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A Prospective Study Comparing the Outcome of Supra-Patellar and Infra-Patellar Tibial Nail Insertion.

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ABSTRACT

Background: Fractures of the tibia are among the most serious long bone fractures, due to their potential for nonunion, malunion, and long-term dysfunction, as well as their propensity for open injury. Intramedullary nailing is the gold standard treatment option for displaced closed or open tibial diaphyseal fractures. **Methods:** This is a prospective study, which was done for a period of one year on 50 patients who underwent patellar nail insertion. They were randomly divided into two groups- Infra-patellar (IP) and Supra-patellar (SP) nail insertion. The technique of nail insertion was revealed to both the surgeon and patient at that time. **Results:** VAS score was 0.78 in suprapatellar and 1.87 in infrapatellar. Data analysis of external features and extension and flexion were almost equal for both suprapatellar and infrapatellar. But pain is significantly more common in supra-patellar tibial insertion. **Conclusion:** Suprapatellar and infrapatellar approach are comparable regarding tibial fracture healing and alignment.

Keywords: Infra-patellar, Nailing, Supra-patellar, Tibial fracture.

INTRODUCTION

An intramedullary rod, also known as an intramedullary nail (IM nail) or inter-locking nail or Kuntscher nail (without proximal or distal fixation), is a metal rod forced into the medullary cavity of a bone. These nails have long been used to treat fractures of long bones of the body.[1]

Fractures of the tibia are among the most serious long bone fractures, due to their potential for nonunion, malunion, and long-term dysfunction, as well as their propensity for open injury. Intramedullary nailing is the gold standard treatment option for displaced closed or open tibial diaphyseal fractures. Intramedullary nailing acts as an internal splint and permits early weight bearing along with fracture healing.[2-5]

The accepted approach to tibial nailing that follows highlights techniques from selected texts. Two positioning options are used to facilitate nailing: (1) a traction table with the patient's hip and knee flexed, (2) the patient supine on a radiolucent patient supine on a radiolucent table with the ability to flex the knee >90° over an aluminum triangle or pile of blankets. This method avoids the use of traction pins, which reduces operative time and removes the risk of iatrogenic nerve injury or nerve compression from the bolster. It also avoids elevated compartment pressures seen with prolonged traction.[6-10]

Anterior knee pain is one of the most common complaints after tibial intramedullary nailing. This has a significant economic impact, since the majority of tibial fractures that require nailing are sustained by men with an average age of 31 years. Some studies found the incidence of anterior knee pain to be 56%. The only difference between patients who developed pain and those who did not was that patients with pain were younger. Ninety-one percent of these patients experienced pain with kneeling and 33% had pain at rest. Possible explanations for this include nail protrusion leading to soft tissue irritation or damage to the gliding tissues in front of the knee during nail insertion. It

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has been suggested that the patellar tendon-splitting approach may be associated with increased pain due to lateral retraction of the tendon, compared to paratendinous approaches.[11-14]

The advantages of suprapatellar tibial nail insertion are that it can prepare and insert nail with knee extended. It is more simple access to entry point at proximal tibia, avoids patellar tendon, theoretically less anterior knee pain, avoids risk to infrapatellar nerve and avoids insertion trough poor skin if skin at proximal tibia is damaged. The disadvantages are they have to place instruments across the patellofemoral joint potentially damaging joint surface. They have higher impact loads across patellofemoral joint. They are not as well studied as infrapatellar insertion. Advantages of infrapatellar tibial nail insertion are that this is tried and true method. It has no potential for damage to patellofemoral joint. Disadvantages of infrapatellar tibial nail insertion are that it is very difficult in proximal tibia fractures as knee is required to be flexed during nail insertion and patellar tendon needs to be navigated around or through.[4,14]

MATERIALS AND METHODS

This is a prospective study, which was done for a period of one year on 50 patients who underwent patellar nail insertion. They were randomly divided into two groups- Infra-patellar (IP) and Supra-patellar (SP) nail insertion. They were also given informed consent and only after they agreed, they were taken into the study. The technique of nail insertion was revealed to both the surgeon and patient at that time.

Exclusion Criteria

a) Pregnant women
b) Patients with intra-articular involvement
c) Periprosthetic fractures
d) Nonunions
e) Ipsilateral injuries
f) Previous knee injuries
g) History of gout, rheumatoid, osteoarthritis, spinal injury and incarceration.

Supra-patellar insertion was done percutaneously with the help of a special cannula system. Arthroscopy was done in Supra-patellar patients to obtain a visual clearance of the Patellar fracture joint. The condition of the articular cartilage was described by out bridge scale. Grade 0 means normal cartilage, grade I- cartilage with softening and swelling, grade II- fragmenting or fissuring <1.5 cm diameter, grade III- fragmenting or fissuring >1.5 cm diameter, grade IV- exposed subchondral bone. Routine follow up with standard tibia and knee radiographs for 6 weeks, 3, 6 and 12 months was done. Visual Analogue Score (VAS), i.e. 0 means excellent and 10 means extreme pain, pain diagram documentation and Range of Motion (ROM) was done.

RESULTS

A total of 50 patients were selected in this study (31 SP and 19 IP). Ten SP and two IP did not respond to follow up examinations. The time from when the index procedure was done to follow up ranged from 12-24 months.

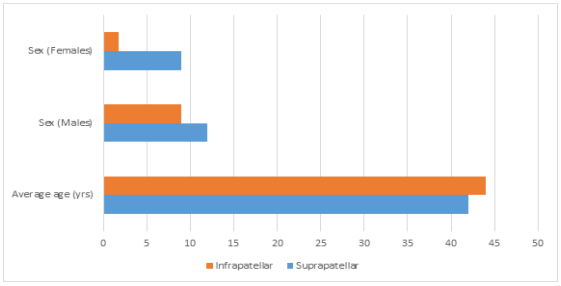

Figure 1: Demographic profile of patients.

The average age of the patient is in the 4th decade of life. Fracture is more common in males. Supra-patellar fracture is more common in both the sex [Figure 1].

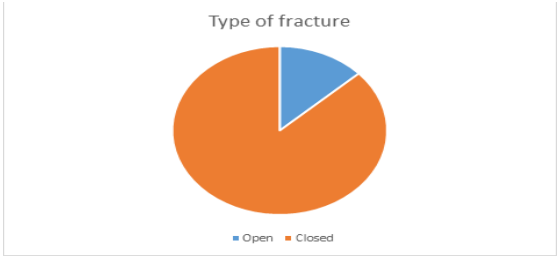

Figure 2: Type of fractures.

Closed type of both the fractures is more common as compared to open type of fracture [Figure 2].

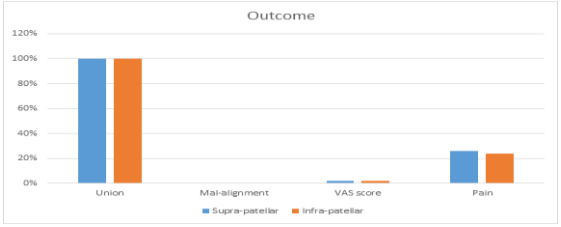

Figure 3: Comparison on the basis of outcome.

In most of the cases both in SP and IP proper union of the bones is the final outcome of the surgery. Pain is significantly more common in supra-patellar tibial insertion ($p<0.05$) [Figure 3]. Malalignment is not found in both the types. VAS score was 0.78 in suprapatellar and 1.87 in infrapatellar.

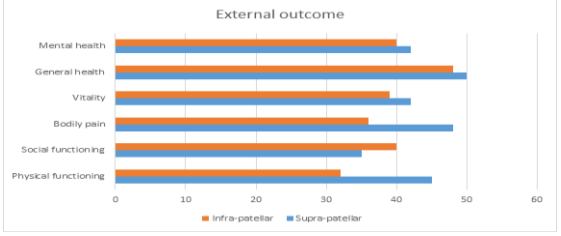

Figure 4: Comparison on the basis of external outcomes.

All the external outcomes are significantly better in SP type except social functioning [Figure 4]

Table 1: Comparison on the basis of outcome movement.

Movement	IP	SP
Affected extension	0.8	-0.2
Unaffected extension	0.8	0.2
Difference extension	0	0.4
Affected flexion	135	131
Unaffected flexion	132	129
Difference flexion	1	-1.8

Data analysis of external features and extension and flexion were almost equal for both suprapatellar and infrapatellar [Table 1].

DISCUSSION

Good outcomes and reproducible results can be achieved with intramedullary nail fixation of tibial shaft fractures. The reported union rates of intramedullary tibial nailing vary among different studies. With contemporary implants and appropriate surgical techniques, union rates above 90 % can be expected. Tibial shaft fractures that fail to heal following intramedullary nail fixation typically respond well to exchange reamed nailing procedures.[5,8]

Statically locked, reamed intramedullary nailing remains the standard treatment for displaced tibial shaft fractures. A correct starting point remains a crucial part of the surgical procedure. Suprapatellar nailing in the semi-extended position has been suggested as a safe and effective procedure and future studies are warranted to further evaluate the risks and benefits of this surgical procedure. The treating surgeon should be familiar with contemporary reduction techniques. Open reduction techniques should be considered if anatomic fracture alignment cannot be achieved by closed means. Favourable union rates above 90 % can be achieved by both reamed and unreamed intramedullary nailing. Despite favourable union rates, patients continue to have functional long-term limitations. In particular, anterior knee pain remains a common complaint following intramedullary tibial nailing. In addition, malrotation remains a commonly reported concern after tibial nailing. As of today, no significant correlation between malrotation and functional outcome has been established in the literature.[10,11]

Gelbke MK et al quantified patellofemoral contact pressures and forces during Infrapatellar (IP) and Suprapatellar (SP) intramedullary tibial nail insertion.[6] Fresh frozen hemi-cadavers with intact lower extremities and pelvis were used for their study. A standard IP entry portal was used on nine tibiae, whereas an SP entry portal was used in eight tibiae. A digital electronic pressure sensor system was used to dynamically measure peak pressures within the patellofemoral joint during each procedure. Data were continuously recorded from the start to completion of each procedure. Mean pressure and force as well as peak contact pressures recorded were then compared between the two techniques. The results were mean patellofemoral pressures and forces as well as peak contact pressures were higher in the SP group than the IP group. The mean peak contact pressure was 0.90 MPa (range, 0.48-1.26 MPa) during IP nailing. The mean peak contact pressure on the patella and femoral condyles was 1.84 MPa (range, 1.09-2.95 MPa) and 2.13 MPa (range, 1.10-2.86 MPa), respectively, during SP nailing. In this study, it was concluded that structural integrity of articular cartilage is compromised at impact loads exceeding 25 MPa and chondrocyte apoptosis can occur at sustained loads of as little as 4.5 MPa in immature bovine cartilage. The results of this study indicate that although the patellofemoral contact pressures are higher with SP nail insertion, they remain below the values reported to be detrimental to articular cartilage.

Daniel S. Chan et al conducted a prospective randomised pilot study to compare the clinical and functional outcomes of the knee joint after infrapatellar versus suprapatellar tibial nail insertion.[7] The results were that a total of 41 patients/fractures were enrolled in this study. Of those, only 25 patients/fractures (14 IP, 11 SP) fully complied with and completed 12 months of follow-up. Six of 11 SP presented with articular changes (chondromalacia) in the PF joint during the pre-insertion arthroscopy. Three patients displayed a change in the articular cartilage based on post-nail insertion arthroscopy. At 12 months, all fractures in both groups had proceeded to union. There were no differences between the affected and unaffected knee with respect to range of motion. Functional visual analogue score and Lysholm knee scores showed no significant differences between groups (P 0.05).

Freedman et al in their study, intramedullary nailing of the tibia was performed on 145 tibiae (137 patients) for fracture or non-union from 1985 to 1992.[9] There were 133 cases available for radiographic analysis of postoperative tibial alignment. Of the 133 nailings, 16 (12%) were mal-aligned (12 acute fractures and 4 non-union, mal-unions). Malalignment was defined as 5 degrees angulatory deformity in any plane. Malalignment was seen in 58% of proximal third fractures, 7% of middle third fractures and 8% of distal third fractures. Of the malaligned fractures, 83% were either segmental or comminuted. Thirteen percent of the reamed tibiae were malaligned as compared with 9% of the unreamed tibiae. There was no relationship between nail insertion site and degree of angulation.

CONCLUSION

From this study, it can be concluded that suprapatellar and infrapatellar approach are comparable regarding tibial fracture healing and alignment. VAS score was 0.78 in suprapatellar and 1.87 in infrapatellar. Data analysis of external features and extension and flexion were almost equal for both suprapatellar and infrapatellar. But pain is significantly more common in supra-patellar tibial insertion.

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