INTRODUCTION

Tibial spine avulsion fractures (TSAF) exhibit bimodal age distribution in both pediatric and adolescent populations. They commonly occur between the ages of 8 to 14. Fracture of the tibial spine is relatively rare. The incidence is 3 per 100,000 pediatric trauma cases yearly.1 The most common mechanism of injury is pivot-type rotation, similar to the mechanism of ACL rupture in adults, but TSAFs can also occur as a result of direct trauma or hyperextension of the joint.2,3 The most common activity that results in these fractures is falling from a bicycle, but skiing and motor vehicle accidents are increasingly common risk factors.4 The early work of Meyers and McKeever led to classifying fractures into three groups. Type I involves an undisplaced fracture, type II fractures are partially displaced with an intact posterior hinge, and type III fractures are completely displaced. Later, Zariecznjy described a fourth type of fracture, which involves complete displacement from the intercondylar eminence associated with comminution.5 Different surgical options have been proposed, including open reduction and internal fixation (ORIF), arthroscopic reduction and immobilization, and ARIF.6 The literature supports conservative management with a knee cast or splint for Type I un-displaced tibial spine fractures and surgical treatment for Type II, if reduction is not anatomical, and Type III and IV fractures.3 Open surgical techniques have several disadvantages and more complications (soft-tissue damage, higher postoperative pain, longer hospital stay, and delay in rehabilitation). For this reason, arthroscopic techniques are considered the gold standard for treating these lesions: they allow direct visualization of intra-articular injuries, simplified diagnosis, accurate reduction of fracture fragments, treatment of associated soft-tissue injuries, and removal of loose pieces.7 Controversy
remains within the literature regarding management. A review concluded that no gold standard treatment had been set out, although the authors did conclude that displaced fractures require operative management. There is still a debate on the most helpful approach for the fixation of tibial spine avulsion fracture, examining the clinical differences among the various fixation methods. This study aims to compare the outcome of open versus arthroscopic fixation of tibial spine avulsion fractures. Outcome variables will include union, range of motion, weight-bearing, and clinical function outcome assessed with Lysholm Knee score, IKDC scoring, and Laxity of ACL. This study will help generate local statistics regarding both these modalities, which will help decide which modality is more useful and effective for treating tibial spinal avulsion fracture among pediatric and adult patients.

**METHODOLOGY:**

The Prospective Comparative study was conducted at the Department of Orthopedic Surgery, Jinnah Hospital Lahore. The study was completed 12 months after the approval of the study. Each case will be followed up to 6 months. The non-probability convenient sampling technique was used. Sample size of 42 patients (21 in each group) was calculated by using 80% power of the study, 90% confidence interval, and by taking the expected mean value of IKD score in ORIF and ARIF groups as 90.52±1.50 and 90.67±6.11 respectively.

\[
n = \frac{(Z_{1-\beta} + Z_{1-\alpha/2})^2 + (\delta_1^2 + \delta_2^2)}{(\mu_1 - \mu_2)^2}
\]

\[Z_{1-\alpha/2}\]

Confidence interval= 90%

\[Z_{1-\beta}\]

power of the study= 80%

\[\mu_1\]

Expected mean value of IKD score in ORIF Group = 87.29

\[\mu_2\]

Expected mean value of IKD score in ARIF Group = 90.52

\[\delta_1\]

Expected standard deviation of ORIF Group=4.67

\[\delta_2\]

Expected standard deviation of ARIF Group= 1.50

n = Expected sample size in a group = 21

Patients aged (8-16 years) both genders, presenting with injury no more than two weeks. Meyer and McKeever type II, III, and IV. Exclusion criteria included patients with inadequate follow-up, hybrid fixation, and any chondral injury or associated fracture that could potentially have a significant effect on recovery and outcomes compared with an isolated tibial spine avulsion injury. Ethical approval was obtained from the hospital’s ethical review committee before initiating the study. Patients were divided into two groups using a non-probability convenient sampling technique.

**RESULTS:**

The study revealed that out of 42 Participants, 36(85.71%) males and 6 (14.29 %) females participated in the study with an age range of 8-16 years with a mean age of 12.02± (2.53) years. Out of 42 Participants, 22 (52.4%) had motor vehicle accidents with type 3(38.1%) and 4(54.8%) modified Meyers and McKeever fracture classification. At the end of the follow-up period, the mean IKDC score progressed from 45.86 ± 4.07 (p=0.02, CI=95%) to 90.52 ± 1.50 (p = 0.00, CI = 95%). The Lysholm score was improved from 49.75 ± 5.30 (p=0.29, CI=95%) to 90.67 ± 6.11(p=0.20, CI = 95%) in comparison to the last follow-up. Compared to ORIF, only 5(11.9%) patients complained of post-op infection vascular injury. After two weeks following surgery, no weight bearing was performed. Out of 42 Participants, 39 (92%) started with partial weight bearing 2.07 ± 0.26 (p=0.07) and progressed to full weight bearing (100%) at the end of the follow-up. The post-op knee flexion range was improved from 30.33 ± 2.10 (p=0.003) to 136.4 ± 10.50 (p=0.13) degrees, and the knee extension range was constant. After eight weeks following surgery, ROM was improved with better pain management, and a return to activities in patients with ARIF was observed.

**Table 1: Patient Outcomes**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Initial Value</th>
<th>Final Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean IKDC Score</td>
<td>45.86 ± 4.07</td>
<td>90.52 ± 1.50</td>
</tr>
<tr>
<td>Lysholm Score</td>
<td>49.75 ± 5.30</td>
<td>90.67 ± 6.11</td>
</tr>
<tr>
<td>Post-op Knee Flexion</td>
<td>30.33 ± 2.10</td>
<td>136.4 ± 10.50</td>
</tr>
</tbody>
</table>

**Table 2: Comparison between ORIF and ARIF**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>ORIF</th>
<th>ARIF</th>
</tr>
</thead>
<tbody>
<tr>
<td>Post-op Infection</td>
<td>05 (11.5%)</td>
<td>N/A</td>
</tr>
<tr>
<td>Vascular Injury</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>Weight Bearing (Partial)</td>
<td>N/A</td>
<td>39 (92%)</td>
</tr>
<tr>
<td>Weight Bearing (Full)</td>
<td>N/A</td>
<td>42 (100%)</td>
</tr>
<tr>
<td>Return to Activities</td>
<td>N/A</td>
<td>Yes</td>
</tr>
</tbody>
</table>

**Table 3: Post-op Complications**

<table>
<thead>
<tr>
<th></th>
<th>Post-op Infection</th>
<th>Vascular Injury</th>
<th>Anterior Knee Pain</th>
</tr>
</thead>
<tbody>
<tr>
<td>N</td>
<td>42</td>
<td>42</td>
<td>42</td>
</tr>
<tr>
<td>Mean</td>
<td>1.88</td>
<td>1.88</td>
<td>1.17</td>
</tr>
<tr>
<td>Median</td>
<td>2.00</td>
<td>2.00</td>
<td>1.00</td>
</tr>
<tr>
<td>Std. Deviation</td>
<td>0.328</td>
<td>0.328</td>
<td>0.377</td>
</tr>
</tbody>
</table>
DISCUSSION

Arthroscopic treatment reduces complications like soft-tissue lesions, post-operative pain, and length of hospitalization compared to open surgery, but clinical outcomes and radiographic results do not seem to differ. A recent study in 2020 by Pailhé et al. evaluated the therapeutic results of ARIF to ORIF in tibial eminence fractures. Results revealed that IKD score and extension exhibited significant differences between groups, although time to return to sports (weeks), Lysholm score, and flexion did not IKDC score at the last follow-up of 68.8 ± 11.8 months was 20.2 points ± 8.9 (p = 0.028). In contrast to our study, the Pedi-IKDC score showed good content of validity and progress to 90.52 ± 1.58 (p = 0.00, CI = 95%) at the end of follow-up months. Lysholm's score improved to 90.67 ± 6.11(p=0.20, CI = 95%) in arthroscopic procedure and earlier return to activity and better pain management. With the advent of arthroscopy and magnetic resonance imaging, it is now known that associated soft tissue injury is common with tibial spine avulsion fractures. These include meniscal injury, ACL injury, and chondral injury. Diagnosis and treatment of these injuries are of utmost importance for successful outcomes. Arthroscopy allows for identifying and treating these soft tissue injuries and the reduction and fixation of displaced Type II, III, and IV fractures, in contrast to our study, where 21 patients out of 41 were treated with arthroscopy, which demonstrated better functional outcomes with less rate of complications. Only 5 (12%) had post-op infection. Only 3(7.1%) can perform mild functional activities without limitations before knee injury 0.63 ± 9.31. The patient showed maximum activity participation in the 24th week of the following. A systematic review comparing suture versus screw fixation outcomes found a 6.3% rate of postoperative contracture after arthroscopic suture fixation based on their defined criteria of a 10-degree extension deficit or a 25-degree flexion loss. Similarly, a previous study found an 8.3% prevalence of arthrofibrosis in children and adolescents after ACL reconstruction. 31 ± 0.97.15 Compared to our study, the range of motion of knee flexion from the 4th-week follow-up was 31.52 ± 2.89, with a significance level (p=0.003) improved to 131.7 ± 6.22 at the 24th week. The mean value of knee extension at the 8th week of follow-up was 2.83 ± 0.59 and remained constant throughout the period, and there was no obvious extension lag and contracture deformity observed in patients with arthroscopy. 10,17,18

CONCLUSIONS

This study observed better functional outcomes in arthroscopic reduction and immobilization than in open reduction internal fixation. Arthroscopy for TSAF decreases risk of arthofibrosis and minimizes morbidities and better management of symptoms. Compared to OIRF, ARIF showed good content validity for the IKDC and Lysholm scales.

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REFERENCES


CONTRIBUTORS

1. Muhammad Amir Sohail - Concept & Design; Drafting Manucript; Critcal Revision; Supervsion; Final Approval
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