CARPAL TUNNEL SYNDROME IN DISTAL RADIUS FRACTURES: AN OBSERVATIONAL STUDY

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ABSTRACT:

Background: Distal radius fractures (DRF) are the most common fractures constituting around 17.5% of fractures encountered in emergency. The incidence of delayed carpal tunnel syndrome (CTS) is reported to be around 20% in patients with DRFs. Though it leads to poor functional outcome, it is not being given much importance. Hence present study is an attempt to determine incidence of CTS in patients with DRF and to assess the factors responsible for variation in its incidence.

Materials & Methods: This prospective study includes 220 patients presented to our tertiary care Hospital with history of DRFs and treated by various modalities in past 5 years. Cross sectional area of median nerve was recorded at level of inlet of carpal tunnel. The data was collected, tabulated and analyzed.

Results: In our study the incidence of CTS in DRF was found to be 32.73% when evaluated using sample size of 220. On analyzing the results incidence of CTS according to treatment modality in increasing order was CRIF/ORIF with K wire <External fixation <Conservative with cast < ORIF with VAVLP < ORIF with VTLP and according to AO classification Group B<A<C and high in groups with more comminution than less comminution.

Conclusions: Carpal tunnel syndrome is the most important complication limiting functional outcome after DRFs, hence demands much more importance and precaution to prevent it. Ultrasonography being easily available, cost effective can be considered as reliable and most preferable mode for screening and diagnosis of CTS.

Key words: Carpal tunnel syndrome(CTS) , Distal radius fractures (DRFs), Various modalities, Cross sectional area, Ultrasonography, Median nerve.

INTRODUCTION:

Distal radius fractures (DRF) are most common fractures being 17.5% of fractures encountered by orthopaedic trauma surgeons in emergency1,2. Its recorded incidence is around 120,000 in UK and 600,000 – 640,000 in US per year2,3,4 around 1 in 10,000 in the general population5. In recent years clinical data point to a rise in the incidence of distal radius fractures in the
pediatric, adult, and elderly population. Tendon ruptures, nerve injuries, compartment syndrome, malunion, nonunion, arthritis, shoulder hand syndrome, complex regional pain syndrome, loss of motion, early or late onset carpal tunnel syndrome (CTS) are commonly encountered complications. The occurrence of these complications depends on the age of the patient, mechanism of injury, fracture type, treatment modality, reduction achieved, position and period of immobilization.

After Abbott and Saunders published a review article in 1933, the association between DRF and CTS was recognized to be more common phenomenon. The incidence of CTS following DRFs in the United States is estimated at 1–3 cases per 1000 subjects per year. The incidence of delayed CTS has been reported to be around 20% in patients with DRFs in general population. Role of prophylactic carpal tunnel release during fixation of fractures in patients with no signs of median nerve compression is still controversial but may reduce incidence of post-operative CTS hence is always a topic of debate. CTS usually presents with symptoms of median nerve compression such as decreased sensation, numbness and pain in its distribution. CTS is traditionally diagnosed by clinical signs but nerve conduction studies (NCS), USG, MRI are considered for confirmation of diagnosis. On USG Cross Sectional Area (CSA) of median nerve of above 10 mm² at the level of carpal tunnel inlet is considered as diagnostic of CTS.

ILLUSTRATION I: The area of hand with Median Nerve sensory supply. Greened area of hand is supplied by median nerve. Even though CTS is one of the common complication associated with DRF and leads to poor functional outcome, it is not being given much importance in clinical practice. There are no much studies available to determine incidence of CTS in patients with DRFs specifically in Indian population. Hence present study is an attempt to determine incidence of CTS in patients with DRF treated by various modalities and to assess the factors responsible for variation in incidence of carpal tunnel syndrome in each modality.

MATERIALS AND METHODS:

This is a cross-sectional study involving 220 patients of either sex who had presented to Emergency/outpatient unit of department of Orthopaedics, in our tertiary Hospital with history of distal radius fractures treated by various available modalities in past 5 years according to hospital records. Patients of either sex of above 20 years with closed/open, intra/extra articular distal end radius fractures treated conservatively or surgically and willing to come for review and examination were included in the study. Those associated with vascular injuries, treated by local bone setters, tendon injuries were excluded. The objective of this study was to
To determine incidence of carpal tunnel syndrome in patients with distal radius fractures treated by various modalities and assess the factors responsible for variation in incidence of carpal tunnel syndrome in each modality. The patient’s details were collected from hospital records and patients were called for clinical examination to find any signs of carpal tunnel syndrome. Affected and normal side wrist of all patients were examined and assessed clinically using Phalen’s test, Reverse Phalen’s test and Median nerve compression tests and results were tabulated. All patients were also evaluated using antero-posterior and lateral view radiograph of affected wrist and ultrasonography of affected and normal wrist and cross sectional area of median nerve was recorded at level of inlet of carpal tunnel. The data were collected, tabulated and analyzed.

RESULTS:

This study was on 220 patients of which 126 were female and 94 were males. All these patients suffered from DRFs of various patterns including Extra-Articular (107) or Intra-Articular (96) DRFs, Volar (14) or Dorsal (02) Barton fractures and Smiths (01) fractures. 190 fractures were closed type and 30 were open. These fractures were treated by using various modalities such as conservative by cast, closed or open reduction and internal fixation using Kirschner wires, variable angled volar locking plates (VAVLP) or volar T locking plates (VTLP). The patient’s functional status and median nerve status in carpal tunnel were assessed by clinical examination and ultrasonography.

<table>
<thead>
<tr>
<th>Modality of Treatment</th>
<th>Number of Patients</th>
<th>Fracture Pattern</th>
<th>Type of Fracture</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Extra-Articular</td>
<td>Intra-Articular</td>
</tr>
<tr>
<td>* Conservative with Cast</td>
<td>42</td>
<td>40</td>
<td>02</td>
</tr>
<tr>
<td>** External Fixation</td>
<td>33</td>
<td>08</td>
<td>25</td>
</tr>
<tr>
<td>† CRIF/ORIF with K Wire</td>
<td>62</td>
<td>41</td>
<td>21</td>
</tr>
<tr>
<td>§ ORIF with VAVLP</td>
<td>42</td>
<td>04</td>
<td>38</td>
</tr>
<tr>
<td>§ ORIF with VTLP</td>
<td>41</td>
<td>14</td>
<td>27</td>
</tr>
</tbody>
</table>

TABLE I: Number of patients treated by each modality, Fracture pattern and Type

Among the 42 conservatively treated patients CSA of median nerve was > 10 mm2 in 17 (40.47%) patients and were diagnosed as having CTS, in External Fixator group 10 (30.3%) of 33 patients, in CRIF/ORIF with K-Wire fixation group 9 (14.5%) of 62 patients, in ORIF with VAVLP group 17 (40.48%) of 42 patients, in ORIF with VTLP group 19 (46.34%) of 41 patients were diagnosed as having CTS based on CSA of median nerve. Overall 72 (32.73%) of 220 patients were diagnosed as CTS. On analysis of results it was found that 33 (30.84%) of 107 extra articular fractures and 39 (34.51%) of 113 intra articular fractures developed delayed CTS. When concentrated on pattern of fracture and comminution, results show CTS
incidence of 30.84% in Group A, 17.85% in Group B and 40% in Group C. It also shows that probability of getting CTS increases with increase in comminution.

<table>
<thead>
<tr>
<th><strong>TABLE NO II</strong></th>
<th>Number of patients with symptoms, positive clinical tests and average of CSA of median nerve on USG of normal and affected wrists. Incidence of CTS is more in conservative group, ORIF with VAVLP/VTLP. CRIF/ORIF with K wire has least incidence of CTS.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>AO Class Group</strong></td>
<td><strong>Number of Patients</strong></td>
</tr>
<tr>
<td></td>
<td><strong>CONS</strong></td>
</tr>
<tr>
<td>*A</td>
<td>107</td>
</tr>
<tr>
<td>**B</td>
<td>28</td>
</tr>
</tbody>
</table>

TABLE NO II: Number of patients with symptoms, positive clinical tests and average of CSA of median nerve on USG of normal and affected wrists. Incidence of CTS is more in conservative group, ORIF with VAVLP/VTLP. CRIF/ORIF with K wire has least incidence of CTS.
TABLE III: Number of patients in AO classification group, modality of treatment, outcome. AO Group A fractures were treated by Conservative or K wire fixation have less incidence compared to Group C and incidence increases with increasing comminution. AO Group B having less comminuted fractures have least incidence of CTS.

<table>
<thead>
<tr>
<th>Group</th>
<th>Conservative</th>
<th>External Fixation</th>
<th>ORIF/ORIF with K-Wire</th>
<th>ORIF with VAVLP</th>
<th>ORIF with VTLP</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>C</td>
<td>85</td>
<td>-</td>
<td>22(7)</td>
<td>1(0)</td>
<td>36(14)</td>
<td>34(40%)</td>
</tr>
<tr>
<td>Total</td>
<td>220</td>
<td>42(17)</td>
<td>33(10)</td>
<td>62(9)</td>
<td>42(17)</td>
<td>41(19)</td>
</tr>
</tbody>
</table>

72 (32.72%)

7.89 10.47

ILLUSTRATION II: Graph depicting sample characteristics and results. Total number of patients treated, symptomatic, diagnosed CTS patients in each treatment modality group.
ILLUSTRATION III: Graph depicting distribution of number of patients according to severity of CTS based on CSA. The severity of CTS increases in increasing CSA of median nerve and is directly proportional to malunion, volar callus and invasiveness of treatment.

Case Example: A 40 year old male with 2 year old left distal radius fracture, treated by variable angle volar locking plate fixation, presented with numbness over lateral 2/3rd of palm with thenar eminence wasting, X ray and USG pictures at the time of evaluation are shown above (Illustration No: 04), CSA of median nerve was 10.8 mm2.
ILLUSTRATION IV: Picture of example case present X ray and USG. A 40 year old male with 2 year old left distal radius fracture, treated by variable angle volar locking plate fixation, presented with numbness over lateral 2/3rd of palm with thenar eminence wasting, X ray and USG pictures at the time of evaluation are shown above (Picture No: 02), CSA of median nerve was 10.8 mm².

Discussion:
The National Hospital Ambulatory Medical Care Survey (NHAMCS) database, suggested that 1.5% of all emergency department visits were due to hand and wrist fractures. Carpal tunnel syndrome is the most frequent peripheral compressive neuropathy of upper extremity which is also one of the common complications of distal radius fractures. Any factor that modifies walls of carpal tunnel may lead to nerve compression and CTS. Early diagnosis and expeditious treatment of acute CTS is necessary, failing which results in permanent median nerve dysfunction. Many patients with transient CTS after DRF do not require surgical release of the carpal tunnel. For patients with delayed CTS, all possible causes of nerve compression (fracture fragments, hardware, synovitis, systemic causes) should be considered, subsequently evaluated and treated. The indication and usefulness of prophylactic CTR in the absence of signs and symptoms of CTS after DRF is still under debate. In our study out of 220 patients with DRFs 72 patients were diagnosed to have CTS with 32.73% incidence. On assessing each corners of the results in our study we found that the incidence of CTS as a complication of DRFs depends on several avoidable/ unavoidable key factors. Will discuss each factor in detail. The fracture pattern is a key factor responsible for functional outcome. In our study when considered all modalities of treatment together 30.84% of 107 AO Group A fractures, 17.85% of 28 Group B fractures and 40% of 85 group C fractures were diagnosed to have CTS. In each group probability of occurrence of CTS increased with increase in comminution. The average of CSA of median nerve at inlet of carpal tunnel was also found to be significantly high in group C, specifically if highly comminuted patterns are considered. Group B fracture pattern with less volar comminution has least incidence of CTS in our study. In 35 patients having moderate to severe CTS, 18 patients belong to highly comminuted groups such as A3.1–3, B3.3 and C3.2–3. These factors in the results suggest strong association of fracture pattern in pathogenesis of CTS. In our study treatment modality also appears to be a
significant factor in pathogenesis of CTS. On comparing results of each modality we found that, incidence of CTS is least, i.e 14.5% when treated with CRIF/ORIF with K wire, followed by External fixation modality with incidence of 30.3% but incidence found to be significantly high when treated by conservative with cast (40.47%), ORIF with VAVLP(40.48%) and ORIF with VTLP(46.34%). Above results shows that conservative and volar plating modalities are having high probability of getting CTS after DRFs compared to K wire fixation and External fixation. This high association of CTS in conservative could be due to prolonged casting with wrist in palmar flexion (Cotton Ladder position). In volar plating soft tissue dissection leading fibrosis and contracture as well as volarly placed fixation plate material could be the pathogenic factors. Both factors lead to significant decrease in dimensions of carpal tunnel traverses median nerve leading to its compression. Since the above factors are long standing factors these conditions will be associated with gradually progressing median nerve compression symptoms. Since all these factors are preventable, studying pathogenesis causing CTS as a complication of DRFs is quite important. The carpal tunnel syndrome being most common complication of distal radius fractures is utmost important factor for functional outcome. This has to be considered as most important factors during treatment and precautions needs to be taken to prevent the same. Avoiding long-term casting, achieving near anatomical reduction, stable fixation and minimum possible manipulation of fractures during reduction, soft tissue care during fixation, appropriate post fixation physiotherapy can decrease the incidence. Concomitant release of flexor retinaculum during fixation has some improvement in functional outcome even though sufficient literature support is not available\textsuperscript{25}.  

CONCLUSION:

This study was done with intention to determine incidence of carpal tunnel syndrome as a complication of distal radius fractures and the factors associated with its occurrence. Carpal tunnel syndrome is the most important complication limiting the functional outcome after distal radius fractures, hence demands much more importance and precaution to prevent it. If occurs, early diagnosis and treatment is warranted to prevent permanent disabilities. Ultrasonography being easily available, cost effective can be considered as reliable and most preferable mode of investigation for screening and diagnosis of carpal tunnel syndrome.

References:


