"A PROSPECTIVE STUDY OF FUNCTIONAL OUTCOME OF MEDIAL OPENING WEDGE HIGH TIBIAL OSTEOTOMY WITH TIBIAL PLATE FIXATION IN MEDIAL COMPARTMENT OSTEOARTHRITIS OF KNEE"

By

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LIST OF CONTENTS

LIST OF ABBREVIATIONS

MOWHTO	Medial opening wedge high tibial osteotomy
CWHTO:	Closing wedge high tibial osteotomy
UKA	Unicondylar arthroplasty
AP	Anteroposterionr
Lat	Lateral
OA	Osteoarthritis
HTN	Hypertension
DM	Diabetes Mellitus
M	Male
F	Female
ICD	Inter condylar distance
MAD	Mechanical axis distance
MPTA	Medial Proximal Tibial angle
ROM	Range of motion

INTRODUCTION

Osteoarthritis is a progressive arthropathy with heterogeneous clinical presentation that can occur in any joints.[1] It involves all the tissues concurrently –cartilage, synovium and bone.It commonly affects knees,hips,spine ,hands and feet.[2] Osteoarthritis occurs due to excessive mechanical stress applied to susceptible joints predisposed on chondrocyte dysfunction that may be genetic or environmental.[1]

Prevalence of osteoarthritis was found to be 28.7% in India. Prevalence is high in female population compared to male and that of unicompartemental medial osteoarthritis is 4.5%[3].The medial and lateral compartment of the tibia-femoral knee joint do not bear weight equally. In neutrally aligned knees, the medial compartment bears 60-70% of the force across the knee in weight bearing activities. Therefore medial compartment is more commonly involved.[4]

Osteoarthritis leads to genu varus deformity of the knee. Genu varus leads to malalignment causing overload and successive medial unicompartmental osteoarthritis of knee. According to the severity osteoarthritis of the knee is divided into five stages. During early stages of osteoarthritis, non-surgical treatment options include weight management, low impact activity and physiotherapy. As the disease progress to end stage osteoarthritis, the surgical treatments available are high tibial osteotomy, medial compartmental arthroplasty and total knee arthroplasty.[4]

High tibial osteotomy can be performed by broadly two methods- open wedge osteotomy and closed wedge osteotomy. These are further divided into medial and lateral open and closed wedge osteotomy. Medial opening wedge high tibial osteotomy is indicated in patients with genu varus

malalignment with less than 12 degree angular deformity and isolated medial compartment osteoarthritis of the knee in young patients (less than 60 years).

Arthroplasty is considered a good option for healthier patient, older than 60 years with good long terms outcome.[4]

High tibial osteotomy is an accepted surgical technique for treatment of medial compartment osteoarthritis of knee in younger patients. Selection of the appropriate patients, extensive pre-operative planning and accurate surgical technique are essential for successful outcome. Medial opening wedge osteotomy with tibial plate fixation stands ahead of closed wedge osteotomy because more precise correction is achieved. The peroneal nerve is not in jeopardy and also there is no disruption of proximal tibiofibular joint and lateral collateral ligaments. The biomechanical principle of high tibial osteotomy is to redistribute the weight bearing forces from the worn medial compartment across to the lateral compartment thereby relieves pain and slows the disease progression.[4]

Most studies have used Circular External fixator for correction of varus deformity, which are complex, may overlengthen the limb, may alter the patellar height and cause patient discomfort. However the medial opening wedge high tibial osteotomy with tibial plate fixation tends to be better accepted by the patient and is found to be safe and simple corrective procedure for varus deformity of proximal tibia.

We have hereby conducted the study to evaluate the functional outcome of medial opening wedge high tibial osteotomy with tibial plate fixation in medial compartment osteoarthritis of knee based on clinical and radiological findings.

OBJECTIVES

To study the functional outcome of medial opening wedge high tibial osteotomy with plate fixation in medial compartment osteoarthritis of knee.

REVIEW OF LITERATURE

INTRODUCTION TO PROXIMAL TIBIAL OSTEOTOMY:

Jackson et al introduced high tibial osteotomy **in 1961**, which is a well accepted procedure for the management of unicompartmental osteoarthritis of the knee.[5] [6]Varus or valgus deformity are quite prevalent and result in an improper weight-bearing stress distribution inside the joint.The most common deformity in patients with osteoarthritis of the knee is a varus position, which causes stresses to be concentrated medially, accelerating degenerative changes in the medial part of the joint; if the deformity is one of valgus position, changes are accelerated in the lateral part.[7] The biomechanical rationale for proximal tibial osteotomy in patients with unicompartmental osteoarthritis of the knee is "unloading" of the involved joint compartment by correcting the malalignment and redistributing the stresses on the knee joint[5]. Many techniques have been described for valgus proximal tibial osteotomy. Four basic types are most commonly used: medial opening wedge, lateral closing wedge, dome, and medial opening hemicallotasis.[8]

The technique with the longest "track record" is lateral closing wedge osteotomy first described by **Coventry.** (6)

A medial opening wedge tibial osteotomy was described by **Hernigou et al**.in 1987, who thought it was more accurate and allowed for more precise correction than a lateral closing wedge osteotomy. A wedge is formed with the aid of an osteotomy jig and secured with the help of a rigid plate.[7] The tricortical iliac crest bone grafts is used to fill the wedge. The goal of a medial opening wedge high tibial osteotomy is to realign the lower limb's mechanical axis.(6,7,9) They performed an opening wedge high tibial osteotomy on 93 knees and reported 45% good to excellent results at a mean 11.5-year-old follow up.(7)

Turi et al in 1987 described Opening wedge hemicallotasis, using an external fixator to distract the osteotomy site gradually. (10)

Maquet described a "barrel vault," or dome, osteotomy, which he believed allowed more accuracy and adjustability of correction. Because this osteotomy is inherently stable, internal fixation usually is not required, but pins, plate-and-screw devices, or external fixation can be used if necessary. (11)

In the 1980s and 90s, due to the obvious success of knee arthroplasty, osteotomy around the knee lost importance. However, during the last 10 years the development of new plates which maintain angular stability, has resulted in a rise of osteotomy around the knee, in younger patients.(7,12) With newer plates, the open wedge osteotomy became the favoured technique, being easier to perform, and is nowadays used frequently with the advantage that it is more precise, quicker, has no risk of peroneal nerve injury and preserves the proximal tibia better when considering a future total knee arthroplasty.(13)

- **M.Asik et al (2006)** studied medial opening wedge high tibial osteotomy with Puddu plate for the treatment of medial compartment osteoarthritis with genu varus in the year 2006. (12)The knees of 65 patients with varus gonarthrosis who had high tibial osteotomies were examined in this study. A total of 13 male and 47 female patients with an average age of 54 (range 39–76) years were included in the study. The Hospital of Special Surgery (HSS) score, the American Knee Society score, and the Oxford knee score, as well as the mechanical axis deviation, the lateral distal femoral angle, the medial proximal tibial angle, the femorotibial angle, and the Insall-Salvati index, were all used for clinical evaluation of the patients. Patients were followed up for an average of 34 months. In the last assessments of their cases, mean improvements detected in HSS scores, Oxford knee scores, knee and

functional scores of Knee Society were26.72, 19.18, 49.9, and 30 points, respectively. According to the data, postoperative discomfort subsided promptly, and patients' knee functions improved significantly. As a result, they concluded that in situations of varus osteoarthritis of knee, high tibial osteotomy with a Puddu plate is an effective option to complete knee arthroplasty.(12)

-Devgan A, Marya KM (2003) showed that medial opening wedge high tibial osteotomy is a good option for individuals with medial compartment osteoarthritis who are concerned about cost and squatting habits. They reviewed retrospectively at 50 knees from patients who had a medial open wedge osteotomy for primary medial unicompartmental osteoarthrosis. The final outcomes after two years were good in 36 instances (72%), acceptable in 12 cases (24%), and bad in two cases. They found that in the early phases of medial compartment primary osteoarthrosis of the knee, medial opening wedge proximal tibial osteotomy is a physiologically better procedure.(13)

-Birmingham TB, Giffin JR (2009) found that a medial opening wedge high tibial osteotomy with correction to approximately neutral alignment resulted in significant and clinically important changes in dynamic knee joint load and patient-reported pain, function, and quality of life 2 years after surgery. (1)(14) They looked at 126 instances in an observational cohort analysis with an average follow-up of two years. A non-locking puddu plate was applied as a fixing method. Malalignment, medial compartment stress during walking, and all KOOS domain scores improved clinically significantly.(14)

-Koshino T et al (2003) showed patients experienced pain alleviation and improved walking capacity following medial opening wedge high tibial osteotomy.(15,16) Twenty-one osteoarthritic knees were treated with a medial opening-wedge high tibial osteotomy in eighteen patients with an average age of 66.6 years. (16)The average follow-up period was 78.6 months. They found that for

individuals with medial compartment osteoarthritis of the knee, medial opening-wedge osteotomy of the proximal portion of the tibia gave excellent clinical outcomes.(16)

- **Patrick J. DeMeo et al (2010)** studied the Midterm Follow-up of Opening-Wedge High Tibial Osteotomy. Twenty consecutive patients with varus gonarthrosis were treated with a medial opening wedge high tibial osteotomy using the Puddu plate and allograft bone graft for a prospective study (14 men and 6 women; average age, 49.4 years [range, 36-67 years]). Gait analysis revealed an abnormal weightbearing pattern preoperatively with the vertical ground-reaction force. The postoperative vertical ground-reaction force revealed a normal double peak pattern. The preoperative adduction moment was 29% greater than the 6-month postoperative adduction moment. The preoperative varus averaged 3.6deg and was corrected to an average of 7.5deg of valgus postoperatively.(17) All patients subjectively rated their preoperative knee as poor. At 2 years postoperatively, most patients rated their knee as good, with 5 excellent and only 1 fair rating. The average preoperative Lysholm and HSS knee scores were 54.2 and 75.9, respectively, compared with the 2-year postoperative averages of 89.1 and 92.7, respectively. At 8 years postoperatively, there was 70% survivorship with 42% of patients rating their knees as good or excellent. Five patients (25%) had undergone total knee arthroplasty. Lysholm and HSS knee scores were 83.0 and 86.8, respectively, for the surviving knees at 8 years postoperatively.According to authors Medial opening-wedge high tibial osteotomy produces good results in the midterm. After the osteotomy, a more normal appearing weight bearing pattern with double peaks was seen. The adduction moment significantly decreased, resulting in less contact pressure through the medial degenerative compartment of the knee. The authors recommend medial opening wedge high tibial osteotomy for young patients with varus alignment and medial compartment arthritis to allow this patient population

to remain highly active and delay progression to total knee arthroplasty without activity restrictions.(18)

-**Robert F. LaPrade et al. (2011)** prospectively studied the outcomes of Young and mid aged adults with Medial Compartment Osteoarthritis managed with Proximal Tibial Opening Wedge Osteotomy.(19) In the year 2011, aged less than 55 years. Their patient sample consisted of 47 individuals with an average age of 40.5 years and a minimum of 2 years of follow-up. After 3.6 years of follow-up, the Modified Cincinnati Knee Scores increased dramatically from 42.9 preoperatively to 65.1 post operatively radiographic analysis of a separate cohort showed the medial tibial eminence to be located at the 41% point along the tibial plateau from medial (0%) to lateral (100%). The mean mechanical axis crossed through the tibial plateau at 23% of the distance down the proximal tibia preoperatively vs 54 percent postoperatively, indicating a considerable improvement in malalignment. The Insall-Salvati index fell from 1.03 to 0.95 (P.05), whereas the posterior tibial slope increased from 9.4 to 11.7 degrees (P .05). Three (six percent) of the osteotomies were considered failures. In this study they observed significant improvement in subjective and objective outcome scores and correction of varus malalignment at a mean of 3.6 years postoperatively.(20)(19)

- **Chaturong Pornrattanamaneewong et al. (2012)** conducted a retrospective comparative study medial opening wedge osteotomy with and without bone graft in the year 2012. The outcomes of a retrospective review of 50 patients who had MOWHTO (a total of 60 knees) were divided into two groups: group A, which included 26 patients (30 knees), was treated with T-buttress plate fixation with autologous iliac bone graft augmentation, and group B, which included 24 patients (30 knees), was treated with a medial high tibial locking compression plate without any augmentation.

The two groups were compared in terms of demographic features and radiographic results, such as union rate, time to union, medial osteotomy defects, and complications. All the patients were followed up for atleast two years. They concluded all osteotomies united within 12 weeks after surgery. Group B had slightly longer time i.e. 10.3 weeks to union than Group A i.e. 9.5 weeks. A significantly higher incidence of medial defects after osteotomy was reported in the locking compression plate group (P = 0.001). A total of 5 (8.3%) knees had complications. It was observed that locking compression plate fixation without the use of bone grafts or bone substitutes results in a good union rate and a low complication rate.(21)

- **Giuseffi, M.D. et al. (2015) reviewed** 100 consecutive cases of Opening wedge high tibial osteotomy. Eighty-nine osteotomies (89%) in 83 patients were included in the study. Most procedures were performed for medial knee arthritis. (22)The mean age at surgery was 48.1 years, and the mean follow-up period was 4.0 years. The mean tibiofemoral alignment was 3.2 degrees of varus preoperatively and 6.4 degrees of valgus postoperatively. Plate and screw fixation was used in all cases. Bone grafting methods included autograft, allograft, iliac crest aspirate, platelet-rich plasma, and demineralized bone matrix. Of the osteotomies, 83 (93%) healed uneventfully. Five nonunions and 1 delayed union occurred. Allograft combined with demineralized bone matrix and/or platelet-rich plasma was associated with nonunion (P ¼ .02). Lateral cortical fracture was associated with repeat surgery for nonunion or alignment loss. Pain was minimal or mild in 65% of patients, moderate in 16%, and severe in 19%. Osteotomy fixation with a small 4-screw plate was associated with increased postoperative pain. Concluded that uncomplicated osteotomy union occurred in 93% of medial opening-wedge high tibial osteotomies. Allograft mixed with demineralized bone matrix and/or platelet rich plasma was associated with nonunion. At intermediate follow-up, 65% of patients had minimal or mild pain.(22)

- **Jorge Chahla MD et al. (2016)** studied about the procedure medial opening wedge high tibial osteotomy and medial plate fixation in the year 2016. Genu varus result in medial compartment overload and ipsilateral compartment osteoarthritis. A medial opening wedge high tibial osteotomy can be used to slow this down.(7,19) Patients with genu varus malalignment and isolated medial compartment osteoarthritis of the knee are indications for this procedure. Sagital and coronal plane deformity correction is an advantage of this surgery. The purpose of this article was to describe the technique used to perform a medial opening wedge proximal tibial osteotomy.(19)

Kyung Wook Nha1 et, al. (2019) Uniplane HTO with a rigid locking plate adding a metal wedge was compared with biplane HTO with a rigid locking plate including a proximal D-hole of 103 knees, including 59 uniplane HTO and 44 biplane HTO, were enrolled.(23) The Oxford scores were 38.1 ± 7.8 in the uniplane group and 35.9 ± 8.3 in the biplane group (ns).[6] On CT scans, more lateral-hinge fractures developed in the biplane group, and seven knees (12%) of the uniplane group and 12 knees (27%) of the biplane group had Takeuchi typeI stable hinge fracture.The authors conclude Uniplane HTO potentially represents a better option than biplane HTO for the prevention of lateral-hinge fracture.(23)

SURGICAL ANATOMY

KNEE JOINT

The knee joint is a modified hinge joint which consists of three bony structures—femur, tibia, and patella—that form three distinct and partially separated compartments: medial, lateral, and patellofemoral compartments.(4)

Femur

The architecture of the distal end of the femur is complex. The femoral condyles are asymmetrical; the larger medial condyle has a more symmetrical curvature. The femoral condyles viewed from the surface, articulating with the tibia, show that the lateral condyle is slightly shorter than the medial. The long axis of the lateral condyle is slightly longer and is placed in a more sagittal plane than the long axis of the medial condyle, which is oriented at a mean angle of about 22 degrees and opened posteriorly.(24) The lateral condyle is slightly wider than the medial condyle at the center of the intercondylar notch. Anteriorly, the condyles are separated by a groove known as the femoral trochlea.

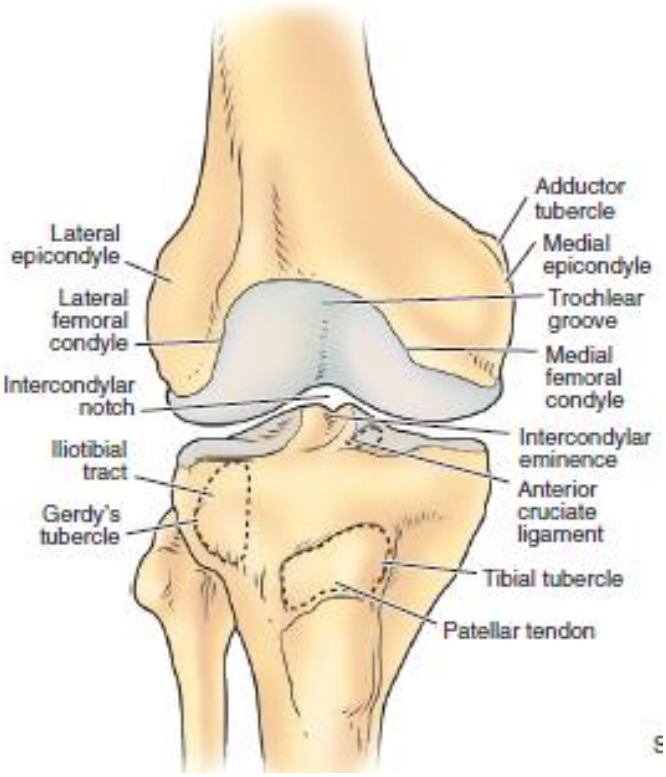


Figure 1 Knee Joint

Tibia

The larger medial tibial plateau is nearly flat and has a squared-off posterior aspect that is distinct on a lateral radiograph. In distinction, the articular surface of the narrower lateral plateau borders on convexity. The menisci enlarge the contact area considerably and increase the conformity of the joint surfaces. The median portion of the tibia between the plateaus is occupied by an eminence: the spine of the tibia. Anteriorly a depression is seen—the anterior intercondylar fossa—to which, from anterior to posterior, the anterior horn of the medial meniscus, the ACL, and the anterior horn of the

lateral meniscus are attached, posterior horn of lateral meniscus, posterior horn of medial meniscus and posterior cruciate ligament.(24)

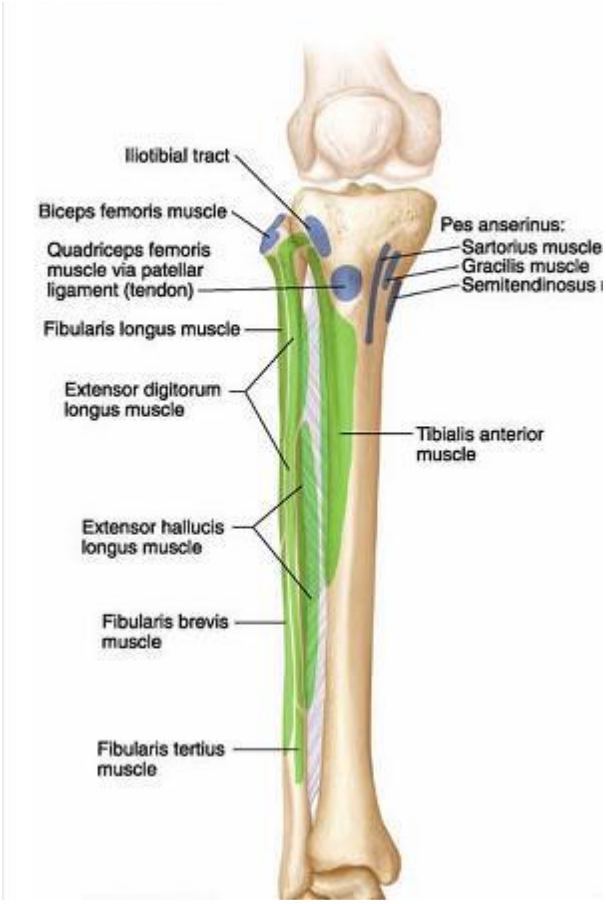


Figure 2 Tibia and its attachments

Articular cartilage

Articular cartilage is a specialized connective tissue composed of hydrated proteoglycans within a matrix of collagen fibrils. Proteoglycans are complex glycoproteins consisting of a central protein core to which glycosaminoglycan chains are attached. The structure of hyaline cartilage is not uniform, but rather can be divided into distinct zones based on the arrangement of the collagen fibrils and the distribution of chondrocytes. The density of chondrocytes is highest close to subchondral bone and decreases toward the articular surface. Cartilage is avascular, and chondrocytes in the superficial zones are believed to derive nutrition from synovial fluid. Deeper zones probably obtain nutrition from subchondral bone.(9,25)

Ligaments

The knee joint is supported by the following ligaments.

1. Fibrous capsule
2. Ligamentum patellae
3. Tibial collateral ligament
4. Fibular collateral ligament
5. Oblique popliteal ligament
6. Arcuate popliteal ligament
7. Anterior cruciate ligament
8. Posterior cruciate ligament
9. Medial meniscus
10. Lateral meniscus
11. Transverse ligament

Fibrous (Articular) Capsule

The fibrous capsule is very thin, and is deficient anteriorly, where it is replaced by the quadriceps femoris, the patella and the ligamentum patellae.

Femoral attachment. It is attached about half to one centimeter beyond the articular margins. The attachment has three special features: (a] anteriorly, it is deficient; (b) posteriorly, it is attached to the intercondylar line; and (c) laterally, it encloses the origin of the popliteus.

Tibial attachment. It is attached about half to one centimeter beyond the articular margins. The attachment has three special features: (a) Anteriorly, it descends along the margins of the condyles to the tibial tuberosity, where it is deficient; (b) posteriorly, it is attached to the intercondylar ridge which limits the attachment of the posterior cruciate ligament; and (c) posterolaterally, there is a gap behind the lateral condyle for passage of the tendon of the popliteus.

Menisci

The menisci are two crescentic fibrocartilage structures that serve to deepen the articular surfaces of the tibia for reception of the femoral condyles. The most abundant components of the menisci include collagen (75%) (type I) and noncollagenized proteins (8% to 13%). The collagen bundles are arranged in a circumferential pattern that is optimal for absorption of compressive loads (Fig. 1-24). Radial fibers found at the surface and in the midsubstance parallel to the plateau may act to increase structural rigidity and help prevent longitudinal splitting. The menisci perform several important functions, including (1) load transmission across the joint, (2) enhancement of articular conformity, (3) distribution of synovial fluid across the articular surface, and (4) prevention of soft tissue impingement during joint motion.

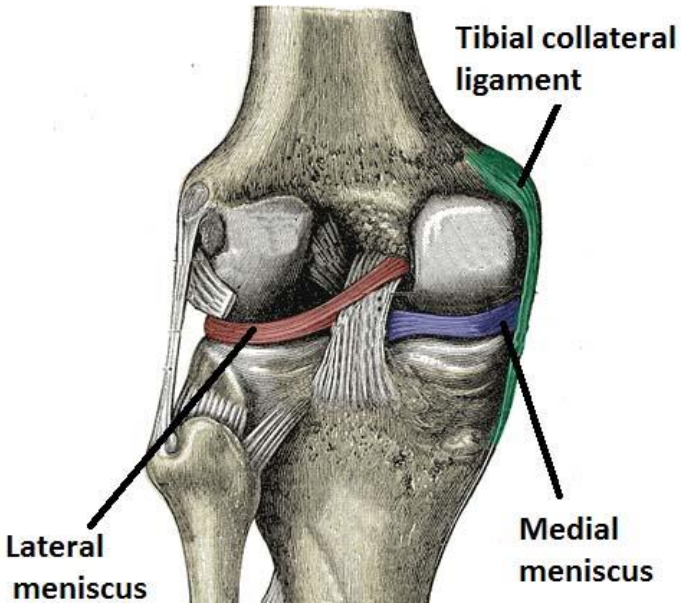


Figure 3 Ligaments around the knee joint

Muscles

The movements of the knee are flexion, extension, and rotation. Flexion is performed by the hamstrings and biceps femoris and, to a lesser extent, by the gastrocnemius and popliteus. Extension is performed by the quadriceps, and because of the shape of the articulation and the ligament attachments, the femur rotates medially on the tibia in terminal extension. The sartorius, gracilis, and semitendinosus medially and the iliotibial tract laterally most often act as “guy ropes” to stabilize the pelvis.

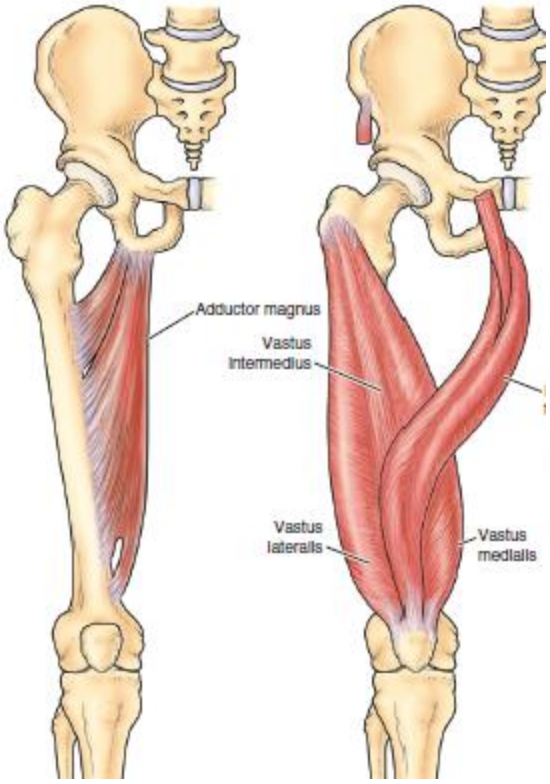


Figure 4 Muscles causing knee extension

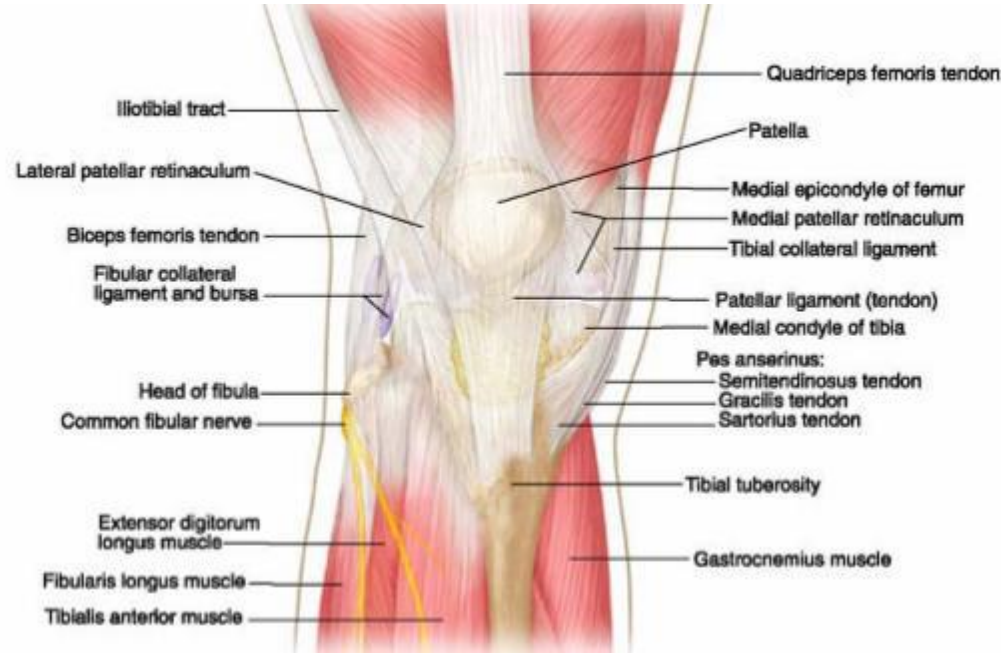


Figure 5 Muscles in anterior aspect of knee joint

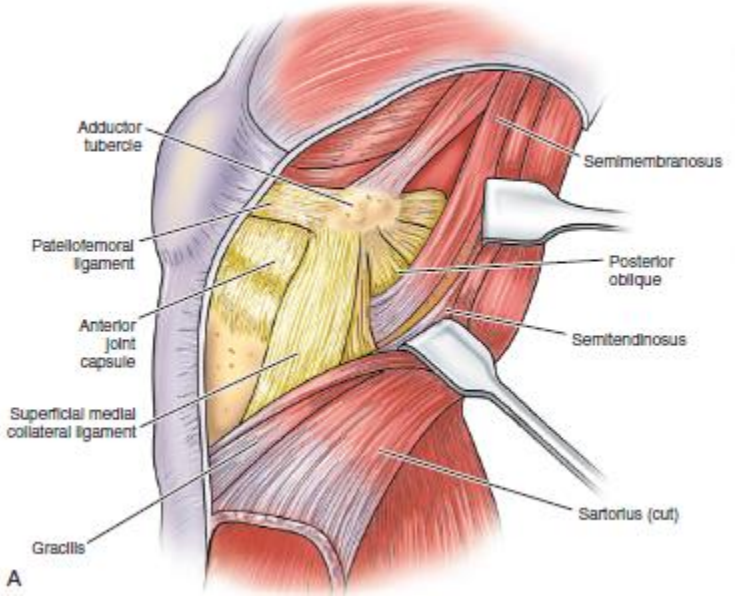


Figure 6 Medial aspect of knee joint

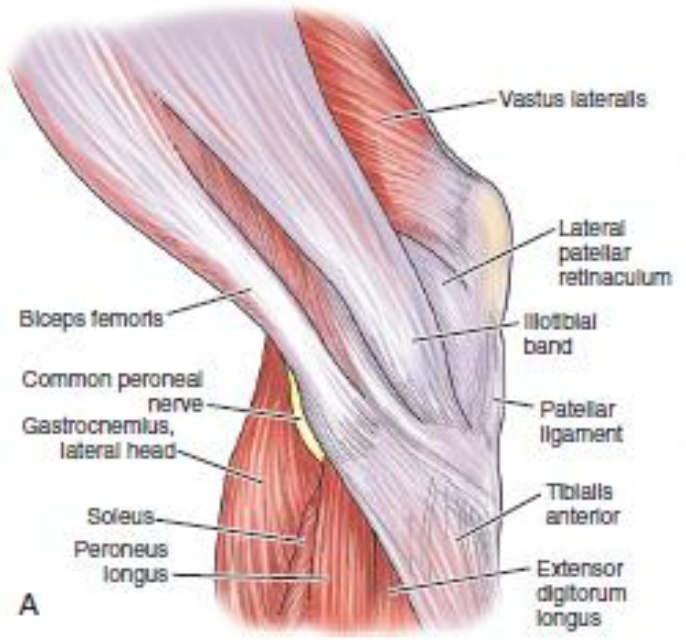


Figure 7 Lateral aspect of knee joint

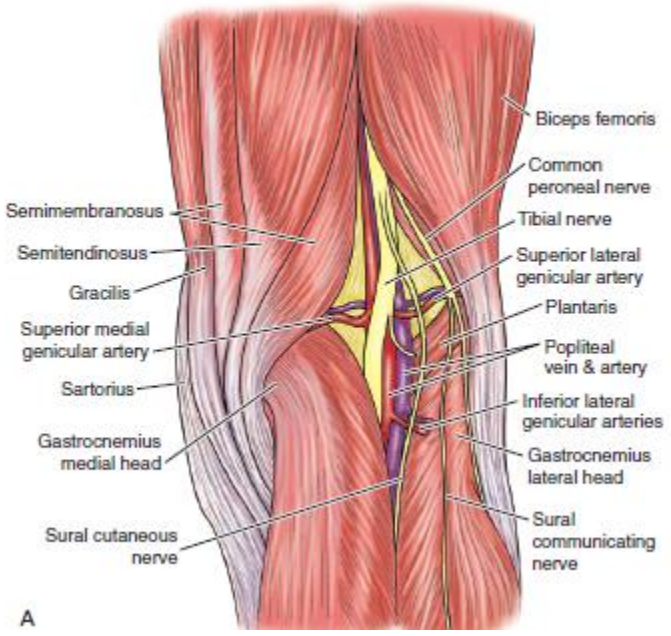


Figure 8 Posterior aspect of knee joint

Blood Supply

Anastomoses around knee joint are the chief sources of blood supply which are formed by : (1) Five genicular branches of the popliteal artery, (2) the descending genicular branch of the femoral artery, (3) the descending branch of the lateral circumflex femoral artery, (4) two recurrent branches of the anterior tibial artery, and (5) the circumflex fibular branch of the posterior tibial artery.

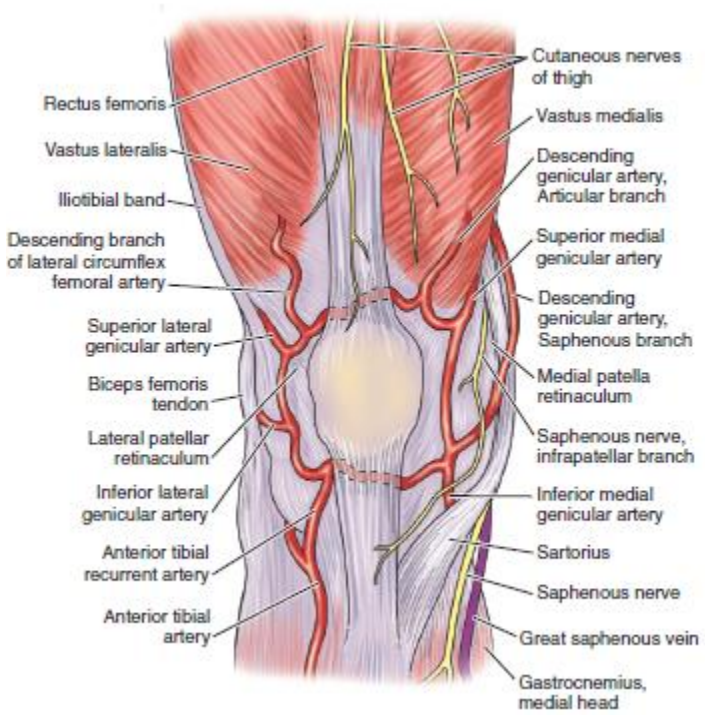


Figure 9 Arterial supply around knee joint

Nerve Supply

1. Femoral nerve, through its branches to the vasti, especially the vastus medialis.

2. Sciatic nerve, through the genicular branches of the tibial and common peroneal nerves.

3. Obturator nerve, through its posterior division.

Movements of knee joint

Sagittal Plane movements-

Flexion- 0-125 degrees

Extension-0- 10 degrees

Rotational movements-

Internal rotation /external rotation- 6 degrees

Mechanical alignment of Knee joint

Normally, the diaphyseal midline of the femur and tibia is the **anatomical axis** it forms a valgus angle of 6 ± 2 degrees. The line drawn on a standing long-leg anteroposterior radiograph from the centre of the femoral head to the centre of the talar dome is defined as **mechanical axis of lower limb**.

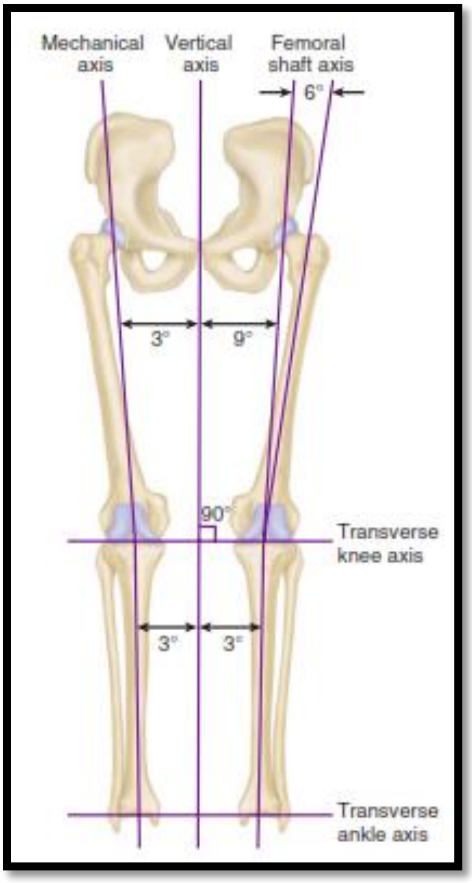


Figure 10 Mechanical axis and anatomical axis

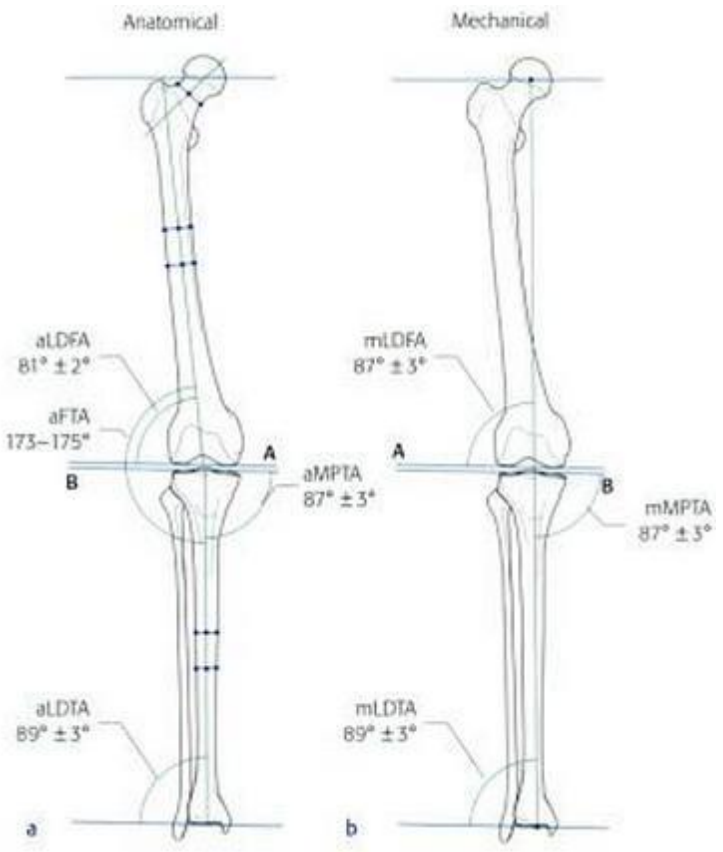


Figure 11 lower limb axis and joint angles in the frontal plane

This mechanical axis typically should project through the centre of the knee joint, described as a "neutral" mechanical axis. In genu varus deformity, the mechanical axis of the limb lies to the medial side of the centre of the knee joint. (1,26)

Guidelines suggest correction of the coronal plane is to be made according to the weight-bearing axis. The most widely used and accepted method, which was first suggested by Dugdale et al, is lateral shift of the weight-bearing axis to 62% to 66% of the width of the plateau.(27) In general, a shift of 65% is set as the upper boundary.

Fujisawa point

Figure 12 Fujisawa point

The weight-bearing line method divides the tibial plateau from 0% to 100% (medial to lateral) to determine the desired intersection coordinate of the mechanical axis through the knee joint. The angle formed by lines drawn from this coordinate to the center of the femoral head and talar dome is corrected for tibiofemoral joint surface distraction allowed by ligamentous laxity to establish the desired angle of correction. (27)Wedge height is calculated by tracing the wedge on the radiograph with the

desired angle of correction. The wedge height measurement on the radiograph is then normalized by the radiographic magnification present.(27)

KNEE OSTEOARTHRITIS:

Epidemiology:

Osteoarthritis (OA) of the knee is the most common form of joint disease and the occurrence of both radiographically visible and symptomatic knee osteoarthritis has been shown to be greater in females.(28) The medial and lateral compartments of the tibial-femoral knee joint do not bear load equally. In neutrally aligned knees, the medial compartment bears 60% to 70% of the force across the knee in weight-bearing activities. Therefore, the medial compartment of the knee is disproportionately afflicted with OA, with medial OA representing up to 75% of the disease burden. (29)(12)

Aetiology & Pathogenesis:

Osteoarthritis is a heterogeneous disorder. Age, trauma, obesity, and gender are independent risk factors for knee OA. These are the common pathway of disruption of biomechanical joint integrity. Pathologically, structural changes occur in and around the knee joint in osteoarthritis. The predominant structural changes are the loss of cartilage and the formation of osteophytes. OA cartilage demonstrates fibrillation, fissuring, neovascularization, areas of focal necrosis. The chondrocyte is also charged with cartilage remodeling and repair. When the demands of repair outpace the reparative capacity of the chondrocytes, OA ensues. Increased expression of ADAMTS, a specific aggrecan proteinase, is a hallmark of OA.Not only do increased levels of glycoprotein break down proteins found in OA joint tissues, they also are found in the circulation.(25) According to Kellgren et al these changes are easily demonstrated radiographically, and disease severity changes are based on the amount joint space loss (a reflection of cartilage loss) and the presence of osteophytes.(30)

According to Burr et al the subchondral bone scleroses in the early phases of osteoarthritis involving micro fracture, has been suggested to be pathogenetic factors in the process of cartilage degeneration. Pain is the most common symptom of osteoarthritis in the knee.(25) Joint stiffness, oedema, and deformity are further clinical characteristics. The symptoms might range from minor to severe. Physical therapy, bracing, orthoses, ambulatory aids, nonsteroidal anti-inflammatory drugs, glucosamine, and chondroitin sulphate, intraarticular injections of steroid or hyaluronic acid, and analgesics may be used in the early stages of treatment. Weight loss, a change in daily routine, as well as job and recreational activities, are all recommended. However, because the condition progresses, many people would need operative treatment. Some procedures are arthroscopic debridement, osteochondral or chondrocyte transplantation, high tibial osteotomy, distal femoral osteotomy, arthroplasty, and arthrodesis.(4,8,12) The choice of procedure depends on the patient's age and activity expectations, the severity of the disease, and the number of knee compartments involved.(1)

Genu varum :

The axis of the femur and tibial diaphysis is noted in genu varum, and the lateral angle between them is determined to be more than 173 -175 degrees. The weight-bearing line from the centre of the femoral head to the midpoint of the upper ankle joint is more than 4 (+/-2) mm medial to the centre of the knee joint, i.e., in the event of a severe varus malalignment, the mechanical axis distance (MAD) is more than 15mm medially. The intercondylar distance (ICD) between the femoral condyles is increased. (12)

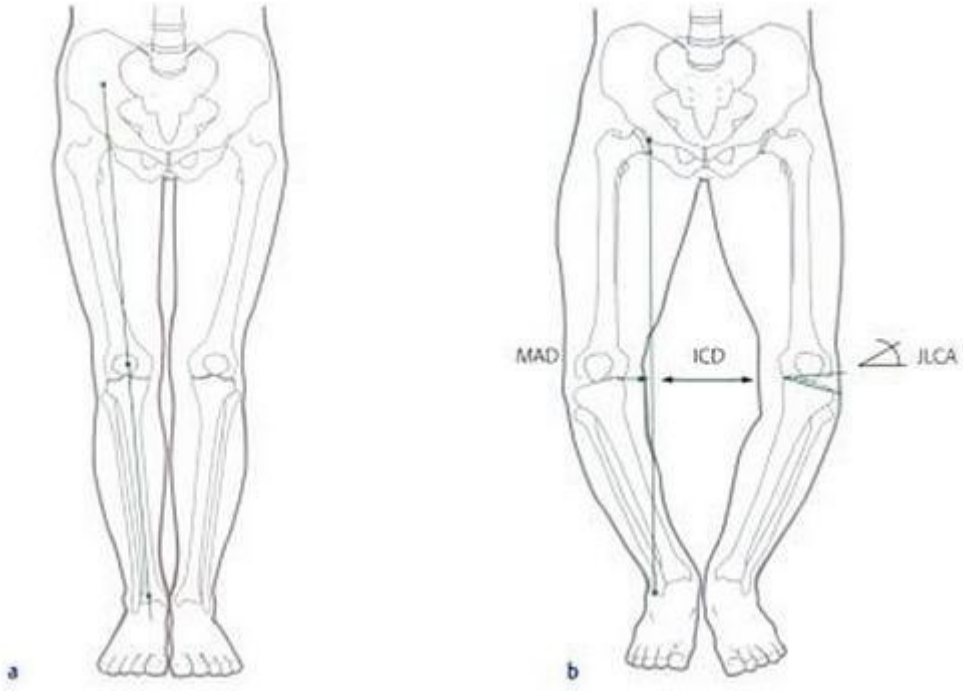


Figure 13 Normal and varus deformity of knee

Consequences of the lower limb deformities:

Forces cannot be transmitted evenly at the knee joint when there are tibial or femoral deformities in the frontal plane. Instead, mechanical stress causes non physiological load distribution in the medial or lateral compartment.(17) Cartilage degradation and progression of degenerative joint disease are linked to mechanical overload of medial or lateral joint. Osteotomy is surgery in which the bones are cut and realigned. Osteotomy around the knee changes the alignment of the knee. Weight bearing will be shifted from the diseased part to a healthy part of the knee. By unloading the damaged cartilage of

the knee, osteotomy may decrease pain, improve function, slow knee deterioration and possibly delay the need for (partial or) total knee replacement surgery. The techniques of open wedge and closed wedge osteotomies are well-established for restoring the physiological axis and treating varus and valgus in the knee joint.(7)

Clinical Examination:

1) Patient assessment:

Before choosing on surgery, the patient's age, profession, weight, BMI, chief complaints, previous history of knee surgery, and post-operative expectations were all taken into account. A nutritional examination, as well as a neurological and peripheral vascular evaluation, were performed to identify conditions that might contribute to worse results.

2) Physical Examination:

The physical examination started with inspection, noting any swelling, scars, sinuses, or apparent deformities. The knee's range of motion was evaluated, with attention paid to the stability of the knee in mid–flexion, complete flexion, and extension. Standing alignment aided in determining the severity of the varus deformity. It was determined whether there was any indication of patellar maltracking or patellar clunk syndrome. The extensor mechanism was examined to ensure that it was in good working order. A thorough neurological, motor, peripheral vascular, and gait evaluation received special attention. We also tried to seek other possible causes of referred pain i.e. examination of the ipsilateral hip and spine.

Unicompartmental Osteoarthritis:

Patients with unicompartmental medial femorotibial osteoarthritis are the most prevalent. During weight bearing, these patients complain of discomfort in the afflicted joint compartment. The rationale for osteotomy should be reviewed if the discomfort is not primarily situated over the medial compartment or the lateral joint space. (2)

Radiographic views:

Preoperative radiography of the knee joint in antero-posterior view and lateral view and a weight-bearing scanogram of the complete lower limb are required to examine the anatomy and leg axis. A weight-bearing x-ray of the leg is required to determine the appropriate indication and to plan any osteotomies around the knee. It is conducted in AP projection with a horizontally focused x-ray beam. Malrotation must be prevented by positioning the patella in front of the femoral condyles.(30)

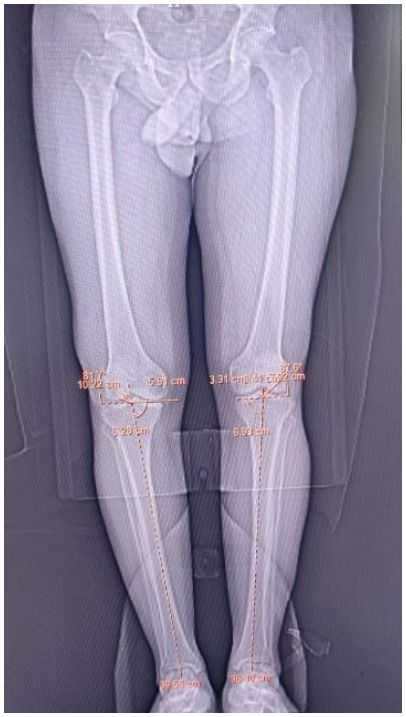


Figure 14 lower limb scanogram

Grade of Osteoarthritis:

Multiple classifications describe stages of osteoarthritis they are as follows.

1. Kellgren and Lawrence classification

2. Ahlbacks classification

1. Kellgren and Lawrence Radiological classification of osteoarthritis(30)

Grade 0 - No radiographic features of osteoarthritis

Grade I – Doubtful joint space narrowing and possible osteophytic lipping

Grade II – Definite osteophytes and possible joint space narrowing on weight bearing radiograph

Grade III – Multiple osteophytes, definite joint space narrowing, sclerosis, possible bony deformity

Grade IV – Large osteophytes, marked joint space narrowing, severe sclerosis and definitely bony deformity.

Figure 15 Kellgren and Lawrence Classification -Osteoarthritis of knee

2. Ahlback radiological Classification of osteoarthritis of knee.(31)(32)

Grade I-Reduction of joint space

Grade II-Obliteration of joint space

GradeIII- Tibial plateau attrition < 5 mm

Grade IV- Attrition 5-10 mm

Grade V- Severe subluxation of tibia

MANAGEMENT OF OSTEOARTHRITIS OF KNEE :

Osteoarthritis of knee can be managed either with non-operative (conservative) methods or operative methods.

❖ CONSERVATIVE (NON-OPERATIVE) MODALITIES OF TREATMENT MANAGEMENT:

Osteoarthritis of the knee is a debilitating and complex medical problem and conservative treatment methods include land-based aerobic and resistance exercise, as well as aquatic exercise and weight loss in the setting of overweight and obese patients. Isometric strengthening of the quadriceps muscles led to improvements in quadriceps torque, clinical status, and pain after walking. This program consisted of exercises performed three times weekly for 6 weeks with the knee flexed to 60 degrees. (33)Suggestions include a variety of strategies to improve joint angulation, including medially wedged insoles for valgus knee, medially directed patellar taping, and subtalar strapped lateral insoles for varus knees. Additionally, self-management program participation, psychosocial intervention, manual therapy in combination with supervised exercise programs, walking aids, and instruction in the use of thermal agents are recommended.

Pharmacological treatment-Oral NSAID if the patient is younger than 75. Intra-articular steroids are also recommended. Tramadol, opioid analgesics, and intra-articular hyaluronate injections are suggested. Glucosamine and chondroitin sulphate is also consumed as it supplements the synthesis of various cartilage components.(1,33)

❖ Surgical Management-

Indications for surgery include pain, continuously disabling and refractory to conservative management, repeated acute episodes of locking, pain and effusion. Surgical options include arthroscopic debridement, prosthetic replacement (unicondylar, total, patellofemoral replacement) and corrective osteotomy (tibial/femoral). Surgical procedures are dependent on patient's age, stage of disease, needs and expectations, overall health, and other socioeconomic status are all aspects to be considered.(7,17)(33)

❖ OSTEOTOMY

Thorough clinical examination of the patient and detailed planning is essential for successful osteotomy. The osteotomy should be performed at the apex of the deformity. This will result in an optimal correction. Performed an osteotomy at a different level will not restore the physiological axis but create a new deformity. The metaphysis of a long bone is the part of the bone with the most regenerative capacity. Bone healing is significantly decreased at the diaphyseal bone.(25)Closed-wedge osteotomies are more difficult to conduct and less exact than open wedge osteotomies. Furthermore, the opening method allows for fine-tuning of the aperture using a spreader during the procedure. When angular stable implants are utilised, bone grafting is rarely required. The horizontal joint line must be restored in order to achieve a good outcome.(12)

Figure 16 Osteotomy Site in MOWHTO

- **Calculation of wedge size (correction angle):**

The Femoro-tibial angle is used to quantify the knee joint's varus deformity. Line is drawn from Centre of the femoral Head to the 62.5% coordinate over knee joint (Fujisawa Point) .Second line is drawn from Centre of the talar dome to the 62.5% coordinate over knee joint.Angle formed by the two lines equals the angle of correction required to result in weightbearing line through the 62.5% coordinate.(27)

Figure 17 Fujisawa point

❖ HIGH TIBIAL OPENING WEDGE OSTEOTOMY:

Surgical principles:

The principle of alleviating the medial compartment of medial compartmental osteoarthritis with varus deformity by moving the mechanical weight-bearing axis (Mikulicz line) to lateral compartment. In young and physically active individuals, a high-tibial osteotomy may postpone the need for arthroplasty. It is recognised as a well-established method for treating medial osteoarthritis that produces positive outcomes.(7,12)

The medial open wedge approach, in contrast to the lateral closed-wedge method, has the following advantages:

- There is just one osteotomy necessary.

- Fibular osteotomy, peroneal nerve dissection, and extensor muscle detachment can all be avoided.
- There is no shortening in the length of the lower extremities.
- Future total knee arthroplasty will be easier.

❖ **Implants- following are some of the implants used to fix the osteotomy site**

➢ **TomoFix-**

the long and rigid T-shaped titanium internal fixator with uniaxial locking system, is currently the gold standard. It combines biomechanical properties that are held accountable for fast bone healing: (1) high primary fixation stability; (2) a compliant bone-implant construct which allows residual micromotion within the osteotomy gap to promote a callus formation.(34) TomoFix plates exist in two versions, such as the small stature (sm) version designed for lighter patients and the standard version without weight restriction. Both plates have a narrow proximal design which allows for a biplanar osteotomy, thus enlarging the surface for rapid contact healing.

These plates are fixed proximally with three 5 mm bicortical locking screws and one 4.5 mm cortical screw and distally with two 5 mm unicortical locking screws.(35)

Figure 18 Tomofix plate

- **Puddu plate**

Giancarlo Puddu, who was an Italian Professor popularised the medial open wedge osteotomies with the Puddu plate in 1990s, which was named after him.(17) He developed this plate with a spacer. There are two designs available for this plate. The plate with a long stem is about 3 inches in length and about 1.25 inches in breadth. The spacer is of two dimensions in height. One is of 10 mm and the other is of 12 mm. The thickness of the spacer is about 5 mm. The disadvantage of this plate is that it cannot be used for very large varus corrections.(36,37)

Figure 19 Puddu plate

MATERIALS AND METHODS

1. SOURCE OF DATA:

The material for the present study was obtained from the patients admitted in

B.L.D.E.A.S' Shri B.M.Patil Medical college hospital and research centre,

Department of Orthopaedics with diagnosis of medial compartment osteoarthritis of knee joint from October 2019 to March 2021.

A minimum of 31 cases were taken and the patients were informed about the study in all respects and informed consent was obtained from each patient.

METHOD OF COLLECTION OF DATA

- By interview
- By clinical examination
- By analyzing case papers
- By follow up at intervals of 6wks, 3months, and 6months

Following inclusion and exclusion criteria were used.

INCLUSION CRITERIA

1. Patient aged 40-60 years.
2. Unicompartment medial osteoarthritis of knee
3. Patients willing for treatment and giving informed and written consent.

EXCLUSION CRITERIA

1. Patients aged > 60 years
2. Patients with previously operated knee.
3. Secondary osteoarthritis
4. Associated neurovascular injury.
5. Patients medically unfit for surgery.
6. Immunocompromised status.
7. Non-union or mal-union cases.

Patients admitted with medial compartment osteoarthritis of knee were examined and investigated with X-ray of involved knee AP and Lateral view and weight bearing scanogram of both lower limbs and angle of correction and medial proximal tibial angle was analyzed. Blood and urine examinations were ordered as follows:

- Blood – Hb%, Total count, Differential count, E.S.R.
- Urine – Albumin, Sugar, microscopy.
- Blood grouping and Rh type
- Bleeding time and Clotting time.
- HIV, HbsAg, HCV
- Blood urea.
- Blood sugar Level.
- ECG

SPECIAL INVESTIGATIONS (In patients adviced by the anesthetist)

- Scanogram of both lower limb(weight bearing)
- 2 D Echocardiography.

- Chest X –ray.

Physician opinions were taken as to the fitness of patient before surgery as & when necessary. X-ray and scanogram were reviewed again and angle of correction was analyzed and confirmed. All osteotomies were treated using a Tomofix plate. All patients were assessed by using the Knee society score, Hospital for special surgeries score and visual analogue score for the functional assessment at the follow-ups. Proforma specially made for the study was used. Data collected at the end of the study was statistically compared and analyzed with the similar studies done before.

PREOPERATIVE PREPARATION

➢The patients were taken up for surgery after obtaining written and informed risk consent of the nature and complications of the surgery. The operative site
(Knee joint) was shaved and prepared with betadine scrub, a day prior to the surgery.

➢ Xylocaine test dose & tetanus toxoid injections were given preoperatively.

➢All patients were started on antibiotics prophylactically. A third generation
Cephalosporin was administered via IV route prior to induction of anaesthesia, and continued at 12 hourly intervals for 3-5days, and switched over to oral form till the 12th day post-operatively, i.e. .until suture removal**.**

PREOPERATIVE PLANNING

1. Fujisawa point-weight bearing line passing through 62.5% medially and 37.5 % lateral coordinate

2. Assessment of angle of correction: Measured on a weight bearing scanogram.Angle between line joining centre of femoral head and fujisawa point and centre of talar dome and fujisawa point.

3.Medial proximal tibial angle (MPTA): Medial angle between the tangent to the tibial plateau line and the mechanical axis line of tibia.

Instruments and Implant details-

Main implants used in the fixation of this osteotomy are:

1. Tomofix

2. Puddu plate

Figure 20 Instruments

The dimensions of tomofix plate are:

Width – 30 mm

Length- 102 mm to 141 mm

Locking screw diameter– 5mm

Cortical screw diameter – 4.5 mm

Figure 21 Tomofix plate and screws

The dimensions of puddu plate are:

Width – 35 mm

Length- 76 mm to 100 mm

Spacer length- 10mm and 12 mm

Spacer thickness - 5 mm

Cortical screw diameter – 4.5 mm

Figure 22 Puddu plate

Surgical steps-

1) Anaesthesia:

Spinal Anaesthesia was given in all of the patients.

2) **Positioning of the patient:**

Patient was placed supine on the operating table. An angle frame was attached below the knee to facilitate flexion.

Figure 23 Patient position

3) Tourniquet protocol:

Above knee pneumatic tourniquet was used with an air compressor. It was applied as proximally as possible. The tourniquet pressure should be kept approximately equal to sum of systolic blood pressure plus 100 mm of mercury and inflated before starting the surgery.

Figure 24 Tourniquet application

4) Skin preparation and draping:

The limb was prepared by scrubbing with betadine scrub, starting from the knee. The proximal level of scrubbing was up to the tourniquet and distally up to the foot. Then the entire lower limb was painted with betadine. First the foot was isolated with a sterile glove to avoid contamination and the

whole patient was draped with sterile drapes. Final draping was done with a disposable ‘O’ drape. All members of the operative team after thorough scrubbing wore double gloves and then proceeded to do sterile draping.

Figure 25 Sterile draping

5) Surgical incision and superficial dissection:

A 6 to 8 cm long proximal anteromedial incision was made halfway between the tibial tubercle and the posteromedial edge of the tibia. The superficial medial collateral ligaments and the distal part of the patellar tendon were identified and preserved. A retractor was introduced after a sub periosteal dissection was done anteriorly under the infrapatellar bursa and patellar tendon. After incising the superficial medial collateral ligament and the popliteus muscle, a sub periosteal dissection was conducted and a retractor was used to preserve the neurovascular bundle.

Figure 26 Skin Incision

6) Tibial osteotomy:

Two guide pins were inserted roughly parallel to the joint line, just distal to the tibial metaphyseal flare and laterally these guide pins were just superior to the head of the fibula. Lateral hinge was kept intact. The guide pins matched the appropriate tibial slope in the sagittal plane. Using an oscillating saw tibial cut was made underneath these guide pins.

Figure 27 Guide Pin insertion

Figure 28 Tibial Cut with saw

7) Stack widening:

Osteotomes were used to progress the osteotomy (initially, anteromedially, then middle, and finally posteromedial cortex). Fluoroscopic imaging was done to check the location and ensure that a lateral bone hinge of roughly 1 cm was maintained to prevent injuring the lateral cortex.

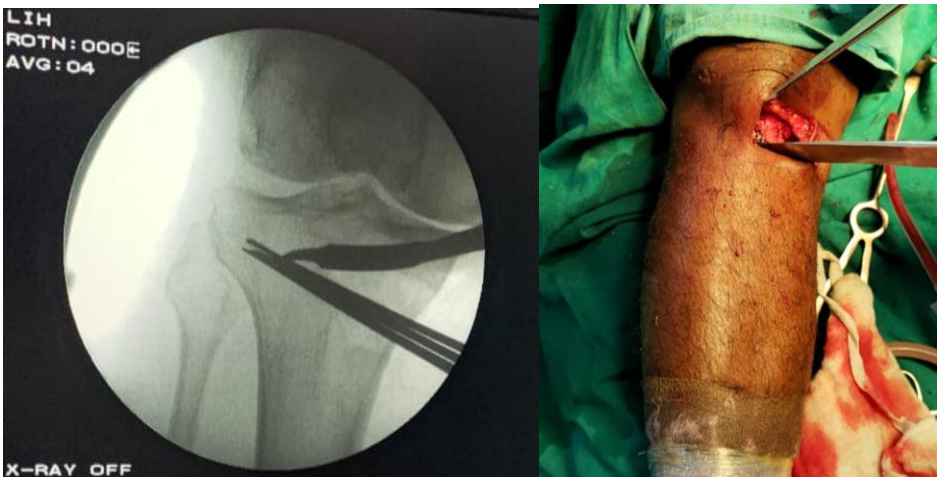


Figure 29 Stack widening

8) Distraction of the medial cortex:

A spreader device was used to slowly distract the medial cortex. The tibial slope was then assessed using lateral fluoroscopic imaging, whereas the coronal plane correction was assessed using anteroposterior imaging. The spreader is maintained in place for few minutes after the necessary correction has been achieved to allow for stress relaxation of the lateral cortex.

Figure 30 Distraction of medial cortex

Figure 31Tibial osteotomy

9) Plate placement:

After accommodation of the lateral cortex, the spreader was removed and puddu plate or tomofix locking plate was fixed over the medial cortex, distally with two 4.5-mm cortical screws and four 5 mm fully threaded cancellous screws proximally.

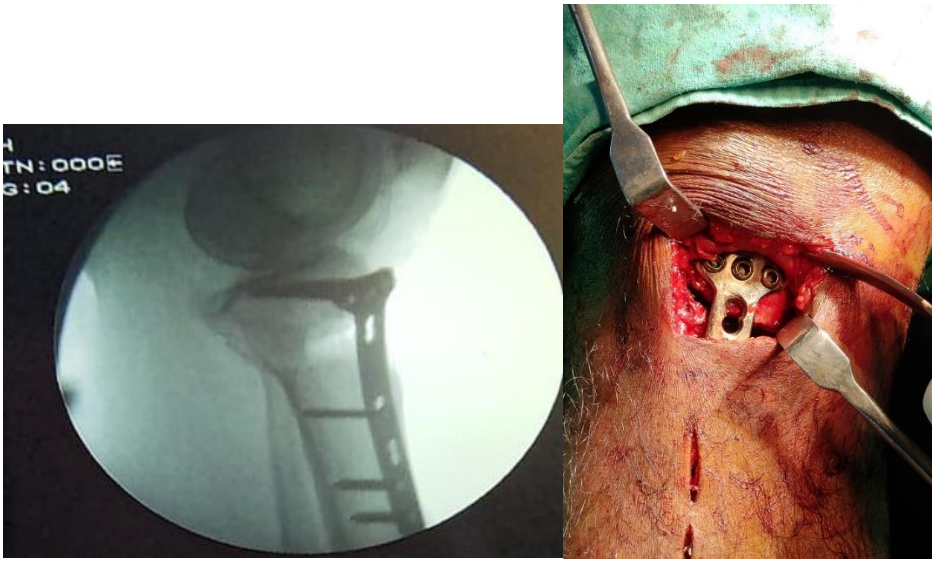


Figure 32 Tomofix plate placement

13) Closure:

Finally, the wound was irrigated with normal saline, closed in layers with or without a drain, and placed into an immobilizer brace.

Figure 33 Skin closure

After surgery:

1) Post operatively, patient's pulse, blood pressure, respiration, temperature were monitored.

2) Foot end elevation was given depending on blood pressure.

3) IV third generation Cephalosporin were administered 12 hourly for 3-5 days, and switched over to oral form till the 12th day post-operatively, i.e. until suture removal**.**

4) Analgesics were given as per patient compliance.

5) Blood transfusion was given depending on the requirement.

6) Suction drainage was removed after 48hours, if it is inserted.

7) Dressing was done on 3rd, 6th and 12th postoperative day.

8) Sutures removed on 12th postoperative day.

POST OPERATIVE REHABILITATION:

Postoperatively, the patient was kept non-weight bearing for 6 weeks and a knee immobilizer brace was worn during this period. (4) Starting on postoperative day 1, a supervised physical therapy program was initiated. Particular emphasis was placed on quadriceps activation. Quadriceps strengthening exercises were performed 3 to 5 times daily. Passive range of motion were limited from 0° to 120° of knee flexion during the first 2 weeks. After 6 weeks, weight bearing is started based on clinical and radiographic evidence of bone healing.(8)

FOLLOW UP:

Patients were scheduled to visit for follow up on 12^{th} day post-surgery for suture removal. Thereafter they followed up at 6 weeks, 3 months and 6 months post the surgery.

Clinical assessment:

All patients were clinically assessed by using the **Knee society score**, **Hospital for special surgeries of knee score** and **visual analogue score** for the assessment of function and pain.

Radiological evaluation –

Check X-Ray of affected knee AP and lateral views.

Table no. 1- Knee Society score

Knee society score involves four scores- (38)

i) Objective knee score- It includes following parameters

Alignment -25

Instability- 25

Range of motion- 5 degrees =1 point

Pain- 25

ii) Functional knee score- It includes following parameters.

Walking and standing- 30

Standard activities- 30

Advanced activities- 25

Discretional activity- 15

iii) Patient satisfaction score- 40

iv) Patient expectation score- 15

I	**Objective Knee score**	
	Alignment	**25**
1	Neutral: 2-10 degrees valgus (25 pts)	25
2	Varus: < 2 degrees valgus	-10

3	Valgus: > 10 degrees valgus	-10
	Instability	**25**
I	Medial / Lateral Instability: measured in full extension	
1	None	15
2	Little or < 5 mm	10
3	Moderate or 5 mm	5
4	Severe or > 5 mm	0
II	Anterior / Posterior Instability: measured at 90 degrees	
1	None (10 pts)	10
2	Moderate < 5 mm (5 pts)	5
3	Severe > 5 mm (0 pts)	0
	Range of motion-	**5 degrees=1 point**
	Pain	**25**
I	With walking	0-10 points
II	With stairs	0-10 points
III	If the knee feels normal	
1	Always	5
2	Sometimes	3
3	Never	0
	Deductions	
	Flexion Contracture Minus Points	
1	1-5 degrees	-2

2	6-10 degrees	-5
3	11-15 degrees	-10
4	> 15 degrees	-15
	Extensor Lag Minus Points	
1	<10 degrees	-5
2	10-20 degrees	-10
3	> 20 degrees	-15
II	**Functional knee score**	
	Walking and standing	30
	Standard activities (1 - Walking on an uneven surface 2 - Turning or pivoting on your leg 3 - Climbing up or down a flight of stairs 4 - Getting up from a low couch or a chair without arms 5 - Getting into or out of a car 6 - Moving laterally (stepping to the side)	30
	Advanced activities 1 - Climbing a ladder or step stool 2 - Carrying a shopping bag for a block 3 - Squatting 4 - Kneeling 5 – Running	25
	Discretional activity (Recreational Activities Workout and Gym Activities)	15
III	Patient satisfaction score	40

IV	Patient expectation score	15

Table no. 2- Hospital for Special Surgeries Knee score(39)

Point scale with maximum of 100 points distributed as follows:-

Pain-30

Function-22

Range of motion-18

Muscle strength-10

Flexion contracture-10

Instability10

Subtractions

Total 100

	Pain	**30**
I	Walking	
1	None	15
2	Mild	10
3	Moderate	5
4	Severe	0
II	At Rest	
1	None	15
2	Mild	10

3	Moderate	5
4	Severe	0
	Function	**22**
I	Walk	
1	walking & standing unlimited	12
2	5–10 blocks, standing 30 min	10
3	1–5 blocks, standing 15–30 min	8
4	1 block	4
5	cannot walk	0
II	Stairs	
1	Normal	5
2	With support	2
III	Transfer	
1	Normal	5
2	With support	2
	Range of motion	**18**
	Each degree= 1point	
	Muscle strength	**10**
1	cannot break quadriceps	10
2	can break quadriceps	8
3	can move through arc of motion	4
4	cannot move through arc of motion	0
	Flexion contracture	**10**
1	none	10
2	5-10 degrees	8

3	10-20 degrees	5
4	>20 degrees	0
	Instability	**10**
1	None	10
2	0-5 degrees	8
3	6-15 degrees	5
4	>15 degrees	0
	Subtractions	
1	One cane	1
2	One crutch	2
3	Two crutches	3
4	Extension lag- 5 degrees 10 degrees 15 degrees	 2 3 5
5	Deformity- Varus/Valgus	5 degrees =1 point

The score is reported as follows:-

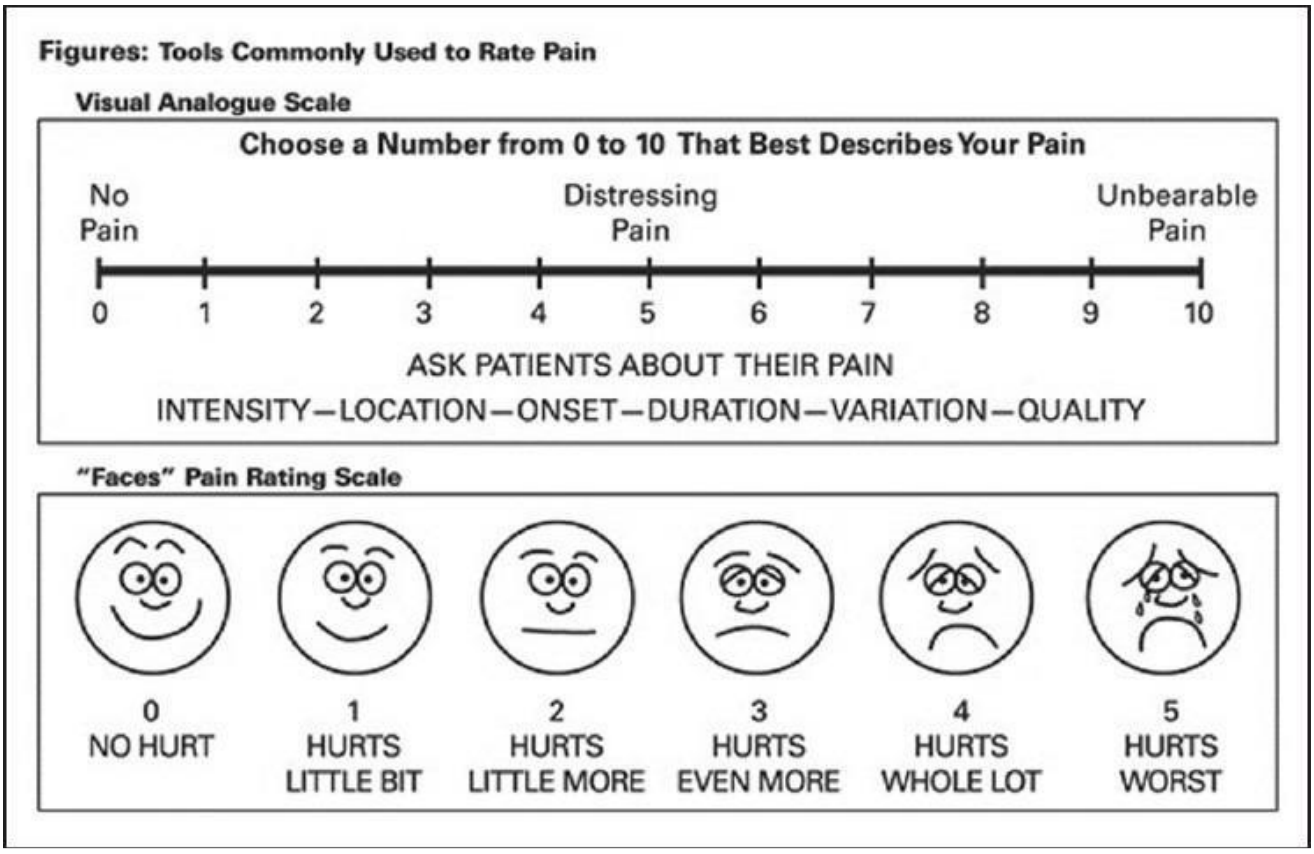
HSS between 85 to 100- Excellent

HSS between 70 to 84- Good

HSS between 60 to 69- Fair

HSS < 60 -Poor

TABLE NO. 3: VISUAL ANALOGUE EVALUATION OF PAIN



Case no 1.

Pre op Xray

Pre op scanogram

Post op xray

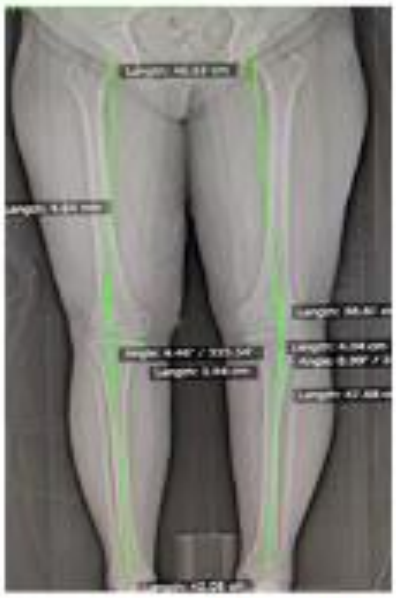
6 weeks post op

6 months follow up

Post op range of motion

Case No. 2

Pre op Xray



Pre op scanogram

Post op xray

6 months post op

Post op ROM

Sample size calculation

With 95% confidence level and margin of error of ±15%, a sample size of 31 subjects will allow the study to determine the functional outcome of medial opening wedge high tibial osteotomy with plate fixation in medial compartment osteoarthritis of knee.

with finite population correction (N=100).

By using the formula:

$$n = \frac{z^2 p(1-p)}{d^2}$$

where

Z= z statistic at 5% level of significance

d is margin of error

p is anticipated prevalence rate (50%)

Statistical analysis

All characteristics were summarized descriptively. For continuous variables, the summary statistics of mean±standard deviation (SD) were used. For categorical data, the number and percentage were used in the data summaries and diagrammatic presentation.

The difference of the means of analysis variables between two time points in same group was tested by paired t test.

T-Statistic

The T-Statistic is the value used to produce the *p*-value (Prob Level) based on the *T* distribution. The formula for the T-Statistic is:

$$T - Statistic = \frac{\overline{x}_{diff} - Hypothesized\ Value}{SE_{\overline{x}_{diff}}}$$

DF

The degrees of freedom define the T *distribution* upon which the probability values are based. The formula for the degrees of freedom is the number of pairs minus one:

$$df = n - 1$$

The difference of the means of analysis variables between more than two independent groups was tested by ANOVA and F test of testing of equality of Variance.

ANOVA

Source	d.f.	SS	MS	F
Treatment	$a-1$	SS_{treat}	$\frac{SS_{treat}}{a-1}$	$\frac{MS_{treat}}{MS_{error(a)}}$
Error (a)	$N-a$	$SS_{error(a)}$	$\frac{SS_{error(a)}}{N-a}$	
Time	$t-1$	SS_{time}	$\frac{SS_{time}}{t-1}$	$\frac{MS_{time}}{MS_{error(b)}}$
Treat x Time	$(a-1)(t-1)$	$SS_{treat\ x\ time}$	$\frac{SS_{treat\ x\ time}}{(a-1)(t-1)}$	$\frac{MS_{treat\ x\ time}}{MS_{error(b)}}$
Error (b)	$(N-a)(t-1)$	$SS_{error(b)}$	$\frac{SS_{error(b)}}{(N-a)(t-1)}$	
Total	$Nt-1$	SS_{total}		

The sources of the variation include treatment; Error (a); the effect of Time; the interaction between time and treatment; and Error (b). Error (a) is the effect of subjects within treatments and Error (b) is the individual error in the model. All these add up to the total.

If the p-value was < 0.05, then the results were considered to be statistically significant otherwise it was considered as not statistically significant. Data were analyzed using SPSS software v.23(IBM Statistics, Chicago, USA)and Microsoft office 2007.

TYPE OF STUDY:

Prospective Study.

Results

The study involved 31 cases of Medial compartment osteoarthritis of knee of either sex from September 2019- May 2021. All the cases were treated with Medial opening wedge high tibial osteotomy with plating. The analysis of the patient data, intraoperative data & postoperative outcome is as follows:

AGE

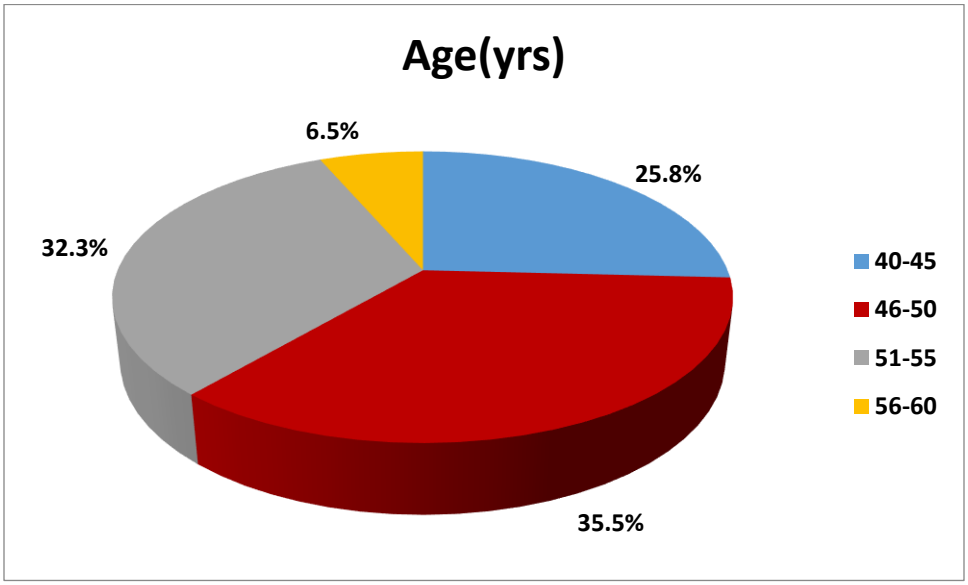
The study involved patients between 40-60 years of age. The age distribution was from 40 and above. The average age was 48.9 years and the largest group of patients being from 46 to 50 years.

Table no. 4: Distribution of Cases according to Age

Age(yrs)	N	Percent
40-45	8	25.8
46-50	11	35.5
51-55	10	32.3
56-60	2	6.5
Total	31	100

Parameter	Minimum	Maximum	Mean	SD
Age	40	60	48.9	4.9

Figure 34 Distribution of Cases according to Age



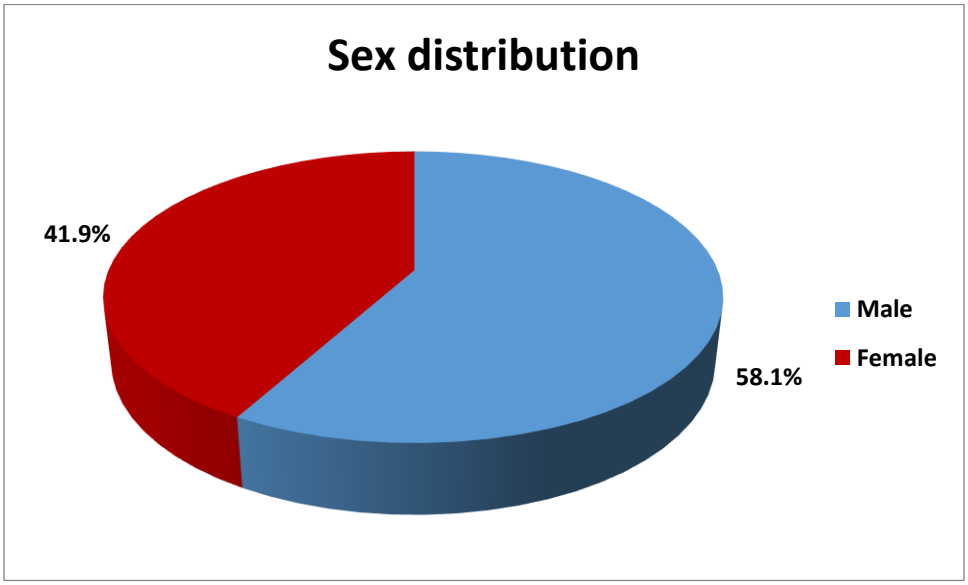
SEX

There were 18 males and 13 females in the study.

Table no 5: Distribution of Cases according to Sex

Sex	N	Percent
Male	18	58.1
Female	13	41.9
Total	31	100

Figure 35 Distribution of Cases according to Sex



Body mass index

Body mass index was calculated for all patients with 19 patients ranging from 18.50-22.99 and 12 patients >25.

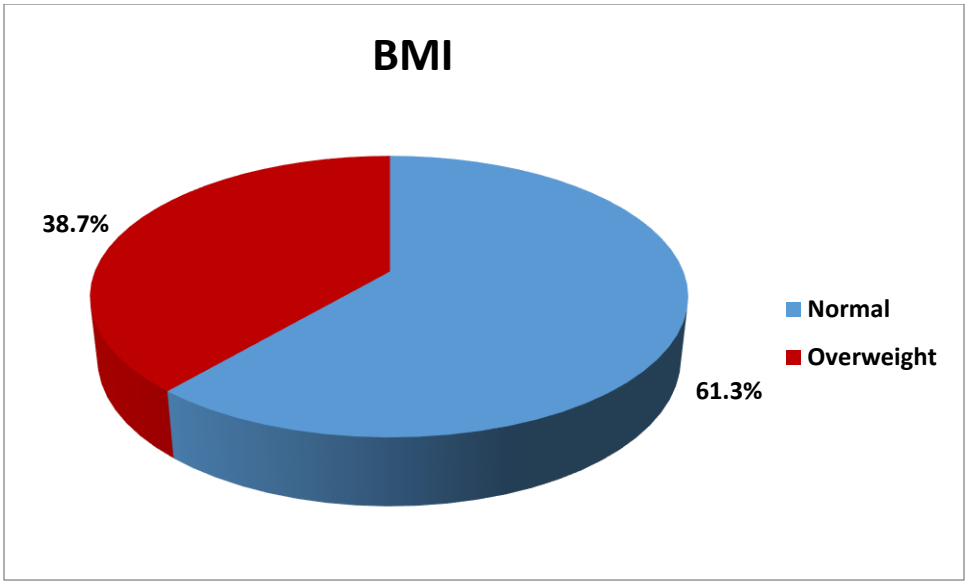
Table no 6: Distribution of Cases according to BMI

BMI	N	Percent
Normal	19	61.3
Overweight	12	38.7
Total	31	100

Parameter	Minimum	Maximum	Mean	SD

BMI	20.8	28.8	24.4	2.1

Figure 36 Distribution of Cases according to BMI



Side involved

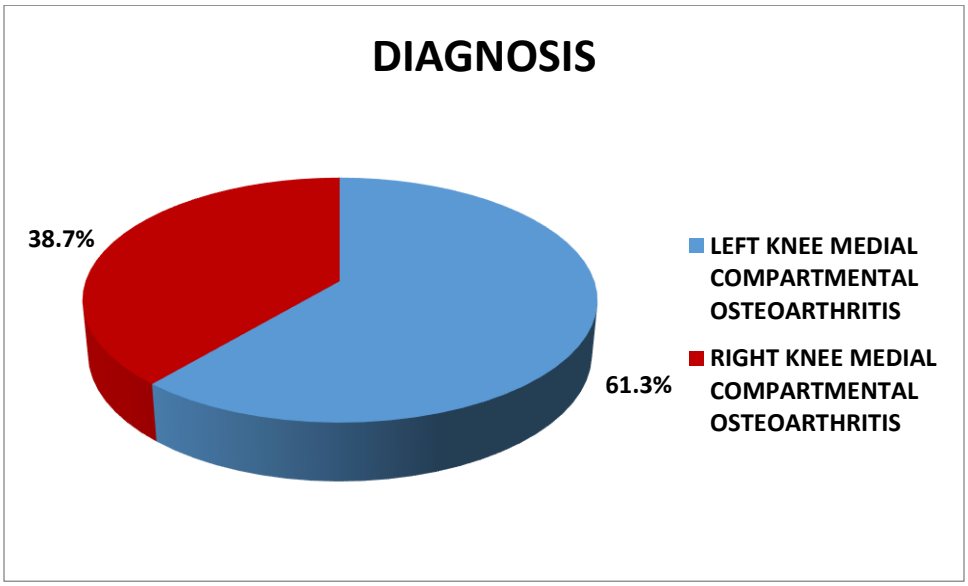
The left knee was operated in 19 patients and the right knee was operated in 12 patients.

Table no 7: Distribution of Cases according to Diagnosis

Diagnosis	N	Percent
Left knee medial compartmental osteoarthritis	19	61.3
Right knee medial compartmental osteoarthritis	12	38.7

Total	31	100

Figure 37 Distribution of Cases according to Diagnosis



Grade of osteoarthritis

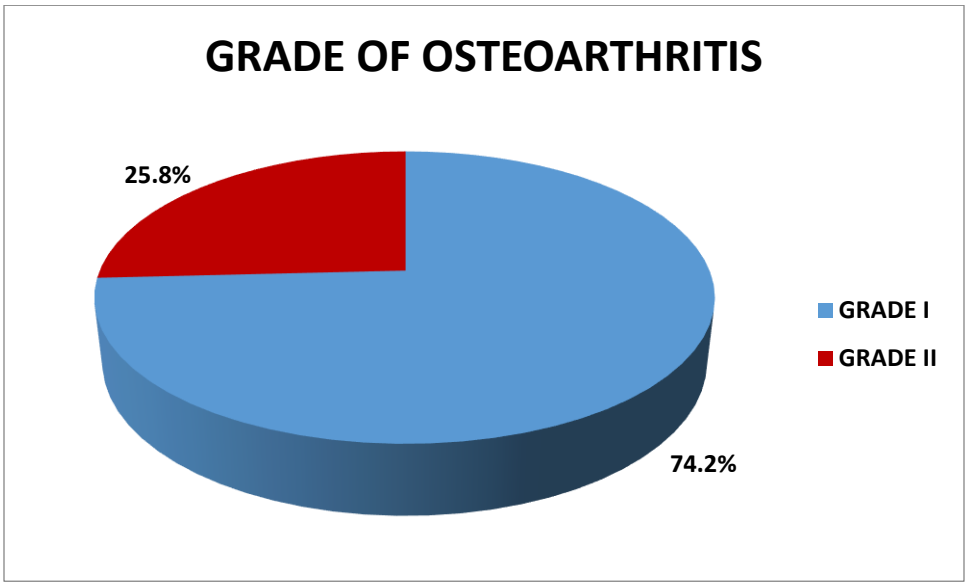
Grade of Radiographic Osteoarthritis was calculated using the Kellen Lawrence scale. Accordingly, patients were group. Majority of the patients (n=40) were Grade I Osteoarthritis.

Table no 8: Distribution of Cases according to Grade of Osteoarthritis

Grade Of Osteoarthritis	N	Percent
GRADE I	23	74.2
GRADE II	8	25.8

Total	31	100

Figure 38 Distribution of Cases according to Grade of Osteoarthritis



Angle of correction

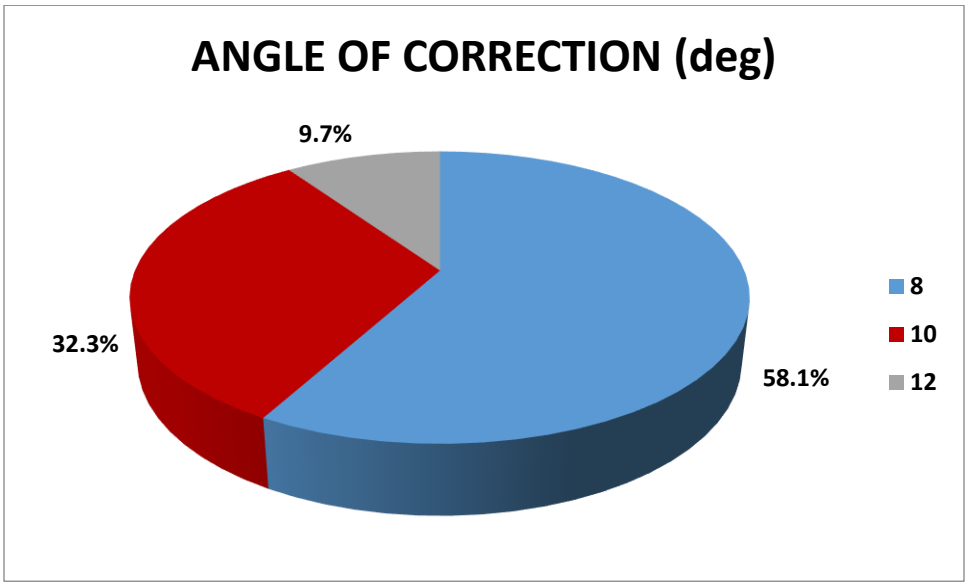
Angle to be corrected was found to be 8 degrees in 18 patients, 10 degrees in 10 patients and 12 degrees in 3 patients.

Table no 9: Distribution of Cases according to Angle of Correction

Angle of Correction (deg)	N	Percent
8	18	58.1
10	10	32.3
12	3	9.7

Total	31	100

Figure 39 Distribution of Cases according to Angle of Correction



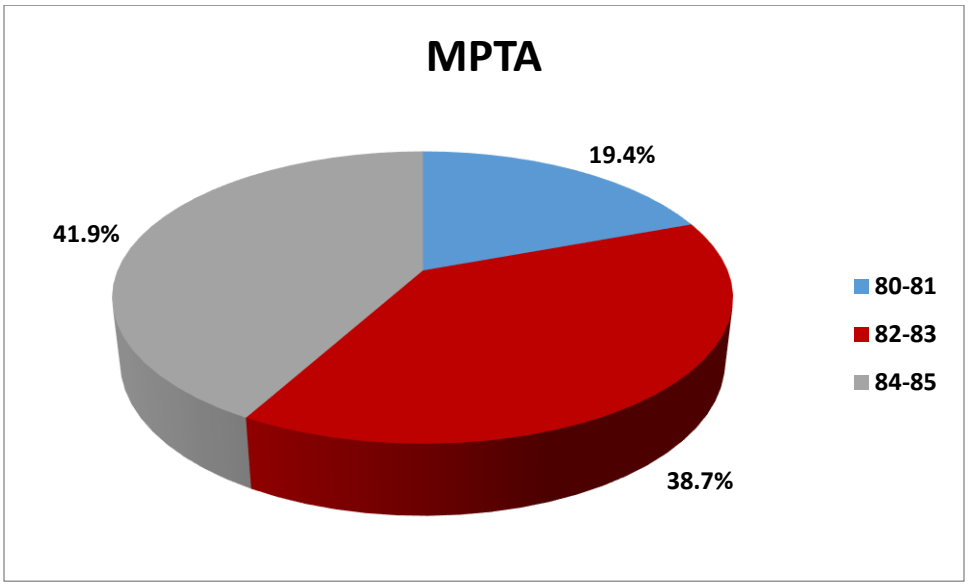
Medial proximal tibial angle (MPTA)

MPTA was 82-83 deg in 12 patients and 80-81 deg in 6 patients.

Table no 10: Distribution of Cases according to MPTA

MPTA (deg)	N	Percent
80-81	6	19.4
82-83	12	38.7
84-85	13	41.9
Total	31	100

Figure 40 Distribution of Cases according to MPTA

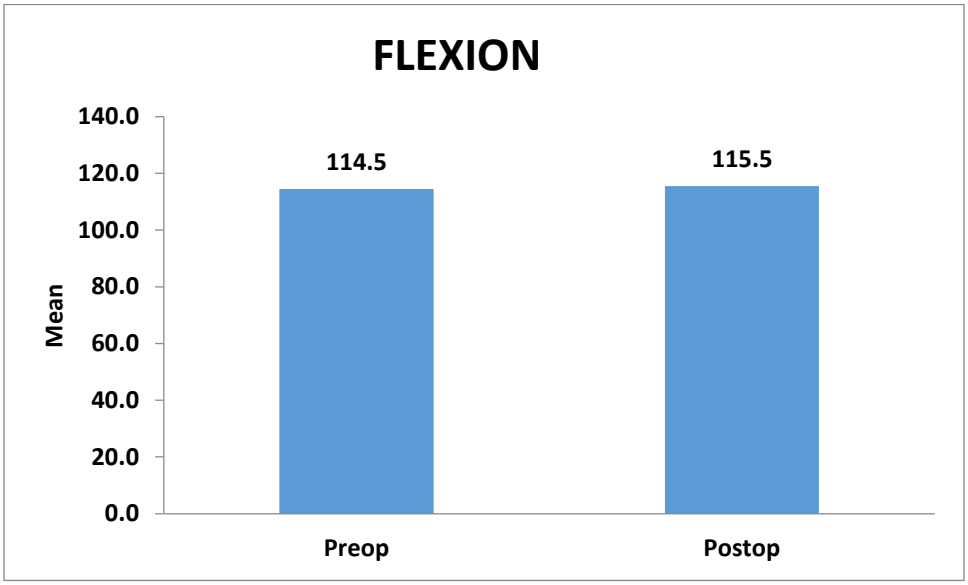


Range of motion - Flexion

Table 11: Distribution of Cases according to flexion

FLEXION	Minimum	Maximum	Mean	SD	p value
Preop	100	130	114.5	7.1	0.264
Postop	100	130	115.5	6.6	

Figure 41 Distribution of Cases according to flexion

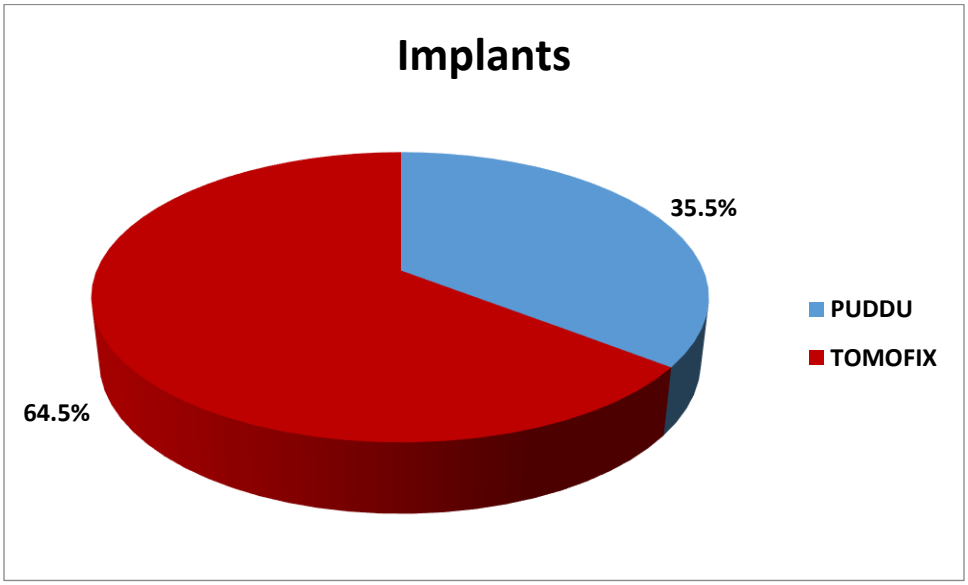


Implant used

Table 12: Distribution of Cases according to Implants

Implants	N	Percent
PUDDU	11	35.5
TOMOFIX	20	64.5
Total	31	100

Figure 42 Distribution of Cases according to Implants



Knee society score

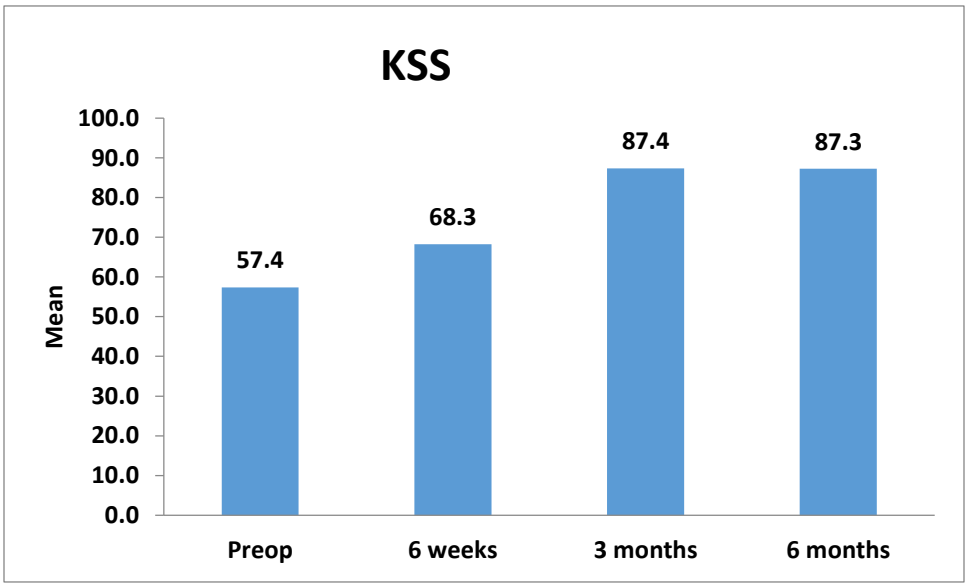
The knee society score was calculated as a measure of objective outcomes in these patients. The pre-operative KSS (Objective score) was 57.4 ± 4.6. There was significant difference as indicated by the p value. There was significant improvement in the post op Objective KSS. The mean post op Objective KSS at 6 months was 87.3 ± 2.4.

Table 13: Distribution of Cases according to Objective score

Functional score	Minimum	Maximum	Mean	SD	p value
Preop	49	68	57.4	4.6	<0.001*
6 weeks	60	78	68.3	4.1	
3 months	84	90	87.4	2.0	
6 months	82	92	87.3	2.4	

Note: p value* significant at 5% level of significance (p<0.05)

Figure 43 Distribution of Cases according to KSS (Objective score)



Patient satisfaction score

The pre-operative KSS patient satisfaction score was 6.3 ± 4.6. There was significant difference as indicated by the p value. There was significant improvement in the post op KSS patient satisfaction score. The mean post op KSS patient satisfaction score at 6 months was 34.5 ± 1.3.

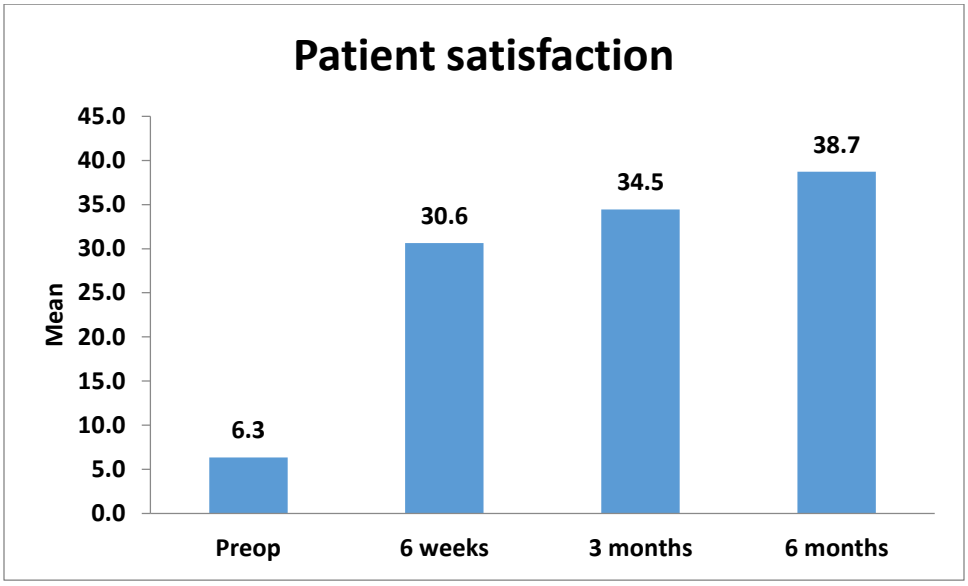
Table 14: Distribution of Patient satisfaction according to follow-up

Patient satisfaction	Minimum	Maximum	Mean	SD	p value
Preop	0	14	6.3	4.6	<0.001*

6 weeks	26	38	30.6	3.1	
3 months	32	36	34.5	1.3	
6 months	36	40	38.7	1.4	

Note: p value* significant at 5% level of significance ($p<0.05$)

Figure 44: Distribution of Patient satisfaction according to follow-up



Patient expectation score

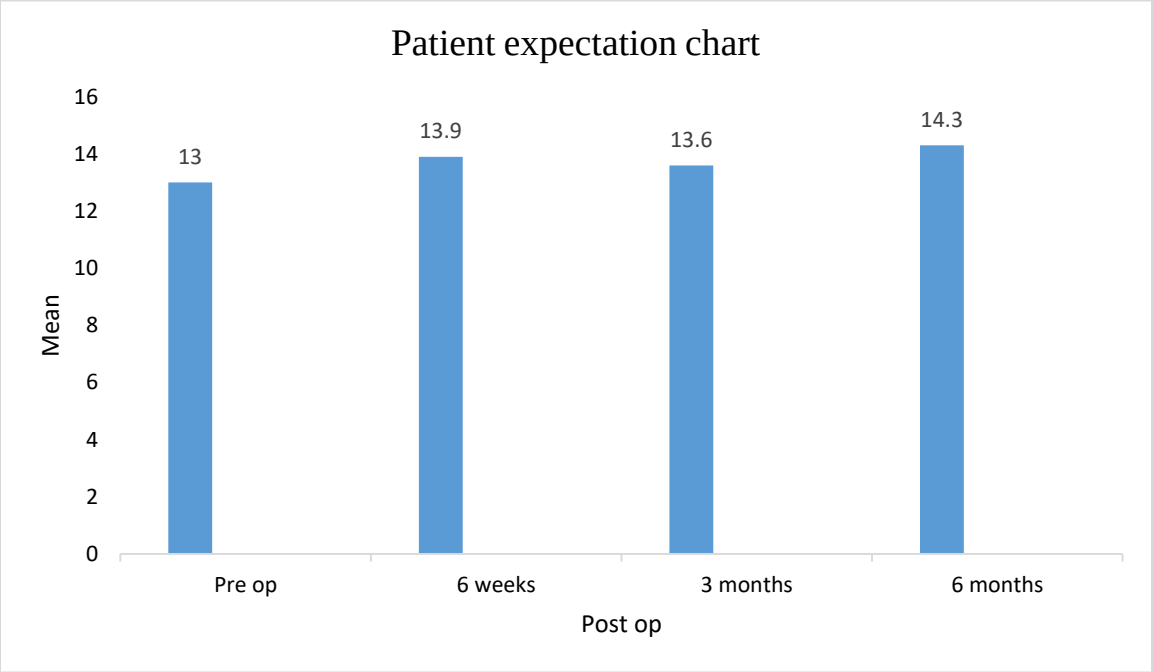
The pre-operative KSS patient expectation score was 13 ± 0.9. There was significant difference as indicated by the p value. There was significant improvement in the post op KSS patient expectation score. The mean post op KSS patient expectation score at 6 months was 14.3 ±0.9.

Table 15: Distribution of Patient expectation according to follow-up

Patient expectation	Minimum	Maximum	Mean	SD	p value
Preop	12	15	13.0	0.9	<0.001*
6 weeks	11	15	13.9	1.4	
3 months	9	15	13.6	2.2	
6 months	12	15	14.3	0.9	

Note: p value* significant at 5% level of significance ($p<0.05$)

Figure 45: Distribution of Patient expectation according to follow-up



Functional Score

The pre-operative KSS (Functional score) was 57.2 ± 6.1. There was significant difference as indicated by the p value. There was significant improvement in the post op functional KSS. The mean post op functional score at 6 months was 87.1 ± 2.9.

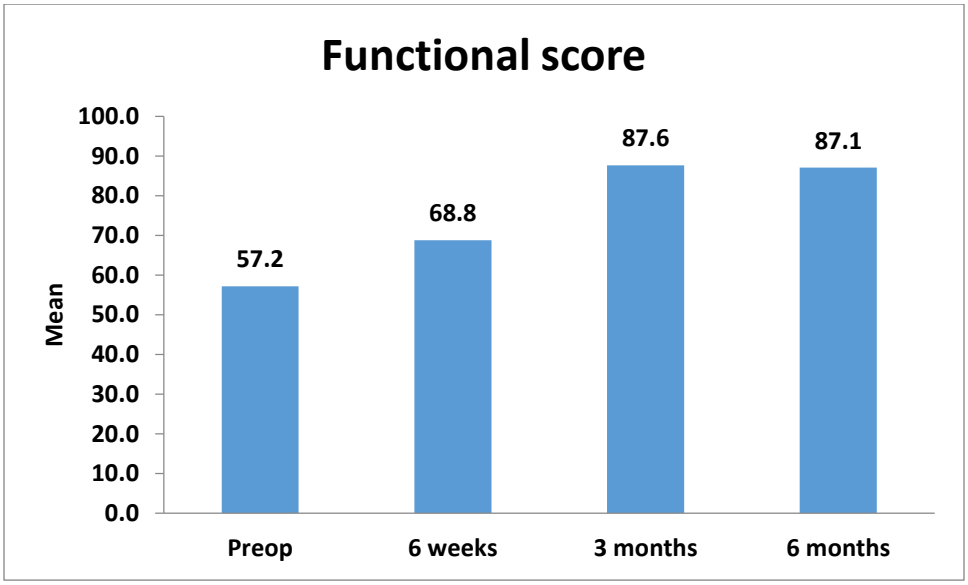
Table 16: Distribution of Functional score according to follow-up

Functional score	Minimum	Maximum	Mean	SD	p value
Preop	40	66	57.2	6.1	
6 weeks	60	76	68.8	4.0	<0.001*
3 months	82	90	87.6	2.3	

6 months	83	92	87.1	2.9	

Note: p value* significant at 5% level of significance (p<0.05)\

Figure 46: Distribution of Functional score according to follow-up



Conclusion: - By using paired t-test p-value < 0.05 therefore there is significant difference between mean knee society functional score, objective score ,patient satisfaction score and patient expectation score at pre-operative and at 3-month, 6 months and 12 months post operatively.

Hospital for special Surgery Knee score

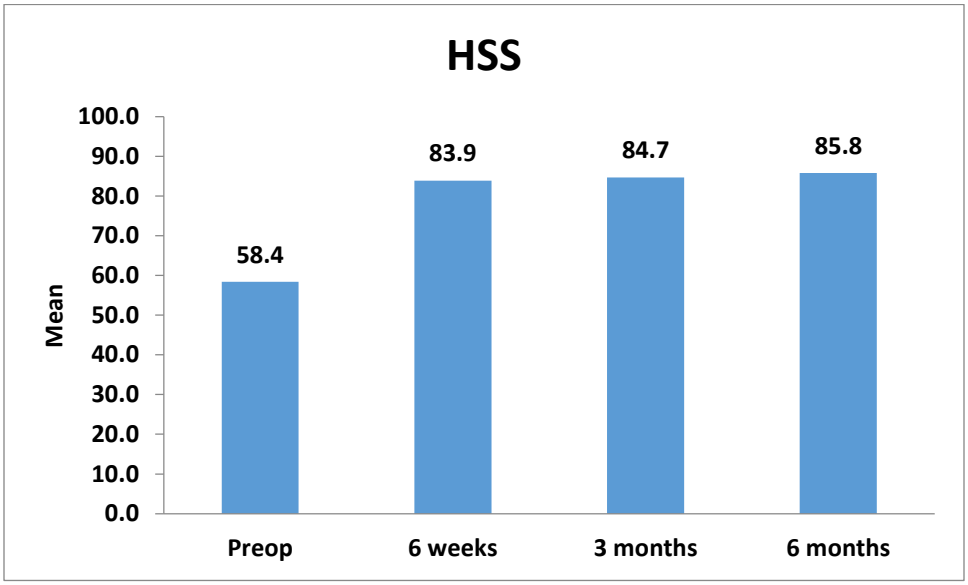
The Hopsital for special surgery knee score was calculated as a measure of functional outcomes in these patients. The pre-operative HSS was 58.4 ± 4.3. There was significant difference as indicated by the p value. There was significant improvement in the post op HSS. The mean post op Objective HSS at 6 months was 85.8 ± 3.1.

Table 17: Distribution of Cases according to HSS

HSS	Minimum	Maximum	Mean	SD	p value
Preop	50	68	58.4	4.3	<0.001*
6 weeks	70	90	83.9	4.3	
3 months	80	90	84.7	2.6	
6 months	80	92	85.8	3.1	

Note: p value* significant at 5% level of significance (p<0.05)

Figure 47: Distribution of Cases according to HSS



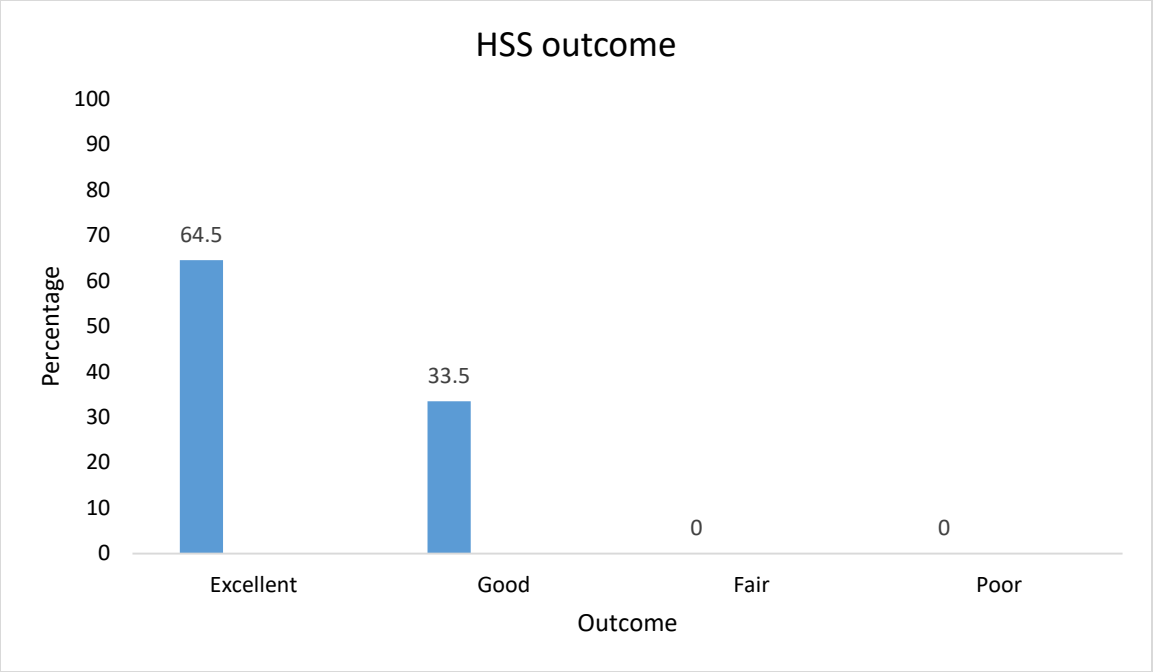
Analysis of HSS score-

85 to 100- Excellent- 20 patients (64.5 %)

70 to 84- Good -11 patients (33.5%)

60 to 69- Fair 0

< 60 –Poor 0



Outcome

20 patients (64.5 %) outcome was excellent. 11 patients (33.5 %) outcome was good.No patients had fair or poor outcome.

Visual analogue scale

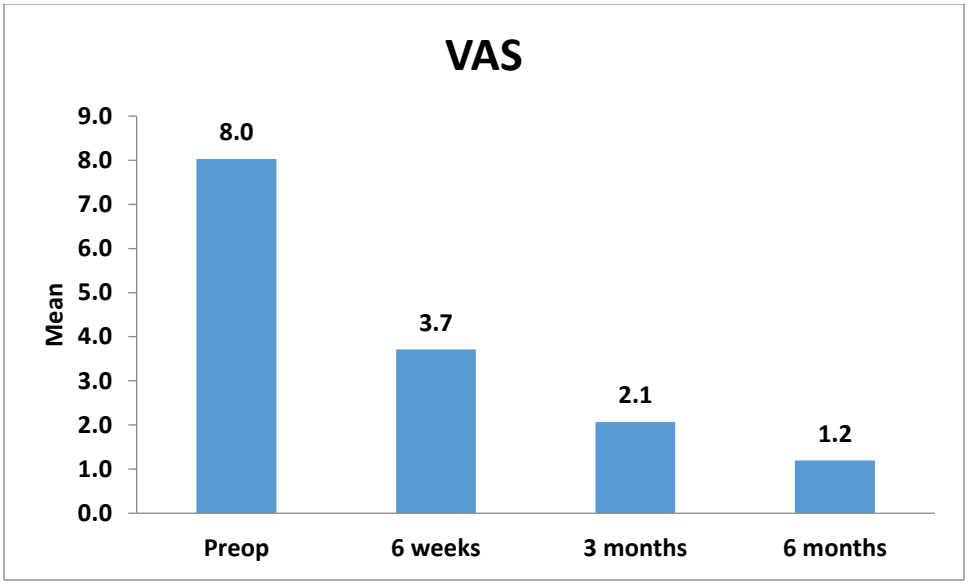
The VAS (Visual Analogue Scale) Score was calculated for all patients. The Mean VAS Score pre-operative was 8 whereas the mean post-operative VAS Score was 1 at 6 months post operatively.

Table 18: Distribution of Cases according to VAS

VAS	Minimum	Maximum	Mean	SD	p value
Preop	7	9	8.0	0.7	<0.001*
6 weeks	3	5	3.7	0.7	
3 months	1	4	2.1	0.8	
6 months	0	3	1.2	0.8	

Note: p value* significant at 5% level of significance (p<0.05)

Figure 48 Distribution of Cases according to VAS



There is a significant difference in the pre op and post op visual analogue scale.

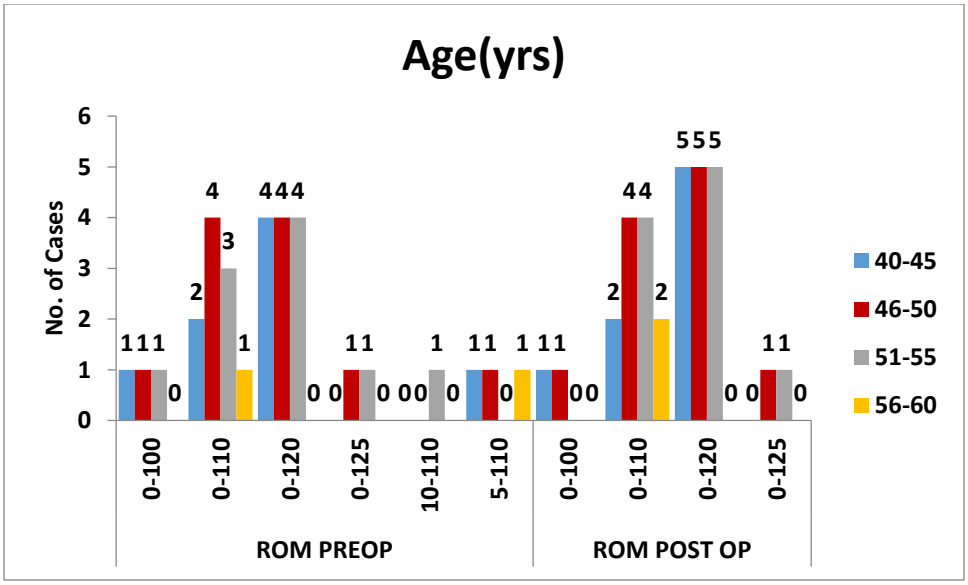
Association of age and Range of motion

Table 19: Distribution of Age according to ROM

Age(yrs)	ROM PREOP						ROM POST OP			
	0-100	0-110	0-120	0-125	10-110	5-110	0-100	0-110	0-120	0-125
40-45	1	2	4	0	0	1	1	2	5	0
46-50	1	4	4	1	0	1	1	4	5	1
51-55	1	3	4	1	1	0	0	4	5	1
56-60	0	1	0	0	0	1	0	2	0	0
Total	3	10	12	2	1	3	2	12	15	2
p value	0.868						0.742			

Note: p value* significant at 5% level of significance (p<0.05)

Figure 49: Distribution of Age according to ROM



Age is not significantly associated with post op range of motion.

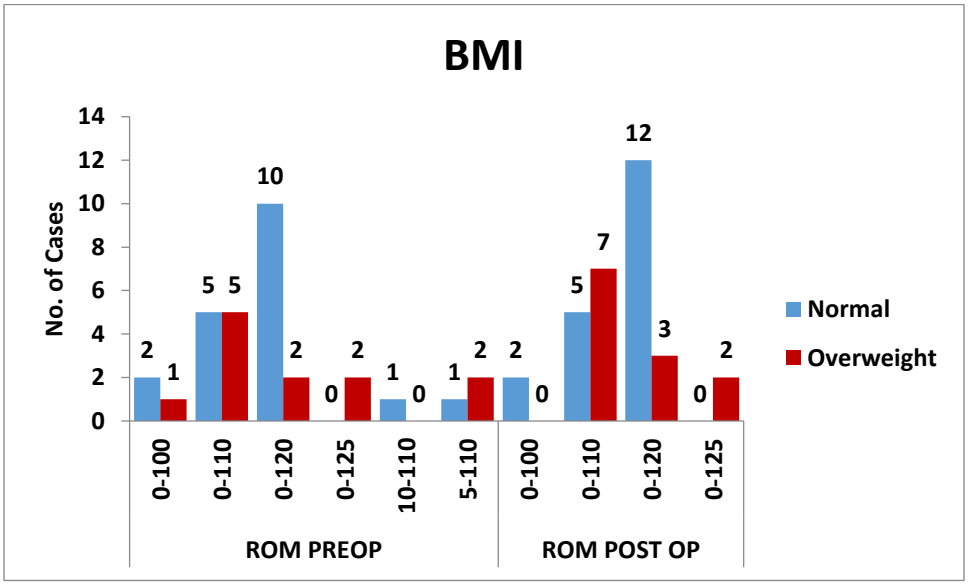
Association of BMI and Range of motion

Table 20: Distribution of BMI according to ROM

BMI	ROM PREOP						ROM POST OP			
	0-100	**0-110**	**0-120**	**0-125**	**10-110**	**5-110**	**0-100**	**0-110**	**0-120**	**0-125**
Normal	2	5	10	0	1	1	2	5	12	0
Overweight	1	5	2	2	0	2	0	7	3	2
Total	3	10	12	2	1	3	2	12	15	2
p value	0.167						0.35			

Note: p value* significant at 5% level of significance ($p<0.05$)

Figure 50: Distribution of BMI according to ROM



BMI is not significantly associated with range of motion.

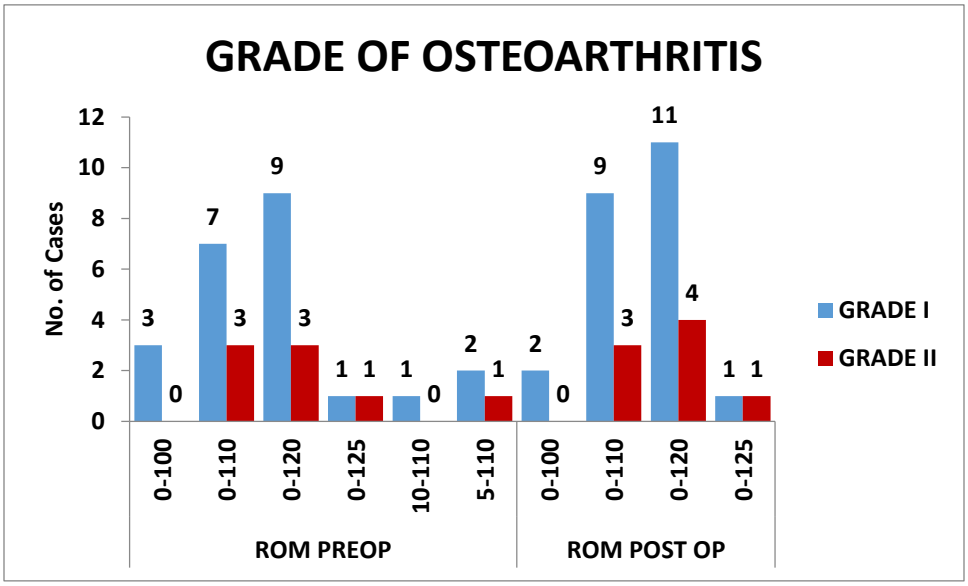
Association of Grade of osteoarthritis and Range of motion

Table 21: Distribution of grade of osteoarthritis according to ROM

GRADE OF OSTEOARTHRITIS	ROM PREOP						ROM POST OP			
	0-100	0-110	0-120	0-125	10-110	5-110	0-100	0-110	0-120	0-125
GRADE I	3	7	9	1	1	2	2	9	11	1
GRADE II	0	3	3	1	0	1	0	3	4	1
Total	3	10	12	2	1	3	2	12	15	2
p value	0.823						0.725			

Note: p value* significant at 5% level of significance ($p<0.05$)

Figure 51: Distribution of grade of osteoarthritis according to ROM



Grade of osteoarthritis is not significantly associated with post op range of motion.

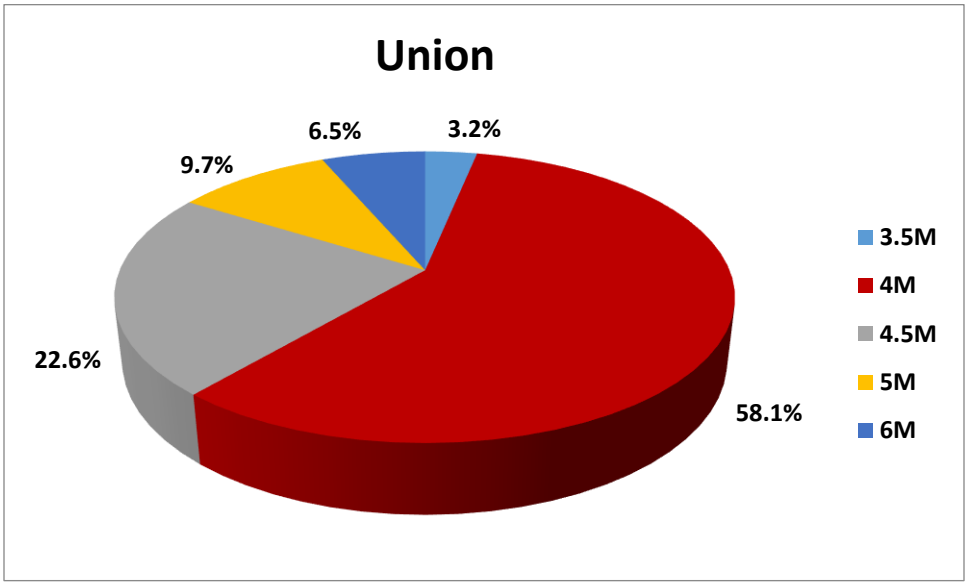
Union

Table 22: Distribution of Cases according to Union

Union	N	Percent
3.5M	1	3.2
4M	18	58.1

4.5M	7	22.6
5M	3	9.7
6M	2	6.5
Total	31	100

Figure 52: Distribution of Cases according to Union

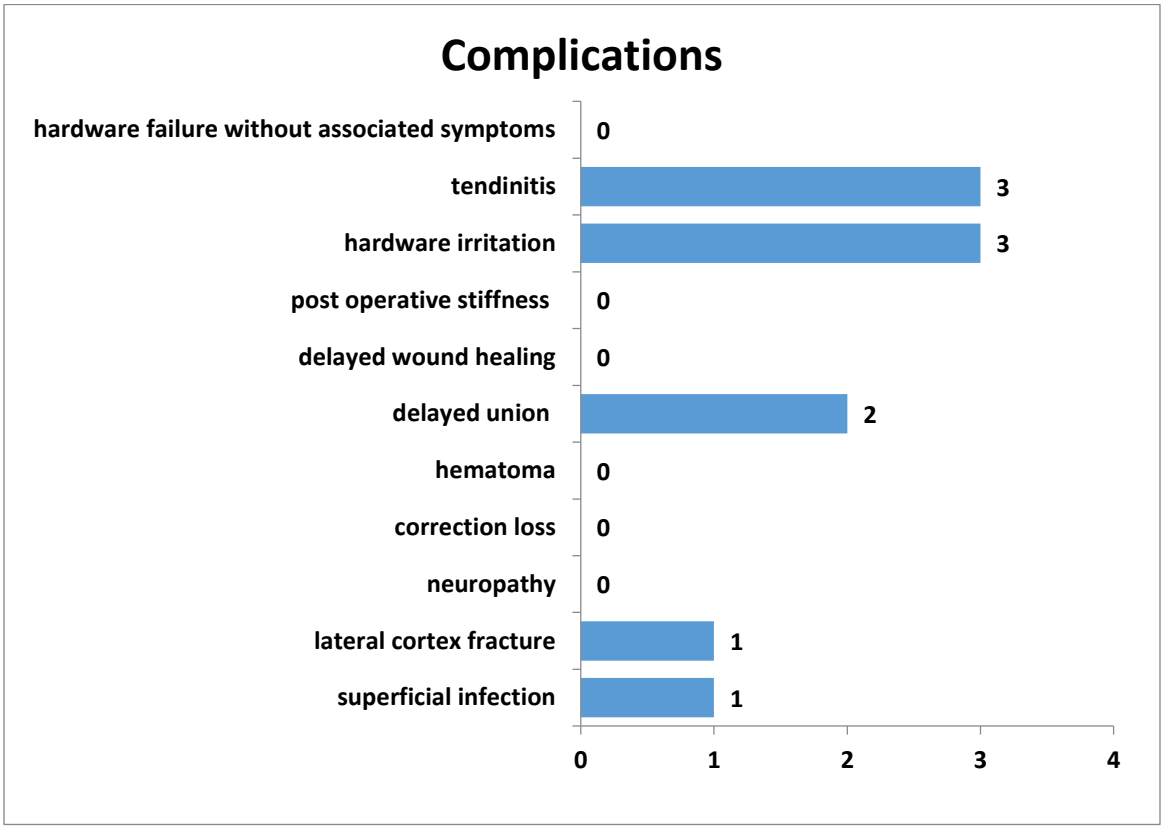


Osteotomy sites were united by 4 months in 18 patients (58.1 %), 4.5 months in 7 patients (22.6 %) and 6 months in 2 patients (6.5%).

Complications

Tendinitis and hardware irritation was see in 3 patients (9.6 %) each. Delayed union was noted in 2 (6.4 %) patients and lateral cortex fracture and superficial infection in 1 (3.2%) patient each.

Figure 53 Complications



Discussion

The redistribution of weight bearing to the medial side of the knee in medial compartment osteoarthritis leads to increased cartilage breakdown and, as a result, varus deformity.(1,25) Therefore, a unicompartmental knee replacement will not correct the alignment. To slow down the degenerative process, a corrective osteotomy to change the weight-bearing axis is ideal. Many factors influence the treatment and prognosis of medial compartment osteoarthritis in the knee, as follows-

- Age of the patient
- Patients general health
- Body mass index
- Grade of osteoarthritis
- Range of motion
- Angle of correction
- Concurrent medical illness

In the our study 31 patients of medial compartment osteoarthritis knee were evaluated.

In our study the average age was 48.9 years. We had 18 male patients and 13 female patients.

Osteoarthritis was graded according to Kellgren and Lawrence classification system. In our study 74.2 % patients belonged to osteoarthritis grade I and 25.2 % patients belonged to grade II.

Results were evaluated by Knee society score, Hospital for special surgeries knee score and visual analogue scale. The outcome was similar to M Asik et al that the postoperative pain usually disappears, and the patient's knee functions improve significantly post-surgery.

Saito et al., (2014) evaluated 78 cases of opening wedge high tibial osteotomy with a follow up of 6.5 years. They observed that the Knee Society Score improved from 49.6 before surgery to 88.1 after surgery.(40)

Bonasia et al., (2014) studied at a group of 99 people who had an opening wedge high tibial osteotomy with a puddu plate. They followed up with all of the patients for an average of 7.5 years. They discovered that after 5 years, the Knee society score (objective score + functional score) increased from 135.6± 33.9 to 160.5 ±26.3.(41)

Floeirkemeier et al., (2013) studied 386 patients who had an opening wedge high tibial osteotomy with a TomoFix plate. The average period of follow-up was two years. After the treatment, they discovered satisfactory midterm outcomes, with a mean oxford knee score of 43.(42)

Duivenvoorden et al., (2014) evaluated over 92 high tibial osteotomies with a TomoFix plate, 47 of which were closing wedge and 45 of which were medial opening wedge. The average follow-up period was 7.3 years. They observed that one one year year after surgery, the HSS score for OWHTO improved (baseline 72.3±9.5; one year 80.9 ±13.5; six years 80.8 ±13.8).(43)

According to our study statistically significant improvement was seen in preoperatively and post-operatively comparable in HSS, KSS and visual analogue scoring systems.

The association between BMI and medial open wedge high tibial osteotomy results is a topic of debate in the literature**. Flecher et al.** studied 313 individuals and observed that those with a BMI of less than 30 had better results. In a study of 95 high tibial osteotomy patients, Howells et al. found a similar result. (31)After high tibial osteotomy, **Giagounidis et al.** assessed 112 knees (94 patients) and concluded that patients with a BMI larger than 10% above normal values had a pain-free duration of 5 years, compared to 7.8 years for those with a BMI less than 10% above normal values.(29)

Comparing with the results of **Kolb et al** the consolidation of the wedge occurred without bone grafting in all 31 of our patients in about 3 to 6 months.(44)

Age, range of motion, body mass index, and osteoarthritis grade were not observed to be significant factors in the clinical and functional results of medial opening wedge high tibial osteotomy. Following the completion of multivariate linear regression analysis. The angle of deformity correction and MPTA were observed to be significant factors in the outcome of medial opening wedge high tibial osteotomy.

Seo S, Kim Gul et al (2016) studied 167 patients with medial opening wedge high tibial osteotomy. (45)They observed complications in 49 people in all. Lateral cortex fracture (15.6%), neuropathy (3.6%), correction loss (2.4%), hematoma (2.4%), delayed union (2.4%), delayed wound healing (2.4%), postoperative stiffness (1.2%), hardware irritation (1.2%), tendinitis (1.2%), and hardware failure without related symptoms were among the minor complications. Hardware failure with symptoms (0.6%), deep infection (0.6%), and nonunion (0.6%) were the most common consequences (0.6 percent). They came to the conclusion that medial opening wedge high tibial osteotomy is a safe and effective procedure.Most of their complications were minor and recovered without any significant problems nor did most of the complications have any significant impact on the radiological and clinical outcomes.(45,46)

In our study of 31 patients we found similar results to literature in short term outcome. Most common complications were hardware irritation (9.6%) (n= 3); tendinitis (9.6%) (n=3). Both of these complications were treated with NSAIDS and did not alter the final functional or clinical outcome. Only one patient sustained lateral cortex fracture (3.2%) and one patient had superficial surgical site infection (3.2%). No cases of peroneal nerve palsy were noted.Two patients (6.4) had a complication

of delayed union; osteotomy site was united by 6 months. There was no difference in outcomes at 6 months due to these complications.

As stated by Sen et al, long term studies are lacking in high tibial osteotomies and are necessary for more clear idea about the outcome. However, in unicompartmental osteoarthritis of the knee, osteotomy is clearly a feasible choice, according to this short-term analysis.(1)

We observed medial opening wedge high tibial osteotomy to be a safe and reliable surgery for medial osteoarthritis of the knee, according to the literature. The majority of complications had no discernible influence on radiologic or clinical outcomes.

Conclusion

Literature suggests that medial opening wedge high tibial osteotomy is safe and a reliable procedure for medial compartment osteoarthritis. According to our study and use of both Tomofix and puddu plate for osteotomy fixation we can say that:

- In unicompartmental osteoarthritis, medial open wedge osteotomy is an effective treatment option that reduces discomfort and improves patients' functional outcomes.
- We also observed that age, BMI, pre-operative ROM, Grade of osteoarthritis did not have a significant relationship with the functional outcome of the procedure.
- Medial opening wedge high tibial osteotomy is a safe procedure without major complications. However, attention needs to be paid to avoid these complications.

Thus we can conclude that Medial opening wedge high tibial osteotomy with plate fixation after proper training and expertise is a reliable and effective procedure for medial compartment osteoarthritis of knee joint.

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Annexure I

Ethical committee certificate

B.L.D.E.(Deemed to be University)
SHRI B.M.PATIL MEDICAL COLLEGE,VIJAYAPUR-586103
INSTITUTIONAL ETHICAL COMMITTEE

Date : 13-11-2019

1. Name of UG/PG Students/Researcher: Dr. Ravikant Kumar Bhogshetti
2. Department : Orthopaedics
3. Title : A Prospective Study Of Functional Outcome Of Medial Opening Wedge High Tibial Osteotomy With Tibial Plate Fixation In Medial Compartment Osteoarthritis of Knee
4. Guide/Co-Guide/Principle Researcher: Dr.Ramangouda Biradar, Associate Professor
5. Date of Admission (PG Only) :

Observation :

- There are no ethical issues.

I.E.C. Remarks : Ethical Clearance accorded/be Chairman after corrected revised version is submitted by stipulated time.

1. Any alternation in Synopsis protocol should be intimated to E.C. in writing for review & approval.
2. Any adverse effects to subject of the study should be intimated in writing to E.C.
3. If study is stopped or an included patient is out of study inform E.C. the same with reason.

Signature of the Committee Members :

1. Dr Raghavendra Kulkarni, Chairman
2. Dr Tejaswini Vallabha
3. Dr Akram Naikawadi
4. Dr P.B.Jaju
5. Dr Chandrashekhar Bhuyyar
6. Dr Pranesh Jahagirdar
7. Dr Manjunatha Aithala
8. Dr Satish Patil
9. Dr Mohammed Shannawaz

ANNEXURE II

B.L.D.E. (DEEMED TO BE UNIVERSITY) SHRI B.M.PATIL MEDICAL COLLEGE HOSPITAL AND RESEARCH CENTER, VIJAYAPURA -586103

INFORMED CONSENT FOR PARTICIPATION IN DISSERTATION/RESEARCH

I, the undersigned,_____ , S/O D/O W/O _____, aged ____years, ordinarily resident of _____ do hereby state/declare **that Dr. Bhogshetti Ravikant Kumar** of Shri. B. M. Patil Medical College Hospital and Research Centre has examined me thoroughly on _____ at _____ (place) and it has been explained to me in my own language that I am suffering from _____ disease (condition) and this disease/condition mimic following diseases. Further Dr. Bhogshetti Ravikant Bhogshetti informed me that he/she is conducting dissertation/research titled "A Clinical Study Of Functional Outcome Of Medial Opening Wedge High Tibial Osteotomy with tibial plate fixation in medial compartment osteoarthritis of knee" under the guidance of **Dr. Ramanagouda Biradar** requesting my participation in the study. Apart from routine treatment procedure, the pre-operative, operative, post-operative and follow-up observations will be utilized for the study as reference data.

Doctor has also informed me that during conduct of this procedure, adverse results may be encountered. Most of them are treatable but are not anticipated hence there is chance of aggravation of my condition and in rare circumstances it may prove fatal in spite of anticipated diagnosis and best treatment made available. Further Doctor has informed me that my participation in this study help in evaluation of the results of the study which is useful reference to treatment of other similar cases in near future, and also I may be benefited in getting relieved of suffering or cure of the disease I am suffering.

The Doctor has also informed me that information given by me, observations made/ photographs/ video graphs taken upon me by the investigator will be kept secret and not assessed by the person other than me or my legal hirer except for academic purposes.

The Doctor did inform me that though my participation is purely voluntary, based on information given by me, I can ask any clarification during the course of treatment / study related to diagnosis, procedure of treatment, result of treatment or prognosis. At the same time I have been informed that I can withdraw from my participation in this study at any time if I want or the investigator can terminate me from the study at any time from the study but not the procedure of treatment and follow-up unless I request to be discharged.

After understanding the nature of dissertation or research, diagnosis made, mode of treatment, I the undersigned Shri/Smt _____ under my full conscious state of mind agree to participate in the said research/dissertation.

Signature of patient:

Witness: 1.

2.

Signature of doctor:

Date:

Place:

ANNEXURE – III

SHRI B.M. PATIL MEDICAL COLLEGE, HOSPITAL AND RESEARCH CENTRE, VIJAYAPURA – 586103

PROFORMA

CASE NO. :

FOLLOWUP NO. :

NAME :

AGE/SEX :

I P NO :

DATE OF ADMISSION :

DATE OF SURGERY :

DATE OF DISCHARGE :

OCCUPATION :

RESIDENCE :

Presenting complaints with duration :

History of presenting complaints :

Family History :

Personal History :

Past History :

General Physical Examination

Pallor: present/absent

Icterus: present/absent

Clubbing: present/absent

Generalized lymphadenopathy: present/absent

Built: poor/moderate/well

Nourishment: poor/moderate/well

Vitals

PR: RR:

BP: TEMP:

Systemic Examination:

Respiratory system -

Cardiovascular system -

Per abdomen -

Central nervous system -

Local examination:

Right/ Left Leg

Gait:

Inspection:

a) Attitude

b) Abnormal swelling

- Site
- Size
- Shape
- Extent

c) Deformity

d) Skin condition

Palpation:

a) Swelling
b) Local tenderness
c) Bony irregularity
d) Abnormal movement
e) Crepitus/ grating of fragments
f) Absence of transmitted movements
g) Range of movement
h) Angular deformity

Movements:	Active	Passive
Flexion		
Extension		
Internal rotation		
External rotation		

Angle of correction

MPTA

Knee society score

Hospital for special surgeries score

Visual analogue scale-

Master chart

SR NC	IP NO	Name	Age	Sex	Heigh	weight	Comorbiditi	Date of surg	PRE-OP FLEXION	PRE-OP EXTENSION	POST-OP FLEXION	POST-OP EXTENSION	DIAGNOSIS	SURGERY	GRADE OF OSTEOARTHRITIS	ANGLE OF CORRECTION	MPTA	Union
1	12541	sampath kumar	52	m	157CM	63KG	NIL	10/31/2019	0-110	0	0-110	0	RIGHT KNEE MEDIAL COMPARTMENTAL OSTEOARTHRITIS	MEDIAL OPENING WEDGE HIGH TIBIAL OSTEOTOMY	GRADE II	10	80	4.5M
2	42380	Rakesh	48	m	163CM	68KG	HYPERTENSION	10/31/2019	0-120	0	0-120	0	LEFT KNEE MEDIAL COMPARTMENTAL OSTEOARTHRITIS	MEDIAL OPENING WEDGE HIGH TIBIAL OSTEOTOMY	GRADE I	10	84	4M
3	42818	Kashibai	50	f	156CM	70KG	NIL	11/13/2019	0-125	0	0-125	0	LEFT KNEE MEDIAL COMPARTMENTAL OSTEOARTHRITIS	MEDIAL OPENING WEDGE HIGH TIBIAL OSTEOTOMY	GRADE I	12	83	4M
4	1209	Haseena	52	f	168CM	72KG	NIL	11/21/2019	0-130	0	0-130	0	LEFT KNEE MEDIAL COMPARTMENTAL OSTEOARTHRITIS	MEDIAL OPENING WEDGE HIGH TIBIAL OSTEOTOMY	GRADE II	10	80	6M
5	44083	Sanjawwa	41	f	155CM	57KG	NIL	11/3/2019	0-110	0-5	0-110	0	LEFT KNEE MEDIAL COMPARTMENTAL OSTEOARTHRITIS	MEDIAL OPENING WEDGE HIGH TIBIAL OSTEOTOMY	GRADE I	8	85	4M
6	6942	Sharanu	47	m	163CM	63KG	NIL	12/15/2019	0-105	0	0-105	0	RIGHT KNEE MEDIAL COMPARTMENTAL OSTEOARTHRITIS	MEDIAL OPENING WEDGE HIGH TIBIAL OSTEOTOMY	GRADE I	8	84	4.5M
7	8760	Shantayya	45	m	155CM	64KG	NIL	12/8/2019	0-110	0	0-110	0	LEFT KNEE MEDIAL COMPARTMENTAL OSTEOARTHRITIS	MEDIAL OPENING WEDGE HIGH TIBIAL OSTEOTOMY	GRADE I	8	84	4M
8	739	Mallawwa	41	f	158CM	58KG	NIL	12/20/2019	0-120	0	0-120	0	RIGHT KNEE MEDIAL COMPARTMENTAL OSTEOARTHRITIS	MEDIAL OPENING WEDGE HIGH TIBIAL OSTEOTOMY	GRADE I	8	85	4M
9	125995	Sunil Kumar	54	m	163CM	68KG	HYPERTENSION	1/10/2020	0-100	0	0-110	0	LEFT KNEE MEDIAL COMPARTMENTAL OSTEOARTHRITIS	MEDIAL OPENING WEDGE HIGH TIBIAL OSTEOTOMY	GRADE I	8	85	4M
10	135543	Shanatamma	51	f	153CM	67KG	NIL	1/18/2020	0-110	0	0-110	0	LEFT KNEE MEDIAL COMPARTMENTAL OSTEOARTHRITIS	MEDIAL OPENING WEDGE HIGH TIBIAL OSTEOTOMY	GRADE I	8	83	4.5M
11	135541	Mallappa	49	m	163CM	73KG	NIL	1/25/2020	0-110	0	0-110	0	RIGHT KNEE MEDIAL COMPARTMENTAL OSTEOARTHRITIS	MEDIAL OPENING WEDGE HIGH TIBIAL OSTEOTOMY	GRADE I	8	85	5M
12	135540	Nagamma	49	f	157CM	67KG	NIL	1/30/2020	0-120	0	0-120	0	RIGHT KNEE MEDIAL COMPARTMENTAL OSTEOARTHRITIS	MEDIAL OPENING WEDGE HIGH TIBIAL OSTEOTOMY	GRADE I	8	84	4M
13	147064	Revappa	55	m	167CM	65KG	DIABETIC	1/10/2020	0-120	0	0-120	0	LEFT KNEE MEDIAL COMPARTMENTAL OSTEOARTHRITIS	MEDIAL OPENING WEDGE HIGH TIBIAL OSTEOTOMY	GRADE I	8	85	4M
14	147062	Kallappa	52	m	169CM	63KG	NIL	1/17/2020	0-120	0	0-120	0	LEFT KNEE MEDIAL COMPARTMENTAL OSTEOARTHRITIS	MEDIAL OPENING WEDGE HIGH TIBIAL OSTEOTOMY	GRADE II	10	83	4M
15	158191	Ramesh	48	m	164CM	56KG	NIL	1/27/2020	0-110	0	0-110	0	RIGHT KNEE MEDIAL COMPARTMENTAL OSTEOARTHRITIS	MEDIAL OPENING WEDGE HIGH TIBIAL OSTEOTOMY	GRADE I	8	84	4M
16	158189	Shekhar Chavan	44	m	176CM	76KG	NIL	1/5/2020	0-120	0	0-120	0	RIGHT KNEE MEDIAL COMPARTMENTAL OSTEOARTHRITIS	MEDIAL OPENING WEDGE HIGH TIBIAL OSTEOTOMY	GRADE II	10	81	4M
17	158192	Ashok	52	m	167CM	64KG	HYPERTENSION	2/10/2020	0-120	0	0-120	0	LEFT KNEE MEDIAL COMPARTMENTAL OSTEOARTHRITIS	MEDIAL OPENING WEDGE HIGH TIBIAL OSTEOTOMY	GRADE I	8	82	4.5M
18	158488	Neelamma	60	f	154CM	60KG	NIL	2/15/2020	0-110	0-5	0-110	0	LEFT KNEE MEDIAL COMPARTMENTAL OSTEOARTHRITIS	MEDIAL OPENING WEDGE HIGH TIBIAL OSTEOTOMY	GRADE I	8	85	5M
19	121792	Tammaray	48	m	156CM	57KG	NIL	2/23/2020	0-120	0	0-120	0	RIGHT KNEE MEDIAL COMPARTMENTAL OSTEOARTHRITIS	MEDIAL OPENING WEDGE HIGH TIBIAL OSTEOTOMY	GRADE I	10	84	4M
20	86519	Fatima	55	f	165CM	63KG	NIL	1/20/2021	0-110	0	0-110	0	LEFT KNEE MEDIAL COMPARTMENTAL OSTEOARTHRITIS	MEDIAL OPENING WEDGE HIGH TIBIAL OSTEOTOMY	GRADE I	10	82	4M
21	20328	Irappa	40	m	170CM	68KG	NIL	1/24/2021	0-100	0	0-120	0	RIGHT KNEE MEDIAL COMPARTMENTAL OSTEOARTHRITIS	MEDIAL OPENING WEDGE HIGH TIBIAL OSTEOTOMY	GRADE I	8	84	4M
22	21430	Yaveen	45	m	168CM	60KG	NIL	1/28/2021	0-120	0	0-120	0	LEFT KNEE MEDIAL COMPARTMENTAL OSTEOARTHRITIS	MEDIAL OPENING WEDGE HIGH TIBIAL OSTEOTOMY	GRADE II	10	83	3.5M
23	21126	Maruthi	48	m	174CM	68KG	NIL	1/4/2021	0-120	0	0-120	0	RIGHT KNEE MEDIAL COMPARTMENTAL OSTEOARTHRITIS	MEDIAL OPENING WEDGE HIGH TIBIAL OSTEOTOMY	GRADE I	10	83	4.5M
24	21041	Avinash	53	m	169CM	69KG	NIL	1/11/2021	0-110	0-10	0-120	0	LEFT KNEE MEDIAL COMPARTMENTAL OSTEOARTHRITIS	MEDIAL OPENING WEDGE HIGH TIBIAL OSTEOTOMY	GRADE I	8	83	4.5M
25	31524	Vinaya	42	f	165CM	67KG	NIL	1/15/2021	0-110	0	0-100	0	LEFT KNEE MEDIAL COMPARTMENTAL OSTEOARTHRITIS	MEDIAL OPENING WEDGE HIGH TIBIAL OSTEOTOMY	GRADE I	8	83	4M
26	49690	Bhima	43	f	165CM	57KG	NIL	2/20/2021	0-120	0	0-120	0	RIGHT KNEE MEDIAL COMPARTMENTAL OSTEOARTHRITIS	MEDIAL OPENING WEDGE HIGH TIBIAL OSTEOTOMY	GRADE I	8	83	6M
27	49692	Umesh	55	m	162CM	60KG	NIL	2/18/2021	0-120	0	0-120	0	LEFT KNEE MEDIAL COMPARTMENTAL OSTEOARTHRITIS	MEDIAL OPENING WEDGE HIGH TIBIAL OSTEOTOMY	GRADE I	8	83	4M
28	75492	Uma	46	f	167CM	65KG	NIL	2/8/2021	0-110	0	0-110	0	LEFT KNEE MEDIAL COMPARTMENTAL OSTEOARTHRITIS	MEDIAL OPENING WEDGE HIGH TIBIAL OSTEOTOMY	GRADE I	8	82	5M
29	10843	Annapurna	47	f	158CM	64KG	NIL	2/1/2021	0-120	0-5	0-120	0	LEFT KNEE MEDIAL COMPARTMENTAL OSTEOARTHRITIS	MEDIAL OPENING WEDGE HIGH TIBIAL OSTEOTOMY	GRADE II	12	80	4M
30	86524	Iramma	56	m	167CM	69KG	HTN and DM	2/15/2021	0-110	0	0-110	0	RIGHT KNEE MEDIAL COMPARTMENTAL OSTEOARTHRITIS	MEDIAL OPENING WEDGE HIGH TIBIAL OSTEOTOMY	GRADE II	10	80	4.5M
31	53005	Suraiyya	49	f	170CM	76KG	NIL	2/27/2021	0-110	0	0-110	0	LEFT KNEE MEDIAL COMPARTMENTAL OSTEOARTHRITIS	MEDIAL OPENING WEDGE HIGH TIBIAL OSTEOTOMY	GRADE II	12	81	4M

	KSS																HSS				VAS					
Implants	PRE OP				6weeks				3months				6 months				PRE OP	6weeks	3months	6 months	PRE OP	6 weeks	3 months	6 months	Weight bearing	Complications
	Objective score	Patient satisfaction	Patient expectation	Functional score	Objective score	Patient satisfaction	Patient expectation	Functional score	Objective score	Patient satisfaction	Patient expectation	Functional score	Objective score	Patient satisfaction	Patient expectation	Functional score										
TOMOFIX	58	14	15	60	60	32	15	66	90	34	15	90	85	38	14	88	58	80	84	85	8	4	3	0	6 w	nil
TOMOFIX	60	10	15	60	68	30	15	65	90	34	9	90	85	40	15	90	62	80	85	82	7	4	2	1	6 W	nil
TOMOFIX	56	8	15	60	66	38	15	72	90	36	15	90	92	36	15	92	58	82	80	80	8	5	2	2	8 W	nil
PUDDU	60	10	15	60	65	26	12	68	90	36	15	90	88	38	15	86	62	84	86	86	8	4	2	1	8 W	delayed union
TOMOFIX	50	8	15	53	65	30	13	68	90	36	9	90	90	40	12	92	54	82	84	84	9	4	1	0	6 W	hardware irritation,t
PUDDU	58	10	15	62	70	36	15	70	90	32	15	90	90	38	15	88	58	84	84	86	8	3	2	1	6 W	nil
TOMOFIX	56	8	15	58	72	30	11	76	90	34	15	90	86	40	14	90	54	70	84	84	7	4	3	2	6 W	nil
TOMOFIX	52	4	15	50	68	30	12	70	88	34	9	90	82	40	14	90	52	80	84	86	8	5	4	1	8 W	tendinitis
TOMOFIX	56	0	15	60	68	30	12	65	90	34	15	90	90	38	13	90	60	84	88	88	8	4	3	2	8 W	nil
PUDDU	62	0	15	64	64	30	15	68	86	32	10	86	85	36	12	83	60	85	87	87	9	3	2	1	6 W	nil
TOMOFIX	56	0	15	54	60	30	15	60	86	34	15	86	85	38	13	83	58	87	87	88	7	3	1	2	6 W	nil
PUDDU	52	4	15	50	68	32	12	74	84	34	11	84	86	40	13	84	58	75	80	80	8	3	2	1	6 W	nil
TOMOFIX	58	2	15	60	68	36	15	68	86	36	15	86	87	40	14	88	60	88	90	90	7	4	2	2	8 W	nil
TOMOFIX	62	4	15	58	70	30	15	70	88	36	15	86	89	40	14	86	62	84	85	84	8	5	2	1	8 W	superficial infection
TOMOFIX	54	4	15	56	60	32	12	62	84	36	15	88	84	38	14	88	54	80	80	80	7	4	3	2	6 W	nil
TOMOFIX	60	0	15	66	70	38	15	68	90	34	15	90	90	40	15	86	62	86	90	92	8	5	2	0	6 W	nil
PUDDU	60	0	15	60	68	26	15	74	86	34	11	84	86	38	15	84	60	86	86	90	9	3	1	0	6 W	nil
TOMOFIX	62	0	15	60	72	30	12	72	86	34	15	86	86	36	15	84	60	90	84	86	8	3	2	1	8 W	nil
PUDDU	58	0	15	60	78	36	15	76	88	32	15	87	88	38	15	87	60	90	80	88	9	3	3	2	8 W	Lateral cortex fractu
PUDDU	52	0	15	48	72	30	15	68	86	34	11	84	86	40	14	83	52	86	86	88	7	4	2	0	6 W	nil
TOMOFIX	51	10	15	40	66	30	15	65	86	34	11	86	85	38	15	84	51	88	84	86	8	3	1	1	6 W	nil
PUDDU	68	8	15	60	70	30	12	70	88	36	15	86	88	38	15	90	68	82	82	83	9	4	2	2	6 W	nil
TOMOFIX	59	12	15	50	72	30	15	64	84	36	15	82	84	40	14	83	59	86	84	84	8	3	1	0	6 W	nil
PUDDU	60	12	15	64	68	28	14	68	88	36	15	88	88	40	15	86	64	86	86	88	7	4	2	1	6 W	hardware irritation
TOMOFIX	58	8	15	50	66	30	13	65	86	32	15	86	88	38	15	84	60	84	84	84	8	3	3	2	6 W	nil
PUDDU	62	10	15	60	70	30	15	65	88	34	12	88	86	36	14	86	60	80	85	88	9	4	2	1	6 W	delayed union
PUDDU	49	10	15	50	72	28	12	72	88	34	15	88	88	38	15	84	52	86	87	87	8	3	1	0	6 W	hardware irritation
TOMOFIX	53	10	15	54	74	28	15	74	90	34	15	90	90	40	15	90	56	90	86	90	9	4	2	2	8 W	nil
TOMOFIX	62	10	15	66	65	28	15	68	88	36	15	88	90	40	15	90	62	84	82	82	8	3	3	3	6 W	nil
TOMOFIX	50	10	15	50	69	30	15	65	86	36	12	88	88	40	15	88	50	86	86	86	8	3	2	1	6 W	tendinitis
TOMOFIX	64	10	15	60	72	30	15	70	90	34	15	90	90	40	15	90	64	85	85	88	9	4	1	2	8W	nil