Usefulness and complications associated with thenar and standard portals during arthroscopic surgery of thumb carpometacarpal joint

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ABSTRACT

Purpose: Advances in small arthroscopy have enabled a minimally invasive surgery for thumb carpometacarpal joints. However, surgery is often difficult using standard CM-radial (CM-R) and CM-ulnar portals (CM-U). Here, we describe the clinical applications and complications associated with using thenar portal (TP) and standard portals.

Methods: Arthroscopic surgeries of thumb carpometacarpal joint were performed in 21 patients including 15 patients with osteoarthritis and six Bennett’s fracture-dislocations. Complications and the frequency of use associated with each portal were evaluated.

Results: Complications associated with the CM-R portal comprised paresthesia due to damage of the radial nerve branches in two patients. No nerves were damaged but the operation scar became tender at the TP in three patients. The CM-R was used at a lower frequency when the TP was utilized.

Conclusion: The clinical use of TP may decrease the risk of radial sensory nerve damage through decreasing frequency of use of the CM-R that is located near the nerve.

Level of study: IV.

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1. Introduction

The thumb carpometacarpal (CMC) joint has multidirectional mobility due to a shallow biconcavity, which depends on capsuloligamentous support to maintain stability in the face of constant loading stresses [1]. Functional disability can easily arise after damaging capsule-ligamentous support, which often occurs during routine, as well as sporting activities. Hand surgeons may treat pathological conditions of this joint under fluoroscopy or by open surgical techniques.

The development of small joint arthroscopy has enabled the use of minimally invasive surgery to treat injured thumb and finger joints [2–8]. Since Menon [7] and Berger [6] introduced interposition arthroplasty with partial resection of the trapezium, arthroscopic surgery for the CMC joint has become more popular. However, the surgery is often technically demanding when using two standard portals (CM-R and CM-U) in the dorsal aspect due to anatomical factors such joint depth and the amount of ligamentous support [9,10]. In addition, the surgical maneuver must be considered with an understanding of local anatomy. Hofmeister et al. [11] described two patients who developed postoperative neuritis of the dorsal radial sensory nerve although details about where or how the nerve became damaged were not provided.

We also have found that the sensory branch of the radial nerve can become damaged when devices are frequently inserted into a CM-R portal. This experience led us to use the thenar portal (TP) introduced by Walsh et al. [12], who described a cadaveric study in which the operation was improved by positioning a TP in a safe zone. Here, we describe the clinical complications associated with each portal including standard portals and the TP during arthroscopic surgery of thumb CMC joint, and compare the frequency of use of the standard portal with and without TP to evaluate the usefulness of TP as working portal.

2. Materials and methods

2.1. Patients

Approval for this study was obtained from our institutional review board. Between April 2006 and March 2012, 21 (12 women and 9 men, mean age, 55.7 years; range, 12 to 80 years) patients underwent arthroscopic surgery for damaged CMC joints at our hospital. Fifteen patients had Eaton stages 2 and 3 osteoarthritis of
the CMC joints [13]. Bennett’s fracture-dislocations were diagnosed in six of them by plain X-rays.

2.2. Surgical technique

Surgery proceeded under brachial plexus block using a traction tower for vertical traction. Firstly, we developed CM-U portals at the proper joint line on the ulnar side of the extensor pollicis brevis tendon in the dorsal aspect. Thereafter, a small curved hemostatic clamp was used for careful spreading to avoid incising too deeply and damaging branches of the radial sensory nerve. A short blunt trocar and cannula system was then inserted into the joint under steady gentle pressure and an arthroscope 2.5-mm in diameter (ConMed Linvatec, Largo, FL, USA) was introduced. The joint surface was inspected and then a 22-gauge needle that also functioned as a probe was inserted at the joint line on the radial side of the abductor pollicis longus. Synovectomy allowed observation of the joint with a 2.0-mm full-radius motorized shaver and a radiofrequency ablator through the CM-R. Thereafter, a TP was constructed under the arthroscopic view. To establish the TP, a 22-gauge needle was placed in the bulk of the thenar muscle at the level of the CMC joint, approximately 90° from the CM-U portal (Fig. 1, see 1A in particular) [12]. The correct position was again confirmed using the arthroscope and a 22-gauge needle was introduced into the dorsal side of the deep anterior oblique ligament (dAOL) (Fig. 1B). We constructed CM-R and CM-U portals in all patients and fashioned TP under arthroscopic visualization in 13 of them. The fracture dislocations were reduced under arthroscopy and then percutaneously pinned. Osteoarthritis of the CMC joint was arthroscopically treated by partial resection of the trapezium and interposition of the palmaris longus tendon [6,7].

2.3. Complications

A single author (M.T.) postoperatively assessed pain and tenderness at each portal through inquiry and palpation and then, the patients were followed up monthly at our hospital for 1 year after surgery. We evaluated damage to the sensory branches of the radial nerve in each portal and recurrent branches of the median nerve only for TP based on feedback from the patients and the findings of physical examinations.

2.4. Arthroscopic findings

We analyzed the frequency with which surgical instruments were inserted at each portal for viewing or working from videos taken during procedures. The frequency was compared between the use of standard portals with and without the TP. We also examined the dAOL, which served as an anatomical landmark for preparing the TP.

2.5. Statistical analysis

StatView 5.0 for Windows (SAS Institute Inc., Cary, NC, USA) was used for statistical analysis. Data were analyzed by Kruskal-Wallis Analysis and Mann-Whitney U test. Values of P ≤ 0.05 were deemed statistically significant.

3. Results

The CM-U was significantly used compared to 2 other portal as a viewing portal without any complication (Tables 1 and 2). TP and CM-R portals also served as working portals and were sometimes used to observe the dorsal and ulnar aspects (Table 1). Furthermore, the CM-R was used during surgery with and without a TP a

Table 1

<table>
<thead>
<tr>
<th></th>
<th>CM-R</th>
<th>CM-U</th>
<th>TP</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total frequency</td>
<td>9.2</td>
<td>7.0</td>
<td>14.3</td>
</tr>
<tr>
<td>Viewing portal</td>
<td>0.8</td>
<td>3.6</td>
<td>0.8</td>
</tr>
<tr>
<td>Working portal</td>
<td>8.4</td>
<td>3.4</td>
<td>13.5</td>
</tr>
</tbody>
</table>


* P < 0.05.

![Image](image-url)
Table 2 Complications associated with portals during arthroscopic surgery of thumb carpometacarpal joint.

<table>
<thead>
<tr>
<th>Complication</th>
<th>CM-R</th>
<th>CM-U</th>
<th>TP</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nerve injury</td>
<td>2/21</td>
<td>0/21</td>
<td>0/13</td>
</tr>
<tr>
<td>Scar tenderness</td>
<td>0/21</td>
<td>0/21</td>
<td>3/13</td>
</tr>
</tbody>
</table>

Arthroscopic surgery was performed using standard portal without TP for two patients with nerve injury on CM-R. CM-R: carpometacarpal-radial portal; CM-U: carpometacarpal-ulnar portal; TP: thenar portal.

Table 3 Mean numbers of insertions of surgical tools at CM-R and CM-U with or without thenar portal per one surgical procedure.

<table>
<thead>
<tr>
<th></th>
<th>CM-R</th>
<th></th>
<th>CM-U</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>TP (+)</td>
<td>TP (-)</td>
<td>TP (+)</td>
<td>TP (-)</td>
</tr>
<tr>
<td>Total frequency</td>
<td>5.5</td>
<td>14.8</td>
<td>6.0</td>
<td>8.6</td>
</tr>
<tr>
<td>Viewing portal</td>
<td>0.2</td>
<td>1.7</td>
<td>3.4</td>
<td>3.5</td>
</tr>
<tr>
<td>Working portal</td>
<td>5.3</td>
<td>13.1</td>
<td>2.6</td>
<td>5.1</td>
</tr>
</tbody>
</table>


4. Discussion

Most reports describing arthroscopic surgery of CMC joints have used two portals from the dorsal aspect [4,6,7]. The safety of standard portals has been evaluated for the neurovascular structures based on a cadaveric study [14]. In addition, damage to the dorsal sensory nerve is usually absent or minimal but has usually been resolved after thumb CMC arthroscopic surgery [2,4,6,15] except for two patients described by Hofmeister et al. [11]. Nerve injury at the CM-R in two patients in our series was also resolved within 2 months without further treatment. Thus, the CM-R carries a risk of nerve damage because it is located near sensory branches of the radial nerve [12]. The use of portals carrying a risk of nerve injury should therefore be avoided and a new portal needs to be established for safe and appropriate surgery because the working portal often requires stretching and manipulation at various angles as the CMC joint is small. Therefore, we assessed each portal during arthroscopic surgery of CMC joint by evaluating complications and the number of portal uses.

However, our study has two major limitations with respect to studying the value of the new portal, TP and standard portals. Firstly, the numbers and comparison groups are too small to define the usefulness and safety of each portal. Secondly, because this study included various surgical procedures, potential bias could arise. Thus, details of the clinical value of TP remain to be investigated, but we found that only patients undergoing arthroplasty developed paresthesia due to injury of the radial sensory nerve on the CM-R and no complications developed during or after surgery for Bennett’s fracture dislocation in the present as well as in previous studies [16,17]. These findings suggested that a high frequency of CM-R use could be one risk of nerve injury. In fact, using the TP decreased the need to use the CM-R located near the sensory nerve and nerves were not damaged at the TP. As a result, use of the TP could decrease the incidence of nerve damage during arthroscopic surgery for thumb CMC joint.

Furthermore, the TP allowed easier arthroscopic maneuvering during procedures such as debridement of the fracture site in Bennett’s fracture-dislocation and resection of the trapezium rim in the dorsal and ulnar aspect because it is positioned at almost 90° relative to the viewing portal, although some authors considered that it was enough in fluoroscopy but not in arthroscopy for reduction of Bennett’s fracture-dislocation [17,18]. In addition, the ability of expansion facilitated the insertion of instruments such as large shavers, the cannula of which were often used to interpose the palmaris longus tendon during interposition arthroplasty (Video).

The ligamentous structure of the CMC joint is anatomically complex with 16 ligaments [9], among which the dAOL and dorsoradial ligament (DRL) are generally recognized as chief stabilizers of the joint. Standard dorsal portals including the CM-R and CM-U
are prepared through the DRL, which is the shortest, thickest and widest ligament that spans the joint [10]. Such ligamentous support might render standard dorsal portals difficult to manipulate and stretch during resection of the trapezium and interposition of the tendon. Such further forcible maneuvers may increase the risk of nerve damage because the standard dorsal portal includes a thin subcutaneous layer with a sensory nerve. On the other hand, the TP was fashioned through the superficial anterior oblique ligament (SAOL) or radial capsule. The SAOL is a capsular ligament that thins at the edges of the trapezius to blend into the capsule itself, especially at its radial margin [9]. A TP prepared through a thin ligamentous structure can theoretically be expansive. In fact, the TP allowed the insertion of large instruments to guide insertion of the interposed tendon within the joint cavity (Video S1).

Nonetheless, three patients developed postoperative pain and tenderness due to scar tenderness at the TP, which might be related to the frequency of instrument insertions (Table 3) and forcible dilation of glabrous skin due to the insertion of large instruments. The surgical wound after arthroscopic surgery often formed a hard tubercle, although complaints about pain were rare. However, the thenar scar would need to be pressed against a surface to rise from a seated position. In fact, our patients reported pain at the TP scar during such routine activities. While a cadaver study [12] and our clinical series verified that the TP is useful and safe, patients should be informed of the risk of post-surgical scar tenderness.

Disclosure of interest

The authors declare that they have no conflicts of interest concerning this article.

Appendix A. Supplementary data

Supplementary data associated with this article can be found, in the online version, at doi:10.1016/j.jotsr.2015.04.009.

References