Ligament reconstruction for the painful thumb carpometacarpal joint: A long-term assessment

An extra-articular ligament reconstruction to stabilize the thumb carpometacarpal (CMC) (basal) joint by routing a portion of the flexor carpi radialis (FCR) through the base of the thumb metacarpal has been performed on more than 100 patients since 1967. This study reviews the first 50 consecutive reconstructions with an average follow-up of 7 years. Intractable pain was the primary indication for surgery. Each joint was examined both pre and postoperatively and rated as a stage I through stage IV according to the radiographic appearance. Of the patients with zero or minimal articular changes (stages I and II), 95% achieved good or excellent results because of having little or no postoperative pain. Of the patients with moderate to advanced degenerative changes (stages III and IV), 74% achieved good or excellent results. All stage I cases and 82% of stage II cases were free of recognizable degeneration on follow-up radiographs up to 13 years postoperatively. These findings suggest that ligament reconstruction that is now recommended only for stage I or stage II disease will restore stability, reduce pain, and possibly even retard joint degeneration in a large proportion of patients with painful instability of the thumb CMC joint. (J HAND SURG 9A:692-9, 1984.)


Freedom from pain is essential for normal thumb function. Pain-free stability at the thumb CMC joint, its basal joint, is particularly important since it is the only joint in the thumb that is normally capable of lateral and rotatory motion.1 Stability of the basal joint is dependent upon its unique anatomy, the saddle contours of its articular surfaces, and the integrity of its ligamentous support. As with most synovial articulations, excessive mobility predisposes to effusion and pain and may lead to premature degenerative changes.2, 3, 4

Idiopathic hypermobility of the basal joint is not uncommon, particularly in women,2, 5 and would seem to be a significant factor in producing the arthrosis that so frequently afflicts this joint. Trauma, which can cause partial tears or stretching of the ligaments, will likewise produce varying degrees of hypermobility. In addition,
Ligament reconstruction for carpometacarpal joint

Inflammatory disease may produce ligament laxity leading to instability and degenerative arthrosis.

When basal joint hypermobility is not responsive to conservative measures such as anti-inflammatory medication and splinting, restoration of ligament stability will not only relieve pain and stabilize the joint when it is done before the onset of articular damage, it may even prevent, or at least retard, subsequent degeneration.6-11

Since 1967 an extra-articular ligament reconstruction procedure for stabilization of the thumb CMC joint has been performed on patients with painful hypermobile basal thumb joints. This procedure reinforces the joint capsule in two planes; it reconstructs a strong palmar ligament while it reinforces the dorsal capsule and provides ligament support for the radial aspect of the thumb that is otherwise membranous.7

Early results of ligament reconstructions demonstrated promise after a short follow-up, which was reported in 1973.7 The study reported here reviews the first 50 consecutive basal ligament reconstructions with a minimum follow-up of 4 years and an average follow-up of 7 years.

Background

The anatomic considerations, etiology, and clinical findings were discussed at length in the 1973 report.7

Major points are represented here.

Anatomy. The thumb CMC joint is a semiconstrained, incongruous saddle joint with the axes of the opposed saddles perpendicular to each other, thus permitting flexion-extension, abduction-adduction, and version such as in opposition and circumduction. When the surfaces are rotated into a less congruous relationship, there is tightening of the joint capsule and increasing stability if all ligaments are competent.12, 13

Joint stability is provided by two ligaments (Fig. 1). The first, and by far the more important, is the palmar ligament (termed “ulnar ligament” by Kaplan,14 “ligament trapezio-metacarpale” by Lanz and Wachsmuth,15 and “anterior oblique” by Napier16) that inserts on the palmar beak of the metacarpal and provides the major contribution to joint stability. The dorsal ligament, which is thin and less well defined, contributes little to joint stability and in no way prevents dorsoradial subluxation.17

Etiology. The cause of instability of the CMC joint may be due to traumatic rupture or inflammation or may be idiopathic. Acute instability can be caused by severe trauma (e.g., after complete dislocation).18 Slowly progressive, chronic ligament instability can be caused by recurrent stress or overuse19 (e.g., repetitious pinching, writing through multiple carbons). The chronic pattern is more common and is often seen in young women with generalized ligament laxity. A large number of patients remain, however, for whom no good explanation for CMC instability can be found other than an anatomic predisposition to a more shallow than normal trapezial saddle contour.5

Clinical findings. The hallmark of basal joint synovitis is pain. This pain results from joint inflammation secondary to either hypermobility or intrinsic articular disease. Basal joint pain is usually diffuse, vaguely localized to the distribution of the thumb abductor muscles, or occasionally the dorsal thumb index metacarpal angle. Reproduction of pain by pressure over a 1-centimeter area directly over the radial capsule* is pathognomonic of basal joint synovitis. Painful hypermobility without crepitus of the thumb metacarpal in the trapezial saddle is an early finding. Crepitus is a later finding.7 Pinch strength may be diminished in proportion to the duration of the symptoms.

Radiographic analysis

Four stages of basal joint degeneration can be recognized by the appearance of the thumb metacarpal-

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*The site of reproduction of pain on viewing the thumb from the dorsum with the nail as the reference point.
Table I. Results of ligament reconstructions

<table>
<thead>
<tr>
<th></th>
<th>Stage I (8 cases)</th>
<th>Stage II (11 cases)</th>
<th>Stage III (10 cases)</th>
<th>Stage IV (9 cases)</th>
<th>TOTALS (38 cases)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Excellent</td>
<td>88% (7)</td>
<td>55% (6)</td>
<td>60% (6)</td>
<td>55% (5)</td>
<td>64% (24)</td>
</tr>
<tr>
<td>Good</td>
<td>12% (1)</td>
<td>36% (4)</td>
<td>20% (2)</td>
<td>11% (1)</td>
<td>20% (8)</td>
</tr>
<tr>
<td>Fair</td>
<td></td>
<td>9% (1)</td>
<td>20% (2)</td>
<td>33% (3)</td>
<td>16% (6)</td>
</tr>
<tr>
<td>Poor</td>
<td></td>
<td></td>
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Table II. Pain, preoperative vs. postoperative in ligament reconstructions

<table>
<thead>
<tr>
<th></th>
<th>Stage I (8 cases)</th>
<th>Stage II (11 cases)</th>
<th>Stage III (10 cases)</th>
<th>Stage IV (9 cases)</th>
<th></th>
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</thead>
<tbody>
<tr>
<td></td>
<td>pre</td>
<td>post</td>
<td>pre</td>
<td>post</td>
<td>pre</td>
</tr>
<tr>
<td>None</td>
<td>88% (7)</td>
<td>91% (10)</td>
<td>—</td>
<td>—</td>
<td>60% (6)</td>
</tr>
<tr>
<td>1+</td>
<td>12% (1)</td>
<td>—</td>
<td>9% (1)</td>
<td>—</td>
<td>20% (2)</td>
</tr>
<tr>
<td>2+</td>
<td>25% (2)</td>
<td>—</td>
<td>9% (1)</td>
<td>—</td>
<td>20% (2)</td>
</tr>
<tr>
<td>3+</td>
<td>75% (6)</td>
<td>82% (9)</td>
<td>—</td>
<td>—</td>
<td>30% (5)</td>
</tr>
<tr>
<td>4+</td>
<td>—</td>
<td>9% (1)</td>
<td>—</td>
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</table>

Table III. Postoperative pinch strength (compared to contralateral strength)

<table>
<thead>
<tr>
<th></th>
<th>Stage I (8 cases)</th>
<th>Stage II (11 cases)</th>
<th>Stage III (10 cases)</th>
<th>Stage IV (9 cases)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Equal or greater</td>
<td>100% (8)</td>
<td>45% (5)</td>
<td>80% (8)</td>
<td>44% (4)</td>
</tr>
<tr>
<td>Within 90%</td>
<td>—</td>
<td>36% (4)</td>
<td>20% (2)</td>
<td>33% (3)</td>
</tr>
<tr>
<td>Within 70%</td>
<td>—</td>
<td>18% (2)</td>
<td>—</td>
<td>22% (2)</td>
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</table>

Trapezium and scaphotrapezium joints as seen on a true lateral radiograph.* Stage IV of this classification has been modified since the 1973 report.7

Stage I (Fig. 2, A). This stage proceeds any joint degeneration. Articular contours are normal. The joint space may be widened if an effusion is present. It is assumed that the intra-articular cartilage is normal.

Stage II (Fig. 2, B). Slight narrowing of the thumb metacarpal-trapezium joint space is present, but the articular contours are maintained. Joint debris, when it is present, is less than 2 mm in size. Mild to moderate intra-articular cartilage attrition is assumed.

Stage III (Fig. 2, C). Significant thumb metacarpal-trapezium joint destruction is present. Sclerotic or cystic changes are observed in the subchondral bone.

Osteophytes are larger than 2 mm in size. The scaphotrapezial articulation, however, appears normal.

Stage IV (Fig. 2, D). This stage differs significantly from the previous classification in that both metacarpal-trapezium and scaphotrapezium articular surfaces exhibit significant degenerative changes. Multiple diseased articular surfaces are in evidence.

Surgical technique

The surgical technique (Fig. 3) is essentially unchanged from the 1973 description.7 The existing palmar ligament is reinforced by creating a new ligament with a strip of tendon harvested from the FCR. The strip remains attached distally and is routed through the base of the metacarpal from palmar to dorsal, passed deep to the abductor pollicis longus insertion, and then looped around the remaining FCR and secured over the radial side of the joint.

The only significant surgical detail not described previously is that both the thumb metacarpal-trapezium and the scaphotrapezium joints are always visualized before reconstruction of the ligament. Cadaver radiographs obtained by North and Eaton20 did not always accurately reflect the actual extent of cartilage involvement, particularly of the scaphotrapezium joint in one third of the specimens. Direct inspection of these joints therefore should be done to avoid missing unsuspected or underappreciated articular degeneration that would require a more comprehensive type of arthroplasty.18, 21, 22–24

*The basal joint of the thumb for functional and reconstructive purposes must include the scaphotrapezial as well as the thumb metacarpal-trapezial joints since both lie in the axis of compression and power transmission along the thumb ray.
Fig. 2. Radiographic stages of thumb basal joint degeneration (lateral radiogram). A, Stage I. Slight widening of thumb metacarpal-trapezium joint space and normal articular contours. B, Stage II. Mild thumb metacarpal-trapezium joint space narrowing; spurs or debris less than 2 mm along joint margins and early erosion of the dorsal radial facet of trapezium. C, Stage III. Marked narrowing of the metacarpal-trapezium joint space and debris greater than 2 mm. Cystic and sclerotic changes are present in subchondral bone. D, Stage IV. Marked narrowing or destruction of joint surfaces of both thumb metacarpal-trapezium joint as well as scaphotrapezium joint. In this stage there are multiple articular surfaces involved.

Material and methods

The first 50 consecutive ligament reconstructions performed since 1967 have been reviewed in 48 patients, two of whom had bilateral reconstructions. All patients had failed to achieve lasting symptomatic relief from anti-inflammatory medication and splinting. Thirty-six patients were available for a follow-up examination and radiographs. Twelve patients were either dead or unavailable for follow-up. Thus a total of 38 reconstructions in 36 patients were evaluated. The average age at surgery was 45.4 years with a range of 18 to 62 years. Female patients outnumbered male patients by nearly 3 to 1. The right and/or dominant thumb was reconstructed in 75% of the patients. The etiology was trauma in 18 patients, idiopathic in 18, and mild rheumatoid arthritis in two patients. Follow-up average was 7.1 years with a range of 4 to 13 years.

Preoperative and postoperative assessment included pain, instability, pinch strength, motion, function, and radiographic staging parameters for evaluation. An overall subjective grade of each result was also determined. All patients were personally evaluated both pre and postoperatively by at least one of the authors.

Freedom from pain was the most important finding. In general, the postoperative level of pain correlated directly with the overall result.

Results

Objective overall results. Results were classified as excellent, good, fair, or failure. Patients with results rated excellent had no pain, pinch strength more than 90% of the contralateral thumb, and no instability. Good results signified occasional pain after prolonged activity, pinch strength greater than 70% of the contralateral thumb, and minimum laxity. Fair results had frequent pain with average use, strength less than 70% of the contralateral thumb or mild joint laxity but were better than preoperatively. Failures were not improved from preoperative status.

Overall results for all stages (Table I) revealed good or excellent results in 32 of 38 cases (84%). Six cases (16%) had fair results. There were no failures.

More significantly, all eight stage I cases achieved excellent or good results. Ten of the 11 (91%) stage II cases had excellent or good results. Thus 18 of 19 patients (95%) in stage I or stage II for whom ligament reconstruction is primarily recommended achieved excellent or good results.

Pain (Table II). Preoperative pain was completely eliminated or dramatically improved in all patients. Seven of eight stage I patients were pain-free, and the eighth patient had only rare discomfort after strenuous activities. Ten of the 11 stage II patients were pain-free. Even 15 of the 19 patients in stage III and stage IV had significant pain relief.

Instability. Thumb metacarpal-trapezium instability was corrected in all but one patient in whom it was only mild.

Pinch strength (Table III). Pinch was either within 90% or more than contralateral pinch strength in all but four patients. Even when some pain was present (stage III or stage IV), pinch strength was improved after ligament reconstruction.

Motion. Clinical measurement of basal joint motion was evaluated by the use of two simple tests. Extension-abduction was tested by evaluating the patient’s ability to place the palm completely flat on the table, and flexion-adduction was tested by the patient’s ability to oppose the tip of the thumb to the fifth metacarpal head. Extension-adduction, measured by the “palm flat test” was slightly reduced in 20 of 38 cases (53%). This did not correlate with overall results but did correlate with the degree of basal joint stability. No patient actually complained of the inability to flatten the hand, and this was often brought to the patient’s attention for the first time during this follow-up examination. Normal flexion-adduction, measured by thumb tip to base of fifth metacarpal head, was preserved in 36 of 38 cases (95%).

Function. A patient’s evaluation of his/her ability to perform the usual activities of daily living and the objective evaluation of a patient’s ability to turn a door knob, open a car door, open a jar, open or close buttons, and turn a key correlated directly with overall objective results.

Postoperative radiographic evaluation (Table IV). Repeat radiographic staging was done in the follow-up to determine whether further joint degeneration had occurred. All joints initially classified as stage I were free of any radiographically demonstrable joint degeneration and therefore remained in stage I. In stage II, nine of 11 cases (90%) demonstrated no progression of degenerative change on the radiograph. The two preoperative radiographic stage II patients who deteriorated to radiographic stage III were noted to have had moderate cartilage attrition at surgery. Two of 10 stage III cases (20%) progressed to stage IV, exhibiting degenerative changes in the scaphotrapezial joint. Of the nine stage IV cases, one developed a spontaneous fu-
Fig. 4. Radiographs 6 years after palmar ligament reconstruction for stage I disease. A, Lateral view reveals well preserved joint space. Note tract for FCR tendon parallel to joint surfaces of metacarpal. B, Stress view reveals stability of right thumb metacarpal. Right side was pain-free and strong. Film taken before ligament reconstruction of symptomatic left thumb.

Discussion

Discussion

This study was designed to evaluate the long-term predictability and durability of ligament reconstruction for the metacarpal-trapezium joint of the thumb. The results indicate that there was minimal deterioration of the metacarpal-trapezium joint in this series of 38 patients who were followed an average of 7 years. The longest was followed 13 years. Stage I and stage II patients continue to be pain-free without restriction of activity (Fig. 4).

The procedure was designed to improve stability and relieve pain at the thumb CMC joint while it is preserving a functional range of motion. Ligament reconstruction is recommended only for patients in stage I and stage II disease, i.e., those patients having zero to only slight cartilage attrition. With 95% of stage I and stage II patients having achieved and maintained good or excellent results, we feel the procedure has proved predictable and durable. Despite limited success in patients with significant articular deterioration (stage III and stage IV), we do not recommend ligament reconstruction alone in such cases. Instead, we would recommend articular resurfacing or implant arthroplasty that would depend on the number of trapezium surfaces involved.18, 21-25

Long-term review of patients with painful basal joint arthritis of the thumb leads us to strongly recommend careful intraoperative assessment, not only of the trapezium-metacarpal joint but also of the scaphotrapezial joint. Although accurate radiographic staging will assist in preoperative selection of appropriate surgical procedure, direct intraoperative inspection of both these joints is essential to avoid missing radiographically unrecognized disease. Cadaver studies of the basal joint have revealed that radiographs do not always accurately indicate the extent of degeneration at either the scaphotrapezial or thumb metacarpal-trapezium joints. In that study the radiographs of the scaphotrapezial joints in particular were either over or under diagnosed when they were compared to sub-
sequent anatomic evaluation of the same joints. The surgical plan therefore must be sufficiently flexible to permit the use of the procedure best suited to the operative findings. In this study only two early patients with ligament reconstruction done before recognition of this possible problem required subsequent implant arthroplasty caused by late scaphotrapezial disease.

Does stabilization of the painful hypermobile thumb CMC joint prevent the degenerative changes which so frequently occur at this joint? Since a controlled study is not practical, an objectively scientific answer is impossible to obtain. However, in most heavily stressed joints, hypermobility, particularly when it is symptomatic, is considered to be a potential cause of traumatic degeneration. Ligament reconstruction for the intractable, symptomatic, hypermobile thumb (stage I and stage II) has consistently relieved pain and restored function, and in this relatively long-term study, such joints have continued to be pain-free and functional without significant degenerative changes as long as 13 years later. Should joint deterioration eventually develop, previous ligament reconstruction would not preclude or even compromise subsequent reconstructive surgery.

REFERENCES
Complications of opponensplasty with transfer of extensor carpi ulnaris to extensor pollicis brevis

The extensor carpi ulnaris (ECU) was transferred to the extensor pollicis brevis, as described by Phalen and Miller, in 12 patients with hand deformities from high and low median and ulnar nerve injuries. Although no complications of this transfer have been reported by other surgeons, four of our 12 patients developed significant radial deviation and loss of power grip. This complication was corrected in two patients by transferring the extensor carpi radialis longus to the base of the fifth metacarpal to balance the wrist extensor forces. We believe that this complication may occur when the extensor carpi radialis inserts into the radial aspect of the second metacarpal and when the ECU inserts into the ulnar aspect of the base of the fifth metacarpal. The flexor carpi ulnaris must have normal strength if the wrist is to be balanced after the ECU is transferred. (J HAND SURG 9A:699-704, 1984.)

Virchel E. Wood, M.D., and James Adams, M.D., Loma Linda, Calif.

We have operated on 12 patients using for an opponensplasty the extensor carpi ulnaris (ECU) transfer to the extensor pollicis brevis (EPB), as described by Phalen and Miller. Although no complications of this transfer have been reported by other surgeons, four of our 12 patients developed significant radial deviation and loss of power grip.

Case reports

Case 1. A 57-year-old white man had attempted suicide by lacerating all the structures of the palmar surface of his right wrist with a razor blade. The median and ulnar nerves, flexor