological result and 13 were considered to have malunion. Functionally a displaced group performed significantly worse than the undisplaced group. We conclude that malunion of a Colles' fracture results in a weak, deformed, stiff and probably painful wrist.

A Colles' fracture is one of the most common fractures encountered by the orthopaedic surgeon, and at times one of the most challenging. Since it was first described by Abraham Colles in 1814, there has been continuing controversy about the best method of treatment. A central issue throughout has been the relationship between the final anatomical and the final functional result.

In 1950, Cassebaum stated that few patients had pain more than a year after a Colles' fracture even in the presence of considerable deformity, and that no person who had a Colles' fracture more than five years old had any serious functional complaints. This optimism has been echoed by some authors (Mason 1953; Older, Stabler and Cassebaum 1965; Benjamin 1982) and challenged by others (Frykman 1967; Saito and Shibata 1983; Melane 1986). Most of these opinions have been based on either subjective or single objective tests of hand and wrist function.

This paper aims to assess objectively the functional results of Colles' fractures in relation to the final anatomical results.

MATERIALS AND METHODS

Thirty patients who had sustained a Colles' fracture at least four years previously were reviewed. None had radiological extension of the fracture into the radiocarpal joint. There were 29 women and one man with an age range of 56 to 86 years (mean 69 years). All had sustained their fracture by a fall on to the outstretched hand and had undergone similar initial treatment by manipulation under regional anaesthesia and immobilisation in a forearm plaster for five to six weeks. Follow-up ranged from four years to six years nine months (mean five years one month). Thirteen patients had fractured the dominant 17 the non-dominant wrist.

Standard anteroposterior and lateral radiographs of both wrists were taken and measurements of dorsal angulation and radial shift were recorded (Van Der Linden and Ericson 1981). On the basis of these measurements the 30 patients were divided into two groups. Group 1 included the patients whose fractures united with 10° or less of dorsal angulation and less than 2 mm of radial shift. There were 17 patients in this group, 16 women and one man, their average age being 67 years. Group 2 included 13 patients with dorsal angulation ranging from 12° to 34° and more than 2 mm of radial shift. All were women and their mean age was 71 years.

The function of both hands and wrists was tested by one author (JC), who had no prior knowledge of the radiological measurements. The tests used were based on a recent review of assessment of hand function (Dent, Smith and Caspers 1985).

Grip strength was assessed using the Jamar dynamometer (Bechtol 1954) and the Jebsen-Grieve test balance (Musur-Grieve 1984) with interchangeable handles to allow assessment of hook, cylinder, key chuck and pinch grips. Grip endurance was tested on the latter apparatus using the hook grip. Manual dexterity was assessed using the Jebsen test (Jebsen et al. 1969) supplemented by the Moberg test performed with the eyes open (Moberg 1956).

The ability to perform both unilateral and bilateral activities of daily living such as lifting weights, turning keys, using scissors, etc., was assessed and scored according to the amount of difficulty in performing these activities (Sheehan, Sheldon and Marks 1983). The range
of movement (flexion/extension, pronation/supination, radial/ulnar deviation) was measured in both wrists using a goniometer. The unaffected wrist was taken as the normal range for each patient. Sensation and motor power in the median nerve distribution also were tested.

Pain was assessed using an analogue scale which was then divided into three equal parts representing mild, moderate and severe pain. An analgesic history was also taken. Finally the examiner’s assessment of cosmetic deformity was recorded. Statistical analysis was performed using the chi-squared test.

RESULTS

The results are summarised in Table 1.

**Tests of strength – Jamar Dynamometer.** In Group 1, the “undisplaced” group, 15 of 17 patients had grip strengths within the normal range for age, sex and dominance in both hands (Bechtol 1954). One patient had reduced grip strength bilaterally with only 10 kg in the dominant unaffected right hand and 9 kg in the non-dominant affected left hand. This patient had osteoarthritis of the proximal interphalangeal joints. One patient had a 17% reduction in grip strength in the dominant affected hand but also had signs and symptoms of median nerve compression.

<table>
<thead>
<tr>
<th>Test</th>
<th>Group 1 Good position</th>
<th>Group 2 Malunion</th>
<th>Statistical significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jamar Dynamometer</td>
<td>88</td>
<td>31</td>
<td>p &lt; 0.001</td>
</tr>
<tr>
<td>Musur-Grieve spring balance</td>
<td>94</td>
<td>54</td>
<td>p &lt; 0.01</td>
</tr>
<tr>
<td>Activities of daily living</td>
<td>94</td>
<td>62</td>
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<tr>
<td>Range of movement</td>
<td>88</td>
<td>31</td>
<td>p &lt; 0.01</td>
</tr>
<tr>
<td>Pain</td>
<td>88</td>
<td>62</td>
<td>NS</td>
</tr>
<tr>
<td>Cosmesis</td>
<td>88</td>
<td>8</td>
<td>p &lt; 0.001</td>
</tr>
</tbody>
</table>

In Group 2 only four of the 13 patients with malunion had normal grip strength in the affected hand allowing for age, sex and dominance. In five patients the grip strength in the non-dominant fractured wrist was more than 30% less than the dominant non-affected side. Bechtol (1954) has stated that the non-dominant hand may be as much as 30% weaker than the dominant, although most subjects have only 5 to 10% differences. Four of our patients had fractured the dominant wrist and in all of these the grip strength was less than that on the non-dominant side and below the lower limit of normal. The weakest grip was 5 kg in a dominant affected wrist which had a residual dorsal angulation of 28°; this was 48% of the grip in the non-dominant unaffected side.

The difference between the two groups was statistically significant ($\chi^2 = 13.3, p < 0.001$).

**Tests of strength – the Musur-Grieve spring balance.** In Group 1, 16 of the 17 patients had normal strengths of all different types of grip as compared with the normals published by Swanson, Göran-Hagert and de Groot Swanson (1984) and compared to the opposite side; the exception was again in the patient with median nerve compression. In Group 2 only seven of the 13 patients had normal grip strengths and endurance. Of the other six patients, four had very poor endurance of grip, two had weakness of all types of grip and three had weakness of one or more types of grip. The difference between the two groups was statistically significant ($\chi^2 = 9.8, p < 0.01$).

**Tests of dexterity.** In both groups all the patients performed the Jepsen test within the time limit. The maximum time taken for any one test in Group 1 was 9.5 seconds and 12.4 seconds in Group 2. Similar results were seen in the Moberg test with the eyes open. One patient in Group 1 took 10 seconds longer to perform the test with the dominant affected hand; not surprisingly, this was the patient with median nerve compression.

**Activities of daily living.** In Group 1, 16 of the 17 patients had no difficulty whatsoever with either unilateral or bilateral activities of daily living. The patient with median nerve compression had difficulty with all activities.

Eight of the 13 patients in Group 2 had no difficulty with the activities of daily living. Three of the others had difficulty with one or two of the tests, mainly those involving strength, e.g., lifting a weight in a bucket. Two patients had considerable difficulty with these tests; both had sustained fractures in the dominant hand and now use the non-dominant hand for the activities of daily living. Again there was a statistically significant difference between the two groups ($\chi^2 = 4.88, p < 0.05$).

**Median nerve function.** One patient in each group had sensory deficit in the median nerve distribution. The patient in Group 1 also had clinically detectable motor weakness.

**Range of movement.** In Group 1, 15 of the 17 patients had similar ranges of movement in both wrists, with no more than 10° difference in any measurement. The patient with median nerve problems had lost 30° of extension but other movements were normal. One other patient lacked 45° of supination and 20° of pronation; radiologically there were degenerative changes in the distal radio-ulnar joint. However, four other patients in this group had radiological evidence of radio-ulnar joint degeneration, although they had normal rotation.

In Group 2, only four of the 13 patients had similar ranges of movement in both wrists. Five patients had reduction in pronation/supination of more than 20°, the worst patient having only 45° of each. Seven patients had
a reduction of between 20° and 40° in the flexion/extension arc of movement. Four patients had lost 15° to 35° of radial/ulnar deviation.

The difference between the two groups reached statistical significance ($\chi^2 = 12.44$, $p < 0.01$).

**Pain.** Two of the patients in Group 1 complained of pain. In one patient this was graded as mild on the analogue scale and she required no analgesia. The second patient with pain had median nerve symptoms and graded her pain as moderate. Five patients of the 13 in Group 2 had pain. Three of these graded their pain as severe and required regular analgesia. One patient considered her pain to be moderate and one mild.

The difference in incidence of pain between the two groups was not statistically significant although no allowance was made for the severity of pain in the analysis.

**Cosmetic assessment.** Fifteen patients in Group 1 were considered by the examiner to have a normal appearance of the wrist; the other two patients had a mild cosmetic deformity. In Group 2 only one patient had no cosmetic deformity; the other 12 had mild to moderate deformity.

The difference in cosmetic appearance between the two groups was statistically significant ($\chi^2 = 19.2$, $p < 0.001$).

**DISCUSSION**

These results show clearly than a malunited Colles' fracture results in significant functional deficit. The two groups were comparable apart from the radiological position of the united fracture. The slightly higher age of the malunited group is probably because older patients have an increased likelihood of malunion (McQueen, MacLaren and Chalmers 1986).

Previous authors have based functional assessments on a variety of methods. Some authors do not define their methods of assessing function (Casseebaum 1950; Older et al. 1965; Benjamin 1982) while others confine their functional assessment to subjective criteria and range of movement (Gartland and Werley 1951; Mason 1953; Green and Gay 1956). More recently some authors have included grip power in their assessment (Frykman 1967; Cooney, Dobyns and Linscheid 1980; Saito and Shibata 1983; Melone 1986) but none of these have reported a comprehensive functional assessment. The weakness of grip following malunion is probably due to pain and to bony shortening which places the flexor tendons at a mechanical disadvantage.

The source of pain is difficult to establish. It has previously been suggested that its main source is the distal radio-ulnar joint (Frykman 1967) or the radiocarpal joint (Cooney et al. 1980). However, of our Group 2 patients with pain only one had radiological evidence of radio-ulnar joint changes. No patient had degenerative changes in the radiocarpal joint. Pain might be attributable to median neuropathy but only one patient in each group showed evidence of median nerve symptoms or signs. Stiffness and deformity are not surprising follow-up malunion and it is agreed that dorsal angulation will restrict the flexion/extension arc.

Our study demonstrates that malunion of a Colles' fracture results in a weak, deformed, stiff and probably painful wrist with a likelihood of difficulty in performing the normal activities of daily living. It is therefore essential to strive for as anatomically accurate a result as possible in order to ensure minimal functional deficit.

No benefits in any form have been received or will be received from a commercial party related directly or indirectly to the subject of this article.

**REFERENCES**


