Post-traumatic instability of the trapeziometacarpal joint of the thumb

DIAGNOSIS AND THE RESULTS OF RECONSTRUCTION OF THE BEAK LIGAMENT

V. J. Takwale, J. K. Stanley, S. A. Shahane

From the Wrightington Hospital for Joint Disease, Wigan, England

In 28 patients with a solitary diagnosis of instability of the trapeziometacarpal joint because of a rupture of the anterior oblique ligament, reconstruction was carried out using a slip of the tendon of flexor carpi radialis. We were able to review 26 patients. The results after a follow-up of four years seven months showed that most (87%) had significant relief from pain and symptoms. Seventeen were graded as good to excellent. The mean grip strength recovered to 86% of the contralateral side. Most patients (81%) felt that they had subjective improvement and would have undergone the operation again. A lesser functional result was seen in those who developed a flexion deformity because of overtightening of the reconstruction. Increased awareness of this lesion can lead to an early and clear diagnosis so that the patient may be advised adequately. We describe a specific, diagnostic, clinical test which we have used consistently and successfully.

Good hand function requires pain-free stability of the thumb. Mechanical instability of the trapeziometacarpal (TMC) joint of the thumb is an important factor which may lead to articular degeneration of the joint and thus interfere with the normal function of the hand.1,2 The anterior oblique ligament, also known as the beak or volar ligament, is an important stabiliser of the joint3,4 which limits its physiological, radiodorsal subluxation. This ligament is ruptured by an extension-supination injury when the point of contact is the base of the metacarpal of the thumb. Eaton and Littler3 described a technique in which a slip of the tendon of flexor carpi radialis was used to stabilise the TMC joint. Diagnosis of this rupture is difficult and stress radiographs are not always reliable. The senior author (JKS) has developed a specific test to diagnose a rupture of the anterior oblique ligament. We now describe this provocative test as an aid to diagnosis and present a retrospective review of 26 patients who were treated by a technique similar to that described by Eaton and Littler.3

**Patients and Methods**

Between September 1992 and December 1999, we performed reconstruction of the beak ligament on 28 thumbs in 28 patients. Two were lost to follow-up leaving 26 available for review. The dominant side was involved in 17 patients. There were seven men and 19 women. The mean age at injury was 31 years (11 to 54) and the mean age at surgery was 34.6 years. This delay in treatment reflects the tertiary nature of the senior author’s practice. The mean follow-up was 53 months (18 to 126).

Most of the patients (20/26) had been referred from other orthopaedic surgeons. The mechanism of injury was a fall onto an outstretched hand in 14 patients, a hyperextension injury in six, sports-related trauma in five and an alleged assault in one. The diagnosis of instability of the TMC joint had been made in only one patient before referral. Most had been initially treated by the referring unit as having a suspected fracture of the scaphoid and had been immobilised for varying lengths of time.

The treatments which the patients had received before referral included immobilisation for more than three months in four, injection of hydrocortisone in two and arthroscopy of the wrist in one. Various investigations had also been undertaken which included MRI in three, bone scanning in four, CT in one and arthrography in one.

**Clinical diagnosis.** Rupture of the beak ligament is first suspected when a patient demonstrates that he or she has pain when pushing up from a flat surface, for example when climbing out of a swimming pool or bath. A clinical, provocative test has been used in our hospital in order to help to make this diagnosis. In a patient with a suspected rupture, the thumb is first abducted in a palmar direction and pro-
nated (Fig. 1a). In this position the capsule of the joint tightens and the abductor pollicis longus comes to lie in front of the joint to become a secondary, extrinsic stabiliser. The joint is therefore stable when forward pressure is applied to the base of the metacarpal of the thumb and there is no forward movement of the metacarpal in relation to the trapezium. The thumb is then gradually abducted radially, supinated and extended. In this position it is only the anterior oblique ligament which will aid the stability of the joint. This is also the position of the joint at the time of injury. Forward pressure is then applied to the now supinated and retropulsed thumb. If the beak ligament is deficient, there will be forward movement of the metacarpal in relation to the trapezium. There will be no endpoint to this movement since there is no volar restraint to the joint. The forward movement will also reproduce the symptoms of instability in the patient (Fig. 1b). The differential diagnosis is osteoarthritis of the trapeziometacarpal (TMC) or scapho-trapezio-trapezoid (STT) joints. In such a situation the compression grind test is positive.

**Radiological assessment.** All patients underwent pre-operative radiography and none showed radiological evidence of arthritis. A larger proportion of the patients underwent stress radiography although this did not correlate with our working diagnosis.

**Current operative technique and rehabilitation.** All operations were directly performed or supervised by the senior author. The joint is approached by an anterior curvilinear incision along the radial border of the metacarpal of the thumb, extending proximally and in an ulnar direction. The superficial radial nerves are at risk here and need to be protected. The thenar musculature is then reflected from the capsule. The findings at surgery which confirmed the lesion were a defect of the beak ligament, a change in orientation of the fibres of the capsule and the slips of abductor pollicis longus between the positions of full supination and full pronation. A slip of one third of the tendon of flexor carpi radialis, based distally, is harvested next. Only the proximal third to one half of the tendon sheath is released from the ridge on the trapezium (Fig. 2). A hole is drilled from the
Table I. Activities of daily living used to assess function

<table>
<thead>
<tr>
<th>Activity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pick up a pen and write</td>
</tr>
<tr>
<td>Unbutton shirt or blouse</td>
</tr>
<tr>
<td>Turn a key in a lock</td>
</tr>
<tr>
<td>Use a can opener</td>
</tr>
<tr>
<td>Handle coins</td>
</tr>
<tr>
<td>Take a lid off a jar</td>
</tr>
<tr>
<td>Carry a milk bottle</td>
</tr>
<tr>
<td>Release the handbrake of a car</td>
</tr>
</tbody>
</table>

The harvested volar beak of the metacarpal passing dorsally and radially in a plane perpendicular to the thumb nail. The harvested tendon is passed dorsally through the hole deep to abductor pollicis longus and sutured to itself and not to flexor carpi radialis in the groove. The position of the thumb during the final suturing of the reconstruction is critical. Retropulsion of the thumb to at least neutral, i.e. the plane of the palm, should be possible. The thumb is then immobilised in a spica for six weeks. The position of immobilisation is in some flexion and abduction, which is the position of function.

Follow-up assessment. An independent observer reviewed each patient clinically and radiographically. The following parameters were recorded:

Pain. The severity of pain which was present before operation and at the time of the review was determined from a visual analogue scale (0 - no pain; 10 - severe pain). Pain was then categorised as either mild (1 to 3), moderate (4 to 6) or severe (≥ 7). Before operation, 20 patients (77%) had severe pain while the remaining six had moderate pain. A positive grinding test or pain along the joint line was also noted as evidence of the early symptoms of arthritis.

Range of movement. The active and passive range of radial and palmar abduction, flexion, extension and opposition, were measured with a standard goniometer.

Stability. Using the test described, a clinical impression of stability was made.

Function. Certain specific questions were asked about various activities of daily living and compared with the pre-operative status of the patient (Table I).

Strength. The grip strength, pinpoint pinch, key pinch and tripod pinch were measured.

The mean of three attempts was assessed with a JAMAR dynamometer (Fabrication Ent. Inc NY, New York). The strength of the injured side was compared with that of the contralateral, uninjured TMC joint.

Patient satisfaction. Subjectively, patients were asked if they felt that there was any improvement in the thumb and wrist and if they would undergo the same procedure again.

Grading of results. We graded the outcome into three groups: excellent, in which the patients were free from symptoms, had no restriction of activity and their strength was at least 90% of that of the contralateral side; good, if they continued to have minimal symptoms but no restriction of activity; and unsatisfactory, if they required subsequent surgery or if there was any restriction of activity. This applied even if there had been some benefit from the treatment.

Results

Revision surgery. Three patients underwent revision surgery. In two, aged 23 and 25 years respectively, the reconstruction failed with recurrence of their symptoms. In the first patient the reconstruction was revised with some benefit. In the second, fusion of the TMC joint was undertaken and good relief of pain was achieved. The third patient who required revision surgery was aged 50 years. Radiography showed the presence of osteoarthritis and he underwent a subsequent trapeziectomy.

Pain. This compared favourably with the pre-operative level. At follow-up, and after eliminating the three thumbs which had required subsequent revision surgery, complete relief from pain was achieved in 15 patients (65%), mild pain was present in five (22%) and moderate pain in three (13%).

Patient satisfaction. Five of the 26 patients who were reviewed were dissatisfied with their operation. Three had undergone revision surgery for the reasons already outlined. The fourth patient was dissatisfied because he had developed a fixed flexion/pronation deformity of the joint and the fifth because of sensitivity of the scar and the formation of a neuroma. The remaining 21 patients would have had a similar operation for identical pathology on their contralateral thumb.

Movement. Seventeen patients could put their hand flat on a surface without hyperextension of the thumb. This was the aim of surgery. Three developed a fixed flexion/pronation deformity of the thumb since it had been tightened excessively during the reconstruction. Three patients demonstrated minimal hyperextension and three were unable to fully oppose their thumb to the little finger.

Grip strength. Table II shows the percentage of strength achieved when compared with the contralateral side.

Function and stability. Nineteen patients showed an improvement in their activities of daily living. Four had a persisting functional deficit. Three developed fixed flexion/pronation deformities secondary to overtightening during the reconstruction. One patient had complex regional pain syndrome (CRPS) and a neuroma which adversely affected the functional outcome. All 26 patients had a negative clinical test for instability.

Outcome. We graded 13 thumbs as excellent, four as good and nine as unsatisfactory. The last outcome was directly

Table II. Assessments of strength when compared with the uninjured thumb, as a percentage

<table>
<thead>
<tr>
<th>Movement</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Radial abduction</td>
<td>84</td>
</tr>
<tr>
<td>Palmar abduction</td>
<td>86</td>
</tr>
<tr>
<td>Flexion</td>
<td>78</td>
</tr>
<tr>
<td>Grip strength</td>
<td>86</td>
</tr>
<tr>
<td>Pinpoint pinch</td>
<td>79</td>
</tr>
<tr>
<td>Key pinch</td>
<td>86</td>
</tr>
<tr>
<td>Tripod pinch</td>
<td>83</td>
</tr>
</tbody>
</table>
related to failure of the reconstruction of the ligament in only three of the nine patients. These were the three patients who required revision surgery for persisting symptoms. Two further patients were graded as poor because of persisting pain and weakness although they demonstrated subjective improvement. The remaining four unsatisfactory outcomes were related to technical reasons which we should be able to avoid in future. Three of these patients in this group developed flexion/pronation deformities and one had persisting scar problems because of a neuroma.

The mean time between injury and reconstruction for those patients who achieved an unsatisfactory outcome was 56 months. The mean age in this group at the time of surgery was 37 years and 2 months. For those patients who achieved an excellent or good outcome the time between injury and reconstruction was 32 months and the mean age was 33 years and 6 months. Although statistical analysis is impossible because of the small numbers in the study, the trend suggests that a better outcome after reconstruction may be possible if surgery is performed early, after a period of conservative treatment. It is also possible that age may have a detrimental effect on outcome.

Complications. Most of the complications were of a minor, transient nature. Two patients continue to have long-term, major, persistent problems directly related to surgery. Eleven developed scar hypersensitivity. In seven this resolved over a six- to nine-month period without surgical intervention. Four patients required exploration of their scar. Two of these continue to experience hypersensitivity, including one who was found to have a neuroma on surgical exploration. Five patients developed CRPS. This was treated successfully in all five, although two required a guanethidine block. Two who developed CRPS also continued to have persisting scar sensitivity. One patient developed a post-operative infection which was successfully treated with appropriate antibiotics.

Discussion

The TMC joint is a biconcave saddle joint whose stability is provided by five main ligamentous structures during static pinch and grasp. The anterior oblique ligament, an important stabiliser of the joint is a thick, broad structure which originates from the palmar tubercle of the trapezium and inserts into the beak at the base of the first metacarpal. From findings on anatomical dissection of fresh frozen cadavers and other studies, we consider that that the ligament is taut in extension and abduction.5 Rupture of this functionally and anatomically distinct ligament may cause symptomatic instability and an increased pressure on the incongruous articular cartilage which may lead to osteoarthritis. A complete detachment of the volar ligaments is related to extensive palmar articular degeneration. Experimental sectioning of the ligament leads to dorsal shift and progressive osteoarthritis of the TMC joint.1 In the young this joint is vulnerable to trauma. The anterior oblique ligament is prone to rupture from a fall onto an outstretched hand where the point of contact is the base of a supinated and extended thumb metacarpal. These patients may require reconstruction of the ligament in order to avoid any compromise to the function of the thumb. Theoretically, surgically stabilised joints will experience reduced shear forces. Various ligamentoplasty techniques which stabilise the TMC joint have been described by substituting either the beak or intermetacarpal ligament. Techniques which substitute the intermetacarpal ligament by using harvested slips of abductor pollicis longus, extensor carpi radialis and palmaris longus have been described. The classic Eaton-Littler TMC ligamentoplasty used a harvested portion of the tendon of flexor carpi radialis as a substitute for the anterior oblique ligament. This had the advantage of reconstructing the joint in two planes, reconstituting the volar ligament and also creating a new ligament radially in a part of the joint capsule which was weak and membranous. Our modification allows an anatomical alignment of the reconstruction. The indications for the classic Eaton-Littler ligamentoplasty were mainly idiopathic disease and secondary laxity of the joint with radiological evidence of stage-1 or stage-2 osteoarthritis. The indication for a reconstruction of the ligament in our patients was the presence of symptomatic instability after an episode of trauma, with normal radiographs and after conservative treatment.

Initially, these ruptures are often clinically undetected. A proportion of the patients will develop disabling symptoms despite treatment.8 In our series, 11 patients had been treated for suspected fracture of the scaphoid, four of whom had been immobilised for over three months. A variety of investigations had been undertaken, including arthrography, arthroscopy, MRI and CT. This is probably because of the difficulty in diagnosing this injury clinically as well as a lack of awareness of the problem. Reliance on the history and specific clinical tests are the bedrock of diagnosis. The diagnostic criteria in our series were a history of injury, pain at the base of thumb (especially when pushing up from a flat surface) and a positive clinical provocative test as described by the senior author. To date, no specific clinical test has been described to identify a rupture of the beak ligament. Eaton and Littler devised a torque test which involved axial rotation of a distracted thumb. This test is sensitive for synovitis but not specific for a rupture of the beak ligament. Others have diagnosed instability of the TMC joint by comparing the mobility of the injured metacarpal in relation to the trapezium with that on the uninjured side. This can be further complemented by stress radiography. A metacarpal base compression test utilises volarly-directed pressure on the thumb metacarpal. The senior author has been using the clinical test described specifically to aid diagnosis. We have found the test to be consistent and useful for both complete and partial injuries of the ligament. We did not address the issue of sensitivity and
specificity since this is ill-defined. We have not offered surgery to a patient with a negative test and we have not operated on a patient for apparent instability who was subsequently found to have a normal ligament.

We have occasionally used stress radiography and arthrography to confirm our clinical impression. In our experience stress radiography failed to show any subtle dynamic instability of the joint. Similarly, our experience with arthrography has been mixed since sometimes there is a false negative result because of a stretched and healed capsule.

Instability of the TMC joint of the thumb can be symptomatic and disabling. An early and clear diagnosis is necessary in order to offer adequate treatment. In most patients conservative treatment will give good results. However, ligament reconstruction should not be delayed for too long since our findings suggest that this may adversely affect outcome. Reconstruction of the beak ligament provides good relief from pain and has a very high subjective outcome. When performing this reconstruction, the superficial nerves should be protected in order to minimise the symptoms of sensitivity of the scar. The final positioning of the thumb is crucial and it is important to avoid a tight reconstruction in order to achieve good functional outcome.

We wish to thank Mrs Sandra Latham and Ms Mavis Luya for their administrative help during the project.

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