**INTRODUCTION:**

Pain and weakness are well-recognized problems following carpal tunnel release (CTR). [1,2] It is well known that the three thenar muscles (flexor pollicis brevis, abductor pollicis brevis and opponens pollicis) and the three hypothenar muscles (flexor digiti minimi, abductor digiti minimi and opponens digiti minimi) take part of their origin from the transverse carpal ligament (TCL). [2] It has been postulated that alteration or instability of these muscle origins may be at least partially responsible for postoperative weakness. [1]

The cause of pillar pain is unclear. While its etiologies may be multifactorial, detachment or relaxation of the thenar and/or hypothenar muscles, pulling of the released TCL on the thenar and hypothenar origins, and periositis of the bony origins of the thenar and hypothenar muscles (the hamate and scaphoid tubercles) have all been suggested as contributing factors. While release of the TCL during CTR may result in a clinically important disturbance of the origins of the thenar and hypothenar muscles, a review of the literature failed to note the percentage of these intrinsic muscles that originate from the TCL, as compared to the percentage that originate from the adjacent carpal bones. The purpose of this study is to quantify the contributions of the various origins to the thenar and hypothenar muscles.

**METHODS:**

Ten fresh-frozen cadaveric arms were sectioned through the distal forearm. All hands and wrists were examined and radiographed to ensure that they were free from trauma or surgery. The superficial soft tissues were removed, and the thenar and hypothenar muscles identified (Figure 1). The thenar muscle insertions were transected to allow unobstructed visualization of the origins. The boundaries of the muscle origins were marked, the muscles excised, and the entire surface of all origins digitized using a stylus connected to a Fastrak Digitizer (Polhemus; Colchester, VT). As the muscles took origin from both bone and soft tissue, their origins were irregular, with significant elevations in the bony architecture. In order to accurately analyze the origin of the muscles in all three dimensions, the Rapidform 2004 program was used (INUS Tech; Seoul, Korea). This program can accurately calculate the two dimensional area of the origins from three-dimensional input. This process was repeated for the hypothenar muscle group.

**RESULTS:**

The thenar muscles took origin from the TCL, the scaphoid tubercle and the trapezoidal ridge. The mean size of the thenar origins from the TCL, scaphoid tubercle, and trapezoidal ridge are shown in Table 1. The hypothenar muscles took origin from the TCL, hook of the hamate, the volar carpal ligament (VCL) and the pisiform. The mean size of the hypothenar origins from the TCL, hook of the hamate, VCL, and pisiform was shown in Table 2.

**DISCUSSION:**

While there was a significant degree of individual variation between specimens, as evidenced by the standard deviations noted in Tables 1 and 2, our results show that the majority (68%) of the thenar muscle origin is from the TCL, while almost half (49%) of the hypothenar muscle origin is from the TCL. As the volar carpal ligament is also relaxed by CTR [3] a total of 72% of the hypothenar origin (from both the TCL and the VCL) may be lengthened by CTR. Therefore, CTR may lead to alteration of over 2/3 of the thenar and hypothenar muscle origins.

The results of this study may help explain the origin of postoperative pinch and grip weakness. Pinch strength, in which the thumb opposes the index, and occasionally the middle finger, is related to strength of the thenar muscles. So is grip strength. The flexor power of the four fingers is most specifically measured by hook strength, which is considerably greater than grip strength. The limiting power of grip strength, which measures the opposing force of the thumb against the four fingers, is that of the thenar muscles. Therefore, the most important muscles in grip are those of the thenar eminence.[4] Any changes in grip strength should be most directly related to its limiting factor, which is the opposition power of the thumb generated by the thenar muscles.

Pillar pain is another common problem following CTR. The results of this study lend support to the hypotheses that pillar pain, in whole or in part, may be due to alterations of the thenar and/or hypothenar origins.[5] It is possible that differential tensioning of the released origins (from the TCL and VCL) and non-released origins (from the bony carpus) may contribute to pillar pain. As 2/3 of the thenar and hypothenar origins are lengthened, the forces of grip and pinch will be preferentially transmitted to the relatively shorter 1/3 of the muscles originating from the bony carpus. This could increase the stress on these small myotendinous units, potentially leading to pain.

In conclusion, this study has found that over 2/3 of the thenar muscles originate from the TCL, and that over 2/3 of the hypothenar muscles originate from the TCL and VCL. Both of these ligaments, and the intrinsic muscle fibers that originate from them, may be functionally lengthened during CTR. These findings lend support to the theory that altered intrinsic muscle origins may be a contributing factor in the etiology of pinch and grip weakness, as well as pillar pain, following CTR.

**REFERENCES:**


**AFFILIATED INSTITUTIONS FOR CO-AUTHORS:**

*Houston VAMC, Houston TX

**tbl:**

<table>
<thead>
<tr>
<th>Area (cm²)</th>
<th>Average</th>
<th>S.D.</th>
</tr>
</thead>
<tbody>
<tr>
<td>TCL</td>
<td>1.73</td>
<td>1.24</td>
</tr>
<tr>
<td>Scaphoid</td>
<td>0.35</td>
<td>0.17</td>
</tr>
<tr>
<td>Hamate</td>
<td>0.78</td>
<td>0.61</td>
</tr>
<tr>
<td>Pisiform</td>
<td>0.50</td>
<td>0.23</td>
</tr>
</tbody>
</table>

Table 2: Area of the Hypothenar Origin.