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Proximal tibia stress fractures with Grade 4 Osteoarthritis of Knee-Experience with long stem TKR

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Abstract
Introduction: Osteoarthritis of the Knee with Tibial stress fracture is not so common entity. It poses additional challenges for doing Total Knee Arthroplasty. We studied the radiological and functional outcome of Single-stage total knee arthroplasty with long stem components for patients with grade 4 of knee osteoarthritis and proximal tibia stress fractures.
Materials and Methods: We analysed 15 patients with proximal tibia stress fractures associated with Grade 4 knee osteoarthritis. The mean age was 66 years (range, 52–80) and included seven men and eight women. Diagnosis of stress fractures was seen on x rays and clinical examination. Standing X Ray views were obtained for all patients preoperatively and postoperatively. All patients were treated with TKA with long stem (PCL sacrificing). Union of the fracture site studied using plain anteroposterior (AP) and lateral leg x-rays at regular intervals.
Results: The mean follow-up period was 17.2 weeks (range of 12–24) months. All patients experienced significant reduction in pain and improvement in functional status. The range of motion of the knee improved significantly. Flexion of knee improved from mean of 88 degrees (60-110) to 122 degrees (100-140). The fixed flexion deformity also decreased from mean of 10 degrees (5-15) to mean of 1 degree (0-5) The Knee Society score and Knee Society functional score had excellent improvements of approximately 825 and 83% respectively. All proximal tibia stress fractures were united till with an average time of 10 weeks (8-12 weeks).
Conclusion: Single- stage Long stem TKR is a good and reliable surgical option for proximal tibial stress fractures with grade 4 OA.

Keywords: Arthritis, primary arthroplasty, knee, fractures, stress, osteoarthritis, proximal, tibia

Introduction
A partial or complete fracture due to repetitive, subthreshold manner of stress which the bone is not able to withstand and is not associated with violent trauma is defined as a stress fracture [1, 2] This stress causes accelerated bone remodelling with microfractures. The bone does not get adequate time to heal causing bone stress injury, eventually leading to stress fracture [3, 4]. These can be divided into fatigue fractures and insufficiency fractures. Fatigue fractures happen in normal bone under abnormally high stress on bone. It's commonly seen in young athletes and military recruits [1].
Insufficiency fractures are seen in normal stress in abnormal or poor bone conditions like osteoporosis, osteoarthritis, Paget's disease, infection and metabolic diseases like hyperparathyroidism [5] Pathological fractures term should be restricted to bone affected by tumours [2].
Repetitive stress concentration on the metaphyseal region of proximal tibia due to coronal plane deformities in knee osteoarthritis causes stress fractures. underlying osteoporosis adds to the insult. Malalignment secondary to osteoarthritis increases the stress at the fracture site, which predisposes to delayed or non-union [5, 6].
Stress fractures are treated with pneumatic brace, cast immobilization, internal fixation and rest [7]. Pre Existing osteoarthritis limits treatment options and poses a challenge for comprehensive treatment. Total knee arthroplasty with a long tibial stem, reestablishes alignment, overcomes arthritic surfaces and also spans the fracture site providing stability and

finally union of the proximal stress fracture. We aim to study the radiological and functional changes in such patients after long stem TKR.

Materials and Methods

15 cases of Proximal tibia fracture with Grade 4 OA were included in our study. All patients had unilateral OA with stress fracture. Male to female ratio was 7:8. The patients underwent evaluation with the help of Knee society score and Knee society functional score, both preoperatively and postoperatively. The metadiaphyseal angle was calculated for full length scanogram in standing position. Patients who had severe pain on standing were given support with railings to stand. When such X Rays were not possible, pelvic radiographs were taken to determine the distal femoral angulation cut. X Rays were used to confirm the presence of tibial stress fractures. X Ray findings seen were horizontal or linear pattern of sclerosis, definite fracture lines, endosteal callus formation and periosteal bone formation.

All patients underwent Posterior stabilised Total Knee replacement (PFC, Depuy), with long intramedullary tibial stem. Two patients who had severe medial tibial defect. In these cases screw augmentation was done.

Preoperative Serum Calcium, Phosphorus, Vitamin D, Alkaline phosphatase and Parathrome levels were checked and recorded. Vitamin D deficient patients were treated with Vitamin D sachets 60,000/week for 3 months along with calcium supplements.

After all standard anesthesia fitness, all patients were given spinal plus epidural anesthesia. Tourniquet was applied in all cases. Standard midline approach with medial parapatellar arthrotomy was done. After taking tibial cut with extramedullary jig, the tibia was sequentially reamed taking care of not breaching the cortex. The cement was used carefully on tibia side to prevent its spread into the fracture site. Fracture site was crossed by long tibia intramedullary stem. This stem corrected the varus angulation at the fracture site and also provide good stability. No internal fixation was required except in one case. The patient was a female with high proximal tibial stress fracture. We felt additional support may be required in this case, hence we applied a long spanning lateral tibial plate.

Partial weight bearing was mobilised with partial weight bearing using a walker. Later full weight bearing was initiated. Sutures were removed after 2 weeks. 2 patients had superficial wound infection which was washed in OT can closed. DVT prophylaxis was started to all patients. Long x rays were taken to assess correction of varus angulation and union of stress fracture site. Patient was regularly followed up every month till 3 months. Later were seen every 3 months.

Results were studied with Knee society score, Knee society functional scores and radiological union of stress fracture.

Statistics- SPSS version 26 was used for the study. paired T test was applied for the improvement in Knee scores. A two-tail p-value of less than 5% was taken as significant.

Results

The mean follow-up period was 17.2 weeks (range of 12–24) months. All patients experienced significant reduction in pain and improvement in functional status. The range of motion of the knee improved significantly. Flexion of knee improved from mean of 88 degrees (60-110) to 122 degrees (100-140). The fixed flexion deformity also decreased from mean of 10 degrees (5-15) to mean of 1 degree (0-5) The Knee Society score improved from preoperative mean score of 14.9 (range 6-26) to 83.7 (range 72 to 102). Paired T test showed The value of t is 54.038503. The value of p is <.00001. The result is significant at $p< .05$. The Knee society score also showed better scores postoperatively of mean of 88.1 (range 72-108) from preoperatively score of 15.1 (range 5-28). Paired T test showed statistically significant results. The value of t is 35.041137. The value of p is <.00001. The result is significant at $p<. 05$. Other complications like wound necrosis, patellar instability or aseptic loosening were not encountered.

All biochemical findings were normal except vitamin D levels were of deficiency levels (< 12 ng/ml) [8] in 12 patients.

The above table shows the improvements in range of motion.

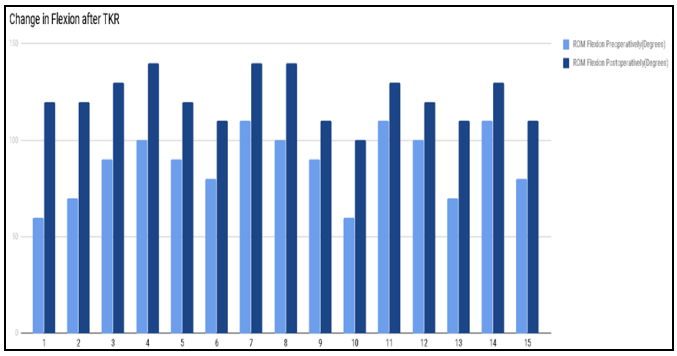

Chart 1: Change in Flexion range of motion after TKR

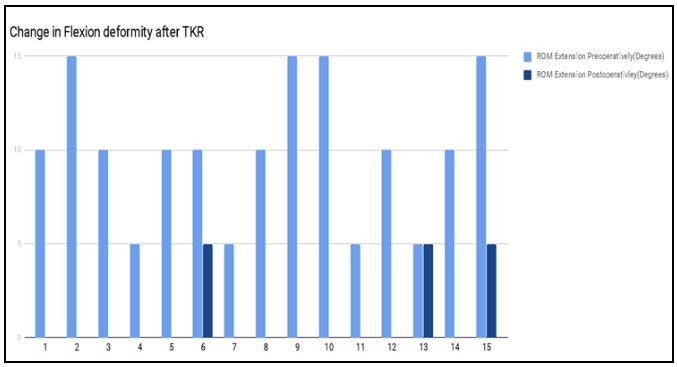

Chart 2: Only 3 cases had minimal flexion deformity after surgery.

Discussion

In elder patients, the genu valgum or varum shift the mechanical axis, causing undue stress and loading on a lateral and medial side of tibia respectively. On walking, this causes repetitive stress which compounded with sagittal plane deformities and underlying osteoporosis causes a stress fracture in the proximal tibia [9]. Hence, the criteria for stress fracture in OA knee are sudden insidious onset pain on the medial shin region along with joint line tenderness and crepitus in knee joint. Later, X Rays can be used to diagnose is conclusively. Stress fractures can be present in cases without osteoporosis too [5, 9].

Biochemical tests were done to rule out any metabolic diseases. All our patients had metabolic parameters within their normal levels, except Vitamin D levels. 12 patients had deficient serum Vitamin D levels (less than 12 ng/mL). Hypovitaminosis D and osteoporosis along with female sex increases chances of proximal tibia stress fractures with OA knee [5, 9].

The main goal of the surgical treatment needs to be correction of alignment both in coronal and sagittal plane at knee level, replacement of arthritic knee surfaces and stable fixation of the stress fractures causing union. These goals can be achieved by either different methods. Osteotomy at proximal

tibia to align angulation deformities, can treat fracture and limb alignment. Later in the second surgery, total knee replacement can be done. This 2 stage technique has shown good results [10].

But, the gap between 2 surgeries is cumbersome, due to prolonged immobilization and which leads to more knee stiffness. One stage TKR with internal fixation, reduces the risk owing to one single surgery and anesthetic risk. Moskal *et al*. had proposed that a single long intramedullary stem may not provide enough stability at the fracture site and may need additional fixation [11]. We too felt that very high proximal tibia fractures, where the metaphysis is wide enough to prevent getting good hold of intramedullary stem, an internal fixation is warranted.

But, studies by Jabalameli *et al*. [12], D Soundarrajan *et al*. [5] and Mittal *et al*. [13] have amply proved that long intramedullary can be used to align the fracture causing union in all cases of proximal tibia stress fractures, without any need of additional internal fixation. Sawant *et al*. studied 4 cases of valgus knee with OA and proximal tibia fractures, with similar treatment protocol. They achieved fracture union in all cases [14].

There are few possible complications of single stage TKR with long stem. During insertion of the intramedullary stem, there can be a periprosthetic fracture, if angulation component is not corrected beforehand. Also, the time required for surgery may increase compared to a standard TKR. But no intraoperative periprosthetic fractures were seen in our study [12] Good preoperative planning to achieve good limb alignment before inserting tibial stem avoids such untoward complications [13].

Thus we conclude that Long stem TKR as a single surgery can be a safe and effective procedure for complex primary cases like Grade 4 Osteoarthritis of the knee with proximal tibia stress fractures. This surgery corrects the alignment of the knee and at the fracture site, causing union of fracture site along with early mobilization.

We had few limitations for our study. The sample size was small. Also the mean follow-up time was only 10 weeks, which may be less to see any other complications which may arise due to Total knee replacement.

CASE ONE- A 65 year old male patient a case of left sided knee knee pain since 4 months

Radiologically- Grade 4 osteoarthritis with proximal tibia and fibula stress fracture.

Fig 1: Preoperative X rays and Postoperative x rays- Case 1

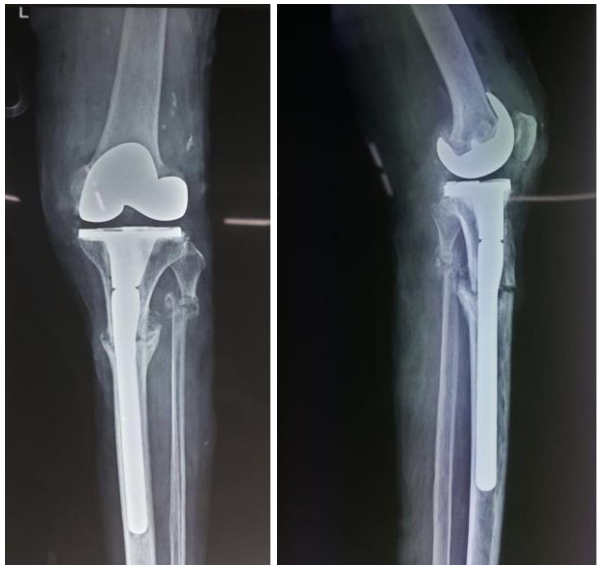

Fig 2: Postoperative X rays and Postoperative x rays- Case 1

CASE TWO- A 63 year old female patient a case of right knee pain since 2 months Radiologically- Right Sided osteoarthritis of the knee with proximal tibia stress fractures.

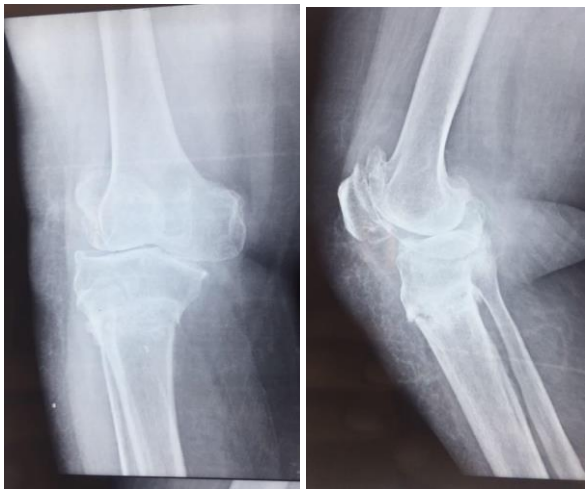

Fig 3: Preoperative X rays and Postoperative x rays- Case 2

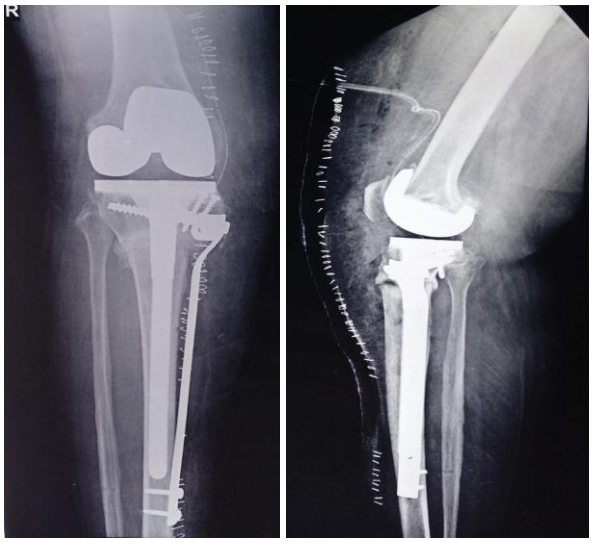

Fig 4: Postoperative X rays and Postoperative x rays- Case 2

Table 1: Master chart- Showing Age, Range of motion, Knee Society scores and Knee society functional scores.

Sr No	Age	Followup (Months)	ROM Flexion Preoperatively (Degrees)	ROM Flexion deformity Preoperatively (Degrees)	ROM Flexion Postoperatively (Degrees)	ROM Flexion deformity Postoperatively (Degrees)	Knee society score Preoperatively	Knee Society score postoperatively	Knee Society functional score Preoperatively	Knee Society functional score Postoperatively	Mean age union of stress fractures
1	75	20	60	10	120	0	12	84	12	74	8
2	80	18	70	15	120	0	9	72	10	80	10
3	65	12	90	10	130	0	17	76	25	82	8
4	78	16	100	5	140	0	22	102	17	97	10
5	58	20	90	10	120	0	14	82	28	93	12
6	63	18	80	10	110	5	8	74	5	72	12
7	75	12	110	5	140	0	26	91	22	108	8
8	56	24	100	10	140	0	22	92	13	87	10
9	70	18	90	15	110	0	6	77	14	88	12
10	67	20	60	15	100	0	9	76	6	84	12
11	72	20	110	5	130	0	21	95	8	87	10
12	62	18	100	10	120	0	13	83	15	83	8
13	59	12	70	5	110	5	10	76	12	91	12
14	52	18	110	10	130	0	22	92	26	104	8
15	60	12	80	15	110	5	13	84	14	92	10

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