SUPRAPATELLAR VERSUS INFRAPATELLAR TIBIAL NAIL INSERTION- A PROSPECTIVE, RANDOMISED CONTROL PILOT STUDY

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ABSTRACT

BACKGROUND

The standard for treating tibial shaft fractures are by intramedullary nails currently. After the procedure, one of the most frequent complication is knee pain, after consolidation even more chronically. Chronic knee pain can affect more than 50% of the cases, which was said by most authors. Alternative routes of inserting the nail is used, which includes by means of lateral patellar paratendon, medial patellar paratendon or transtendon to avoid the symptom.

The aim of the study is to study the clinical and functional outcomes of suprapatellar versus infrapatellar tibial nail insertion.

MATERIALS AND METHODS

This is a prospective study, which was done from January 2014 to February 2015 and 50 patients who were skeletally mature were selected and randomised into IP and SP nail insertion groups. 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 the patient at that time.

Exclusion Criteria- Pregnant women, patients with intra-articular involvement, periprosthetic fractures, nonunions, ipsilateral injuries, previous knee injuries, history of gout, rheumatoid, osteoarthritis, spinal injury and incarceration. SP insertion was performed percutaneously with the help of a special cannula system.

RESULTS

A total of 50 patients were selected in this study. 31 SP and 19 IP. 10 SP and 2 IP did not show up for follow up examinations, so only 38 patients were present for 12 months. At last, there were 21 SP and 17 IP patients. The time from when the index procedure was done to follow up was 14.6 months, i.e. it ranged from 12-28 months. 12 were males and 9 were females with suprapatellar, 9 were males and 8 were females in infrapatellar. Average age of suprapatellar was 42 and that of infrapatellar was 44. Open fractures were 5 and closed fractures were 33. 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.

CONCLUSION

Based on the data obtained above, it can be concluded that suprapatellar and infrapatellar approach are equivalent regarding tibial fracture healing and alignment, knee pain and functional disability.

KEYWORDS

Suprapatellar, Infrapatellar, Tibial Nail Insertion.

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BACKGROUND

The standard for treating tibial shaft fractures are by intramedullary nails currently. After the procedure, one of the most frequent complication is knee pain, after consolidation even more chronically. Chronic knee pain can affect more than 50% of the cases, which was said by most authors.[1,2] Alternative routes of inserting the nail is used, which includes by means of lateral patellar paratendon, medial patellar paratendon or transtendon to avoid the symptom. However, these alternatives cause post-treatment pain and even removal of the nail often used does not improve the complication. Because of the intramedullary nail, lesions of tendon are often associated with knee pain after implantation.[3] So, suprapatellar and infrapatellar routes do not injure the tendon. They lead to lower levels of knee pain after implant placement. 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.[4,5] They have higher impact loads across patellofemoral joint. They are not as well studied as infrapatellar insertion. Advantages of infrapatellar

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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.

MATERIALS AND METHODS

This is a prospective study, which was done from January 2014 to February 2015 and 50 patients who were skeletally mature were selected and randomised into IP and SP nail insertion groups. 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

Pregnant women, patients with intra-articular involvement, periprosthetic fractures, nonunions, ipsilateral injuries, previous knee injuries, history of gout, rheumatoid, osteoarthritis, spinal injury and incarceration. SP insertion was performed percutaneously with the help of a special cannula system. Arthroscopy was undergone by SP patients to obtain a visual clearance of the PF 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. 10 SP and 2 IP did not show up for follow up examinations, so only 38 patients were present for 12 months. At last, there were 21 SP and 17 IP patients. The time from when the index procedure was done to follow up was 14.6 months, i.e. it ranged from 12-28 months.

Age and Sex Distribution	Suprapatellar	Infrapatellar
Males	12	9
Females	9	8
Average age	42	44
Type of fractures	Open	Closed
	5	33

Table 1. Shows Patient Demographics

	SP	IP
Union	100%	100%
Malalignment	0%	0%
VAS score	0.78	1.87
Pain	26	24

Table 2. Shows 12 Months Outcome Data Analysis

	SP	IP
Physical functioning	45	32
Bodily pain	48	36
General health	50	48
Vitality	42	39
Social functioning	35	40
Mental health	42	40

Table 3. Shows Data Analysis Outcome of other External Features

	IP	SP
Affected extension	0.7	-0.3
Unaffected extension	0.7	0.3
Difference extension	0	0.6
Affected flexion	135	130
Unaffected flexion	132	128
Difference flexion	1	-1.9

Table 4. Shows Data Analysis Outcome of Extension and Flexion

DISCUSSION

Many studies have been reported similar to this study. Gelbke MK et al[6] in their study, they quantified patellofemoral contact pressures and forces during Infrapatellar (IP) and Suprapatellar (SP) intramedullary tibial nail insertion. Fresh-frozen hemicadavers with intact lower extremities and pelvis were used for this 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 ofs 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[7] conducted a prospective randomised pilot study to compare the clinical and functional outcomes of the knee joint after infrapatellar versus suprapatellar tibial nail insertion. 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 preinsertion arthroscopy. Three patients displayed a change in the articular cartilage based on postnail 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). The SF-36v2 comparison also revealed no significant differences in the overall score, all 4 mental components and 3/4 physical components (P 0.05). The bodily pain component score was superior in the SP group (45 vs. 36, P = 0.035). All 11 SP patients obtained MRIs at 1 year. Five of these patients had evidence of chondromalacia on MRI. These findings did not correlate with either the prenail or postnail insertion arthroscopy. Importantly, no patient in the SP group with postnail insertion arthroscopic changes had PF joint pain at 1 year. It concluded that overall there seemed to be no significant differences in pain, disability, or knee range of motion between these 2 tibial intramedullary nail insertion techniques after 12 months of follow-up. Based on this pilot study data, larger prospective trial with long-term follow-up is warranted. Eastman J et al[8] performed a cadaveric and radiographic study utilising 16 limbs. We performed a retropatellar approach via longitudinal quadriceps split, passed a specialised trocar through the patellofemoral joint and onto the superior aspect of the tibia and inserted Kirschner wires into the anatomic safe zone of the tibial plateau at 0, 10, 20, 30, 40 and 50 degrees of knee flexion utilising biplanar fluoroscopy. We recorded knee flexion with a goniometer and the entrance vector of the Kirschner wire in relation to the anterior tibial cortex. The results were that there was a progressive increase in the ability to obtain the correct anatomical start site from 1 of 16 (6.25%) at full extension to 12 of 16 (75%) at 50 degrees of knee flexion (P = 0.00098). A statistically significant decrease in the average sagittal plane entrance vector in relation to the anterior tibial cortex was found from 23.1 degrees at full extension to -0.41 degrees at 50 degrees of knee flexion (P <0.0001). It concluded that the retropatellar technique allows the radiographically defined correct start site to be localised particularly at higher degrees of knee flexion. More favourable intramedullary nail insertion angles were possible with the retropatellar technique particularly with knee flexion angles greater than 20 degrees. The retropatellar technique demands further investigations to further delineate its advantages, limitations and possible risks to local anatomy. Freedman et al[9] in their study, intramedullary nailing of the tibia was performed on 145 tibiae (137 patients) for fracture or nonunion from 1985 to 1992. There were 133 cases available for radiographic analysis of postoperative tibial alignment. Of the 133 nailings, 16 (12%) were malaligned (12 acute fractures and 4 nonunion-malunions). 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. The medial entrance angle averaged 9.5 degrees and contributed to a valgus deformity in 4 proximal third tibial fractures. The average anterior bow deformity of 5 proximal third fractures was 7 degrees (range, 5 degrees-12 degrees). Careful attention to operative technique and entrance angle particularly with proximal third or comminuted fractures is recommended to prevent angular deformity and malunion after tibial nailing. Proximal third tibial fractures may require a neutral or slightly lateral entrance angle to ensure a more anatomic reduction and centromedullary nail orientation to offset the tendency for valgus angulation. Tornetta P et al[10] conducted a study to identify the risks to intra-articular structures of the knee during tibial portal creation and to identify the safe zone for tibial nail placement in university trauma center, which was a cadaveric anatomic. Forty fresh frozen cadaveric knees were studied to elaborate the risks of tibial portal creation and nail placement to the intraarticular structures of the knee. Nails were placed through medial and lateral parapatellar approaches, and the distance from the nail portal to the intra-articular structures of the knee was measured. A safe zone for portal placement was determined. The results were that the tibial portal location averaged 4.4 ± 3 millimetres lateral to the midline of the plateau. Actual intra-articular structural damage occurred in 20 percent of the specimens; however, an additional 30 percent demonstrated the nail to be subjacent to one of the menisci. A lateral paratendinous approach placed the lateral articular surface at most risk and a medial paratendinous approach placed the medial meniscus at most risk. The safe zone for nail placement was identified and is located 9.1 ± 5 millimetres lateral to the midline of the plateau and three millimetres lateral to the center of the tibial tubercle. The width of the safe zone averaged 22.9 millimetres and was as narrow as 12.6 millimetres. It concluded that damage to the intraarticular structures of the knee is possible during tibial nailing with a superior portal. The safe zone for nail placement is small and can be exceeded if a reamed nail is used. The safest starting point for tibial nailing should be slightly lateral to the center of the tibial tubercle.

CONCLUSION

Based on the data obtained above, it can be concluded that suprapatellar and infrapatellar approach are equivalent regarding tibial fracture healing and alignment, knee pain and functional disability.

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