Limited Triscaphoid Intercarpal Arthrodesis for Rotatory Subluxation of the Scaphoid

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ABSTRACT: Rotatory subluxation of the scaphoid is a well known lesion that is relatively common and results in instability of the wrist. It has been well accepted that because of the subluxation of the scaphoid, degenerative changes in the wrist may develop rapidly, and for that reason correction of the subluxation in its early stages is indicated.

Over the past thirteen years, many cases of rotatory subluxation of the scaphoid in various stages of the pathological process have been successfully treated with a triscaphoid arthrodesis of the wrist (fusion of the scaphoid, trapezium, and trapezoid) at the Connecticut Combined Hand Surgery Service. A follow-up of thirty patients with an average length of follow-up of three years and eleven months is described. From this experience, a classification system and treatment plans for each type of rotatory subluxation of the scaphoid have evolved.

In 1934, mid-carpal subluxation was brought to the attention of the medical community by Mouchet and Belot, but only recently has a heightened interest developed in that and other positional abnormalities of the carpal bones. Several papers have described various regimens for treatment of the lesions classified under the term rotatory subluxation of the scaphoid. They include cast immobilization, closed or open reduction with or without pinning, capsular reefing, reconstruction or substitution of ligaments, limited intercarpal arthrodesis, proximal row carpectomy, and total arthrodesis of the wrist. No useful classification of the rotatory abnormalities and no consistent plan of treatment for the different degrees of severity of those lesions has been suggested to date. One purpose of this paper is to propose such a classification, and four classes of rotatory subluxation of the scaphoid (Table I) are postulated. Our second purpose is to show what results were obtained with triscaphoid arthrodesis in the treatment of rotatory subluxation of the scaphoid.

The concept of a limited intercarpal arthrodesis is not new. In 1946 Sutro first reported on arthrodesis of the scaphoid, trapezium, and trapezoid in the treatment of non-union of a scaphoid fracture, and it was first suggested as treatment of rotatory subluxation of the scaphoid by Peterson and Lipscomb in 1967. We have given preliminary reports of its use in the treatment of several lesions, including certain instabilities of the wrist, degenerative joint disease, and Kienböck's disease. Others have recently reported on its use for rotatory subluxation of the scaphoid, but the results of a longer follow-up than is contained in their report are needed. In this report we give our results with follow-up averaging nearly four years.

Material

One hundred and forty-seven patients have had the triscaphoid arthrodesis to be described for rotatory subluxation of the scaphoid during the period from February 1972 to June 1985. Follow-up of two years or more was available in forty-three of the fifty-one patients who were operated on before May 1983. The large number of patients (ninety-six) who were seen after that date is attributable to the increase in referrals because of our cited publications. Eight of the fifty-one patients were not available for follow-up and have been excluded from this report: one was dead, another was severely disoriented, and six patients could not be found. Of the remaining forty-three patients, four had dynamic rotatory subluxation of the scaphoid (our Type 1), twenty had static rotatory subluxation of the scaphoid (Type 2), and six patients had rotatory subluxation of the scaphoid with degenerative arthritic changes (Type 3). The degenerative changes in all six patients were limited to the scaphoid joints (between the scaphoid, trapezium, and trapezoid). Excluded from the report are thirteen patients with Type-4 involvement: twelve with Kienböck's disease and one with lateral dislocation of the trapezium. Those thirteen patients have been reported on previously. The present report therefore deals with thirty patients, seventeen of whom were male and thirteen, female. The ages at the time of operation ranged from sixteen to sixty-nine. The dominant hand was involved in twenty-three patients. The duration of symptoms before the arthrodesis ranged from one month to ten years (average, two years and five months). The average length of follow-up was three years and eleven months (range, two to almost twelve years). Eight patients had follow-up of longer than five years, and their results were compared with those in the other twenty-two patients.
Classification

Type 1: dynamic rotatory subluxation of the scaphoid (four wrists in this series) is diagnosed when symptoms and signs of instability exist with no radiographic abnormality; that is, stress radiographs, arthrograms, and cineradiographs are normal. There is a history of pain in the wrist, usually lasting for at least six months. The pain usually is worse on activity and afterward, and it is not completely relieved by rest. The patients usually have a decreased range of motion of the wrist, particularly of flexion. There is tenderness over the scaphoid (in the anatomical snuff-box) indicative of periscaphoid synovitis. The so-called scaphoid test is positive. For this test, the examiner places his or her fingers (of the same hand as that to be examined) posterior to the dorsal end of the patient's radius and his or her thumb on the tuberosity (distal pole) of the scaphoid. The examiner's other hand deviates the patient's wrist first ulnarward and then radialward. Normally, in ulnar deviation the scaphoid assumes a position in line with the forearm, and in radial deviation it lies nearly perpendicular to the axis of the forearm. As the examiner presses on the scaphoid tuberosity with his or her thumb while moving the patient's wrist from ulnar deviation to radial deviation, the examiner obstructs the motion of the scaphoid from assuming a transverse position. If there is instability, the proximal pole of the scaphoid will displace dorsally out of the elliptical radial fossa.

<table>
<thead>
<tr>
<th>Type 1: dynamic</th>
<th>Rotatory subluxation of the scaphoid with no radiographic evidence of abnormality</th>
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<tbody>
<tr>
<td>Type 2: static</td>
<td>Rotatory subluxation of the scaphoid with radiographic findings of scapholunate dissociation, foreshortening of the scaphoid, a wide scapholunate joint, a ring sign, overlapping of the scaphoid and capitare, and an increased scapholunate angle</td>
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<tr>
<td>Type 3: degenerative</td>
<td>Type 1 or Type 2 with concomitant degenerative arthritic changes</td>
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<tr>
<td>Type 4: secondary</td>
<td>Rotatory subluxation of the scaphoid secondary to Kienböck's disease, scaphoid non-union, or other causes</td>
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This displacement is accompanied by significant pain. Some mid-carpal dorsal displacement also may occur. Comparison of the two sides is important, and the examiner should develop experience with this test in many patients with normal wrists.

Type 2: static rotatory subluxation of the scaphoid (twenty wrists in this series) is diagnosed when the history and findings on physical examination are similar to those in Type 1, but more severe. In addition, there usually is a history of an acute injury, and the radiographs reveal the typical signs of rotatory subluxation of the scaphoid (Figs. 1-A and 1-B). It should be emphasized that the only dif-

Figs. 1-A and 1-B: Static rotatory subluxation of the scaphoid is demonstrated.
Fig. 1-A: Posteroanterior radiograph demonstrating a definite foreshortening of the scaphoid, a ring sign, a wide gap (dissociation) between the scaphoid and the lunate, and excessive overlapping of the scaphoid and the capitare.
Fig. 1-B: Lateral radiograph demonstrating the scaphoid in a well flexed position. As a result of the subluxation, the scapholunate angle exceeds the normal limit, which is 70 degrees. The angle is 81 degrees in this wrist. Because of the scapholunate dissociation, the lunate usually dorsiflexes and rotates so that its concavity tilts dorsally, producing a so-called DISI (dorsiflexed intercalated-segment instability) pattern, but occasionally there is a VISI (volar intercalated-segment instability) pattern.
ference between Types 1 and 2 is the presence of radiographic changes of rotatory subluxation of the scaphoid. Occasionally asymptomatic patients have similar radiographic findings secondary to ligament hypermobility.

Type 3: rotatory subluxation of the scaphoid with concomitant degenerative changes (six wrists in this series) is diagnosed on the basis of a history similar to that in either Type 1 or Type 2, but the symptoms are usually more severe, their duration often is longer, and the patient is older. There most often is swelling as well as severe tenderness over the scaphoid, and the range of motion of the wrist invariably is decreased in all directions. The scaphoid test is positive. Degenerative changes are present most commonly between the radius and scaphoid as well as in the scaphoid-capitate and scapholunate joints (that is, the SLAC wrist [scapholunate advanced collapse pattern])\(^{18,20}\) (Fig. 2), or in the scaphoid-trapezium and scaphoid-trapezoid joints\(^ {19,20}\) (Figs. 3-A and 3-B). We will be discussing only wrists in which degeneration was confined to the latter joints. Triscaphoid arthrodesis is contraindicated if there is degeneration between the scaphoid and the radius.

Type 4: secondary rotatory subluxation of the scaphoid, while excluded from this report, designates a secondary rotatory subluxation of the scaphoid because of other carpal lesions such as a collapsed wrist due to Kienböck's disease\(^ {21}\) or non-union of the scaphoid.

Treatment

The two main indications for the triscaphoid arthrodesis are, first, that the rotatory subluxation of the scaphoid be demonstrable clinically and radiographically. Second, in dynamic subluxation, the duration of symptoms and their severity must be sufficient to justify the procedure, and a reasonable period of conservative therapy must have been followed unsuccessfully. A third indication is the development of arthritic changes at the triscaphoid joints; however, if the degenerative changes involve the radioscapphoid joint, triscaphoid arthrodesis should not be done.

The operative technique and postoperative care for the arthrodesis have been described previously\(^ {19,20}\). It should be emphasized that the position of the scaphoid must be such that its long axis, viewed laterally, lies at approximately 45 degrees to the long axis of the forearm. The most frequent major technical error is positioning the scaphoid in line with the forearm instead of at the recommended angle. This will result in significant limitation of range of motion of the wrist because of the incongruous alignment of the surface of the scaphoid in relation to the articular surface of the radius.

Results

The average length of follow-up for the thirty wrists in this report was three years and eleven months, with a range from two years to eleven years and nine months. None of the thirty patients changed their vocational or avocational activities after the operation. Four patients had only mild pain during use of the wrist, and there was an ache after activity only following vigorous exercise or heavy manual work. We analyzed the ranges of motion and grip strengths with the patients divided into two groups: those with more than five years of follow-up and those with two to five years of follow-up. We did not find any significant difference in these two groups, so our results will be discussed for all thirty wrists together.

At the time of follow-up, the average grip strength on the operative side was thirty-one kilograms, representing 92 per cent of that on the opposite, normal side. The maximum difference in grip strength was twenty-two kilograms. Nine patients had a difference in grip strength of zero to five kilograms. Only five patients had a difference in grip strength exceeding ten kilograms.

The average extension of the wrist that had been operated on was 55 degrees, 75 per cent of that on the unaffected side. The average flexion on the treated side was 68 degrees, 84 per cent of that on the contralateral side. The average radial deviation of the involved side was 12 degrees, representing 55 per cent of the range on the contralateral side.
Figs. 3-A and 3-B: Degenerative arthritis is evident in the triscaphoid joint space, with obvious rotatory subluxation of the scaphoid.

Fig. 3-A: The radiocarpal joints can be seen to be free from degenerative changes. There is some joint-space narrowing between the capitate and the lunate.

Fig. 3-B: Lateral radiograph demonstrating associated rotatory subluxation of the scaphoid with a scapholunate angle of almost 90 degrees as well as an advanced DISI pattern.

tralateral side, and the average ulnar deviation was 28 degrees, 73 per cent of that on the contralateral side. The loss of extension was more than 30 degrees in four patients, 20 to 30 degrees in eight, and 10 to 20 degrees in fourteen. The loss of flexion exceeded 30 degrees in only two patients and was more than 20 degrees in eleven. There was no statistically significant correlation between the decrease in grip strength, duration of symptoms before operation, and length of follow-up.

No patient had significant pain during the range-of-motion examination at follow-up, and the radiographs of all patients at the time of follow-up demonstrated solid fusion of the three bones at the site of arthrodesis. No degenerative change in the remaining intercarpal joints or in the radiocarpal joint was demonstrated in any patient (Fig. 4). We performed ninety-six additional triscaphoid arthrodeses between May 1983 and June 1985, and the results to date have been consistent with the results in this report.

Complications

No patient had an infection, non-union, or delayed union. Three patients had mild to moderate dystrophic changes after the operation, but all responded well to physical therapy.

Discussion

Rotatory subluxation of the scaphoid is a common type of instability in the wrist and usually is troublesome and difficult to treat. Appropriate treatment is indicated because degenerative changes in the wrist often will develop.
We have treated the various types of rotatory subluxation of the scaphoid with a triscaphoid arthrodesis (fusion of the scaphoid, trapezium, and trapezoid) over the last thirteen years, and thirty such wrists had a successful result after an average follow-up of approximately four years. Wrist injuries with more than five years of follow-up did not show any deterioration of the result compared with wrists that had two to five years of follow-up, which suggests that the long-term results of the arthrodesis are durable. Theoretically, degenerative arthritis of one or more of the unfused intercarpal joints or of the radiocarpal joint might be anticipated sequelae, but our radiographic examinations did not demonstrate that complication (Fig. 4). No patient in this study and none of the many more recently operated on (but not yet reported) have required surgery for degenerative changes in or about the involved wrist.

At the time of the last follow-up, our patients had an average grip strength of thirty-one kilograms, approximately 90 per cent of the contralateral grip strength. The average postoperative ranges of motion of the wrist were extension of 55 degrees (73 per cent of the contralateral side), flexion of 68 degrees (84 per cent of the contralateral side), radial deviation of 12 degrees, and ulnar deviation of 28 degrees. All of the arthrodeses healed solidly, and at the time of follow-up no degenerative changes were found in any of the wrist joints other than those that had been present preoperatively. All thirty patients returned to their vocational and avocational activities shortly after the operation. Therefore, in our experience, arthrodesis seems to be a successful procedure. The decrease in the range of motion of the involved wrist, mostly in radial deviation, is acceptable and does not compromise function.

From this experience, we classified rotatory subluxation of the scaphoid in four types (Table I). Type 1 (four wrists in our series) is a dynamic type in which no radiographic abnormality is present despite clinical symptoms and signs. Conservative treatment with immobilization is indicated initially, but triscaphoid arthrodesis may be considered if, despite the treatment, the symptoms are persistent or increase over a minimum period of six months. Type 2 (twenty wrists) has typical radiographic findings of rotatory subluxation of the scaphoid along with the clinical findings, and triscaphoid arthrodesis is indicated. Type 3 (six wrists) demonstrates degenerative changes. Triscaphoid arthrodesis is indicated only when the degenerative change is limited to the distal periscaphoid joints and does not involve the radioscaphoid joint. If a degenerative process is present in any other carpal or radiocarpal joint, triscaphoid arthrodesis alone is contraindicated. Treatment for such wrists will be more extensive, and was discussed in our previous papers. Type 4 is a secondary rotatory subluxation of the scaphoid which usually occurs due to Kienböck's disease. It was described in one of our previous papers on that specific subject.

References