Coincidence or complication? A systematic review of trigger digit after carpal tunnel release

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Coincidence or complication? A systematic review of trigger digit after carpal tunnel release

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ABSTRACT

Background: Carpal tunnel syndrome (CTS) and trigger digits are among the most common nontraumatic hand disorders treated by plastic surgeons. The onset of trigger digits after carpal tunnel release (CTR) has been inconsistently reported. This systematic review assessed the prevalence of trigger digits development in patients after CTR surgery.

Methods: We searched the MEDLINE, EMBASE and SCOPUS databases for papers published between January 1966 and August 2016. Eligible studies contained quantitative data on the incidence of trigger digits after CTR. The primary outcome measure was the onset of trigger digits after CTR. The secondary outcome measure was the prevalence of digital involvement in patients who developed trigger digits after CTR.

Results: A total of 5654 CTR surgeries were performed in the included nine studies, and 483 patients (8.5%) developed trigger digits after CTR. The reported incidence of trigger digits after CTR ranged from 5.2% to 31.7%. The time to development of trigger digits was approximately 6 months postoperatively. In the eight observational studies and in the randomized controlled trial, the thumb and ring finger were reported as the most commonly involved trigger digits, respectively.

Conclusions: The incidence of trigger digits after CTR surgery is not negligible. Thumbs and ring fingers are the most commonly involved digits. This topic should therefore be suitably addressed during preoperative consultations.

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KEYWORDS
Carpal tunnel syndrome; trigger finger

Introduction

Carpal tunnel syndrome (CTS) is the most common peripheral nerve entrapment syndrome. It results from compression of the median nerve at the wrist, which is caused by the increased pressure in the carpal tunnel [1]. The prevalence of CTS is 3.8% in the general population [2], and the overall lifetime prevalence of clinically diagnosed CTS among current/recent workers is 6.7% [3]. Carpal tunnel release (CTR), which involves surgical decompression of the median nerve by releasing the transverse carpal ligament, was first described by Learmonth [4]. Currently, CTR surgery is among the most common hand procedures. It offers definite median nerve decompression and is usually performed under local anesthesia as a daycare procedure. CTR surgery is associated with a low rate of complications [5,6]. A systematic review analyzing 22,327 cases of endoscopic CTR and 5669 cases of open CTR revealed that the incidence of structural damage to nerves, arteries, or tendons was 0.49% and 0.19% in open CTR and endoscopic CTR (transbursal and extrabursal), respectively [7].

Trigger digit is a hand disorder characterized by the presence of local tenderness, a palpable lump, and triggering of the flexor tendon at the A1 pulley [8]. Trigger digits may present with CTS upon evaluation, and this tendency to coexist in the same patient suggests the possibility of a common pathophysiological process [9,10]. However, the development of trigger digits after CTR surgery has been inconsistently reported. As the relationship between the occurrence of trigger digits and CTR surgery has yet not been fully established, we conducted a systematic review to assess the onset of trigger digits after CTR surgery.

Materials and methods

To achieve a high standard of reporting, we followed the procedures specified in the 2009 update of the Preferred Reporting Items for Systematic reviews and Meta-Analyses (PRISMA) guidelines (http://www.prisma-statement.org/). Our compliance with the PRISMA guidelines is explained in the Supplementary Appendix. The protocol of the present systematic review is available through PROSPERO (http://www.crd.york.ac.uk/PROSPERO/), where it is assigned the following registration number: CRD42016047060.

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Supplemental data for this article can be accessed here.

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Literature search

Two authors independently performed literature searches to identify studies investigating trigger digits in patients who underwent CTR. We searched the MEDLINE database for papers published between January 1966 and March 2016 by using the following keywords: ‘carpal tunnel syndrome’ (MeSH term) and ‘trigger finger disorder’ (MeSH term). Free text words, namely trigger finger, trigger digits, trigger thumb and stenosing tenosynovitis, were also used instead of MeSH terms to avoid missing recent articles that had not yet been given a MeSH label. The EMBASE database was searched using the following terms: ‘carpal tunnel syndrome’ and ‘trigger finger (or trigger digits or stenosing tenosynovitis).’ The SCOPUS database was also checked for relevant studies by using the following keywords: ‘carpal tunnel syndrome’ and ‘trigger finger (or trigger digits or stenosing tenosynovitis).’ The search was not restricted to any language, but in the systematic review, only studies published in English were considered.

After identifying relevant titles, all abstracts were read, and eligible articles were retrieved. A manual cross-reference search of the references of relevant articles was performed to identify other studies not found in the search. The full search strategy is described in the Supplementary Appendix.

Methodological quality assessment

Two authors independently assessed the methodological quality of the included articles. The methodological quality of randomized controlled trials (RCTs) was assessed using the Jadad scale [11]. On the basis of Jadad score, quality of reporting was categorized as poor (Jadad score <3) or good (Jadad score ≥3).

For non-RCTs, we used the Methodological Index for Non-Randomized Studies (MINORS) guidelines to assess the methodological quality [12]. MINORS guidelines consist of 12 indexes: (i) a clearly stated aim, (ii) inclusion of consecutive patients, (iii) prospective collection of data, (iv) endpoints appropriate to the aim of the study, (v) unbiased assessment of the study endpoint, (vi) follow-up period appropriate to the aim of the study, (vii) loss to follow-up less than 5%, (viii) prospective calculation of the study size, (ix) adequate control group, (x) contemporary groups (control and studied group should be managed during the same time period, no historical comparison), (xi) baseline equivalence of groups and (xii) adequate statistical analyses; every item has two points, and the total score is 24; a score of ≥16 points indicates a high methodological quality, and lower scores (<16 points) indicate a low methodological quality.

Inclusion and exclusion criteria

Types of studies

Our inclusion criteria were as follows: publications dealing with patients receiving CTR and the development of trigger digits after CTR surgery, articles in English, articles on human studies, and articles for which full text was available.

The following exclusion criteria were used for study selection: conference abstracts and non-English articles.

Types of participants

Adult patients with CTS who developed trigger digits after CTR surgery were included.

Types of outcome measures

The primary outcome measure was the prevalence of trigger digits after CTR surgery. The secondary outcome measure was the prevalence of digital involvement in patients who developed trigger digits after CTR surgery.

Data extraction

The following data were extracted from each article for analysis: journal, year of publication, author, study design, operation methods, follow-up period, number of patients and/or hands that received CTR surgery, number of patients and/or hands that developed trigger digits after CTR surgery, and the distribution of trigger digits among the hands involved.

Results

The flowchart of the systematic review is shown in Figure 1. A total of 1090 publications were initially identified in the literature search, among which 31 articles were retrieved for more detailed information. After reading the 31 retrieved articles and applying our inclusion criteria, we selected nine relevant articles. All authors completely agreed on the inclusion of these studies. The included studies (Tables 1 and 2) comprised one RCT, one prospective comparative study, four retrospective comparative studies and three case series. Only the prospective comparative study achieved a high methodological quality.

![Figure 1. Preferred reporting items for systematic reviews and meta-analyses (PRISMA) statement of search results.](image-url)
<table>
<thead>
<tr>
<th>Author, year</th>
<th>Country</th>
<th>Study design</th>
<th>Methodology quality (score)</th>
<th>Patient characteristics</th>
<th>Operation method</th>
<th>Follow-up</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hombal et al., 1970</td>
<td>UK</td>
<td>Case series</td>
<td>Low (MINORS: 6/24)</td>
<td>CTS: 113 patients (132 hands)</td>
<td>Open CTR</td>
<td>Not reported</td>
</tr>
<tr>
<td>Hayashi et al., 2005</td>
<td>Japan</td>
<td>Prospective comparative study</td>
<td>High (MINORS: 17/24)</td>
<td>Idiopathic CTS: 164 hands</td>
<td>Either open CTR or ECTR</td>
<td>12 months</td>
</tr>
<tr>
<td>Harada et al., 2005</td>
<td>Japan</td>
<td>Retrospective comparative study</td>
<td>Low (MINORS: 12/24)</td>
<td>Idiopathic CTS: 875 hands</td>
<td>Open CTR: 254 (29.0%) ECTR (Chow's method): 621 (71.0%)</td>
<td>Mean 353–400 days</td>
</tr>
<tr>
<td>Goshtasby et al., 2010</td>
<td>USA</td>
<td>Retrospective comparative study</td>
<td>Low (MINORS: 14/24)</td>
<td>CTS: 792 patients</td>
<td>CTR-TF group: 54% ECTR</td>
<td>N/A</td>
</tr>
<tr>
<td>Kim et al., 2013</td>
<td>Korea</td>
<td>Case series</td>
<td>Low (MINORS: 11/24)</td>
<td>Idiopathic CTS: 362 patients (633 hands)</td>
<td>Open CTR</td>
<td>Median 36 months (range: 24–96)</td>
</tr>
<tr>
<td>King et al., 2013</td>
<td>USA</td>
<td>Retrospective comparative study</td>
<td>Low (MINORS: 14/24)</td>
<td>CTS: 1185 hands</td>
<td>Open CTR</td>
<td>6 months</td>
</tr>
<tr>
<td>Lee et al., 2014</td>
<td>Korea</td>
<td>Case series</td>
<td>Low (MINORS: 12/24)</td>
<td>Idiopathic CTS: 497 patients</td>
<td>Minimal incision open CTR</td>
<td>18 months</td>
</tr>
<tr>
<td>Grandizio et al., 2014</td>
<td>USA</td>
<td>Retrospective comparative study</td>
<td>Low (MINORS: 14/24)</td>
<td>CTS: 957 patients (1217 hands)</td>
<td>DM group: 160 (74.8%) open CTR</td>
<td>12 months</td>
</tr>
<tr>
<td>Acar et al., 2014</td>
<td>Turkey</td>
<td>Prospective RCT</td>
<td>Low (Jadad score: 2/5)</td>
<td>Idiopathic CTS: 113 patients (159 hands)</td>
<td>Open CTR</td>
<td>24 months</td>
</tr>
</tbody>
</table>

RCT: randomized controlled trial; MINORS: Methodological Index for Non-Randomized Studies; CTR: carpal tunnel release; TF: trigger finger; TD: trigger digit; RA: rheumatoid arthritis; TCL: transverse carpal ligament.
<table>
<thead>
<tr>
<th>Author, year</th>
<th>No. of CTS operated</th>
<th>No. of TD developed after CTR</th>
<th>Onset of TD after CTR</th>
<th>Digital involvement in TD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hombal et al., 1970</td>
<td>132</td>
<td>29 (22.0%)</td>
<td>In the majority, the early symptoms of TD began 4–6 weeks after CTR</td>
<td>Thumb &gt; Ring &gt; Middle</td>
</tr>
<tr>
<td>Hayashi et al., 2005</td>
<td>164</td>
<td>52 (31.7%)</td>
<td>5.6 months (range, 0.2–12 months)</td>
<td>Thumb (41.0%) &gt; Middle &gt; Ring</td>
</tr>
<tr>
<td>Harada et al., 2005</td>
<td>875</td>
<td>52 (5.9%)</td>
<td>N/A (TD release was done most frequently within a period of 3 months)</td>
<td>Thumb (37.2%) &gt; Middle &gt; Ring</td>
</tr>
<tr>
<td>Goshtasby et al., 2010</td>
<td>792</td>
<td>50 (6.3%)</td>
<td>Average 141.4 days (range, 17–349 days); 23.3% occurred in postoperative 6 months</td>
<td>Thumb (48.3%) &gt; Middle &gt; Index</td>
</tr>
<tr>
<td>Kim et al., 2013</td>
<td>633</td>
<td>64 (10.1%)</td>
<td>Median 6 months (range, 1.5–36 months)</td>
<td>Thumb (50.0%) &gt; Middle &gt; Ring</td>
</tr>
<tr>
<td>King et al., 2013</td>
<td>1185</td>
<td>78 (6.6%)</td>
<td>N/A</td>
<td>Thumb was the most common digit</td>
</tr>
<tr>
<td>Lee et al., 2014</td>
<td>497</td>
<td>59 (11.9%)</td>
<td>Four fingers at postop. 1 month, 31 more fingers at 3 months, 26 more fingers at 6 months and 11 more fingers at 12 months (total 72 fingers with TD)</td>
<td>Thumb (30.6%) &gt; Middle &gt; Ring</td>
</tr>
<tr>
<td>Grandizio et al., 2014</td>
<td>1217</td>
<td>63 (5.2%)</td>
<td>0–6 months: DM group: 18 (8.4%) Non-DM group: 31 (3.1%) 6–12 months: DM group: 3 (1.4%) Non-DM group: 11 (1.1%) Mean: 5.1 months (range 3–6 months)</td>
<td>Thumb (44.1%) &gt; Ring &gt; Middle</td>
</tr>
<tr>
<td>Acar et al., 2014</td>
<td>159</td>
<td>36 (22.6%)</td>
<td>TCR release only group: 79 TCR release only group: 11 (13.9%) Mean: 5.1 months (range 3–6 months)</td>
<td>TCR release only group: Ring 61.5% &gt; Middle &gt; Index</td>
</tr>
<tr>
<td></td>
<td>– TCL release only group: 79</td>
<td>– TCL release only group: 11 (13.9%)</td>
<td>– TCL release only group: 11 (13.9%) Mean: 5.1 months (range 3–6 months)</td>
<td>– TCL release only group: Ring 61.5% &gt; Middle &gt; Index</td>
</tr>
<tr>
<td></td>
<td>– TCL + forearm fascia release group: 80</td>
<td>– TCL + forearm fascia release group: 25 (31.7%)</td>
<td>– TCL + forearm fascia release group: 25 (31.7%)</td>
<td>– TCL + forearm fascia release group: Ring (31.3%) &gt; Middle &gt; Index</td>
</tr>
</tbody>
</table>

CTR: carpal tunnel release; TD: trigger digit; RA: rheumatoid arthritis; TCL: transverse carpal ligament.

*52 hands with trigger digits that received trigger digit release (i.e. underestimate the number of patients developed trigger digits after carpal tunnel release).
Hombal and Owen analyzed 132 hands in 113 patients, excluding those with rheumatoid arthritis (RA) who underwent CTR surgery [13]. Twenty-nine hands (22.0%) in 26 patients developed trigger digits. Among them, 21 hands required surgical treatment. The majority of these patients began to develop trigger digits symptoms at 4–6 weeks after CTR surgery. The most commonly involved digits (in descending order of frequency) were the thumb, ring finger and middle finger.

Hayashi et al. conducted a prospective comparative study of 164 patients, after excluding those with diabetes mellitus (DM), RA and hemodialysis, to examine the effect of CTR surgery on the occurrence of trigger digits [14]. Among the patients who received CTR surgery for CTS, the postoperative incidence of trigger digits was 31.7% (52/164). The average interval between CTR surgery and the onset of trigger digits was 5.6 months (range, 0.2–12 months). The most frequently affected digit was the thumb (41.0%), followed by the middle finger, ring finger, index finger and little finger.

Harada et al. performed a retrospective comparative study to analyze patients who required endoscopic CTR and those who required both endoscopic CTR and trigger digits release. Among 875 CTR cases, the incidence of trigger digits release was 5.9% (52/875) [15]. Trigger digits release surgeries were most frequently performed within 3 months of CTR. The most commonly involved digits requiring surgical release were the thumb (37.2%), followed by the middle finger, ring finger, index finger and little finger.

Goshtasby et al. performed a retrospective comparative study of patients with DM, thyroid diseases, osteoarthritis and RA, as well as of those who underwent other hand surgeries during CTR [16]. In this study, the incidence of new-onset trigger digits after CTR surgery was 6.3% (50/792), which was determined as the number of patients who needed postoperative trigger digits release or steroid injections into the A1 pulley. The average postoperative time to development of trigger digits was 141.4 days (range, 17–349 days), and only 23.3% of cases occurred after the 6-month postoperative period. The thumb was the most frequently affected (48.3%) digit, followed by the middle finger, index finger and ring/little finger.

In a case series of 362 patients (633 hands), Kim et al. revealed that the incidence of new-onset trigger digits after CTR was 10.1% (64/633), after excluding those with DM, hypothyroidism, RA, tuberculosis and neurological diseases. The median time period from CTR surgery to trigger digits development was 6 months (range, 1.5–36 months) [17]. Trigger digits most commonly developed in the thumb (50.0%), followed by in the middle finger and ring finger.

In 1185 procedures, King et al. reported that the incidence of new-onset trigger digits was 6.6% (78/1185) within 6 months of CTR surgery. This study excluded patients with prior hand surgery or injections, RA, inflammatory arthropathy, scleroderma, traumatically induced CTS, pregnancy, CTR performed in conjunction with another procedure, bilateral CTR and unilateral CTR followed by a procedure on either hand, but included those with DM, osteoarthritis and thyroid diseases [18]. After CTR, trigger digit most commonly developed in the thumb.

Lee et al. reported their case series of 497 patients, excluding those with DM, RA, scleroderma, amyloidosis and previous trigger digits, and reported that the incidence of new-onset trigger digits after CTR surgery was 11.9% (59/497) [19]. Postoperatively, triggering was noted in four fingers at one month, 31 more fingers at 3 months, 26 more fingers at 6 months and 11 more fingers at 12 months. No further triggering was noted at 18 months postoperatively. Trigger digits most commonly developed in the thumb (30.6%), followed by the middle finger and ring finger.

Grandizio et al. conducted a retrospective cohort study of 1217 patients and reported that the incidence of new-onset trigger digits after CTR surgery was 5.2% (63/1217) [20]. Patients with DM, RA, thyroid disorders, gout and additional surgeries during CTR were included in their study. Eighteen patients (8.4%, 18/214) with DM and 31 (3.1%, 31/1003) without DM developed trigger digits within 6 months of CTR. The most commonly involved digit was the thumb (44.1%), followed by the ring finger, middle finger, little finger and index finger.

Acar et al. presented the only prospective RCT that excluded patients with DM, RA, thyroid disorders, pregnancy, acute trauma, and a history of trigger digits and focused on new-onset postoperative trigger digits [21]. The incidence of trigger digits was higher among patients randomized to receive transverse carpal ligament release together with distal forearm fascia release (31.3%, 25/80) than among those who received only transverse carpal ligament release (13.9%, 11/79) trigger digits developed in 36 (22.6%) hands of 34 patients at a mean of 5.1 months (range, 3–6 months) after CTR. Among patients who developed trigger digits after receiving only transverse carpal ligament release, the ring finger was the most commonly affected digit (61.5%), followed by the middle finger (23.1%), index finger (15.4%) and thumb/little (0%) finger. Among patients who developed trigger digits after receiving transverse carpal ligament release together with distal forearm fascia release, the ring finger was the most commonly affected digit (31.3%), followed by the middle finger (28.1%), index finger (18.8%), thumb (15.6%) and little finger (6.3%).

**Pooled data**

A total of 5654 CTR surgeries were performed in the nine included studies, with the development of trigger digits in 483 cases (8.5%). The incidence of trigger digits after CTR surgery ranged from 5.2% to 31.7%. The time to development of trigger digits was approximately 6 months postoperatively. In all the eight observational studies, the thumb was the most commonly involved trigger digit, whereas in the RCT, the ring finger was most commonly involved.

**Discussion**

**Overall prevalence of trigger digits after CTR**

In this systematic review, a total of 5654 CTR surgeries were performed in nine studies, and trigger digits developed in
483 of these cases, resulting in an average prevalence of 8.5% and an incidence ranging from 5.2% to 31.7%. In addition, trigger digits may present with CTS upon evaluation. Kumar and Chakrabati reported 681 consecutive patients with CTS, trigger digits, or both conditions [9]. The final study group comprised 551 patients with no obvious predisposing cause (excluding 130 patients with DM, RA, or thyroid disease). Of the 211 patients with trigger digits, 91 (43.1%) also had CTS. These 91 patients with trigger digits comprised 21.1% of 431 patients with CTS. In this systematic review, after excluding studies that involved or possibly involved patients who received a preoperative diagnosis of trigger digits, 7.7% (236/3058) of the patients from four studies were noted to develop trigger digits after CTR surgery [18–21].

**Time to development of trigger digits after CTR**

In the prospective RCT performed by Acar et al., the mean time to development of trigger digits after CTR was 5.1 months (range, 3–6 months) [21]. Similarly, in the prospective comparative study performed by Hayashi et al., patients developed trigger digits after CTR at an average time point of 5.6 months (range, 0.2–12 months) [14]. Among the nine included studies, eight studied reported that most of their patients developed trigger digits within 6 months of CTR.

**Digital involvement of trigger digits after CTR**

The digital involvement of trigger digits after CTR surgery varied among the included studies. In the prospective RCT performed by Acar et al., both patient groups had the same distribution of digital involvement of trigger digits [21]. The ring finger was the most frequently involved digit, followed by the middle finger and index finger. In the group that received only transverse carpal ligament release, 61.5% of the involved digits were ring fingers. All the eight observational studies reported that thumbs were the most commonly involved digits in trigger digits after CTR. Kim et al. even reported that up to 50.0% of the involved digits in trigger digits were thumbs [17].

**Risk factors for developing trigger digits after CTR**

We identified the possible risk factors contributing to the development of trigger digits after CTR. Hayashi et al. revealed that surgery is a significant risk factor for the onset of trigger digits and may accelerate the development of trigger digits in mild-to-moderate, but not severe CTS [14]. In a retrospective study, Harada et al. found that 11.5% of cases required trigger digits release surgeries within 3 years before and/or after CTR [15]. In nerve conduction studies, a relatively increased distal motor latency of the median nerve predicts a high incidence of trigger digits associated with CTR. In addition, the incidence of trigger digits release after CTR was 5.9%, and it most frequently occurred within the first 3 months postoperatively. This study proved that CTS and trigger digits share a common pathophysiological factor and concluded that the incidence of trigger digits after open or endoscopic CTR did not differ; however, this issue needs to be further examined because of the significantly high percentage of secondary CTS patients in the open CTR group.

In a retrospective study, Goshtasby et al. reported that endoscopic surgery and osteoarthritis were two independent risk factors for the development of new-onset trigger digits after CTR surgery [16]. The severity of CTS and the presence of DM could not predict the occurrence of trigger digits after CTR.

Grandizio et al. stated that the presence of DM, rather than its severity, was the key predictive factor for the development of trigger digits [20]. However, because of the differences between the DM and non-DM groups in terms of surgical methods and the presence of gout and hyperthyroidism, the conclusions of this study were weakened.

**Limitations of this review**

Our review has some limitations. First, from 1996 to 2016, only nine studies have assessed the occurrence of trigger digits after CTR surgery, thus indicating that this issue has been overlooked. On the other hand, publication bias may exist across studies. Additional better-powered, registered studies with prospective collection of data are warranted to verify the findings of this systematic review. Second, the included studies showed obvious variations in study design, patient demographics, surgical approach and follow-up period. This potentially challenges the generalizability of our synthesized results. Finally, we only included English publications, possibly eliminating studies with good methodologies but were published in non-English journals. However, we believe it is necessary to summarize the current evidence on the occurrence, time to development, and digital involvement of trigger digits.

**Summary**

The prevalence of trigger digits after CTR surgery may be uncertain, but it definitely exists. The development of
new-onset trigger digits after CTR seems unavoidable to a certain extent. Thumbs and ring fingers are the most commonly involved digits. We suggest that this information should be suitably incorporated into comprehensive pre-operative consultations.

Acknowledgements

Prior presentations: This work has been podium presented at the American Society of Plastic Surgeons, The Meeting on 17 October 2015 in Boston, MA. The abstract has been published online: Cheng HT, Wu CI, Hsu YC. Coincidence or complication? A systematic review of trigger digits after carpal tunnel release. Plast Reconstr Surg 2015;136:21–2.

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