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Cubital tunnel syndrome: Comparative results of a multicenter study of 4 surgical techniques with a mean follow-up of 92 months


Service de Chirurgie Orthopédique 1 et 2, Unité de Chirurgie de la Main, Hôpital Trouseau, CHRU de Tours, 37044 Tours cedex, France
Service de Chirurgie Orthopédique, Hôpital de la Cavale-Blanche, CHU de Brest, 29200 Brest, France
Service de Chirurgie Orthopédique, CHU de Poitiers, 2, rue de la Militerie, 86021 Poitiers, France
Service de Chirurgie Orthopédique, CHU de Versailles, 78157 Le Chesnay cedex, France
Centre de la Main, Angers Assistance Main, 49100 Angers, France
Clinique Jeanne-d’Arc, Nantes Assistance Main, 44000 Nantes, France
Service d’Électroneuromyographie, Hôpital Trouseau, CHRU de Tours, 37044 Tours cedex, France

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ABSTRACT

Background: Cubital tunnel syndrome is the second most frequent entrapment syndrome. Physiopathology is mixed, and treatment options are multiple, none having yet proved superior efficacy.

Objectives: The present retrospective multicenter study compared results and rates of complications and recurrence between the 4 main cubital tunnel syndrome treatments, to identify trends and optimize outcome.

Material and methods: Patients presenting with primary clinical cubital tunnel syndrome diagnosed on electroneuromyography were included and operated on using 1 of the following 4 techniques: open or endoscopic in situ decompression, or subcutaneous or submuscular anterior transposition. Four specialized upper-limb surgery centers participated, each systematically performing 1 of the above procedures. Subjective and objective results and rates of complications and recurrence were compared at end of follow-up.

Results: Five hundred and two patients were included and 375 followed up for a mean 92 months (range, 9–144 months); 103 were lost to follow-up and 24 died. Whichever the procedure, more than 90% of patients were cured or showed improvement. There was a single case of scar pain at end of follow-up, managed by endoscopic decompression; there were no other long-term complications. None of the 4 techniques aggravated symptoms. There were 6 recurrences by end of follow-up: 1 associated with open in situ decompression and 5 with submuscular transposition.

Conclusion: Surgery was effective in treating cubital tunnel syndrome. Submuscular anterior transposition was associated with recurrence. In contrast to literature reports, subcutaneous anterior transposition, which is a reliable and valid technique, was not associated with a higher complication rate than in situ decompression.

Level of evidence: Level IV. Multicenter retrospective.

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1. Introduction

Cubital tunnel syndrome is the second most frequent entrapment syndrome [1]. Physiopathology is specific and treatment attitudes remain a subject of discussion.

Physiopathology is mixed, involving both static and dynamic factors. Ulnar nerve (UN) entrapment is usually located under the thickening of the proximal fascia between the two heads of the ulnar flexor of the carpus or arcade of Osborne [2], at the distal part of the epicondylar groove (EG). Elbow flexion induces physiological stretching of the nerve; compliance may be impaired by intraneural fibrosis. Flexion also increases pressure within the ulnar tunnel and intraneurally [3]. There is also a tendency for UN subluxation. Susceptibility to local compression may be worsened by nerve fiber disorder (diabetes, polyneuropathy, leprosy, etc.) or double crush (underlying thoracic outlet syndrome [TOS], C8 radiculopathy).

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Electroneuromyography (ENMG) is the reference examination. The diagnostic criteria for cubital tunnel syndrome are ≥10 m/s reduction in UN motor conduction speed at the elbow and/or ≥1.4 m/s difference between medial and ulnar nerve potential speeds. Signs of axon involvement are ≥50% reduction in sensory potential amplitude with respect to the contralateral value and signs of denervation in ulnar-innervated intrinsic muscles.

Surgical options are conditioned by one or more physiopathologic factors. In situ decompression (ISD) acts only on compression by the arcade of Osborne, whereas the other techniques also take dynamic factors into account. Intramuscular transposition induces fibrosis and total or partial medial epicondylectomy causes pain, and have been discarded from the present study.

The 4 main procedures currently employed in cubital tunnel syndrome and assessed here are: open (OISD) or endoscopic (EISD) in situ decompression, and submuscular (SMAT) or subcutaneous (SCAT) anterior transposition.

The present study investigated trends for the 4 techniques and sought to determine optimal management of cubital tunnel syndrome.

2. Material and methods

2.1. Study population, overall and per center

In a retrospective multicenter study, 4 centers each systematically performed 1 of the 4 surgical techniques. The principal inclusion criterion was clinically diagnosed cubital tunnel syndrome confirmed on ENMG with primary surgery using 1 of the 4 techniques.

Revision surgery and polyneuropathy were exclusion criteria.

The 2 principal assessment criteria at end of follow-up were: subjective result as assessed by the patient, and evolution of neurologic stage on the McGowan scale as modified by Goldberg (MGG) between preoperative and final assessment [4,5]. Mean follow-up was 92 months (range, 9–144 months). Secondary assessment criteria were: rate and type of complications, and rate of aggravation and recurrence at end of follow-up.

The initial population comprised 502 patients: 217 female, 285 male; mean age, 55 years (range, 19–92 years). Thirty-eight procedures were bilateral.

One hundred and three patients were lost to follow-up and 24 died. Thus, 375 patients were finally assessed, including 34 bilateral cases, whence 409 elbows.

Four specialized upper-limb surgery centers performed inclusion. Each exclusively used 1 of the 4 study procedures.

Table 1 details patient data per center.

### Table 1
Patient data, overall and per center.

<table>
<thead>
<tr>
<th>Center</th>
<th>No. 1</th>
<th>No. 2</th>
<th>No. 3</th>
<th>No. 4</th>
<th>Total/Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>Surgical technique</td>
<td>Open in situ decompression</td>
<td>Submuscular anterior transposition</td>
<td>Subcutaneous anterior transposition</td>
<td>Endoscopic in situ decompression</td>
<td></td>
</tr>
<tr>
<td>Patients included (n)</td>
<td>48</td>
<td>82</td>
<td>229</td>
<td>143</td>
<td>502</td>
</tr>
<tr>
<td>Mean (range) age (years)</td>
<td>48 (24–71)</td>
<td>61 (37–92)</td>
<td>54 (19–87)</td>
<td>56 (28–84)</td>
<td>55</td>
</tr>
<tr>
<td>Mean symptom duration (months)</td>
<td>8</td>
<td>13</td>
<td>25</td>
<td>18</td>
<td>16</td>
</tr>
<tr>
<td>Mean FU (months)</td>
<td>94 (66–110)</td>
<td>133 (132–144)</td>
<td>50 (9–127)</td>
<td>91 (64–120)</td>
<td>92</td>
</tr>
<tr>
<td>Bilateral cases (n)</td>
<td>0</td>
<td>2</td>
<td>24</td>
<td>8</td>
<td>34</td>
</tr>
<tr>
<td>FU (n)</td>
<td>44</td>
<td>82</td>
<td>154</td>
<td>95</td>
<td>375</td>
</tr>
<tr>
<td>Lost to FU (n)</td>
<td>4</td>
<td>0</td>
<td>51</td>
<td>48</td>
<td>103</td>
</tr>
<tr>
<td>Deaths (n)</td>
<td>2</td>
<td>0</td>
<td>18</td>
<td>4</td>
<td>24</td>
</tr>
<tr>
<td>Preoperative distribution according to McGowan-Goldberg (%)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I</td>
<td>20</td>
<td>52</td>
<td>45</td>
<td>48</td>
<td>45</td>
</tr>
<tr>
<td>IIA</td>
<td>39</td>
<td>28</td>
<td>24</td>
<td>27</td>
<td>27</td>
</tr>
<tr>
<td>IIIB</td>
<td>14</td>
<td>16</td>
<td>10</td>
<td>17</td>
<td>13</td>
</tr>
<tr>
<td>III</td>
<td>27</td>
<td>4</td>
<td>21</td>
<td>8</td>
<td>15</td>
</tr>
</tbody>
</table>

FU: follow-up.
Table 2
Distribution of ulnar pathology at end of follow-up on the McGowan scale as modified by Goldberg. Data for n = 403 operated UNs, excluding recurrence.

<table>
<thead>
<tr>
<th>Center</th>
<th>No. 1</th>
<th>No. 2</th>
<th>No. 3</th>
<th>No. 4</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>31 (73%)</td>
<td>67 (85%)</td>
<td>123 (69%)</td>
<td>83 (80.5%)</td>
<td>304 (84.6%)</td>
</tr>
<tr>
<td>I</td>
<td>6 (14%)</td>
<td>7 (9%)</td>
<td>31 (18%)</td>
<td>15 (14.5%)</td>
<td>59 (16.5%)</td>
</tr>
<tr>
<td>IIA</td>
<td>4 (9%)</td>
<td>4 (5%)</td>
<td>15 (8%)</td>
<td>2 (2%)</td>
<td>25 (7%)</td>
</tr>
<tr>
<td>IIB</td>
<td>2 (4%)</td>
<td>1 (1%)</td>
<td>7 (4%)</td>
<td>3 (3%)</td>
<td>13 (3.6%)</td>
</tr>
<tr>
<td>III</td>
<td>0 (0%)</td>
<td>0 (0%)</td>
<td>2 (1%)</td>
<td>0 (0%)</td>
<td>2 (0.05%)</td>
</tr>
<tr>
<td>Total</td>
<td>43 (98%)</td>
<td>79 (94%)</td>
<td>178 (100%)</td>
<td>103 (100%)</td>
<td>403 (98.5%)</td>
</tr>
</tbody>
</table>

Z-flap was harvested from the medial epicondyle muscles and sutured above the transposed UN, stabilizing it.

2.2.4. Subcutaneous anterior transposition (SCAT)

An arched 8-10 cm skin incision was centered on the EG. The UN trunk was released along the tunnel and transposed forward of the medial epicondyle. Stabilization used a fascial flap with lateral pedicle harvested from the superficial fascia of the medial epicondyle muscles; the medial edge was sutured to the subcutaneous tissue, stabilizing the UN. Immediate mobilization was authorized.

2.3. Assessment

2.3.1. Objective data: McGowan scale as modified by Goldberg (MGG)

All included patients were graded on the classification published by McGowan in 1950 [4] as modified by Goldberg in 1989 [5]. This 4-stage classification is founded on objective clinical examination data on sensitivity in the ulnar sensory innervation territory and the force and atrophy of intrinsic muscles with ulnar innervation. Patients still symptomatic at last follow-up were re-examined and reclassified; totally asymptomatic patients were considered cured, with MGG stage 0 by definition.

2.3.2. Subjective data: self-assessment

Self-assessed residual cubital tunnel syndrome symptomatology was collected at end of follow-up. All patients were able to be recontacted. They were classified as cured, improved, unchanged, worsened or recurrent; those totally asymptomatic were considered cured, while all those with new or residual symptoms of whatever nature were re-examined.

2.4. Statistical analysis

Populations and results were compared between centers on classic inferential statistical tests. Qualitative variables were analyzed on Chi² and quantitative variables on analysis of variance (ANOVA) and Kruskal-Wallis test. Tests were two-tailed, with a significance threshold of P < 0.05.

3. Results

3.1. Principal results: subjective and objective efficacy

Table 2 presents residual MGG neurologic stages per center at end of follow-up, excluding recurrence.

Table 3 presents patient-assessed symptom evolution per center at end of follow-up, excluding true recurrence.

No significant differences were found for objective (MGG) or subjective (self-assessed) efficacy between centers. There were, on the other hand, significant differences between centers in duration of preoperative symptoms and in distribution of preoperative MGG stages. Within each center, subjective efficacy correlated strongly with preoperative MGG stage.

3.2. Complications, aggravation and recurrence

3.2.1. Complications

The OISD technique induced no complications, whereas EISD was associated with a painful scar at end of follow-up. The transposition techniques led to complications: 3 postoperative hematomas, not requiring surgery, 18 cases of sensitive scar and one stiff elbow, all early and fully resolved by end of follow-up.

3.2.2. Aggravation and recurrence

None of the techniques led to worsened symptoms at end of follow-up. Two, however, were associated with genuine recurrence of cubital tunnel syndrome at end of follow-up: OISD in 1 case (2.5% of patients followed up), with stage-1 recurrence at 4 years, and SMAT in 5 cases (6% of patients followed up): MGG stages were low; mean onset of recurrence was at 6.3 years; revision surgery found extensive fibrosis.

The low rates of complications and recurrence precluded statistical analysis.

Table 3
Subjective results per center at end of follow-up. Data for n = 409 operated UNs.

<table>
<thead>
<tr>
<th>Surgical technique</th>
<th>No. 1</th>
<th>No. 2</th>
<th>No. 3</th>
<th>No. 4</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Subjective assessment</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cured</td>
<td>31 (70%)</td>
<td>69 (82%)</td>
<td>123 (69%)</td>
<td>77 (75%)</td>
<td>298 (73%)</td>
</tr>
<tr>
<td>Improved</td>
<td>11 (25%)</td>
<td>7 (8%)</td>
<td>39 (22%)</td>
<td>19 (18%)</td>
<td>76 (18%)</td>
</tr>
<tr>
<td>Unchanged</td>
<td>1 (2.5%)</td>
<td>3 (4%)</td>
<td>16 (9%)</td>
<td>7 (7%)</td>
<td>27 (7%)</td>
</tr>
<tr>
<td>Worsened</td>
<td>0 (0%)</td>
<td>0 (0%)</td>
<td>0 (0%)</td>
<td>0 (0%)</td>
<td>0 (0%)</td>
</tr>
<tr>
<td>Total</td>
<td>43 (97.5%)</td>
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<td>92</td>
</tr>
</tbody>
</table>

FU: follow-up.
4. Discussion/Conclusion

The main finding of the present study was that surgery was effective in treating cubital tunnel syndrome, whichever the technique. Despite differences in the distribution of preoperative MGG stages, in each center more than 90% of patients were cured or showed improvement. This rate is in agreement with the literature [6–9]; combined with the lack of proven durable efficacy of conservative treatment, this argues for systematic surgical management of cubital tunnel syndrome [10].

In the absence of consensus, on the other hand, the choice of procedure is less straightforward. All 4 techniques are reported as giving 85–95% good results [6], while all published studies display methodological weaknesses [10].

Analysis of the present results according to technique confirmed the efficacy and relative non-invasiveness of OISD and EISD, with between 93% and 95% complication-free improvement or cure. This is in agreement with the literature and most authors, by precaution, recommend ISD as being relatively non-invasive and usually effective, although not addressing the whole physiopathology of cubital tunnel syndrome [10–12].

UN transposition techniques proved just as effective as OISD; associated complications were real, but exclusively early and resolutive. The literature likewise reveals no clear difference between ISD and transposition, apart from the complications rate [10,12]; some reports favor transposition, and SCAT in particular [13,14], while others reported poor results with ISD [15].

The optimal therapeutic attitude for any given patient thus seems to be a complex question. ISD does not cure, but the systematic answer to cubital tunnel syndrome: it leaves the UN open to dynamic stress and possible dislocation [9,14] while failing to deal with the static component of physiopathologic stress. Moreover, several authors reported poorer results on ISD with more severe neurologic involvement [16–18], with surgical revision following failure proving unreliable [14,19,20].

Transposition manages all the physiopathologic phenomena underlying ulnar neuropathy. It is rigorous and technically demanding, and several authors reserve it for salvage revision [14,21–23]. The question in that case is which type of transposition to apply.

In the present study, a submuscular location of the transposed UN induced fibrosis and recurrence (6%) due to nerve fixation. We consider that SMAT requires an experienced surgeon. Jaddue’s 2009 comparative study came out in favor SCAT [24]. In the present study, SCAT was associated with no recurrence (which usually implicates defective technique [6]).

The present retrospective multicenter study involved several limitations. The various center series were not comparable, differing significantly in symptom duration and MGG stage distribution. Each center implemented its preferred technique, with results that cannot be extrapolated to less specialized surgeons.

In practice, we would recommend 2 procedures. ISD is the simplest technique, with the lowest rate of complications and, in theory, the most rapid recovery. There is no doubt that a well-performed OISD is to be preferred to a botched transposition. EISD also provided good results, but involves a learning curve and does not avoid the risk of scar pain. As there is a risk of not having dealt with everything and of destabilization of the ulnar nerve, ISD patients should be maintained under surveillance.

Transposition, on the other hand, is formally indicated in unstable UN (61% of the present series), large triceps, or any other local etiology. Relative indications include severe forms or forms implying severe tension [25].

SCAT deals with all potential etiologies, but requires rigorous execution to avoid creating new loci of compression. Under these conditions, it may be indicated systematically; results are more favorable than with ISD, and no recurrence is associated [9]. SCAT is simpler and more reproducible than SMAT.

Disclosure of interest

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

References