Post-Traumatic Carpal Tunnel Syndrome in Children

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Introduction

Carpal tunnel syndrome (CTS) is rare in children but can occur after traumatic wrist or forearm injuries.[1-7] Distal radius fractures are the most common cause.[8-12] Patients present acutely in the emergency department after recent injury and urgent carpal tunnel release (CTR) is recommended.[8] Alternatively, those who present later after an injury are treated more like idiopathic CTS cases and may trial more conservative measures before surgery.[10]

In adults with distal radius fractures, studies have showed good outcomes after acute CTR done at the same time as open reduction and internal fixation.[12,13] Given the limited information about CTS in children, the purpose of this study is to describe the presentation and treatment results of post-traumatic CTS in a pediatric population. It should be noted that children with mucopolysaccharide storage disorder such as Hurler syndrome can develop CTS without a history of trauma.[14,15]

Methods

In this retrospective single-center cohort study, all children with post-traumatic CTS from June 2007 to August 2022 were identified by diagnostic codes. Demographic and clinical presentation, treatment, and outcomes data were collected from electronic medical record review and descriptive statistics were calculated. Patients were categorized by time of presentation (Acute < 3 days, Subacute 1-6 weeks, or Delayed > 6 weeks) and whether patients were monitored before surgical treatment. Chi-Square and independent sample t-test were used to compare subgroups. $P<0.05$ was considered statistically significant.

Results

Eighteen patients (16 male) with post-traumatic CTS were identified. The average age at time of presentation was 12.8 ± 3.6 years. Of the associated traumas, 83% (15/18) had a history of a fracture involving the distal radius. Of these fractures, 93% (14/15) were displaced, 40% (6/15) had an associated ulna fracture, 40% (6/15) involved the physis, and 27% (4/15) were open fractures. Most of these patients (10/15) had a closed reduction and 6 required open reductions and internal fixation.

In this group, 72% (13/18) patients presented acutely including 6 with symptoms and clinical concern for CTS on the day of injury. 22% (4/18) presented sub-acutely and one patient had a delayed presentation. For all presentations, the most common symptoms were numbness (78%), paresthesias (33%), swelling (33%), and increasing pain (28%). 17% (3/18) had clinical concern for concomitant compartment syndrome on presentation. 6 patients were initially monitored (2 acute, 3 subacute, 1 delayed). Ultimately, 16/18 of the patients underwent operative CTR (13/13 acute, 2/4 subacute, 1/1 delayed).

At follow-up, 81% (13/16) of surgically treated patients had complete symptomatic relief. After CTR, there was no detectable difference in treatment outcomes between patients who presented acutely versus subacutely or delayed ($p = 0.214$). On average, there was not a significant difference in time to symptom resolution between patients who presented acutely versus those who presented subacutely or delayed (1.73 versus 1.58 months, $p = 0.89$). However, among children that developed symptoms acutely, patients who underwent a brief period of observation before CTR had a significantly longer time to symptom resolution than those who underwent immediate CTR (28.0 versus 2.4 weeks, $p < 0.001$).

Discussion

Given its rare presentation, there are few studies on CTS in a pediatric population. Rusch et al. review the etiology of CTS in a cohort of 38 children with 2 traumatic cases.[3] This study is novel for its in-depth assessment of the presentation and outcomes of trauma associated CTS in children and adolescents.

The clinical presentation of post-traumatic acute CTS can be similar to compartment syndrome including symptoms of pain out of proportion and paresthesia.[16] In our cohort, 17% of patients had clinical concern for compartment syndrome. Each underwent

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forearm fasciotomies in addition to CTR. With the potential for permanent disability from long durations of decreased perfusion, acute compartment syndrome should be treated immediately. Though, given the overlap in symptoms, surgeons should consider the concomitant CTR.

Timing of CTR is important. Patients with acute post-traumatic CTS who were observed to monitor symptom resolution had a prolonged recovery (28.0 versus 2.4 weeks) than patients who had more urgent CTR. This finding is similar to adults, in whom delayed intervention for traumatic carpal tunnel had permanent consequences including irreversible and intraneural fibrosis.[8] These results strongly suggest that surgery should not be delayed in children with acute CTS. Next, our subacute post-traumatic CTS group may be akin to previously described "transient CTS" patients in which CTS symptoms after trauma are temporary from nerve contusion and/or stretch.10 Arguably, transient CTS does not require surgical release of the carpal tunnel as nerve dysfunction may resolve with observation, elevation, and adequate fracture reduction. However, of patients who presented sub-acutely, 2/4 ultimately went on to have CTR and of the two that did not, one still had symptoms at their last follow up 18-months later. While it appears that these patients can be safely monitored, we found that the patient may nonetheless need surgery for complete symptom relief. Similarly, for delayed presentations, it is less likely that non-operative treatment such as orthosis or steroid injections will relieve symptoms in pediatric patients.[17] In Van Meir's review of 163 cases of pediatric carpal tunnel, 89% ultimately underwent CTR.[16] Thus, while acute CTS should undergo urgent CTR, there is a high likelihood later presentations will undergo surgical treatment as well and should be anticipated. Encouragingly, operative treatment tends to result in positive outcomes. In our cohort, 80% of surgically treated patients had symptomatic relief at follow-up. These findings in children match adults, in which the clinical benefit of post-traumatic CTR is as effective as those who underwent elective CTR.[2,8-10,12]

Conclusions

Overall, CTS is a rare but known complication of traumatic forearm injuries, especially distal radius fractures. This diagnosis should not be missed in pediatric patients who present with numbness and tingling along the median nerve following forearm injury. Presentation and symptoms justify timely surgical intervention in the acute setting. Urgent surgery reduces the risk of prolonged neurologic recovery following acute CTS in children. Lastly, with subacute presentation, surgery should be considered for patients whose symptoms do not resolve after monitoring given the symptomatic alleviation after treatment.

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