A RETROSPECTIVE AND PROSPECTIVE STUDY ON

ANALYSIS OF CLINICAL OUTCOME OF

KNEE SPARING FIXATION

AFTER TEMPORARY

KNEE SPANNING EXTERNAL FIXATION

Dissertation submitted to

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ORTHOPAEDIC SURGERY

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CERTIFICATE

This is to certify that this dissertation titled **"A Retrospective and Prospective Study on Analysis of Clinical Outcome of Knee Sparing Fixation after Temporary Knee Spanning External Fixation"** is a bonafide record of work done by **DR.A.SYED ABDHAHIR,** during the period of his Post graduate study from May 2012 to September 2014 under guidance and supervision in the INSTITUTE OF ORTHOPAEDICS AND TRAUMATOLOGY, Madras Medical College and Rajiv Gandhi Government General Hospital, Chennai-600003, in partial fulfillment of the requirement for **M.S.ORTHOPAEDIC SURGERY** degree Examination of The Tamilnadu Dr. M.G.R. Medical University to be held in April 2015.

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DECLARATION

I declare that the dissertation entitled **"A Retrospective and Prospective Study on Analysis of Clinical Outcome of Knee Sparing Fixation after Temporary Knee Spanning External Fixation "** Submitted by me for the degree of M.S is the record work carried out by me during the period of **May 2012 to September 2014** under the guidance of **Prof.V.SINGARAVADIVELU,M.S.Ortho.,D.Ortho.,** Professor of Orthopaedics, Institute of Orthopaedics and Traumatology, Madras Medical College, Chennai. This dissertation is submitted to the Tamilnadu Dr.M.G.R. medical university, Chennai, in partial fulfillment of the University regulations for the award of degree of M.S.ORTHOPAEDICS (BRANCH-II) examination to be held in April 2015.

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ABSTRACT

TITLE: RETROSPECTIVE AND PROSPECTIVE STUDY ON ANALYSIS OF CLINICAL OUTCOME OF KNEE SPARING FIXATION AFTER TEMPORARY KNEE SPANNING EXTERNAL FIXATION

ABSTRACT: Compound periarticular knee injuries are difficult to treat. Compound periarticular knee injury occurs usually due to high energy/velocity trauma. There is an increase in the occurrence of compound periarticular knee injuries due to the increase in the number of road traffic accidents. These injuries are always associated with high morbidity. Most of these injuries result in some permanent disability. Immediate open reduction and internal fixation of these high velocity injuries were associated with larger rates of deep seated infection and even amputation. These patients should undergo staged intervention with initial temporary knee spanning external fixation. Early planned conversion from temporary knee spanning external fixator to definitive knee sparing internal or external fixation is necessary to get optimal out come in union and knee function. For this study 30 patients with high energy periarticular knee fractures were included. All these patients were treated with initial temporary knee spanning external fixation and then converted to definitive knee sparing internal or external fixation. The overall functional outcome was assessed using knee society score. The results show 8 patients (26.67%) with excellent outcome, 5 patients (16.67%) with good outcome, 8 patients (26.67%) with fair outcome and 9 patients (30%) with poor outcome. The most important factors which determine the functional outcomes were the type of fractures (open or closed), nature of comminution including intra articular extensions, timing of fixations and postoperative infections. Duration of initial knee spanning external fixator and final knee range of motion have statistically significant association.

KEY WORDS: Compound periarticular knee injuries, knee spanning external fixation, definitive knee sparing fixation, knee society score, comminution

INTRODUCTION

Fractures are known to be as old as mankind itself, It goes as far back as the Egyptian mummies (2700 BC).

External splintage has been the only option for thousands of years. In older days palm bark and linen bandages were used for external splintage.

In 1987 Clayton Park Hill developed the modern external fixator. He used unilateral external fixator with two pairs of screws on either side of the fracture. Dr. Roger Anderson used a frame with Trans fixation pins in1934. Even now external fixators play a major role in fracture fixation.

Primary total care of all bone fractures in multiple injured patients may benefit sometimes. However this mode of treatment is not a good option, rather it might be dangerous for some. To avoid such complications, the concept of damage control orthopedics was developed.

“Damage control” is a term used to explain procedures performed to keep a compromised ship afloat. In medicine general surgeons first utilized this term to describe immediate lifesaving procedures to control internal hemorrhage and minimize definitive lengthy procedures that may be deleterious to the patients following trauma. Only after the patient is resuscitated and adequately stabilized, definitive procedures can be performed. The term "damage control orthopedics" was first used by scalea(1) to describe a similar approach to musculoskeletal trauma.

Damage control orthopedics emphasizes control of the ongoing injury and stabilization with external fixation. Damage control orthopedics is an approach that stabilizes and contains orthopedic injuries so that the overall physiology of the patients can improve. The purpose is to avoid worsening of the condition of the patient by the "second hit" of a major orthopedic surgical procedure and to delay definitive repair of fractures until the time when the patient's overall condition is optimized. Minimally invasive techniques such as external fixation are used initially. Damage control orthopedics focuses on control of hemorrhage, soft tissue injury management and achievement of provisional fracture stability, in the meantime avoiding additional insults to the patients.

High velocity injuries like road traffic accidents produce complex and violent injuries often multiple fractures in the same limb, which increase the problems of their management. These injuries mostly associated with local soft tissue compromise and injuries to abdomen, head or chest.

Historically, immediate open reduction and internal fixation of these high velocity injuries were associated with larger rates of deep seated infection and even amputation.[2] It has been shown that immediate open reduction and internal fixation (ORIF) of lower extremity periarticular fractures through compromised soft tissues has higher wound complication rates.[3] The theory of damage control orthopedics, therefore, allows for at least partial recovery of the patient's biologic reserve and soft tissues after traumatic injury prior to further reconstructive procedures.[4]

There are two categories of patients who can benefit from temporary external stabilization of lower extremity injuries.

The first group of patients includes those who are multiple injured or clinically unstable at the time of presentation to the emergency room.

The second group of patients that would benefit from temporary external stabilization includes those with isolated, complex, and unstable extremity injuries with soft-tissue compromise. Frequently, these injuries are associated with shortened, deformed diaphyseal, and periarticular extremity fractures.

Benefits of temporary external fixation

- Easy to apply.
- Applied rapidly, even with inexperienced staff.
- Able to rigidly stabilize multiple, ipsilateral fractures/dislocations during single procedure.
- Important in comminuted intra/periarticular injuries to maintain appropriate length.
- Significantly improves quality of radiographic evaluation such as CT scan.
- Allows easy access to traumatic and surgical wounds.
- Minimizes further possible embolic pulmonary insult.
- Negligible blood loss.
- Reduces need for narcotic analgesia.
- Improves patient mobility in bed during transfers and with nursing care

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Prolonged joint spanning external fixator leads to severe joint stiffness, pin site infection and poor functional outcome. So, early planned conversion from temporary knee spanning external fixator to definitive knee sparing internal or external fixation is necessary to get optimal out come in union and knee function.

AIM OF THE STUDY

The aim of our study is to analyze retrospectively and prospectively the clinical outcomes in patients treated with temporary knee spanning external fixation followed by definitive knee sparing internal or external fixation for high energy periarticular knee fractures and floating knee fractures at the Madras Medical College and Institute of Orthopedics and Traumatology, Rajiv Gandhi Government General Hospital, Chennai between August 2013 to August 2014.

APPLIED ANATOMY

FEMUR

The femur is the strongest and longest bone in the human body (Figs.1&2). Femur shaft, almost cylindrical along most of its length, is bowed forward. It has a proximal rounded, articular head projecting medially from its short neck, which is a medial extension of the proximal shaft. The distal extremity is wider and presents a double condyle that articulates with the tibia. In standing, the femoral shafts on two sides show an inclination upwards and outwards from their tibial articulations, with the femoral heads being separated by the pelvic width. Tibia and fibula descend vertically from the knees. So the ankles are also in the line of body weight in standing or walking. The degree of femoral obliquity varies between individuals and is generally greater in women, reflecting the relatively greater pelvic breadth. The femur consists of a head, neck, and greater and lesser trochanters proximally.

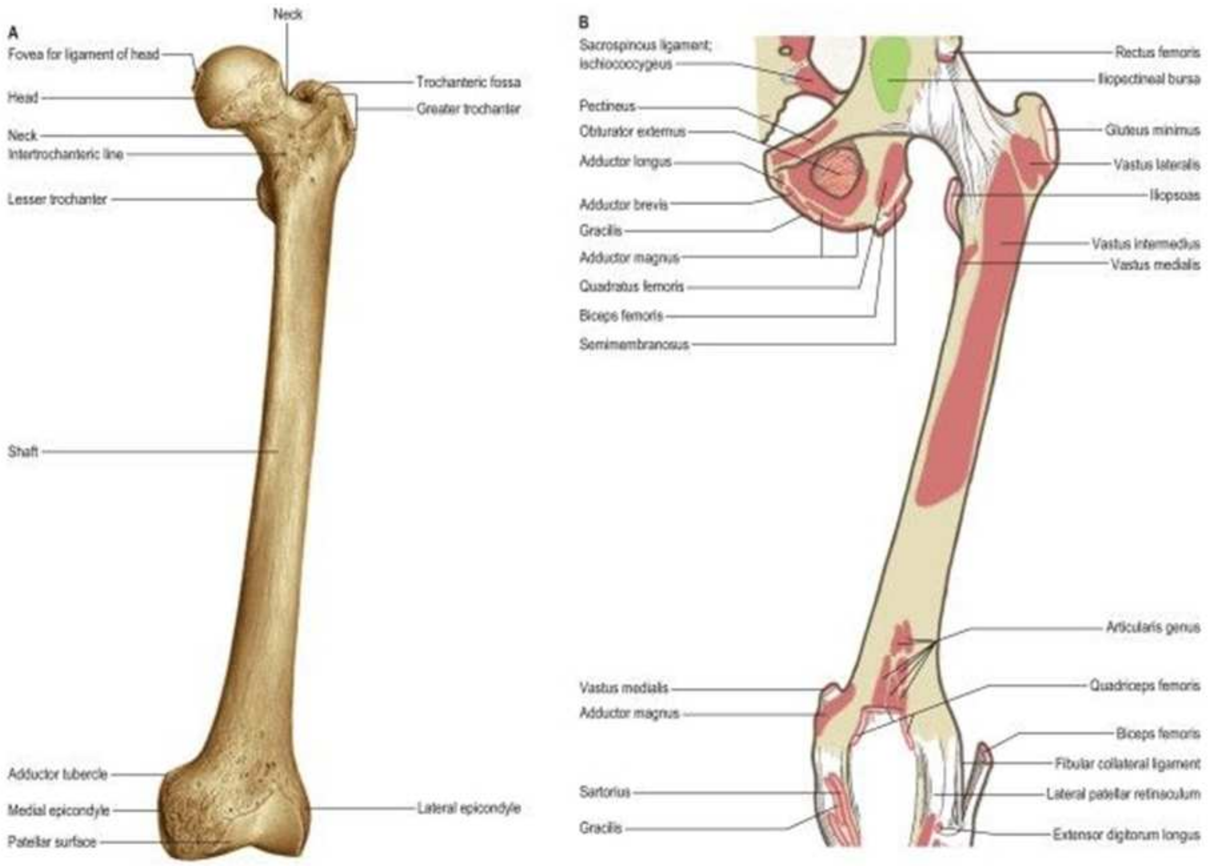
Shaft of femur

The shaft is surrounded by muscles and impalpable (Figs.1&2). Distal and anteriorly, for 5–6 cm above the patellar articular surface, it is covered by a suprapatellar bursa, between bone and muscle. The distal lateral surface is covered by vastus intermedius. The medial surface is devoid of attachments and covered by vastus medialis.

The shaft is narrowest centrally and expands a little at its proximal end, and substantially more at its distal end. Its middle third has three borders and surfaces. The extensive anterior surface, smooth and gently convex, is between the lateral and medial borders, which are both round and not sharply defined. The posterolateral surface is bounded posteriorly by the broad, rough linea aspera, which is usually a crest with lateral and medial edges. Its subjacent compact bone is made bigger to withstand compressive forces, which are concentrated here by the anterior curvature of the shaft. Adductor longus, intermuscular septa and the short head of biceps femoris gets attached to linea aspera, all inseparably blended at their attachments. Perforating arteries crosses the linea laterally below tendinous arches in adductor magnus and biceps femoris. Nutrient foramina, directed proximally, appear in the linea aspera, varying in number and site, one which is usually near its proximal end, a second usually near its distal end. The posteromedial surface, which is smooth like the others, is bounded in front by the indistinct medial border and behind by the linea aspera. In its proximal third the shaft has a fourth, posterior surface, bounded medially by a narrow, rough spiral line that is continuous proximally with the intertrochanteric line, distally with the medial edge of linea aspera. Laterally this posterior surface is limited by the broad, rough, gluteal tuberosity, ascending a little laterally to the greater trochanter and descending to the lateral edge of the linea aspera. In its distal third the posterior surface of the shaft has a further surface, the popliteal surface between the medial and lateral supracondylar lines. These supracondylar lines are continuous above with the corresponding edges of the linea aspera. The lateral line is the most distinct in its proximal two-thirds, where the short head of biceps femoris and lateral intermuscular septum are attached. Its distal third has a tiny rough area for the attachment of plantaris, often encroaching on the popliteal surface. The medial line is not clear in its proximal two-thirds, where vastus medialis is attached. On the distal aspect, the medial line is crossed obliquely by the femoral vessels entering the popliteal fossa from the adductor canal. Further distally, the line is often sharp for 3 or 4 cm and proximal to the adductor tubercle.

The popliteal surface, which is triangular in outline, lies between the medial and lateral supracondylar lines. Distally its medial part is rough and slightly elevated. Forming the proximal part of the floor of the popliteal fossa, the popliteal surface is covered by a variable amount of fat which separates the popliteal artery from bone. The superior medial genicular artery, which is a branch of the popliteal artery, arches medially above the medial condyle. It gets separated from bone by the medial head of gastrocnemius. The latter is attached a little above the condyle; further distally there is a smooth facet underlying a bursa for the medial head of gastrocnemius. Medially, there is often an imprint proximal to the articular surface: in flexion this is close to a rough tubercle on the medial tibial condyle which is for the attachment of semimembranosus. The superior lateral genicular artery arches up laterally proximal to the lateral condyle and is separated from bone by the attachment of plantaris to the distal part of the lateral supracondylar line.

Fig 1


A
Neck
Fovea for ligament of head
Head
Neck
Intertrochanteric line
Lesser trochanter
Trochanteric fossa
Greater trochanter
Shaft
Adductor tubercle
Medial epicondyle
Patellar surface
Lateral epicondyle
B
Sacrospinous ligament; ischiococcygeus
Pectineus
Obturator externus
Adductor longus
Adductor brevis
Gracilis
Adductor magnus
Quadratus femoris
Biceps femoris
Semimembranosus
Rectus femoris
Iliopectineal bursa
Gluteus minimus
Vastus lateralis
Iliopsoas
Vastus intermedius
Vastus medialis
Articularis genus
Vastus medialis
Adductor magnus
Quadriceps femoris
Biceps femoris
Fibular collateral ligament
Sartorius
Lateral patellar retinaculum
Gracilis
Extensor digitorum longus

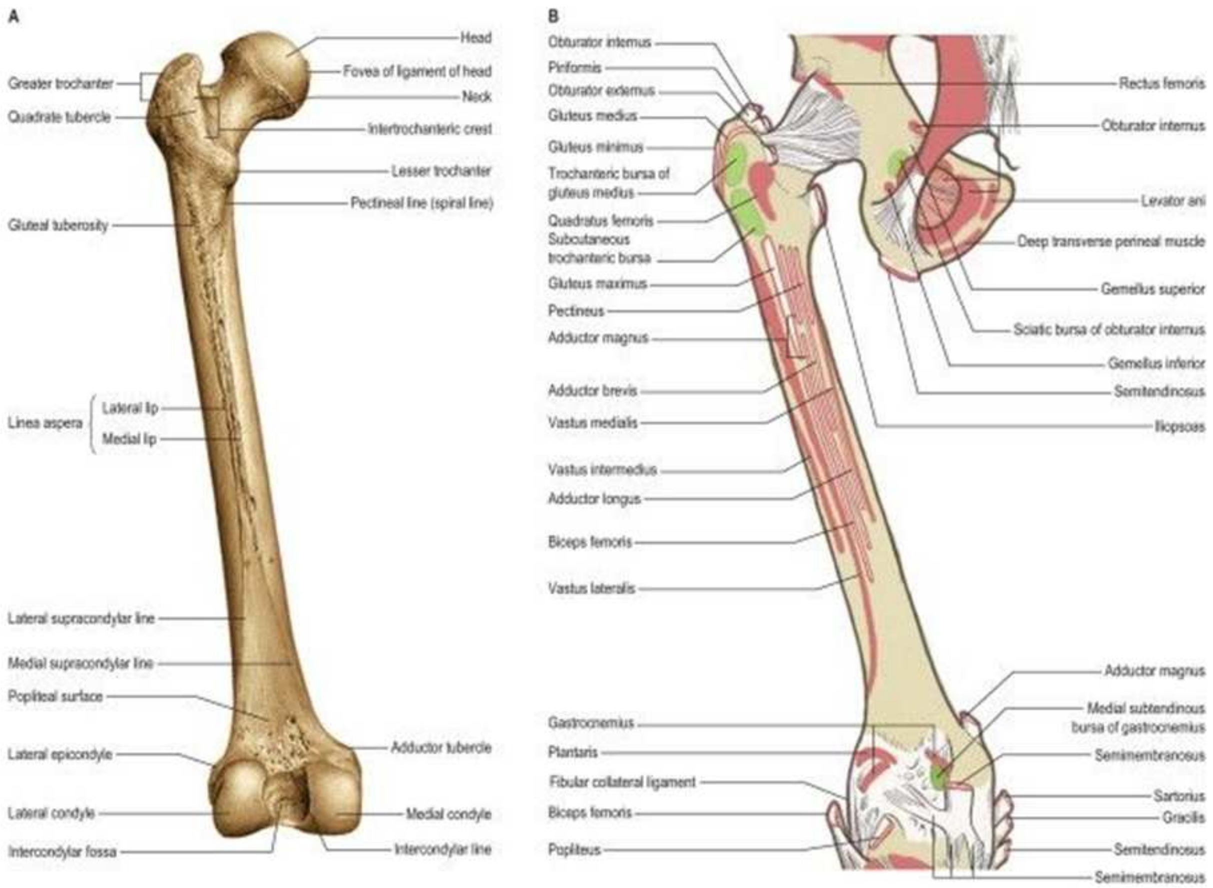

A
Head
Greater trochanter
Fovea of ligament of head
Neck
Quadrate tubercle
Intertrochanteric crest
Lesser trochanter
Pectineal line (spiral line)
Gluteal tuberosity
Linea aspera
Lateral lip
Medial lip
Lateral supracondylar line
Medial supracondylar line
Popliteal surface
Lateral epicondyle
Adductor tubercle
Lateral condyle
Medial condyle
Intercondylar fossa
Intercondylar line
B
Obturator internus
Piriformis
Obturator externus
Gluteus medius
Gluteus minimus
Trochanteric bursa of gluteus medius
Quadratus femoris
Subcutaneous trochanteric bursa
Gluteus maximus
Pectineus
Adductor magnus
Adductor brevis
Vastus medialis
Vastus intermedius
Adductor longus
Biceps femoris
Vastus lateralis
Rectus femoris
Obturator internus
Levator ani
Deep transverse perineal muscle
Gemellus superior
Sciatic bursa of obturator internus
Gemellus inferior
Semitendinosus
Iliopsoas
Adductor magnus
Medial subtendinous bursa of gastrocnemius
Gastrocnemius
Plantaris
Semimembranosus
Fibular collateral ligament
Sartorius
Biceps femoris
Gracilis
Popliteus
Semitendinosus
Semimembranosus

Fig 2

FEMORAL CONDYLES

The femoral condyles are asymmetric both in size and shape. The medial femoral condyle is about 1.7 cm longer than the lateral femoral condyle in its outer circumference. In the sagittal axis the lateral femoral condyle extends anteriorly than the medial condyle and in coronal plane the medial femoral condyle projects more distally than the lateral condyle. However in normal weight bearing alignment the condyles both appear to be equal in level. The parallel femoral condylar surfaces are created by the mechanical axis configuration of the lower extremity. The weight bearing axis is a straight line starting from the centre of femoral head that intersects the centers of the knee and ankle joints. The distal femoral joint line forms a 6^0 valgus angle to the long axis of the femoral shaft, which creates physiological valgus at knee.

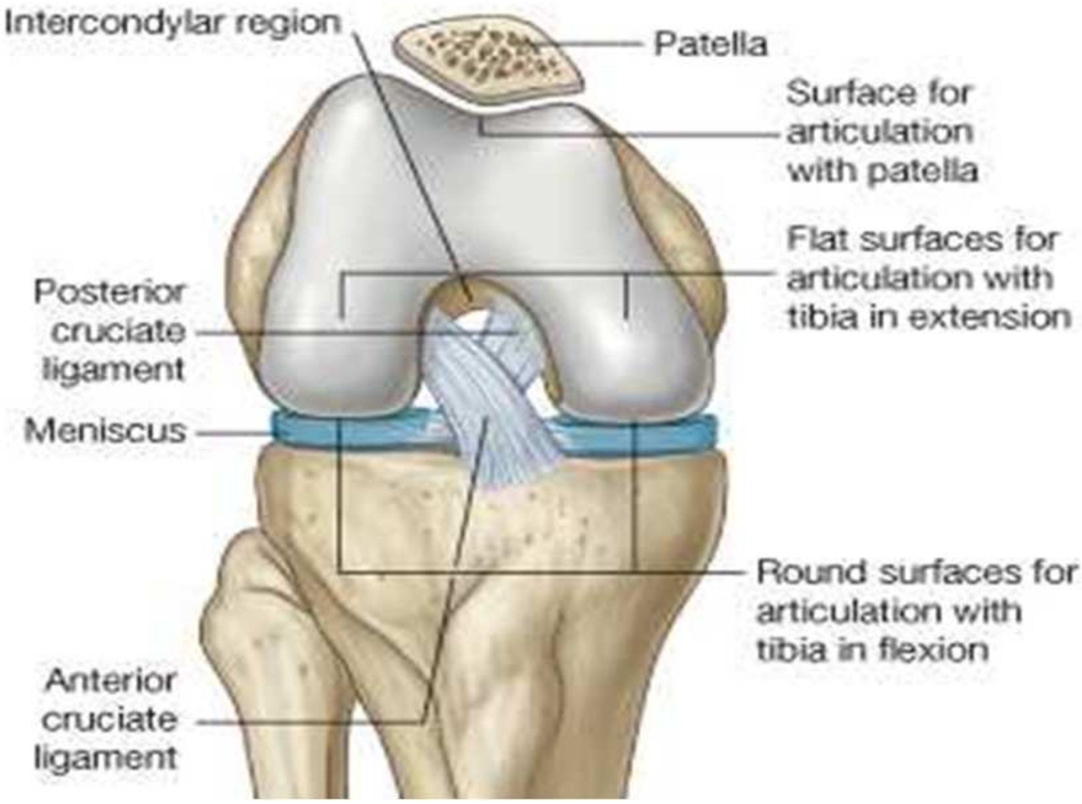


FIG-3: KNEE FLEXION/EXTENSION, FEMORAL CONDYLES

TIBIA

The tibia lies medial to the fibula and is exceeded in length only by the femur (Figs.4&5). Its shaft is triangular in section and has got expanded ends; a strong medial malleolus projects distally from the smaller distal end. The anterior border of the shaft is sharp and it curves medially towards the medial malleolus. Together with the medial and lateral borders it forms the three surfaces of the bone. The exact shape and orientation of these surfaces show individual and racial variations.

TIBIAL PLATEAU

The tibial joint surface is very complex. A normal tibial articulation includes the menisci to provide stability to the distal femoral condyles. The menisci functions to create balance between the flat tibial and curved femoral surfaces. Biomechanically the menisci function is to decrease the stress concentration of tibiofemoral contact by increasing the surface area of contact between the femur and tibia during weight bearing. Without the menisci, the tibial and femoral articular surfaces would carry similar forces distributed over smaller surface area resulting in stress concentration. The medial condyle is almost flat and has a larger surface area than the lateral condyle. The lateral condyle surface is slightly convex. Both tibial condyles have a 10^0 posterior inclination to the tibial shaft in the sagittal plane. Bordering the femoral notch are the medial and the lateral tibial spines which stabilize the tibia from moving sideways. The interspinous area is devoid of hyaline cartilage and is the site of insertion for the meniscal horns and cruciate ligaments. The cruciate ligaments insert on to this intertubercular sulcus and not on the tibial spine themselves.

Proximal end

The expanded proximal end is the bearing surface for body weight, which is transmitted through the femur. It consists of both medial and lateral condyles, an intercondylar area and the tibial tuberosity.

Condyles

The tibial condyles overhang the proximal part of the posterior surface of the shaft and both condyles have articular facets on their superior surfaces that are separated by an irregular, non-articular intercondylar area. The condyles are visible and palpable at the sides of the patellar tendon, the lateral being more prominent of the two. In the passively flexed knee the anterior margins of the condyles are palpable in fossae that lie on the side of patellar tendon.

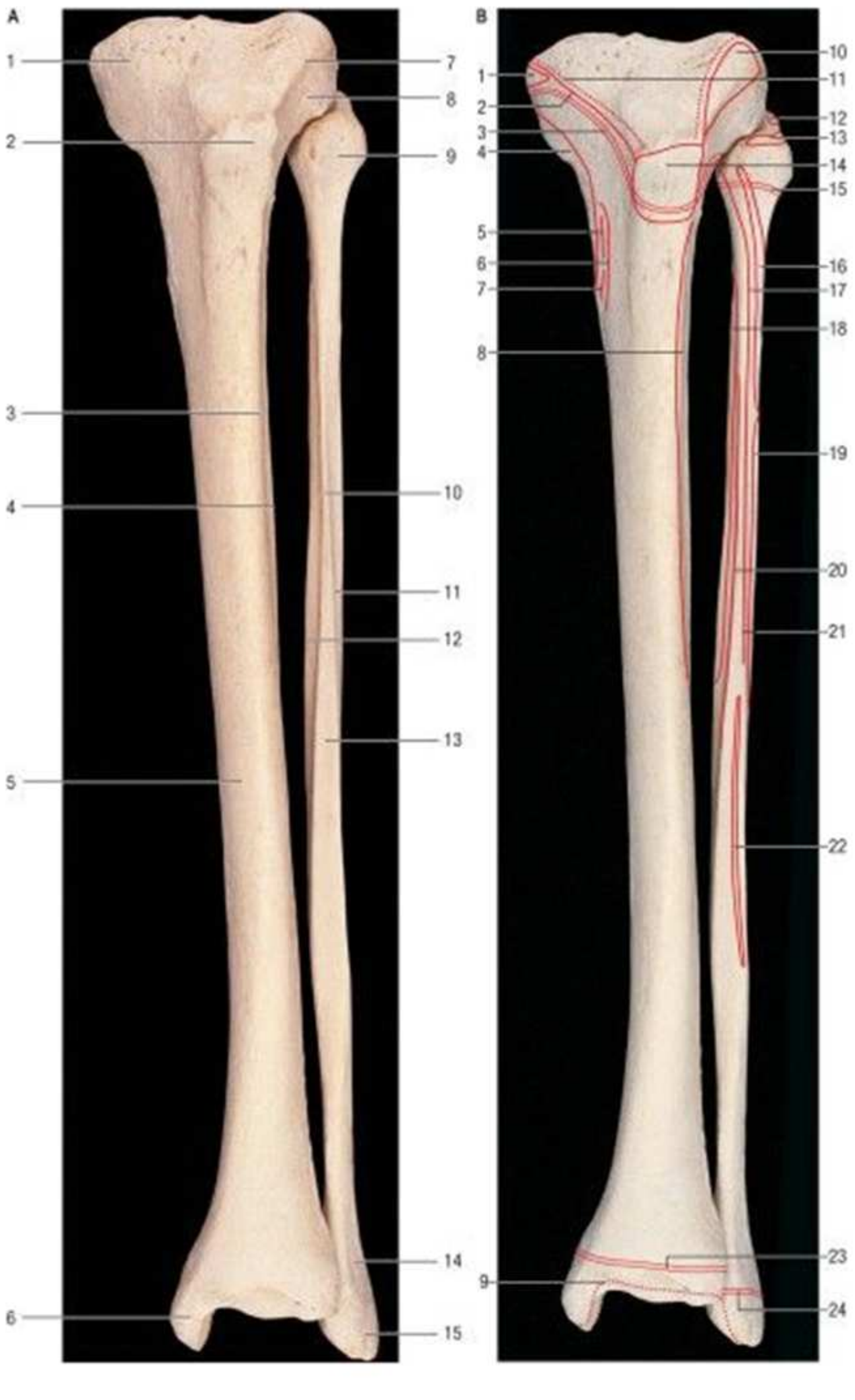


Fig.4. A, Left tibia and fibula: anterior aspect. B, The muscle attachments. A: 1. Medial condyle. 2. Tibial tuberosity. 3. Anterior border of tibia. 4. Interosseous border of tibia. 5. Medial surface. 6. Medial malleolus. 7. Gerdy's tubercle. 8. Lateral condyle. 9. Head of fibula. 10. Interosseous border of fibula. 11. Anterior border of fibula. 12. Medial crest. 13. Anterior surface. 14. Subcutaneous area. 15. Lateral malleolus. B: 1. Semimembranosus. 2. Medial patellar retinaculum. 3. Epiphysial line (growth plate). 4. Medial collateral ligament. 5. Gracilis. 6. Sartorius. 7. Semitendinosus. 8. Tibialis anterior. 9. Capsular attachment. 10. Iliotibial tract. 11. Capsular attachment. 12. Lateral collateral ligament. 13. Biceps femoris. 14. Patellar tendon. 15. Epiphysial line (growth plate). 16. Fibularislongus. 17. Extensor digitorumlongus. 18. Tibialis posterior. 19. Fibularisbrevis. 20. Extensor hallucislongus. 21. Extensor digitorumlongus. 22. Fibularistertius. 23. Epiphysial line (growth plate). 24. Epiphysial line (growth plate).

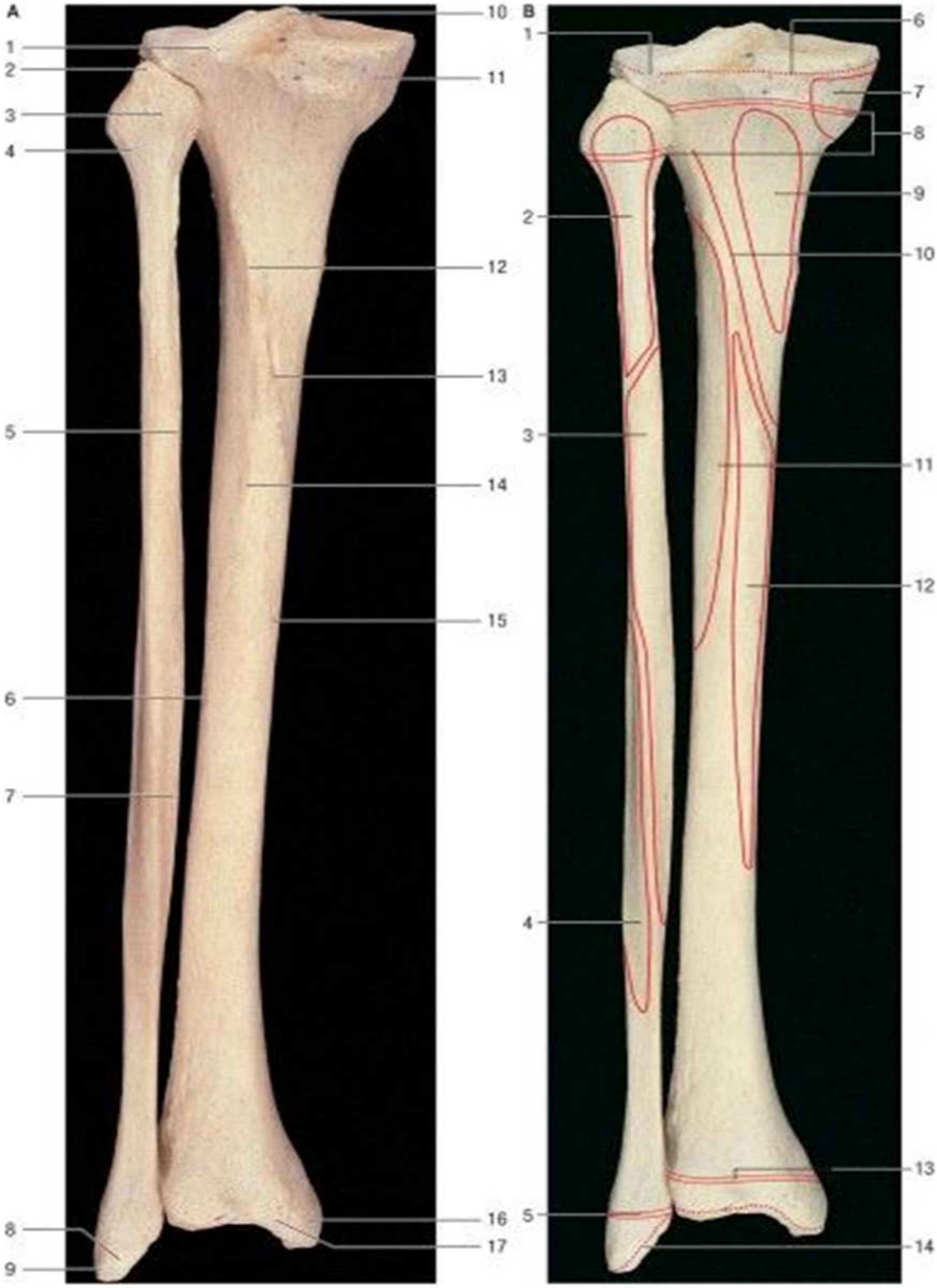


Fig.5.A, Left tibia and fibula: posterior aspect. B, The muscle attachments. A: 1. Groove for tendon of popliteus. 2. Styloid process (apex) of fibula. 3. Head of fibula. 4. Neck of fibula. 5. Medial crest. 6. Interosseous border of tibia. 7. Posterior border. 8. Groove for fibular tendons. 9. Lateral malleolus. 10. Intercondylar eminence. 11. Groove for semimembranosus attachment. 12. Soleal line. 13. Nutrient foramen. 14. Vertical line. 15. Medial border of tibia. 16. Medial malleolus. 17. Groove for tibialis posterior tendon. B: 1. Gap in capsule for popliteus tendon. 2. Soleus. 3. Flexor hallucislongus. 4. Fibularisbrevis. 5. Epiphysial line (growth plate). 6. Capsular attachment. 7. Semimembranosus. 8. Epiphysial lines (growth plates). 9. Popliteus. 10. Soleus. 11. Tibialis posterior. 12. Flexor digitorumlongus. 13. Epiphysial line (growth plate). 14. Capsular attachment.

The fibular facet on the posteroinferior aspect of the lateral condyle faces more distally and posterolaterally. The angle of inclination of the superior tibiofibular joint varies from one individual to other, and may be horizontal or oblique. Superomedial to it the condyle is grooved on its posterolateral aspect by the tendon of popliteus; a synovial recess intervenes between the tendon and bone. The anterolateral aspect of the condyle is separated from the lateral surface of by a sharp margin for the attachment of deep fascia. The distal attachment of the iliotibial tract makes a flat and definite marking, Gerdy's tubercle, on its anterior aspect. This tubercle, which is triangular and facet-like, is usually palpable. The anterior condylar surfaces are continuous with a large triangular area whose apex is distal and is formed by the tibial tuberosity. The lateral edge is a sharp ridge lying between the lateral condyle and lateral surface of the shaft.

Shaft of tibia

The shaft which is triangular in section and has (antero) medial, lateral and posterior surfaces separated by anterior, lateral (interosseous) and medial borders. It is narrowest at the junction of the middle and distal thirds, and expands gradually towards both the ends. The anterior border descends from the tuberosity to the anterior margin of the medial malleolus which is subcutaneous throughout. Except in its distal fourth, where it is not clearly defined, it is a sharp crest. It is slightly sinuous, and turns medially in the distal fourth. The interosseous border begins distal and anterior to the fibular facet and it descends to the anterior border of the fibular notch; it is indistinct proximally. The interosseous membrane is attached to most of its length and connecting tibia to fibula. The medial border descends from the anterior end of the groove on the medial condyle to the posterior margin of the medial malleolus. Its proximal and distal fourths are ill defined but its central region is sharp and distinct.

The anteromedial surface, between the anterior and medial borders, is broad, smooth and almost completely subcutaneous. The lateral surface, between the anterior and interosseous borders, also is broad and smooth. It faces laterally in its proximal three-fourths and it is transversely concave. Its distal fourth swerves to face anterolaterally, on account of the medial deviation on the anterior and distal interosseous borders. This part of the surface is almost convex. The posterior surface, between the interosseous and medial borders, is widest above, from where it is crossed distally and medially by an oblique, rough soleal line. A faint vertical line descends along the centre of the soleal line for a short distance before becoming indistinct. A large vascular groove joins the end of the line and then descends distally into a nutrient foramen. Deep fascia and, proximal to the medial malleolus, the medial end of the superior extensor retinaculum, are all attached to the anterior border. Posterior fibres of the medial collateral ligament and slips of semimembranosus and the popliteal fascia are attached to the medial border proximal to the soleal line, and some fibres of soleus and the fascia covering the deep calf muscles are attached distal to the line. The distal medial border runs into the medial lip of a groove for the tendon of tibialis posterior. The interosseous membrane is attached to the lateral border, except at either end of this border. It is indistinct proximally where a large gap in the membrane transmits the anterior tibial vessels. Distally the border is continuous with the anterior margin of the fibular notch, to which the anterior tibiofibular ligament is attached.

The anterior part of the medial collateral ligament is attached to an area approximately 5 cm long and 1 cm wide, near the medial border of the proximal medial surface. The remaining medial surface is subcutaneous and crossed obliquely by the long saphenous vein. Tibialis anterior is attached to the proximal two-thirds of the lateral surface. The distal third, devoid of attachments, is crossed in mediolateral order by the tendons of tibialis anterior (lying just lateral to the anterior border), extensor hallucis longus, the anterior tibial vessels and deep fibular nerve, extensor digitorum longus and fibularis tertius.

On the posterior surface, popliteus is attached to a triangular area proximal to the soleal line, except near to the fibular facet. The popliteal aponeurosis, soleus and its fascia, and the deep transverse fascia are all together attached to the soleal line: the proximal end of the line does not reach the interosseous border, which is marked by a tubercle for the medial end of the tendinous arch of soleus. Lateral to the tubercle, the posterior tibial nerve and tibial vessels descend on tibialis posterior. Distally to the soleal line, a vertical line separates the attachments of flexor digitorum longus and tibialis posterior. Nothing is attached to the distal quarter of this surface, but the area is medially crossed by the tendon of tibialis posterior travelling to a groove on the posterior aspect of the medial malleolus. Flexor digitorum longus crosses obliquely beneath tibialis posterior; the posterior tibial vessels and nerve and flexor hallucis longus contact only the lateral part of the distal posterior surface.

Muscle attachments

The patellar tendon is attached to the proximal half of tibial tuberosity. Semimembranosus is attached to the distal edge of the groove which is on the posterior surface of the medial condyle; a tubercle at the lateral end of the groove is the main attachment of the tendon of this muscle. Slips arising from the tendon of biceps femoris are attached to the lateral tibial condyle anteroproximal to the facet of fibula. Proximal fibres of extensor digitorum longus and (occasionally) fibularislongus are attached distally to this area. Slips of semimembranosus are attached to the medial border of shaft posteriorly, proximal to the soleal line. Some fibres of soleus gets attached to the posteromedial surface distal to the line. Semimembranosus is attached to the medial surface proximally, near to the medial border, behind the attachment of the anterior part of the medial collateral ligament. Anterior to this area (in anteroposterior sequence), are the linear attachments of the tendons of gracilis, sartorius and semitendinosus: which rarely mark the bone. Tibialis anterior is attached to the proximal two-thirds of the lateral (extensor) surface and Popliteus is attached to the posterior surface in a triangular area proximal to the soleal line, except near the fibular facet. Soleus along with its associated fascia are attached to the soleal line itself. Flexor digitorum longus and tibialis posterior are both attached to the posterior surface distal to the soleal line, medial and lateral respectively to the vertical line.

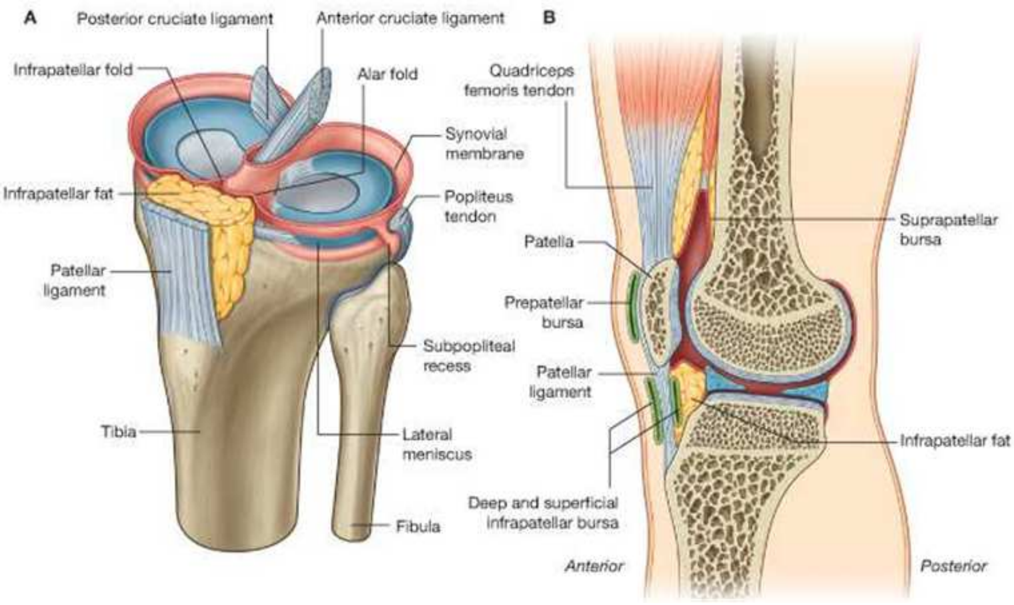


FIG-6: PROXIMAL TIBIA

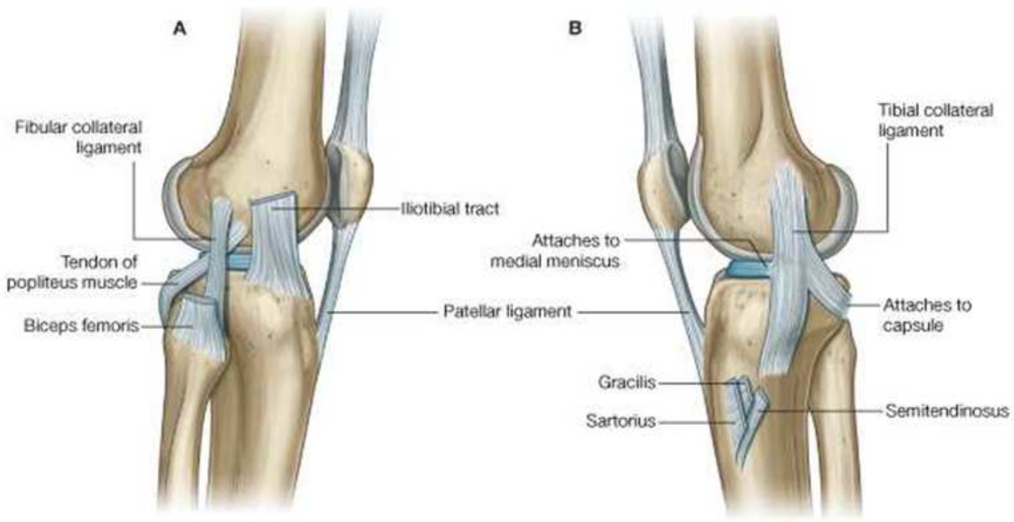


FIG-7: LIGAMENTS AROUND THE KNEE

LIGAMENTS AROUND THE JOINT

The ligaments of the knee joint are divided functionally into a three layer system.

FIRST LAYER

This is the fascial layer which is the most superficial. It is made up of an arciform layer anteriorly, the sartorius fascia medially, iliotibial band and biceps femoris laterally.

SECOND LAYER

This contains all of the patellar tendon, the superficial medial collateral ligament and the lateral collateral ligament.

THIRD LAYER

This is made up of the joint capsule including its functional capsular thickenings, the posterior oblique ligament, arcuate ligament and deep medial collateral ligament. The anterior cruciate ligament is attached both on the posterior and lateral aspect of the femoral notch as a semicircle rotated 25 degrees from long axis of the femoral shaft. The insertion of the anterior cruciate ligament on the tibia is narrow and long, measuring almost 30 mm in length with attachments to the anterior horn of lateral meniscus. It has a synovial envelope and has been described as being extrasynovial but intraarticular. It is vascularised by middle geniculate artery. It has two parts, the anteromedial and posterolateral band. The posterior cruciate ligament originates from two anatomic sites on the anterior aspect of the medial femoral notch. It has two bundles, the anterolateral and posteromedial which are named by the relative position of origin and insertion. The anterolateral bundle originates from the anterior aspect of the femur and inserts on the lateral aspect of tibia. The posteromedial bundle originates posterior to the anterolateral bundle on the femur and gets inserted medial to it on the tibia.

MUSCLES

The quadriceps muscle is composed of four muscles and they are the rectus femoris, vastuslateralis, vastusmedialis and vastusintermedius. They have a common tendinous insertion on the patella. The rectus femoris crosses the hip joint originating from the anterior inferior iliac spine and forms the anterior portion of the quadriceps muscle tendon group. The vastuslateralis originates from the lateral surface of femur along the lateral intermuscular septum and the linea aspera. It has attachments to both the lateral aspect of patella and has an expansion to the iliotibialtract. The vastusmedialis originates from the medial surface of proximal femur and get inserted into the common tendon as well as the medial portion of the patella. The lower portion of vastusmedialis gets originated from the tendon of the adductor magnus with the transverse fibres inserting into the patella. This part is known as vastusmedialisobliqus. The vastusintermedius is arising from the anterior surface of femoral shaft and blends with the medialis musculature and tendinous insertion. Quadriceps muscle forms a trilaminar tendon, with the rectus anteriorly, vastusmedialis and intermedius in the intermediate layer and the vastuslateralis in the deep layer. The hamstring musculature is composed of the gracilis, semitendinosus and the semimembranosus medially and biceps femoris laterally. On the medial side the semimembranosus has got a separate insertion and the gracilis and semitendinosus combine with the sartorius to create pesanserinus. The gastrocnemius is made up of two muscle bellies the medial and lateral. Both muscle bellies originate above the respective femoral condyles in the area of distal femoral physis. The tendinous part combines with the common tendon of soleus to form tendoachilles. The motor function about the knee is important in understanding the gait as well as dynamic knee joint stability. The specific function of the quadriceps and hamstrings during walking is not to produce extension and flexion respectively, but really the reverse. At heel strike the quadriceps eccentrically contracts thereby allowing controlled flexion of the knee, absorbing impact energy. Likewise the hamstrings muscles fire eccentrically during swing phase to slow down the leg in preparation for heel strike, creating controlled extension of the knee. The gastrocnemius also plays important functions in the gait cycle. Although a strong knee flexor, it functions is eccentrically to decelerate the leg and body for heel strike. Once in stance phase the gastrocnemius controls the knee flexion to prevent a back knee gait and finally at toe it fires concentrically in conjunction with the soleus for producing push off.

BLOOD SUPPLY

Vascular supply to the knee is a complex anastamosis of two separate systems called the intrinsic and extrinsic networks. The intrinsic supply is an anastamotic ring made up of the articular, muscular and five geniculate arteries (superomedial, superolateral, middle, inferomedial and inferolateral). The extrinsic system is made up of the descending branch of superficial femoral artery, recurrent branch of anterior tibial artery and the descending branch of the lateral femoral circumflex artery.

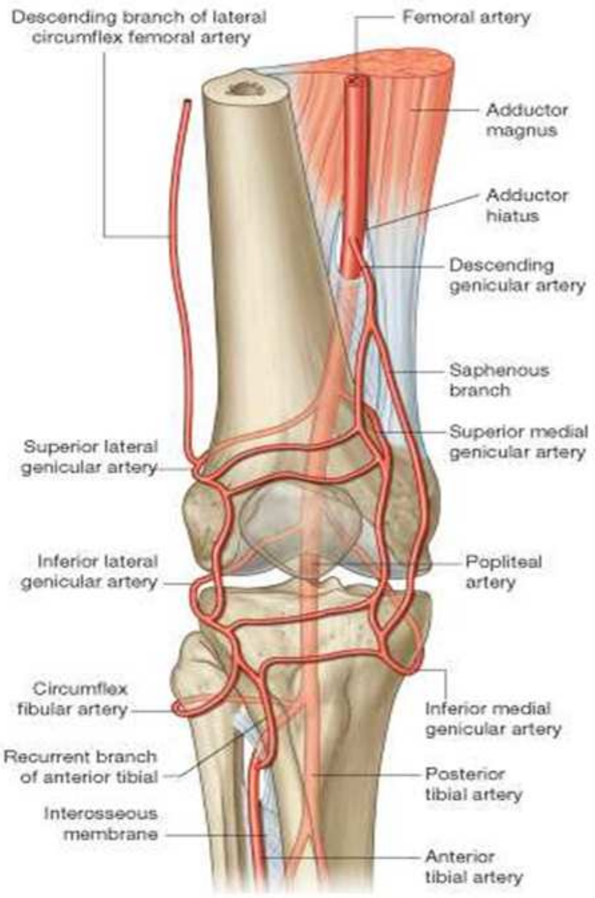


FIG-8: BLOOD SUPPLY AROUND THE KNEE

NERVE SUPPLY

Nerve supply to the knee is from sciatic nerve and from branches of femora nerve.

CLASSIFICATIONS

Classifications used in this study are AO classification for shaft of femur, shaft of tibia, proximal tibia and supra condylar femur fractures, Fraser's classification for floating knee injuries and Schatzker classification for tibial plateau frctures. The other classifications available are Blake and Mcbryde's classification and Lett's classification for floating knee fractures and Winquist classification for shaft of femur fractures. Open fractures in long bones classified by Gustilo-Anderson classification.

GUSTILO- ANDERSON CLASSIFICATION

Type 1: Open fractures with wound less than 1cm long and clean.

Type 2: Open fractures with laceration more than 1cm without extensive soft tissue damage, flaps or avulsions.

Type 3: High velocity injuries, an open segmental fracture, open fractures with extensive soft tissue damage or a traumatic amputation.

A - Adequate soft tissues cover despite high energy open fracture.

B - Extensive soft tissue stripping and contamination.

C - Open fracture with vascular injury requiring repair.

FEMORAL SHAFT FRACTURE CLASSIFICATION

Femoral shaft fractures are often described in terms of the level at which they occur (proximal, middle, distal third) and configuration (spiral, transverse, oblique, segmental, comminuted). In 1980, Winquist proposed a classification based on fracture comminution (Fig.11).

Type I

Minimal or no comminution, If comminution is present, there is involvement of 25% or less of the bony circumference.

Type II

Comminuted fragments involve up to 50% of the width of the bone.

Type III

Comminuted fragment involves more than 50% of the width of the bone that leaves only a small area of contact between the proximal and distal fragments.

Type IV

Comminution involves the entire bony circumference and there is no cortical contact.

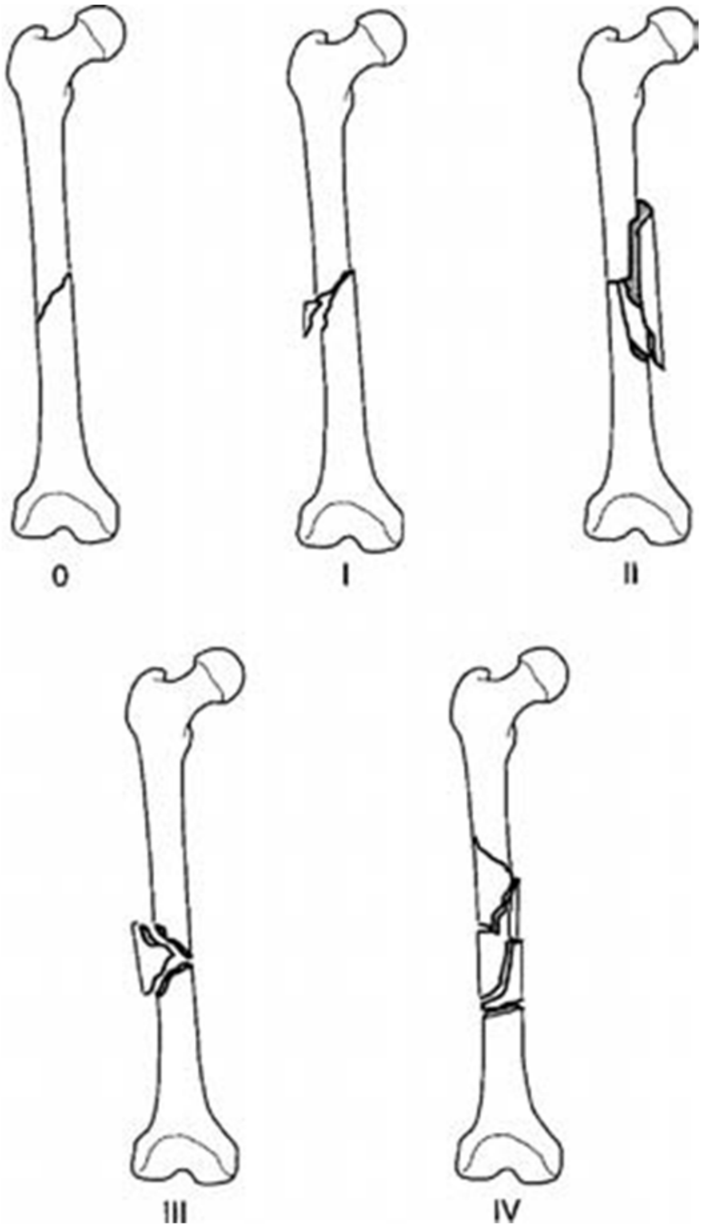


Fig.11. Winquist's classification of femoral shaft fractures.

AO CLASSIFICATION SHAFT OF FEMUR FRACTURES: (Fig.12)

Bone = femur = 3; Segment = diaphysis = 2; Type = A, B, C

32 - Femur diaphysis

32-A Femur diaphysis, simple fracture

32-B Femur diaphysis, wedge fracture

32-C Femur diaphysis, complex fracture

Groups

A1: Simple fracture, spiral

A2: Simple fracture, oblique (=30)

A3: Simple fracture, transverse (<30)

B1: Wedge fracture, spiral wedge

B2: Wedge fracture, bending wedge

B3: Wedge fracture, fragmented wedge

C1: Complex fracture, spiral

C2: Complex fracture, segmental

C3: Complex fracture, irregular

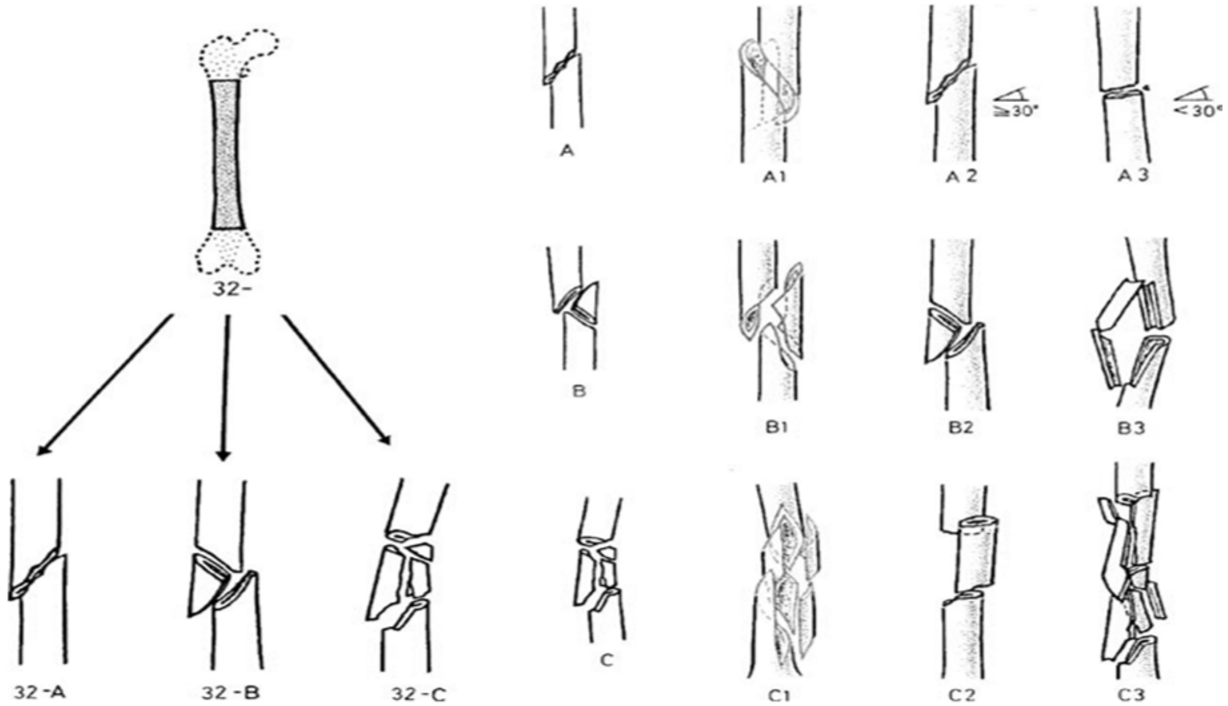


Fig.12. AO classification of femoral shaft fractures.

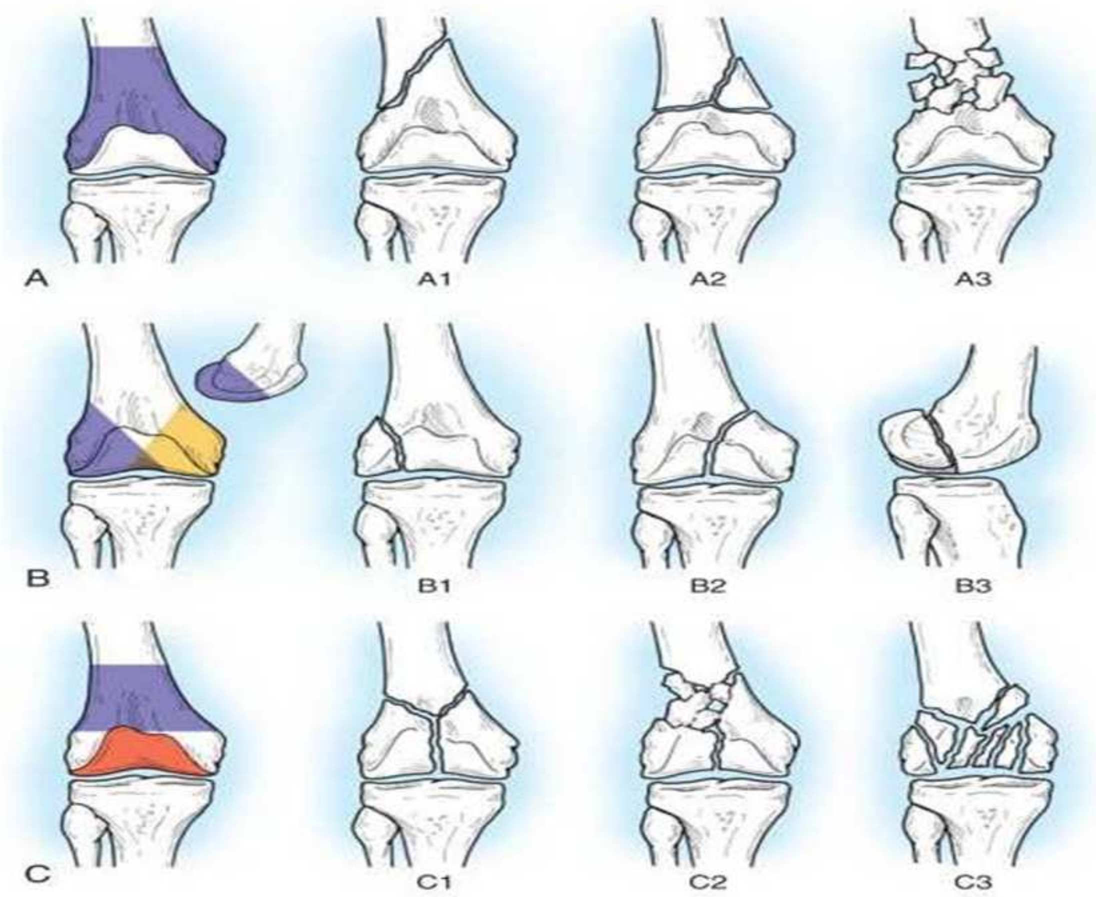


Fig.13. AO classification of distal femoral fractures

A.O DISTAL FEMUR FRACTURE CLASSIFICATION

Type A	Extra articular
Type A1	Simple two part fracture
Type A2	Metaphyseal Wedge.
Type A3	Metaphyseal complex comminuted.
Type B	Partial articular

Type B1	Lateral condyle in sagittal plane
Type B2	Medial condyle in sagittal plane
Type B3	Fracture of both condyles in coronal plane
Type C	Complete intraarticular
Type C1	Articular simple, metaphyseal simple
Type C2	Articular simple, metaphyseal multifragmentary
Type C3	Multifragmentary intraarticular

CLASSIFICATIONS FOR FLOATING KNEE INJURIES

A] BLAKE AND McBRYDE'S CLASSIFICATION FOR FLOATING KNEE INJURIES

TYPE 1 : TRUE FLOATING KNEE

The knee joint is isolated completely and not involved with either shafts fractured

TYPE 2 : VARIANT FLOATING KNEE

Involves one or more joints with either shafts fractured

2A: The knee joint alone is involved

2B: Involves the hip or ankle joint.

B] FRASER CLASSIFICATION FOR FLOATING KNEE INJURIES

Type I is the same as the true injury Blake and McBryde described with extra-articular fractures of both bones.

Type II is subdivided into 3 groups, as follows:

Type IIa involves femoral shaft and tibial plateau fractures.

Type IIb includes fractures of the distal femur and the shaft of the tibia.

Type IIc indicates fractures of the distal femur and tibial plateau.

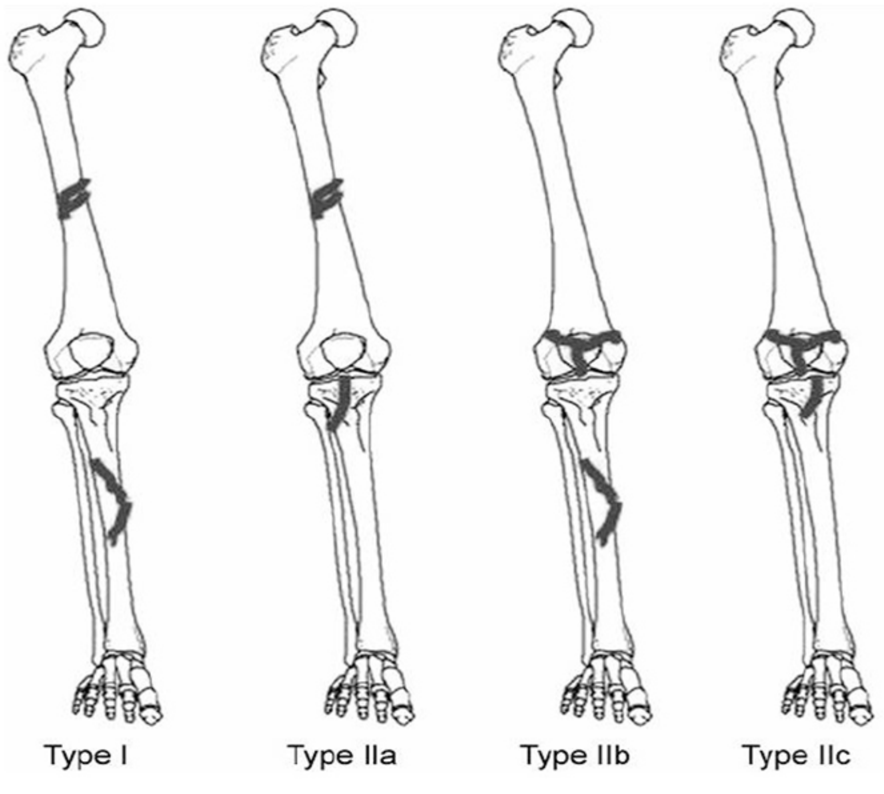


Fig.14. Fraser classification

C] LETTS CLASSIFICATION :

TABLE-1: LETT’S CLASSIFICATION

Type	Location	Nature of
A	Both Diaphyseal	Both closed
B	One Diaphyseal Other	Both closed
C	Intraarticular Extension in any One	Both closed
D	Regardless of Site	One open
E	Regardless of Site	Both open

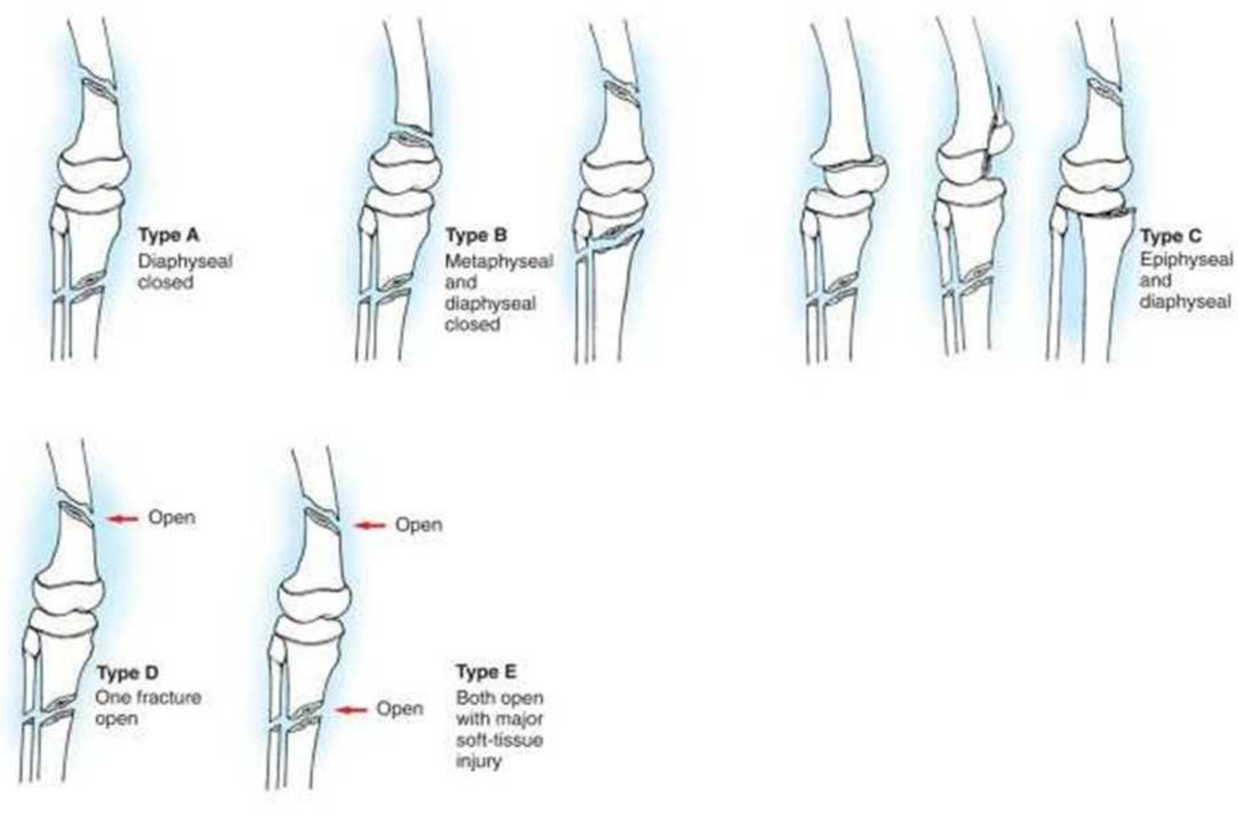


FIG-15: LETT’S CLASSIFICATION

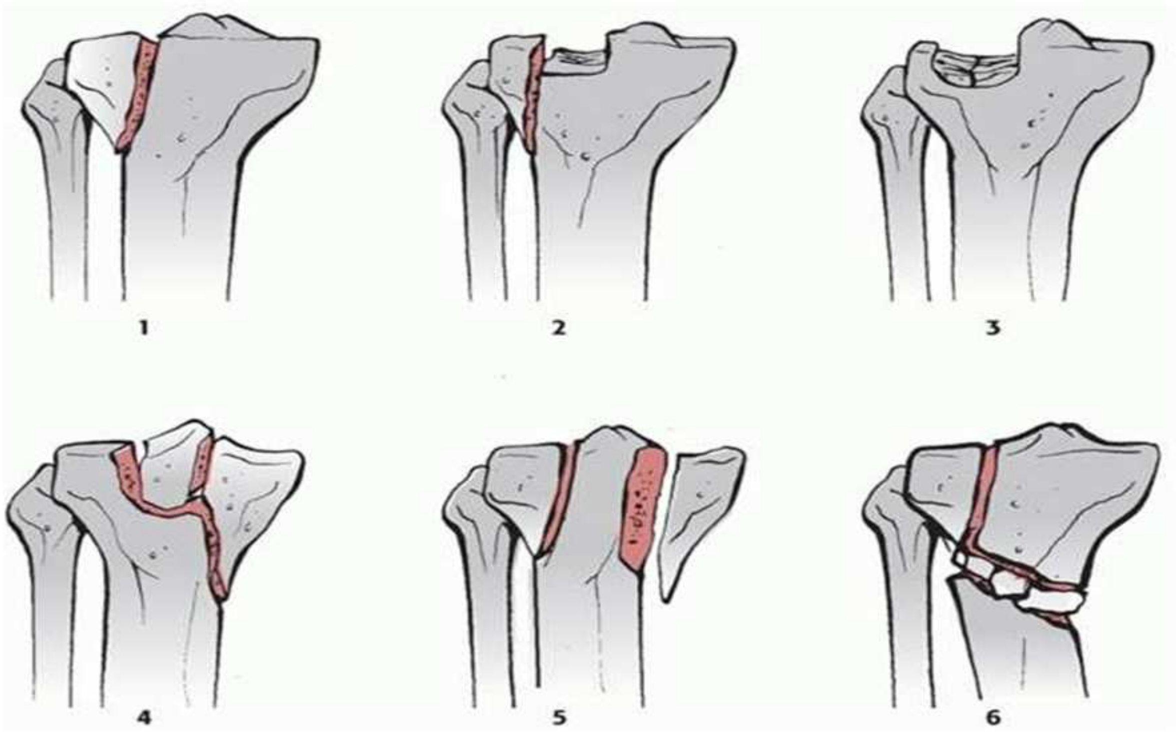


FIG-16: SCHATZKER CLASSIFICATION OF TIBIAL PLATEAU FRACTURES

SCHATZKER CLASSIFICATON OF TIBIAL PLATEAU FRACTURES

Type 1 Split fracture of the lateral tibial condyle

Type 2 Split and depressed fracture of the lateral tibial condyle.

Type 3 Isolated depression of the lateral plateau.

Type 4 Fracture of the medial condyle.

Type 5 Bicondylar fracture with varying degree of depression and displacement of the tibial condyles.

Type 6 Bicondylar tibial fracture with diaphyseal- metaphyseal dissociation.

TIBIAL SHAFT FRACTURES CLASSIFICATION

Based on fracture configuration, most tibial fractures are commonly referred to as transverse, oblique, spiral or comminuted. These fractures have been classified by the AO group as follows (Fig.17): Bone = tibia = 4; Segment = middle = 2; Types = A/B/C = simple/wedge/complex.

Groups

A1: Simple fracture, spiral

A2: Simple fracture, oblique (=30)

A3: Simple fracture, transverse (<30)

B1: Wedge fracture, spiral wedge

B2: Wedge fracture, bending wedge

B3: Wedge fracture, fragmented wedge

C1: Complex fracture, spiral

C2: Complex fracture, segmental

C3: Complex fracture, irregular

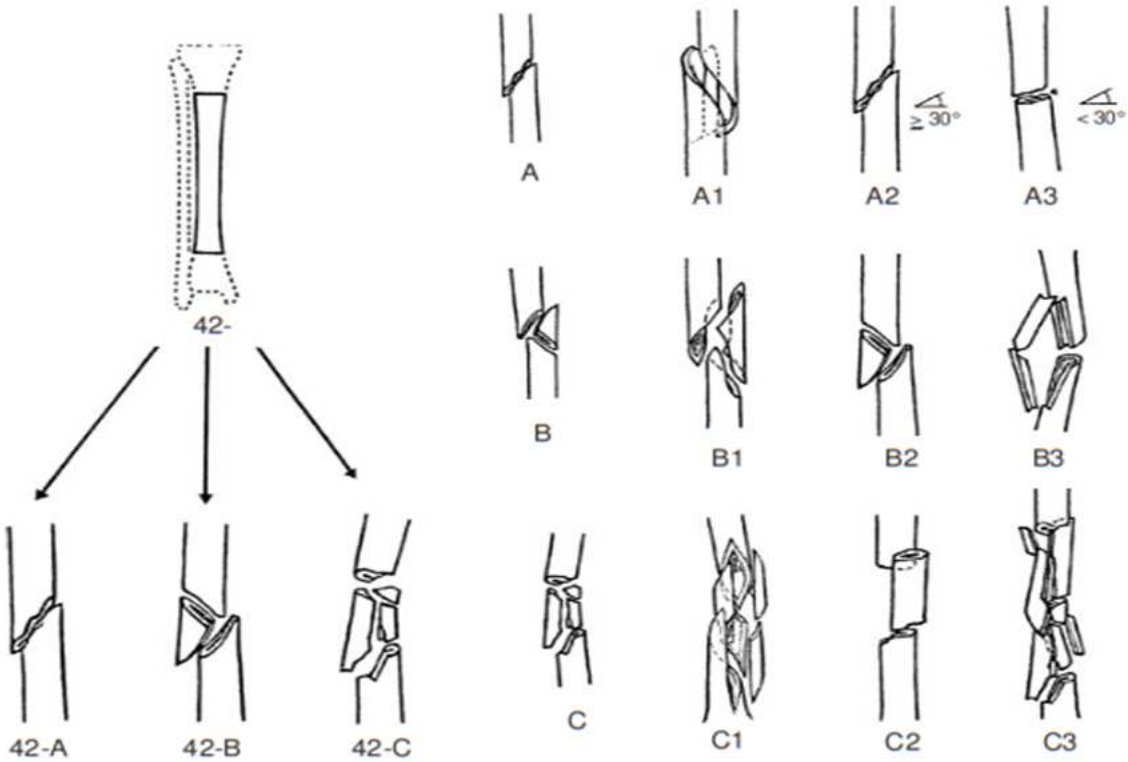


Fig.17. AO classification of the mid-diaphyseal fractures of the tibia

REVIEW OF LITERATURE

There are only few literatures dealing the analysis of outcome of temporary knee spanning external fixation conversion into knee sparing fixation for high energy periarticular knee injuries.

In 1980, Salter et al(5) describes Early joint motion is probably the most important factor in promoting cartilage nutrition and healing.

In 1998, Anglen(6) study retrospectively reviewed temporary transarticular external fixation to delineate more clearly the risks and benefits of their practice. Fifty-seven patients who had been treated with a temporary fixator over a five-year period were identified. The mean duration of initial external fixation was six days for the knee. No difference was apparent in the incidence of complications with the use of temporary external fixation. Of the low number of infections observed, only one was related to a half-pin site.

In 1999, Patterson and Cole(7) reported 77% good results using this protocol for severe pilon fractures with no soft tissue complications and no infections.

In the same year, Sirkin et al[8] also reported a decreased complication rate with no fractures requiring coverage for soft-tissue breakdown using a similar protocol for delayed open reduction and internal fixation for 56 pilon fracture. 3% infection rate among closed fractures and 10% rate in compound fractures were noted.

In 2000, Watson and Colleagues[9] reported on 107 patients with pilon fractures treated using a standard staged protocol for patients with open fractures, compartment syndromes, and polytrauma. They reported significant reduction in the infection rate compared to historical controls.

In 2002, Haidukewych and Collinge[10] studied 50 high velocity, intra-articular fractures at the ankle and knee. They used initial temporary joint bridging external fixation and conversion into open reduction and internal fixation when soft tissue condition was operable. 6% infection rate was noted. Late sepsis noted in 2 patients (4%). In both cases, Xrays showed overlap between final implant and prior pin sites. Average duration needed for conversion of spanning external fixation to internal fixation in their study is 10 days.

At ten years follow up, Weigel (2002) and associates[11] showed that high velocity tibial plateau fractures treated with external fixation have a good outcome. Cartilage damage of knee joint will be minimal in patients who had treated with this approach.

In 2004, Barei et al[12] reported 8.4% infection rate in 83 high velocity tibial plateau fractures treated with single-incision double plating after temporary external fixation.

In 2004, Nirmal C. Tejwani et al[13] describes two staged protocol for complex tibial plateau fractures, and states that the soft tissue envelope must be violated and the use of the two stage protocol will allow optimal conditions to proceed.

In the same year, Hildebrand et al[14] advocating the application of damage control orthopedics in multiple injured patients where early primary total care is associated with an poor outcome.

In 2005, Egol et al[15] evaluated 57 high energy proximal tibia fractures treated with temporary external fixation with later conversion into definitive fixation. There were 16 open cases. Good union rate and a minimal wound infection rate (5%) were noted. Better wound care of open compound fractures and fasciotomies, was possible with this staged management.

In 2006, Yokoyama et al[16] studied the causative factors for deep seated infection in secondary intra medullary nailing after external fixation in 42 compound tibial fractures. They found 16.7% infection rate, all occurring in Gustilo Anderson type III wounds. The skin closure time was statistically significant.

In 2008, Anand A. Parekh et al[17] reported 91% union rate and 16% infection rate and one failure of fracture fixation in treating complex periarticular knee fractures. Open fractures were more prone to infection especially Gustilo Anderson grade III. The deficiencies of this study are no functional outcome analysis, and small sample size.

In 2011, Oh et al[18] described temporary bridging external fixation problems in 7 out of 59 patients(11%). Out of these 7 cases, shortening was noted in 3 cases (1 pilon fracture and 2 distal femur fracture). Deep seated infection was noted in 2 patients, and both were distal femur fractures. 4 among the seven complications were distal femur fractures. The mean conversion time was 15.3 days.

MATERIALS AND METHODS

This is a retrospective and prospective study conducted in the Institute of Orthopedics and Traumatology, Madras Medical College and Rajiv Gandhi Government General Hospital, Chennai between august 2013 to august 2014.

This study is about the analysis of clinical outcome of knee sparring fixation after temporary knee spanning external fixation.

For this study 30 patients with high energy periarticular knee fractures who presented to RGGGH casualty from August 2013 to August 2014 who fulfilled the criteria were included.

Inclusion criteria:

- Age >14 years.
- Age < 70 years
- High energy periarticular knee injuries
- Treated with initial knee spanning external fixation
- Converted into knee sparring external or internal fixation

Exclusion criteria:

- Age < 14 years.
- Age >70 years
- Periarticular knee injuries treated with primary internal fixation
- Patients treated with knee spanning external fixation alone

When the patients presented in casualty, primary survey of airway, breathing and circulation was done. The patients were resuscitated accordingly. Once the patient was hemodynamically stable necessary primary investigations were done. All fractures were splinted in Thomas splint or plaster of paris slab.

Open fractures and wounds were documented properly. Cultures were sent. Broad spectrum antibiotics and prophylactic tetanus toxoid were started. A primary survey was made and x-rays were taken to image the entire femur and tibia with the adjacent articulations of the knee, hip and ankle.

The fractures were stabilized using a knee spanning external fixator within 24 hours of the admission. Compound wounds were thoroughly debrided and washed with 9Lof normal saline. Perioperative antibiotics were given. 5mm Schantz pins were applied on either side of fracture. A single or double row of spanning External Fixation was constructed.

Figure.18. Appropriate femoral pin location (green) is anterolateral. Anterior or lateral placement (red) is not preferred.

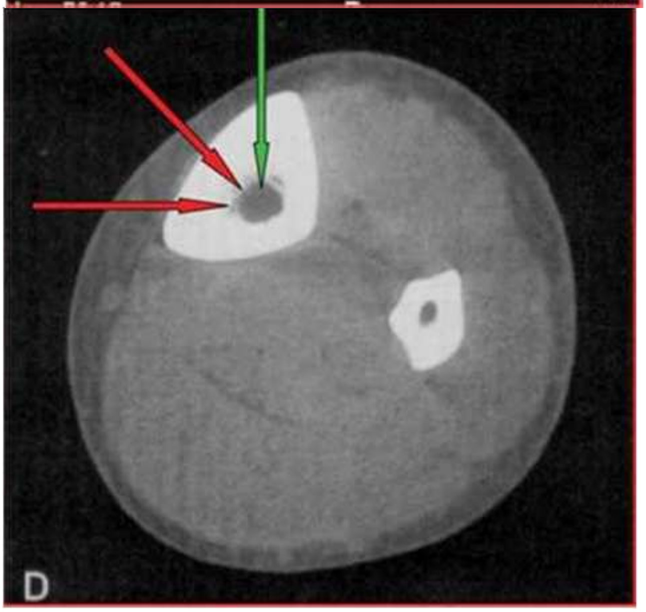


Figure.19. Appropriate tibial pin location (green) in anterior. Anteromedial or medial placement (red) is not preferred.

The further plan of management for the given patient was made depending on the nature of fracture, location of fracture, associated soft tissue injuries.

In this study 25 patients had associated compound soft tissue injuries, out of these 7 patients were needed flap cover with split thickness skin graft and 3 patients were needed split thickness skin graft alone. Rest of the compound soft tissue injuries were healed without any intervention. Definitive knee sparing fixations in these patients were delayed mainly due to these soft tissue injuries.

Out of the 24 femur fractures, four patients were treated with the external fixation itself, since these patients took longer time for soft tissue recovery. These patients were treated with just reinforcement of external fixation alone. 5 diaphyseal femur fractures were undergone interlocking intramedullary nailing and 15 distal femur fractures were undergone either locking compression plating fixation (13 patients) or cancellous screws fixation (2 patients).

Out of the 19 tibia fractures, seven patients were treated with the external fixation itself, since these patients took longer time for soft tissue recovery. These patients were treated with either reinforcement of external fixation (5 patients) or conversion to hybrid external fixation (2 patients). 3 diaphyseal femur fractures were undergone interlocking intramedullary nailing and 8 proximal tibia fractures were undergone either plating (locking compression plate, buttress plate or biological plate) fixation (7 patients) or cancellous screws fixation (1 patient). One patient was treated with ilizarov fixation.

Before undergoing definitive internal fixation from external fixation, patients were checked for ESR and CRP to rule out infection.

Five patients were undergone initial knee spanning external fixation for the following reasons. Two patients had head injury, one patient had haemopnuemothorax, one patient had compartment syndrome and remaining one patient had multiple fractures in the same limb, this patient was undergone initial knee spanning external fixation to prevent fat embolism.

The subject was included into the study once he had undergone knee sparing fixation either internal or external fixation after knee spanning external fixation.

The patient was subjected to mobilization schedule according to associated injuries and general condition. Knee mobilization started as soon as the patient undergone knee sparing fixation from knee spanning external fixator. Weight bearing depended upon the fracture type, the implant used and associated other injuries. Partial weight bearing allowed with support as soon as possible then gradually increased to full weight bearing. Weight bearing was started early in patients fixed with intramedullary nails.

All patients came back for follow up. Follow up study was done at 6 weeks, 12 weeks, 6 months and 1 year. Serial x-rays and functional assessment were carried out at each visit in outpatient clinic itself using the knee society score (annexure-I). All the patients were assessed using a standard Proforma (annexure-II).

In patients, who had already undergone the surgeries, the details of preoperative status like mode of injury, fracture pattern, closed or open injuries and any associated injuries were evaluated and follow up assessment undertaken.

The complications occurred in this study were postoperative infection (11 patients), nonunion (2 patients), compartment syndrome of leg (1 patient) and implant failure (1 patient). These complications were treated accordingly.

Infection was seen in most of the open type of fractures. There were eleven (36.67%) cases with infection out of which two patients required implant removal. Four Patients were Staphylococcus aureus positive. One patient (3.3%) had an implant failure. Delayed union was seen in Eight patients (26.67%) out of which two required bone grafting.

Ten (33.3%) patients required wound coverage in the form of flaps or split skin grafting. Bone grafting was done in two (6.67%).

TABLE–2: POST OPERATIVE COMPLICATION

No.	Complication	No of Patient	Additional procedures
I	Infection	11	Implant removal – 2 Wound debridement – 4 Sequestrectomy – 2
II	Delayed Union Femur - 5 Tibia – 3	8	Bone grafting – 2 Ilizarov – 1 (tibia)

OBSERVATIONS AND RESULTS

1) AGE DISTRIBUTION

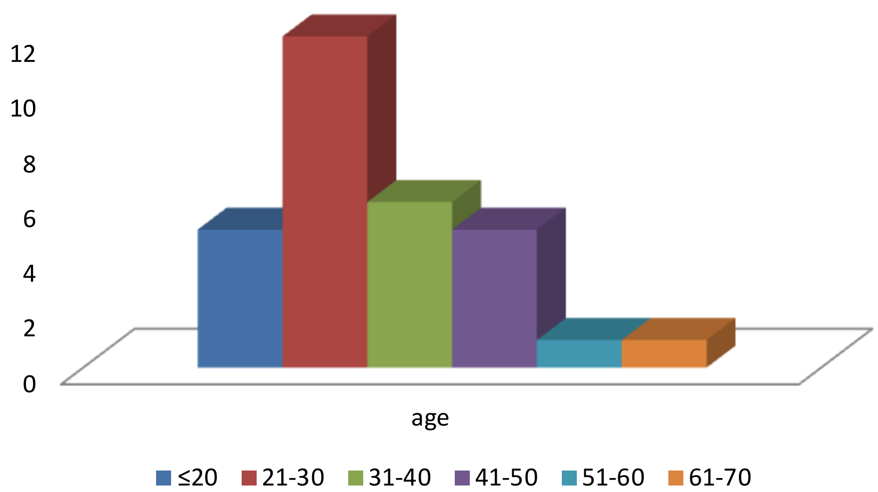
The age distribution ranged from 18 years to 64 years.

TABLE 3: AGE DISTRIBUTION

AGE GROUP	NO OF PATIENTS	PERCENTAGE
≤20	5	16.67%
21 – 30	12	40%
31 – 40	6	20%
41 – 50	5	16.67%
51 – 60	1	3.33%
61 – 70	1	3.33%

The mean is 32.1, median is 27.5, mode is 18 and the standard deviation is 11.998.

FIG-20:AGE DISTRIBUTION



2) GENDER DISTRIBUTION

Males predominated in our study. Out of 30 patients all were male.

3) SIDE OF INJURY

In our study out of the 30 patients, 20 patients had right lower limb Injury, 8 patients had left lower limb injury and 2 patients had bilateral lower limb injury. Out of this 32 lower limb injuries, 30 injuries underwent staged management and that 30 injuries are our primary concern. Of this 21 patients (70%) had right lower limb Injury, 9 patients (30%) had left lower limb injury.

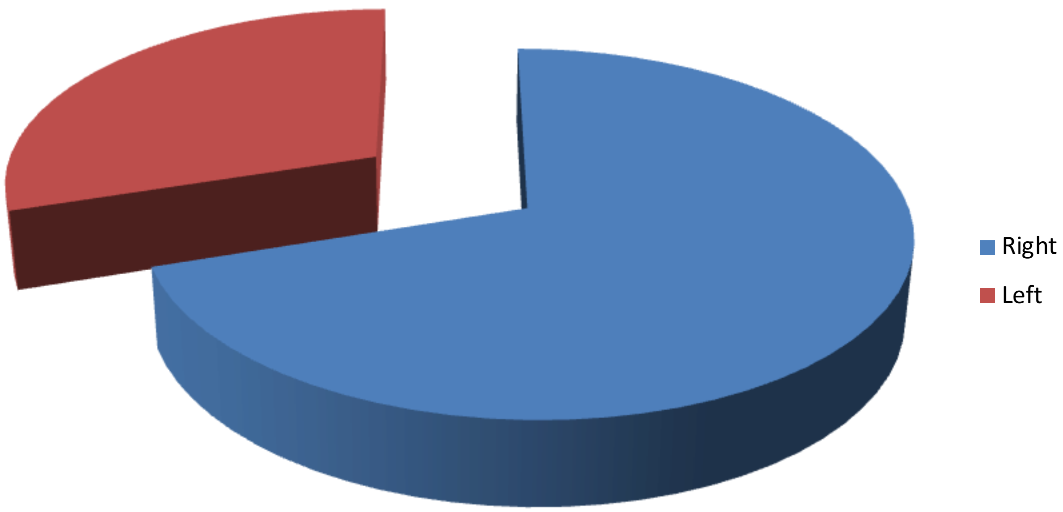


FIG21-: SIDE OF INJURY

4) MECHANISM OF INJURY

Out of the 30 Patients, 28 (93.33%) were injured due to road traffic accident and the rest 2 (6.6%) were injured due to fall from height. Out of the 28 RTA's 24 (80%) were due to two wheeler accident, 3 (10%) were due to four wheeler accident and 1(3.33%) were pedestrians.

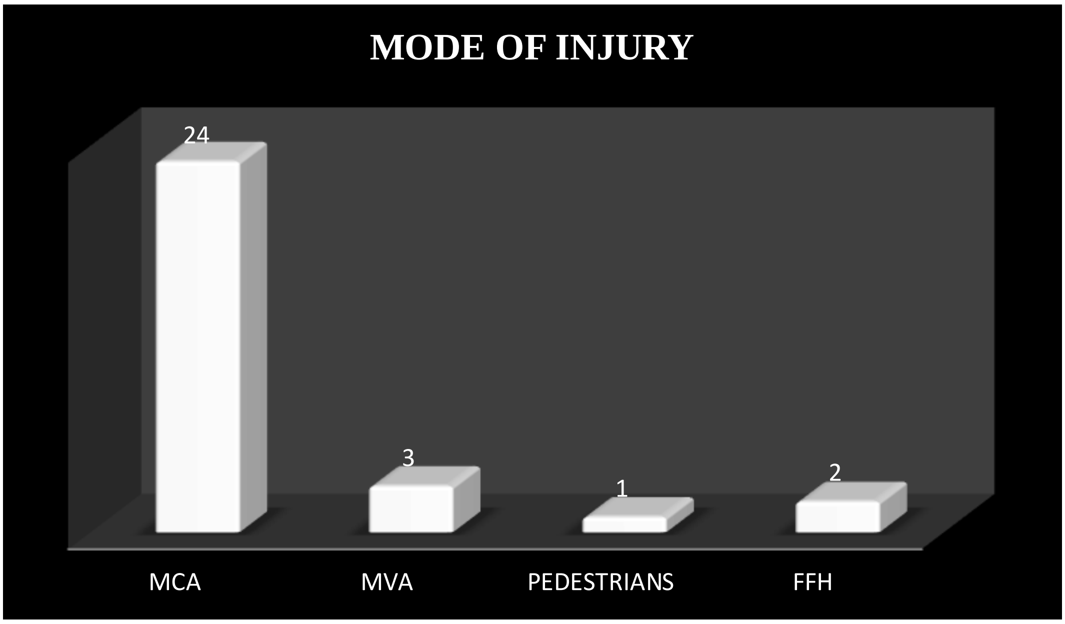


FIG-22: MECHANISM OF INJURY

MVA- Motor vehicle accidents – four wheelers

MCA-Motorcycle accident- two wheelers

FFH – Fall from height

5) DISTRIBUTION OF TYPES OF FRACTURES ACCORDING TO GUSTILO ANDERSON CLASSIFICATION

Out of the 30 patients in our study, 13 (43.33%) patients were sustained floating knee injuries, having both femur and tibia fracture. 11 (36.67%) patients having isolated femur fracture and 6 (20%) patients having isolated tibia fracture.

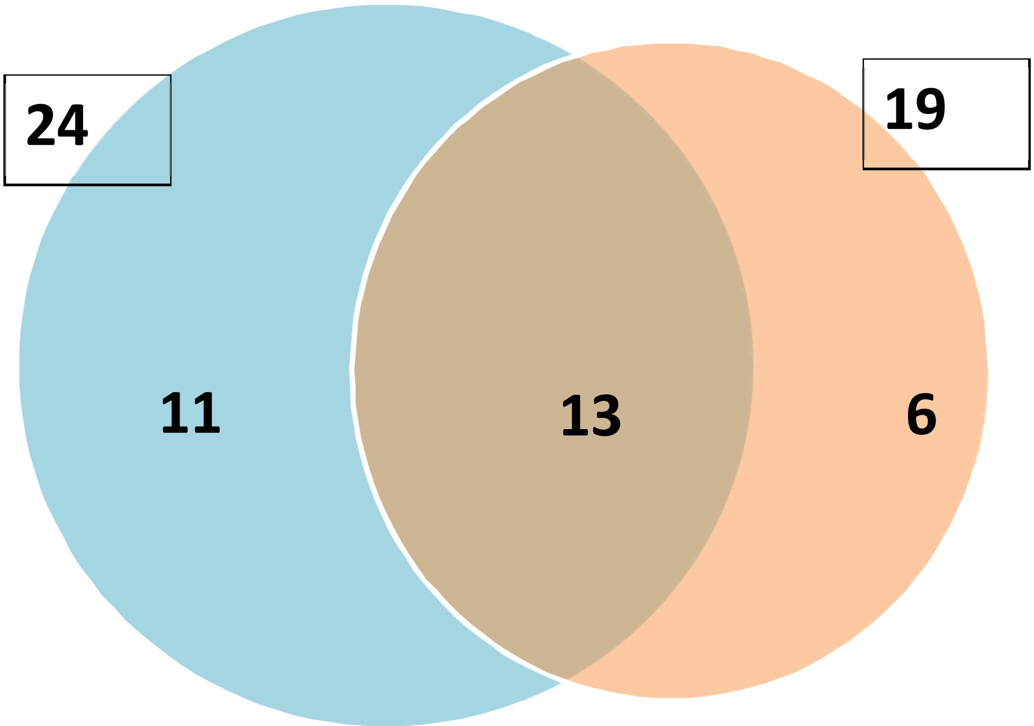


FIG.23

TABLE 4

TYPES	FEMUR	TIBIA
CLOSED	**7**	**11**
OPEN	**17**	**8**
TOTAL	**24**	**19**

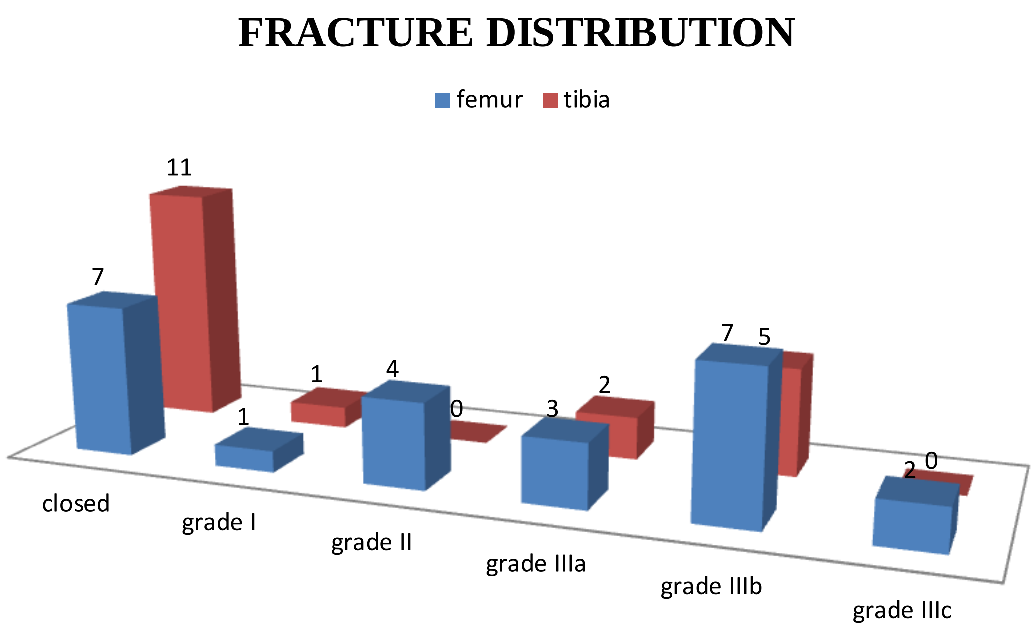


FIG24: TYPES OF FRACTURE DISTIBUTION

Out of the 24 fractures of the femur, 17 (70.83%) were open fractures and 7 (29.17%) were closed fractures. Out of the 19 fractures of tibia, 8 (42.11%) were open and 11 (57.89%) were closed fractures.

6) DISTRIBUTION OF FEMUR FRACTURES ACCORDING TO GUSTILO ANDERSON CLASSIFICATION

TABLE.5 TYPES	NO OF FRACTURES	PERCENTAGE
CLOSED	7	29.17%
OPEN-GRADE I	1	4.17%
OPEN-GRADE II	4	16.67%
OPEN-GRADE III A	3	12.5%
OPEN-GRADE III B	7	29.17%
OPEN-GRADE III C	2	8.33%
TOTAL	24	100%

7) DISTRIBUTION OF TIBIA FRACTURES ACCORDING TO GUSTILO ANDERSON CLASSIFICATION (TABLE 6)

TYPES	NO OF FRACTURES	PERCENTAGE
CLOSED	11	57.89%
OPEN-GRADE I	1	5.26%
OPEN-GRADE II	0	0%
OPEN-GRADE III A	2	10.53%
OPEN-GRADE III B	5	26.32%
OPEN-GRADE III C	0	0%
TOTAL	19	100%

8) TYPE OF OPEN FRACTURES ACCORDING TO GUSTILO ANDERSON CLASSIFICATION(TABLE 7)

GRADE	FEMUR	TIBIA	TOTAL	PERCENTAGE
I	**1**	**1**	**2**	**8%**
II	**4**	**0**	**4**	**16%**
III A	**3**	**2**	**5**	**20%**
III B	**7**	**5**	**12**	**48%**
III C	**2**	**0**	**2**	**8%**
TOTAL	**17**	**8**	**25**	**100%**

Out of the 25 open fractures. There were 17 femur and 8 tibial open fractures. The fractures were classified using Gustilo and Anderson classification. Among the open fractures grade I accounted to two(8%), grade II accounted to four(16%), grade III-A accounted to five(20%), grade III-B accounted to twelve(48%) and grade III-C accounted to two (8%).

9) TYPE OF FEMUR FRACTURES(TABLE 9)

TYPE	NO OF PATIENTS	PERCENTAGE
SIMPLE	6	25%
COMMUNITED	18	75%
TOTAL	24	100%

Out of the femur fractures 6 (25%) were simple, 18 (75%) were comminuted.

10) FEMUR-INTRAARTICULAR AND EXTRAARTICULAR DISTRIBUTION(TABLE 10)

TYPES	NO OF PATIENTS	PERCENTAGE
INTRAARTICULAR	14	58.33%
EXTRAARTICULAR	10	41.67%
TOTAL	24	100%

Among the 24 fractures, 14 (58.33%) were intraarticular and 10 (41.67%) were extraarticular. The 14 intraarticular cases were confined to the knee joint.

11) LEVEL OF FRACTURES - FEMUR(TABLE 11)

TYPES	NO OF PATIENTS	PERCENTAGE
DIAPHYSEAL	7	29.17%
METAPHYSEAL	3	12.5%
ARTICULAR (EPIPHYSEAL)	14	58.33%
TOTAL	24	100%

Among the 24 femur fractures, 7 (29.17%) were diaphyseal fractures, 3 (12.5%) were at the metaphysis. The remaining 14 (58.33%) were at the knee articular surface.

12) TYPE OF FRACTURES-TIBIA(TABLE 12)

TYPE	NO OF PATIENTS	PERCENTAGE
SIMPLE	6	31.58%
COMMUNITED	13	68.42%
TOTAL	19	100%

Out of the 19 tibial fractures, 6 (31.58%) were simple fractures, 13 (68.42%) were comminuted fractures (table)

13) TIBIA-INTRAARTICULAR AND EXTRAARTICULAR-DISTRIBUTION(TABLE 13)

TYPES	NO OF PATIENTS	PERCENTAGE
INTRAARTICULAR	8	42.11%
EXTRAARTICULAR	11	57.89%
TOTAL	19	100%

Among the 19 fractures of tibia, 8 (42.11%) were intraarticular fractures and the remaining 11 (57.89%) were extraarticular fractures. (table.13). Intraarticular fractures were confined to the knee joint.

14) LEVEL OF FRACTURE-TIBIA(TABLE 14)

TYPES	NO OF PATIENTS	PERCENTAGE
DIAPHYSEAL	9	47.37%
METAPHYSEAL	1	5.26%
ARTICULAR (EPIPHYSEAL)	9	47.37%
TOTAL	19	100%

Among the 19 tibia fractures, 9 (47.37%) were diaphyseal type of fractures, 1 (5.26%) was at the diaphyseal and metaphyseal junction, 9 (47.37%) were intraarticular (epiphyseal) fractures confined to the knee joint.

15) FRASER CLASSIFICATION OF FLOATING KNEE CASES(TABLE 15)

The floating knee injuries were classified according to FRASER Classification.

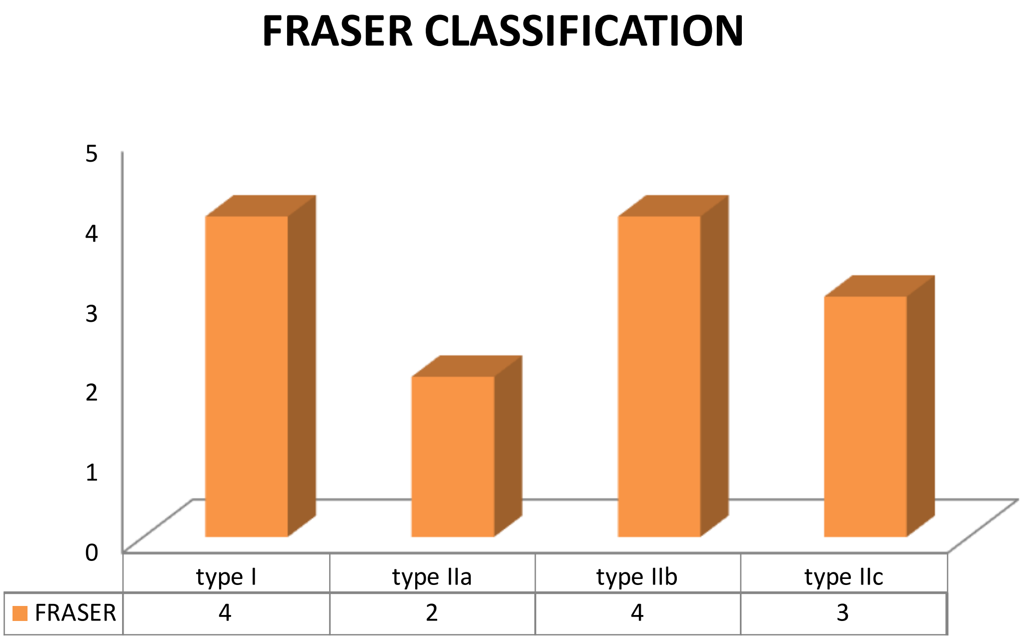
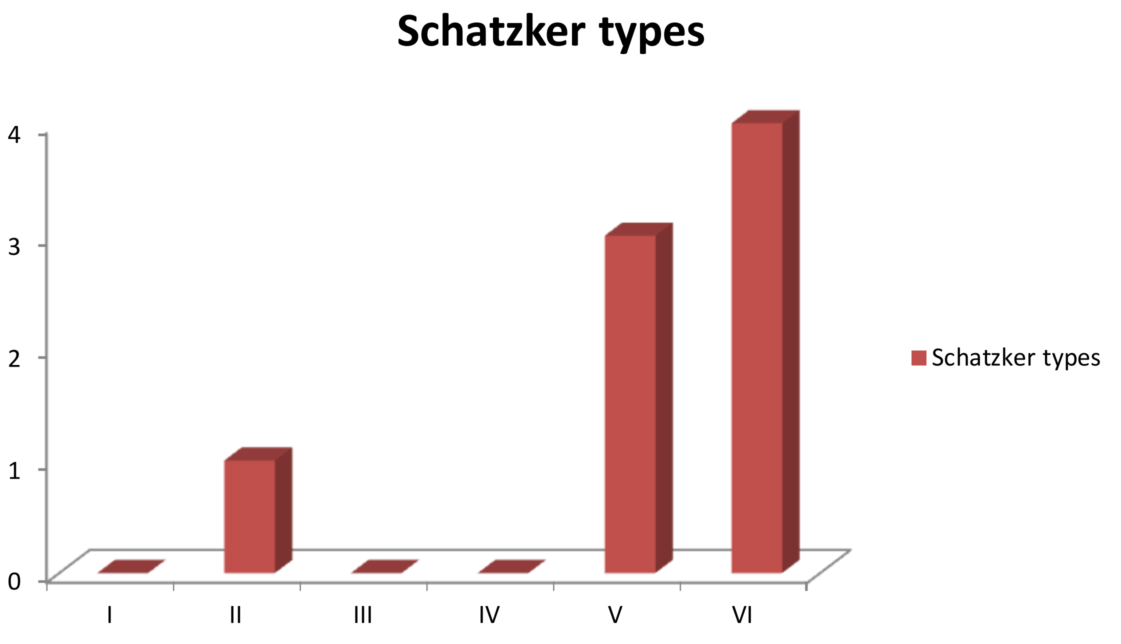


FIG.25: FRASER CLASSIFICATION OF FLOATING KNEE CASES

Out of the 13 floating knee injuries, 4 (30.77%) were type I, 2 cases (15.38%) were type II-A, 4 (30.77%) cases were type II-B and the remaining 3 (23.08%) were type II-C.(fig.25)

16) SCHATZKER CLASSIFICATION OF TIBIAL PLATEAU FRACTURES

Tibial plateau fratures were classified by schatzker classification



17) DURATION INITIAL EXTERNAL FIXATION(TABLE 16)

NO OF DAYS	NO OF PATIENTS	PERCENTAGE
≤ 14 DAYS	5	16.67%
15-30 DAYS	9	30%
31-90 DAYS	14	46.67%
> 90 DAYS	2	6.67%

Mean 45.9

Median 32.5

Mode 34

SD 46.689

18) TYPE OF FINAL SURGERY [FEMUR] (TABLE 17)

TYPE OF SURGERY	NO OF PERSON	PERCENTAGE
EX FIX	3	12.5%
PLATING	13	54.17%
NAILING	5	20.83%
SCREWS	2	8.33%
K WIRES	1	4.17%
TOTAL	24	100%

The final fixation of femur depends upon the type of fracture. The different modalities used were intramedullary nailing, external fixators, locking plating, Dynamic condylar screw, K wires and Cancellous screws. Totally 3 (12.5%) external fixators, 12 (50%) plating, 5 (20.83%) intramedullary nailing, 1 (4.17%) Dynamic condylar screw, 1 (4.17%) K wires and two (8.33%) Cancellous screws were done.(table 17)

19) TYPE OF FINAL SURGERY FOR TIBIA(TABLE 18)

TYPE OF SURGERY	NO OF PERSON	PERCENTAGE
EX FIX	5	26.32%
PLATING	7	36.84%
IMIL	3	15.79%
ILIZAROV	1	5.26%
HYBRID EX FIX	2	10.53%
SCREWS	1	5.26%
TOTAL	19	100%

The final management of tibia were depends up on the level and the type of the fractures, 5 (26.32%) cases were treated with external fixators, 7(36.84%) were treated with plating, 3 (15.79%) were treated with intramedullary nailing, one (5.26%) patient was treated with ilizarov, two (10.53%) were treated with hybrid external fixators and one (5.26%) was treated with Cancellous screws.(table 18)

20) DURATION OF INITIAL SURGERY (KNEE SPANNING EXTERNAL FIXATION) (FIG.27)

The duration of initial knee spanning external fixation ranged from 40 minutes to 75 minutes. The Mean was 53 minutes, Median was 50, Mode was 50 and Standard deviation was 8.9635.(fig.27)

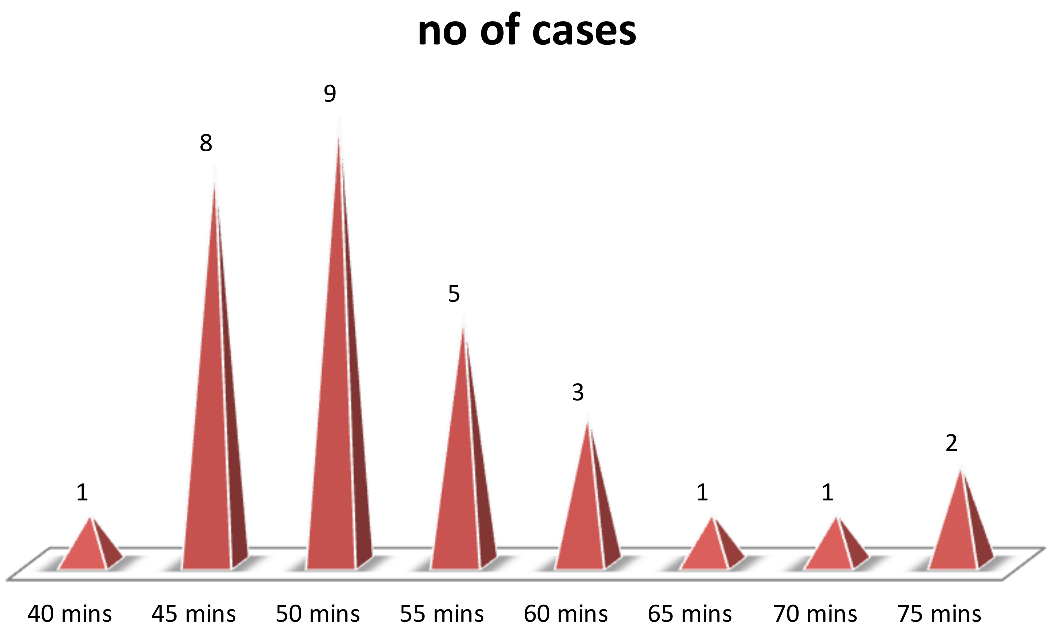


FIG.27: DURATION OF SURGERY AND NUMBER OF CASES

21) ASSOCIATED OTHER INJURIES

The Associated other injuries were seen in fifteen cases (50%) (table.19). Contralateral lower limb injuries were three, (10%) one patient had grade IIIB tibial fracture for which an external fixator was applied and the other patient had a grade I tibia fracture for which interlocking nailing done, the remaining one patient had a shaft of femur fracture for which interlocking nailing done. Upper limb injures were five (16.67%) out of which four were ipsilateral and one was contralateral. Among the four ipsilateral upper limb injuries, two were distal radius fractures treated with K wires, one was grade I fracture both bone forearm treated with plating, one was grade II shaft of humerus fracture treated with plating and two patients with ulna fracture treated with K wire and plating. The one contralateral upper limb injury was shaft of humerus fracture for which ORIF with plating was done.

Head injury was present in two (6.67%) patients. Both the patients were treated conservatively. The fixation of the periarticular knee injury had to be delayed till the patients have stabilized. Chest injury was seen in three (10%) patients, two patients had multiple rib fractures. two patients needed intercostal chest tube for haemothorax.

TABLE–19: ASSOCIATED OTHER INJURIES

No.	Associated other injuries	No. patients	Treatment
I	**Contralateral lower limb** Grade IIIB tibia fracture -1 Grade I tibia fracture - 1 Shaft of femur fracture - 1	3	External fixation Interlocking nailing Interlocking nailing
II	**Upper limb Ipsilateral** Distal radius fracture – 2 Grade I both bone forearm # – 1 Grade II shaft of humerus # - 1 Ulnar shaft fracture – 1	4	K wire fixation Plating Plating Plating(1), K wire(1)
III	**Upper limb contralateral** Shaft of humerus fracture - 1	1	ORIF – Plating
IV	**Head Injury** Extradural Haemotoma – 2	2	Conservative
V	**Chest injury** Pneumothorax – 2 Haemopnemothorax -1	3	Intercostal drainage – 2

22) ASSOCIATED INJURIES IN THE SAME LIMB

There were nine (30%) (table-20) associated injuries in the same limb, among these there were two (6.67%) patients with vascular injury. Both were at the level of popliteal artery, both under went for vascular repair. Following which external fixators were applied. one had an acetabulum fracture for which ORIF with recon plating done, two had fracture dislocation of hip for which one undergone total hip replacement and the other one undergone ORIF with screw fixation of femoral head, four had patella fracture of which two were managed with cerclage, one treated conservatively and one patients required resection. One had medial malleolus fracture treated with K wire fixation. One had calcaneal fracture treated conservatively. The functional outcome was poor in majority of these patients.

Twenty five (83.33%) patients required wound debridement before fracture fixation and two (6.67%) patients required vascular repair before fixation.

No.	Associated injuries in the same limb	No. Patients	Treatment
I	Vascular Popliteal artery injury	2	Vascular repair – 2
II	Acetabulum fracture – 1 Hip fracture dislocation – 2 Patella fracture – 4 Fibular head fracture – 1 Medial malleolus fracture - 1 Calcaneal fracture - 1	7	Plating THR(1), Screw fixation(1) Cerclage(2), Resection(1), Conservative(1) Screw fixation K wire fixation Conservative

TABLE–20: ASSOCIATED INJURIES IN THE SAME LIMB

23) FUNCTIONAL OUTCOME

The overall functional outcome was assessed using KNEE SOCIETY SCORE (annexure-I) and the patients were classified accordingly.

The results show EIGHT patients (26.67%) with EXCELLENT, FIVE patients (16.67%) with GOOD, EIGHT patients (26.67%) with FAIR and NINE patients (30%) with POOR outcome.

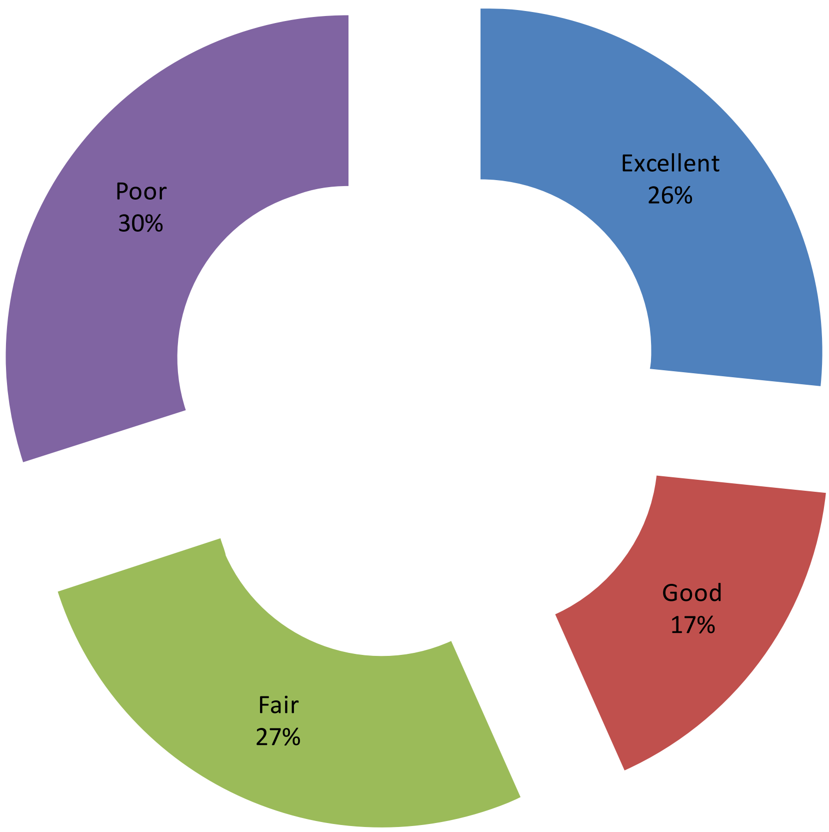


FIG.28: FUNCTIONAL OUTCOME

24) KNEE - RANGE OF MOTION

The knee range of motion was a main criteria for the functional outcome. The maximum range recorded was 0-120°. The minimum range recorded was FFD 20°(table–21) (fig–29). The average range of motion in the thirty patients was 5 – 70°.

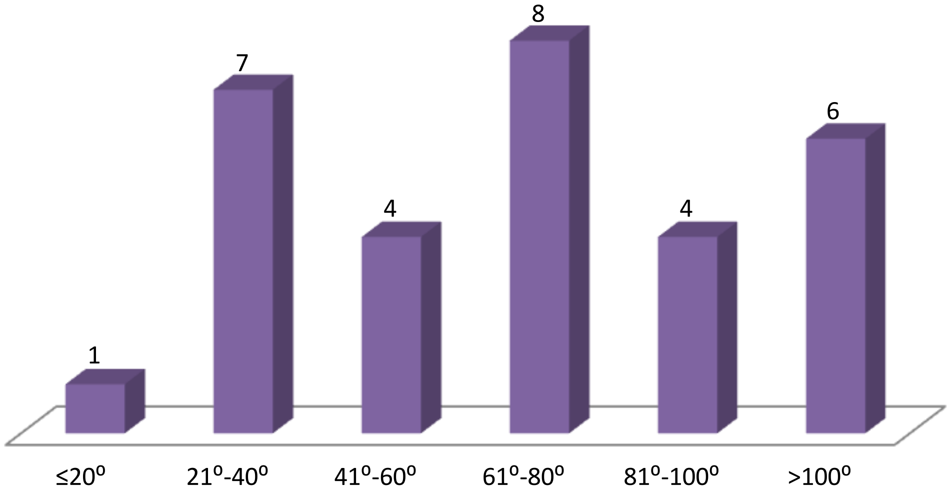


FIG.29 KNEE – Range of Motion

KNEE RANGE OF MOTION In degrees	NO OF PATIENTS	PERCENTAGE
20	1	3.33%
40	7	23.33%
45	2	6. 67%
60	2	6. 67%
70	6	20%
80	2	6. 67%
90	4	13.33%
110	3	10%
120	3	10%
TOTAL	30	100%

TABLE–21: KNEE – RANGE OF MOTION

STATISTICAL ANALYSIS

The different variables of the study were analyzed with the final outcome of the patient in order to identify the factors affect the final outcome. The different variables correlated with the outcome were

- Age of the patient
- Mode of injury
- Duration of initial spanning external fixator
- Fraser classification type
- Schatzker classification type
- Femur closed or open fractures
- Tibia closed or open fractures
- Femur Level of fractures
- Tibia level of fractures
- Femur type of final surgery
- Tibia type of final surgery
- Femur bony union (in months)
- Tibia bony union (in months)
- Infection

1) CORRELATION OF AGE OF THE PATIENT AND FUNCTIONAL OUTCOME: TABLE -22

AGE OF THE PATIENT	FUNCTIONAL OUTCOME				TOTAL
	EXCELLENT	GOOD	FAIR	POOR	
≤20	3	1	0	1	5
21-30	4	1	3	4	12
31-40	1	0	2	3	6
41-50	0	3	1	1	5
51-60	0	0	1	0	1
61-70	0	0	1	0	1
TOTAL	8	5	8	9	30

chi-square = 19.2

degrees of freedom = 15

p value = 0.204

As the p value was more than 0.05, the age of the patients and functional outcome were statistically not significant.

2) CORRELATION OF MODE OF INJURY AND FUNCTIONAL OUTCOME: TABLE-23

MODE OF INJURY	FUNCTIONAL OUTCOME				TOTAL
	EXCELLENT	GOOD	FAIR	POOR	
FALL FROM HEIGHT	1	0	0	1	2
PEDESTRIAN	0	0	1	0	1
MOTOR CYCLE ACCIDENT	6	5	7	6	24
MOTOR VEHICLE ACCIDENT	1	0	0	2	3
TOTAL	8	5	8	9	30

chi-square = 7.52

degrees of freedom = 9

p value = 0.583

As the p value was more than 0.05, the mode of injury and functional outcome were statistically not significant.

3) CORRELATION OF DURATION OF INITIAL EX FIX AND FUNCTIONAL OUTCOME: TABLE -24

DURATION OF INITIAL EX FIX	FUNCTIONAL OUTCOME				TOTAL
	EXCELLENT	GOOD	FAIR	POOR	
≤ 14 DAYS	2	2	1	0	5
15-30 DAYS	3	1	2	3	9
31-90 DAYS	3	2	4	5	14
> 90 DAYS	0	0	1	1	2
TOTAL	8	5	8	9	30

chi-square = 5.87

degrees of freedom = 9

p value = 0.753

As the p value was more than 0.05, the duration of initial ex fix and functional outcome were statistically not significant.

4) CORRELATION OF DURATION OF INITIAL EX FIX AND FINAL KNEE RANGE OF MOTION: TABLE -25

DURATION OF INITIAL EX FIX	**FINAL KNEE RANGE OF MOTION**				**TOTAL**
	≤30 deg	**31 to60**	**61 to90**	**>90**	
≤ 14 DAYS	0	0	4	1	5
15-30 DAYS	0	4	3	2	9
31-90 DAYS	0	6	5	3	14
> 90 DAYS	1	1	0	0	2
TOTAL	1	11	12	6	30

chi-square = 19.6

degrees of freedom = 9

probability = 0.020

As the p value was less than 0.05, the duration of initial ex fix and final knee range of motion were **statistically significant**.

5) CORRELATION OF FRASER TYPE AND FUNCTIONAL OUTCOME: TABLE -26

FRASER TYPE FLOATING KNEE	FUNCTIONAL OUTCOME				TOTAL
	EXCELLENT	GOOD	FAIR	POOR	
TYPE I	1	1	1	1	4
TYPE II A	0	1	0	1	2
TYPE II B	0	0	2	2	4
TYPE II C	0	0	2	1	3
TOTAL	1	2	5	5	13

chi-square = 7.26

degrees of freedom = 9

probability = 0.610

As the p value was more than 0.05, the fraser's type and functional outcome were statistically not significant.

6) CORRELATION OF SCHATZKER TYPE AND FUNCTIONAL OUTCOME: TABLE -27

SCHATZKER TYPE TIBIAL PLATEAU FRACTURE	FUNCTIONAL OUTCOME				TOTAL
	EXCELLENT	GOOD	FAIR	POOR	
TYPE I	0	0	0	0	0
TYPE II	0	0	1	0	1
TYPE III	0	0	0	0	0
TYPE IV	0	0	0	0	0
TYPE V	0	0	2	0	2
TYPE VI	0	1	0	3	4
TOTAL	0	1	3	3	7

chi-square = 7.00

degrees of freedom = 4

probability = 0.136

As the p value was more than 0.05, the schatzker type and functional outcome were statistically not significant.

7) **CORRELATION OF FEMUR FRACTURE- TYPE AND FUNCTIONAL OUTCOME: TABLE -28**

TYPE	**FUNCTIONAL OUTCOME**				**TOTAL**
	EXCELLENT	**GOOD**	**FAIR**	**POOR**	
SIMPLE	2	0	2	2	6
COMMINUTED	3	4	5	6	18
TOTAL	5	4	7	8	24

chi-square = 1.98   degrees of freedom = 3

p value = 0.576

The type of femur fracture and the functional outcome were statistically not significant, as the P value was more than 0.05

8) **CORRELATION OF TIBIA FRACTURE- TYPE AND FUNCTIONAL OUTCOME: TABLE -29**

TYPE	**FUNCTIONAL OUTCOME**				**TOTAL**
	EXCELLENT	**GOOD**	**FAIR**	**POOR**	
SIMPLE	1	1	2	2	6
COMMINUTED	3	2	4	4	13
TOTAL	4	3	6	6	19

chi-square = 0.101   degrees of freedom = 3

p value = 0.992

The type of tibia fracture and the functional outcome were statistically not significant, as the p value was more than 0.05.

9) CORRELATION OF LEVEL OF FRACTURE – FEMUR AND FUNCTIONAL OUTCOME: TABLE - 30

LEVEL	FUNCTIONAL OUTCOME				TOTAL
	EXCELLENT	GOOD	FAIR	POOR	
DIAPHYSEAL	2	2	1	2	7
METAPHYSEAL	1	0	2	0	3
ARTICULAR	2	2	4	6	14
TOTAL	5	4	7	8	24

chi-square = 5.27 degrees of freedom = 6

p value = 0.510

The level of fracture of femur and the functional outcome are statistically not significant, as the p value is more than 0.05.

10) CORRELATION OF LEVEL FRACTURE TIBIA AND FUNCTIONAL OUTCOME: TABLE -31

LEVEL	FUNCTIONAL OUTCOME				TOTAL
	EXCELLENT	GOOD	FAIR	POOR	
DIAPHYSEAL	2	1	3	3	9
METAPHYSEAL	1	0	0	0	1
EPIPHYSEAL	1	2	3	3	9
TOTAL	4	3	6	6	19

chi-square = 4.57 degrees of freedom = 6

p value = 0.599

The level of fracture of tibia and the functional outcome are statistically not significant, as the p value was more than 0.05.

11) CORRELATION OF TYPE OF FRACTURE FEMUR-CLOSED OR OPEN AND FUNCTIONAL OUTCOME: TABLE -32

GUSTILO AND ANDERSON	FUNCTIONAL OUTCOME				TOTAL
	EXCELLENT	GOOD	FAIR	POOR	
CLOSED	2	2	1	2	7
OPEN-GRADE I	1	0	0	0	1
OPEN-GRADE II	0	2	2	0	4
OPEN-GRADE III-A	0	0	2	1	3
OPEN-GRADE III-B	1	0	2	4	7
OPEN-GRADE III-C	1	0	0	1	2
TOTAL	5	4	7	8	24

chi-square = 17.6

degrees of freedom = 15

p value = 0.286

The type of fracture of femur (classified according to Gustilo and Anderson) and the functional outcome were statistically not significant, as the p value was more than 0.05.

12) CORRELATION OF TYPE OF FRACTURE TIBIA-CLOSED OR OPEN & FUNCTIONAL OUTCOME: TABLE -33

GUSTILO AND ANDERSON	FUNCTIONAL OUTCOME				TOTAL
	EXCELLENT	GOOD	FAIR	POOR	
CLOSED	2	1	3	5	11
OPEN-GRADE I	0	0	1	0	1
OPEN-GRADE II	0	0	0	0	0
OPEN-GRADE III-A	1	1	0	0	2
OPEN-GRADE III-B	1	1	2	1	5
OPEN-GRADE III-C	0	0	0	0	0
TOTAL	4	3	6	6	19

chi-square = 7.18

degrees of freedom = 9

p value = 0.618

Tibia type of fracture weather closed or open and the functional outcome were statistically not significant, as the p value was more than 0.05.

13) CORRELATION OF TYPE OF FINAL FIXATION OF FEMUR AND THE FUNCTIONAL OUTCOME: TABLE -34

TYPE OF FIXATIONS	FUNCTIONAL OUTCOME				TOTAL
	EXCELLENT	GOOD	FAIR	POOR	
EX FIX	1	0	0	2	3
PLATING LCP	2	1	5	5	13
NAILING	1	3	1	0	5
SCREWS/ K WIRES	1	0	1	1	3
TOTAL	5	4	7	8	24

chi-square = 12.1

degrees of freedom = 9

p value = 0.208

Type of final fixation of femur and the functional outcome were statistically not significant, as the p value was more than 0.05.

14) CORRELATION OF TYPE OF FINAL FIXATION OF TIBIA AND THE FUNCTIONAL OUTCOME: TABLE -35

TYPE OF FIXATIONS	FUNCTIONAL OUTCOME				TOTAL
	EXCELLENT	GOOD	FAIR	POOR	
EX FIX/ ILIZAROV	2	1	3	2	8
PLATING	0	2	2	3	7
NAILING	1	0	1	1	3
SCREWS	1	0	0	0	1
TOTAL	4	3	6	6	19

chi-square = 7.26

degrees of freedom = 9

p value = 0.610

The final fixation of tibia and the functional outcome were statistically not significant, as the p value was more than 0.05.

15) CORRELATION OF FRASER'S TYPE AND THE TYPE OF FINAL FIXATION - FEMUR: TABLE -36

FRASER'S TYPE	TYPE OF SURGERY – FEMUR				TOTAL
	EXTERNAL FIXATOR	PLATING LCP	NAILING	SCREWS/ K WIRES	
TYPE I	1	0	3	0	4
TYPE II A	1	0	1	0	2
TYPE II B	0	3	0	1	4
TYPE II C	0	2	0	1	3
TOTAL	2	5	4	2	13

chi-square = 13.9

degrees of freedom = 9

p value = 0.125

The Fraser's type of floating knee and the type of final fixation of femur are statistically not significant, as the p value was more than 0.05.

16) CORRELATION OF FRASER'S TYPE AND THE TYPE OF FINAL FIXATION - TIBIA: TABLE -37

FRASER'S TYPE	TYPE OF SURGERY – TIBIA			TOTAL
	EXTERNAL FIXATOR	PLATING LCP	NAILING	
TYPE I	3	0	1	4
TYPE II A	0	2	0	2
TYPE II B	2	0	2	4
TYPE II C	0	3	0	3
TOTAL	5	5	3	13

chi-square = 13.9

degrees of freedom = 6

p value = 0.031

The Fraser's type of floating knee and the type of final fixation of tibia are **statistically significant**, as the p value was less than 0.05.

17) CORRELATION OF BONY UNION (FEMUR) TIME PERIOD AND THE FUNCTIONAL OUTCOME: TABLE -38

Out of 24 femur fractures, due to many nonunion cases and short follow up of some patients bony union achieved in 10 femur fractures (41.67%)

BONY UNION IN MONTHS	**FUNCTIONAL OUTCOME**				TOTAL
	EXCELLENT	**GOOD**	**FAIR**	**POOR**	
≤3 MONTHS	1	0	0	0	1
4 TO 6 MONTHS	2	1	3	2	8
>6 MONTHS	0	0	1	0	1
TOTAL	3	1	4	2	10

chi-square = 4.06

degrees of freedom = 6

p value = 0.668

The time period of the bony union of femur in months and functional outcome were statistically not significant, as the p value was more than 0.05.

18) CORRELATION OF BONY UNION (TIBIA) TIME PERIOD AND THE FUNCTIONAL OUTCOME : TABLE -39

Out of 19 tibia fractures, due to many nonunion cases and short follow up of some patients bony union achieved in 8 tibia fractures (42.1%)

BONY UNION IN MONTHS	**FUNCTIONAL OUTCOME**				TOTAL
	EXCELLENT	**GOOD**	**FAIR**	**POOR**	
≤3 MONTHS	1	0	0	0	1
4 TO 6 MONTHS	2	1	2	2	7
>6 MONTHS	0	0	0	0	0
TOTAL	3	1	2	2	8

chi-square = 1.90

degrees of freedom = 3

p value = 0.592

The time period of the bony union of tibia in months and functional outcome were statistically not significant, as the p value was more than 0.05.

BONY UNION

The time needed for the bony union was a critical factor for the final outcome and depended up on many factors, one of the important factor was the type of fracture – closed or open.

19) CORRELATION OF TYPE OF FRACTURE FEMUR–CLOSED OR OPEN AND BONY UNION: TABLE -40

BONY UNION	GUSTILO AND ANDERSON- FEMUR					TOTAL
	CLOSED	GRADE II	GRADE III-A	GRADE III- B	GRADE III-C	
≤3 MONTHS	1	0	0	0	0	1
4 TO 6 MONTHS	1	1	1	4	1	8
>6 MONTHS	0	0	1	0	0	1
TOTAL	2	1	2	4	1	10

chi-square = 8.75

degrees of freedom = 8

p value = 0.364

The bony union and the type of fracture femur- closed or open were statistically not significant, as the p value was more than 0.05.

20) CORRELATION OF TYPE OF FRACTURE TIBIA – CLOSED OR OPEN AND BONY UNION IN MONTHS : TABLE -41

BONY UNION	GUSTILO AND ANDERSON-FEMUR					TOTAL
	CLOSED	GRADE I	GRADE III-A	GRADE III- B	GRADE III-C	
≤3 MONTHS	1	0	0	0	0	1
4 TO 6 MONTHS	5	0	0	2	0	7
>6 MONTHS	0	0	0	0	0	0
TOTAL	6	0	0	2	0	8

chi-square = 0.381

degrees of freedom = 1

p value = 0.537

The time period for bony union and the type of tibial fractures- closed or open were statistically not significant, as the p value was more than 0.05.

INFECTION

Infection is the most dreaded complication in periarticular knee injuries. In our study, there were 11 cases with infection. Infection was correlated with various factors as follows. Infection was correlated with different variables such as Type of fracture- Femur, Type of fracture-Tibia, Level of fracture-Femur, Level of fracture-Tibia, Femur- Type of fracture open or closed, Tibia- Type of fracture open or closed, Femur- Type of final fixation, Tibia- type of final fixation and conversion time.

21) CORRELATION OF INFECTION AND THE FEMUR TYPE OF FRACTURE - CLOSED OR OPEN : TABLE -42

INFECTION	GUSTILO AND ANDERSON- FEMUR						TOTAL
	CLOSED	GRADE I	GRADE II	G III-A	G III-B	G III-C	
PRESENT	1	0	1	2	3	0	7
ABSENT	6	1	3	1	4	2	17
TOTAL	7	1	4	3	7	2	24

chi-square = 4.70 (degrees of freedom = 5)

p value = 0.454

The type of femur fracture closed or open (Gustilo and Anderson) and the infection rate were statistically not significant, as the p value was more than 0.05.

22) CORRELATION OF INFECTION AND THE TIBIA TYPE OF FRACTURE- CLOSED OR OPEN: TABLE -43

INFECTION	GUSTILO AND ANDERSON- FEMUR						TOTAL
	CLOSED	GRADE I	GRADE II	G III-A	G III-B	G III-C	
PRESENT	5	1	0	0	3	0	9
ABSENT	6	0	0	2	2	0	10
TOTAL	11	1	0	2	5	0	19

chi-square = 3.25

degrees of freedom = 3

p value = 0.355

The type of tibia fracture closed or open (Gustilo and Anderson) and the infection rate were statistically not significant, as the p value was more than 0.05.

23) CORRELATION OF INFECTION & FUNCTIONAL OUTCOME : TABLE -44

INFECTION	FUNCTIONAL OUT COME				TOTAL
	EXCELLENT	GOOD	FAIR	POOR	
PRESENT	2	2	4	3	11
ABSENT	6	3	4	6	19
TOTAL	8	5	8	9	30

chi-square = 1.15

degrees of freedom = 3

p value = 0.765

The functional outcome and the infection rate were statistically not significant, as the p value was more than 0.05.

24) CORRELATION OF INFECTION AND TYPE OF FRACTURE- FEMUR : TABLE -45

INFECTION	TYPE OF FRACTURE-FEMUR		TOTAL
	SIMPLE	COMMINUTED	
PRESENT	0	7	7
ABSENT	6	11	17
TOTAL	6	18	24

chi-square = 3.29

degrees of freedom = 1

p value = 0.070

Infection and the type of fracture of femur were statistically not significant, as the p value was more than 0.05.

25) CORRELATION OF INFECTION AND TYPE OF FRACTURE- TIBIA : TABLE -46

INFECTION	TYPE OF FRACTURE-TIBIA		TOTAL
	SIMPLE	COMMUNITED	
PRESENT	1	8	9
ABSENT	5	5	10
TOTAL	6	13	19

chi-square = 3.32

degrees of freedom = 1

p value = 0.069

Infection and the type of fracture of tibia were statistically not significant, as the p value was more than 0.05.

26) CORRELATION OF INFECTION AND LEVEL OF FRACTURE- FEMUR : TABLE -47

INFECTION	LEVEL OF FRACTURE-FEMUR			TOTAL
	DIAPHYSEAL	METAPHYSEAL	INTRA-ARTICULAR	
PRESENT	2	1	4	7
ABSENT	6	2	9	17
TOTAL	8	3	13	24

chi-square = 0.109

degrees of freedom = 2

p value = 0.947

Infection and level of fracture of femur were statistically not significant, as the p value was more than 0.05.

27) CORRELATION OF INFECTION AND LEVEL OF FRACTURE- TIBIA : TABLE -48

INFECTION	LEVEL OF FRACTURE-TIBIA			TOTAL
	DIAPHYSEAL	METAPHYSEAL	EPIPHYSEAL	
PRESENT	3	1	5	9
ABSENT	6	0	4	10
TOTAL	9	1	9	19

chi-square = 2.06

degrees of freedom = 2

p value = 0.356

Infection and level of fracture of tibia were statistically not significant, as the p value was more than 0.05.

28) CORRELATION OF INFECTION AND TYPE OF FINAL FIXATION-FEMUR: TABLE -49

INFECTION	TYPE OF FIXATION-FEMUR				TOTAL
	EX FIX	PLATING LCP	NAILING	SCREWS/ K WIRES	
PRESENT	1	5	1	1	8
ABSENT	2	8	4	2	16
TOTAL	3	13	5	3	24

chi-square = 0.554

degrees of freedom = 3

p value = 0.907

29) CORRELATION OF INFECTION AND TYPE OF FINAL FIXATION-TIBIA: TABLE -50

INFECTION	TYPE OF FIXATION-TIBIA				TOTAL
	EX FIX	PLATING	IMIL NAILING	SCREWS/ K WIRES	
PRESENT	3	5	1	0	9
ABSENT	5	2	2	1	10
TOTAL	8	7	3	1	19

chi-square = 3.07

degrees of freedom = 3

p value = 0.380

Infection and neither the type of final fixation of femur nor tibia were statistically not significant, as the p value was more than 0.05.

30) CORRELATION OF INFECTION AND DURATION OF INITIAL SPANNING EX FIX : TABLE -51

INFECTION	DURATION OF INITIAL SPANNING EX FIX				TOTAL
	≤ 14 DAYS	15-30 DAYS	31-90 DAYS	> 90 DAYS	
PRESENT	1	3	6	1	11
ABSENT	4	6	8	1	19
TOTAL	5	9	14	2	30

chi-square = 1.03

degrees of freedom = 3

p value = 0.795

Infection and duration of initial spanning external fixation were statistically not significant, as the p value was more than 0.05.

DISCUSSION

Compound periarticular knee injury occurs usually due to high energy/velocity trauma. There is an increase in the occurrence of compound periarticular knee injuries due to the increase in the number of road traffic accidents. These injuries are always associated with high morbidity. Most of these injuries result in some permanent disability.

Most common mechanism of injury was road traffic accidents (93%). The rest (7%) were injured due to fall from height. Among the road traffic accidents motor cycle (Two wheeler) accidents (80%) accounted the most. Four wheeler accidents accounted to about 10% and the remaining 3 % were pedestrians.

Hayes JT[19] described that automobile passengers braced their feet firmly against the sloping floor of the front seat of the vehicle. Just prior to the collision, their lower limbs getting crumpled under the massive decelerating forces produced by the impact. Pedestrians were frequently catapulted some distance from the point of impact and were further injured by striking the pavement. In a study of 222 cases of floating knee by Fraser[20] all cases were involved in road traffic accidents.

There are many studies showing the association of other injuries like head injuries, chest injuries, abdominal injuries and contralateral limb injuries. Many of these injuries are often life threatening.

Adamson et al[21] in their study encountered 71% major associated injuries with 21% vascular injuries. But in this study 13% (4 patients) were associated with head or chest injuries. 2 patients (7%) were associated with vascular injuries. There were low numbers of associated injuries in our study because most of the patients with associated head or chest injuries haven't undergone conversion to knee sparing fixation and were excluded from the study.

In this study, all patients were males (100%). Other similar studies in literature also describes the male predominated gender distribution (Karlstrom et al[22] and Fraser et al[20])

The age distribution was from 18 years to 64 years (Mean 32.1, Median 27.50, Mode 18.0). Skeletally immature paediatric age group patients were not included in the study. Hee et al[23] in their study described almost the same age group. Right sided injuries (70%) were more common than left sided injuries (30%).

There were totally twenty five (25) open fractures among which femur fractures were seventeen (68%) and tibia fractures were eight (32%).

Among the 24 femur fractures seven (29%) were closed, open grade I was one (4%), open grade II were four (17%), open grade III A were three (13%), grade III B were seven (29%) and grade III C were two (8%). Closed femur fractures had more number of excellent outcomes in this study (40%). Among the tibia fractures, closed were eleven (58%), open grade I was one (5%), open grade III A were two (11%),and open grade III B were five (26%). Closed tibia fractures had more number of excellent outcomes in this study (50%). There were 14 compound knee injuries in our study, in which10 patients (71%) had either poor or fair outcomes; 4 patients (29%) had either good or excellent outcomes. Hee et al[23] had described 55 open floating knee injuries in which grade I were 10 cases(18%), grade II were 16 (29%) and grade III were 29 (53%). 32 patients(58%) had open fractures of the tibia; 3 patients (5%) had open fractures of the femur; 20 (36%) had both open fractures of the femur and tibia. Hee et al[23] had described that open fractures were poor predictors of the functional outcome and projected that increase in the grade of open fracture inversely affect the outcome.

There were twelve (28%) transverse fractures and thirty one (72%) comminuted fractures. Transverse fractures had more excellent outcomes (25%) than comminuted fractures (19%) in this study. Hee et al[23] had described that comminuted fractures were poor predictors of the functional outcome.

Among these types of fractures, twenty two (51%) were intra articular and twenty one (49%) were extra articular. Extra articular fractures had more excellent outcomes (33%) than intra articular fractures (9%) in this study. Fraser et al[20] studied 222 cases with ipsilateral fractures of the femur and tibia in 1978. They observed that poor functional outcome was seen with intra articular fractures. Similar results were found by Bansal et al[24].

Classifying the floating knee injuries according to Fraser's classification, in our study we had four (31%) of type-I, two (15%) of type-IIA, four (31%) of type-IIB and remaining three (23%) cases were type-IIC. We found more number of poor outcomes (38%) associated with floating knee injuries in this study. Fraser et al[20] had less number of poor outcome (24%) compared to our study.

There are only few studies in literature which shows specific treatment protocol for staged management for high energy periarticular knee injuries.

In our study three (13%) femur fractures were treated with external fixator itself, out of which two (67%) patients had poor out come because these patients had taken longer time for conversion, so they treated in the external fixator itself. One (33%) patient had excellent outcome. The study of floating knee injuries by karu[25] was observed 9.1% excellent outcome in the patients treated with external fixator for femur fractures.

Femur locking compression plating was done in thirteen (54%) patients for distal femur fractures, of which three (23%) had either good or excellent outcomes. And ten (77%) had either poor or fair outcomes. The study of floating knee injuries by karu[25] was observed 50% patients had either good or excellent outcomes. And 50% had either poor or fair outcomes. Five patients underwent interlocking intramedullary nailing for diaphyseal fractures of femur out of which four (80%) patients had either good or excellent outcome. No poor outcome was noted with nailing. Hence among the femoral fixations, Intrameduallary nailing has a better prognosis. But interlocking nailing was done for diaphyseal fractures and locking compression plating was done for distal femur fractures with articular extension (type C) where nailing could not be done.[26] Distal femur fractures were associated with soft tissue problems which require plastic surgical intervention which in turn delayed the definitive intervention.

Among the tibial fractures, eight (42%) were fixed with External fixators or ilizarov fixator out of which two patients had poor outcomes and three patients fair outcomes. Seven patients were treated with plating (locking compression plate, buttress plate or biological plate) and they had either poor or fair outcome. Three patients were treated with interlocking intramedullary nailing and out of which one patient had excellent outcome. There were many postoperative complications at tibial side. All the complications (100%) were found to be associated either with open fractures or with comminuted fractures.

STATISTICAL OUTCOME ANALYSIS

Various Variables were correlated with the functional outcome; the factors which were significant are as follows.

FRASER'S CLASSIFICATION and THE TYPE OF FINAL FIXATION OF TIBIA were statistically SIGNIFICANT ($p = 0.031$). This shows that diaphyseal fractures of tibia were fixed statistically more with interlocking nailing or external fixation than with plating (locking compression plate, buttress plate or biological plate). In the same manner proximal tibial fractures were fixed statistically more with plating (locking compression plate, buttress plate or biological plate) than with interlocking nailing or external fixation. Because comminuted intra articular fractures show better results with plating (locking compression plate, buttress plate or biological plate).

DURATION OF INITIAL EXTERNAL FIXATOR and FINAL KNEE RANGE OF MOTION were statistically SIGNIFICANT ($p = 0.020$). The duration of initial knee spanning external fixation was inversely proportional to the final knee range of motion. The average time taken for conversion was 46 days. The main reason for this delayed intervention was mainly due to plastic surgical interventions. They took longer time to give adequate skin cover in compound injuries. The increase in duration of initial knee spanning external fixation leads to soft tissue contractions and surrounding muscle fibrosis. Knee spanning external fixator should converted in to knee sparing fixation within two weeks to get better knee range of motion.

Infection was correlated with various factors and it was found to be NONE was statistically SIGNIFICANT. Though compound comminuted intraarticular fractures were found to be more associated with infection in this study, we couldn’t establish a statistically significant association due to the minimum number of patients.

COMPARISON WITH OTHER STUDIES (table –52)

No comparative study was available for functional outcome. This study was compared with various floating knee injury studies in the literature and result were

TABLE –52: COMPARISON WITH OTHER STUDIES

Name of Study	**Total Number patients**	**Excellent**	**Good**	**Fair**	**Poor**
Fraser et al 1978	63	3	15	30	15
Schiedts et Al[27] 1994	18	4	7	-	7
Hee et al 2001	89	6	53	25	4
Anoop Kumar et al[28] 2006	42	7	14	14	7
Ulfin Rethnam et al[29] 2007	29	15	9	2	3
THIS STUDY 2014	30	8	5	8	9

EXCELLENT OUTCOMES

There were eight patients (27%) with excellent outcome. one patient had both femur and tibia nailing done. Two patients had femur locking compression plating. Two patients had minimal internal fixation. Three patients were treated with external fixator. All these patients had no pain or any deformity. Out of these 8 patients, 4 (50%) had compound injuries; 5 (63%) had intra articular fractures and the average time taken for conversion was 27 days. These patients returned back to their work as before accident. The knee range of motion was from 0-120° in two patients, 0 – 110° in three patients and 0 – 90° in three patients.

GOOD OUTCOMES

There were five (17%) patients with Good outcome. Among the five patients, intramedullary interlocking nailing was done in two femurs. Tibial plating (locking compression plate, buttress plate) was done in two patients. Among the Good outcomes, some patients had intermittent knee pain but not severe. Out of these 5 patients, 3 (60%) had compound injuries; 3 (60%) had intra articular fractures and the average time taken for conversion was 28 days. The knee range of motion ranged from 20 – 120° in one patient, two patients had a range of 0 – 80°, one patient had 5 – 80° and one patient had 20 - 90°.

FAIR OUTCOMES

Fair outcome were seen in 8 (27%) patients, out of these four patients had delayed union and three patients had infection. Out of these 8 patients, all (100%) had compound injuries; 5 (63%) had intra articular fractures and the average time taken for conversion was 56 days. The average range of motion at the knee for these patients was 0 – 70°. The walking distance of these patients were restricted. Four patients have severe symptoms impairing function.

POOR OUTCOMES

Poor outcomes were seen in nine (30%) patients. There were six patients with comminuted fracture of femur and tibia. Out of these 9 patients, 6 (67%) had compound injuries; 8 (89%) had intra articular fractures and the average time taken for conversion was 63 days. The average range of motion of knee of these patients was 10 - 45°. Five patients need support in the form of cane or crutch.

CONCLUSION

Periarticular knee injuries are due to high velocity/energy trauma. Road traffic accident particularly two wheeler accident is the most common cause. Males are affected more. Many are associated with other injuries such as patellar fractures and vascular injuries.

There are common complications like infection, delayed union and malunion. Poor outcomes are mainly due to open fractures, intra articular extensions and comminution. Patients who undergo nailing will have Excellent or Good results.

The most important factors which determine the functional outcomes were the type of fractures (open or closed), nature of comminution including intra articular extensions, timing of fixations and postoperative infections.

Duration of initial knee spanning external fixator and final knee range of motion have statistically significant association.

CASE ILLUSTRATIONS

Case 2: 18/m, Grade I compound # SOF Rt, grade IIIa compound # BB Leg Rt, initial knee spanning ex fix followed by open IL nailing for femur and IL nailingfor tibia


R


Govt General Hospital
SATHISH 18/M
M 24077
Acc:
2014 Mar 05
09:31:30.0
R

Case 2: 18/m, Grade IIIb compound fracture proximal both bone leg right with medial malleolus fracture right side, Knee spanning ex fix and K wire application for medial malleolus(6/10/13), Hybrid external fixator for tibia(9/11/13)


L


Case 3: 22/M, Grade IIIb comminuted fracture Rt. Patella, Type B1(muller)Supracondylar fracture Rt. Femur,Type V (Schatzker) Tibial plateau fracture, ORIF with Lateral bridge plating for tibial plateau,two 6.5 mm cancellous screw for supracondylar femur fracture

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KNEE SOCIETY SCORE

Criteria		**Points**
1. Pain		
None	-	50
Mild or occasional	-	45
Stairs only	-	40
Walking and stairs	-	30
Moderate occasional	-	20
Continual	-	10
Severe	-	0
2. Range of motion (5 degrees = 1 point)	-	25
3. Stability (maximal movement in any position) Anteroposterior		
< 5 mm	-	10
5 – 10 mm	-	5
> 10 mm	-	0
Mediolateral		
< 5 degrees	-	15
6 – 9 degrees	-	10
10 – 14 degrees	-	5
> 15 degrees	-	0

Deductions

1. Flexion contracture

5 – 10 degrees	-	2
10 – 15 degrees	-	5
16 – 20 degrees	-	10
> 20 degrees	-	15

2. Extension lag

< 5 degrees	-	5
5 – 10 degrees	-	10
> 10 degrees	-	15

3. Alignment

5 – 10 degrees	-	0
0 – 4 degrees	-	3 points each degree
11 – 15 degrees	-	2 points each degree
Other	-	20

Interpretation

85 – 100 points	**: Excellent**
70 – 84 points	**: Good**
60 – 69 points	**: Fair**
< 60 points	**: Poor**

PATIENT'S PROFORMA

S. No

Name : **Age:**

IP NO.:

Sex : **Male / Female**

Address: **Phone No.**:

Mechanism of injury :

Pedestrian

MVA [Four wheeler]

MCA [Two wheeler]

Fall form height

Date and Time of Injury :

Place of Injury :

Associated factors influencing injury: h/o seizure disorder / alcohol consumption / any other

Time of presentation :

Associated General illness : DM / HT / any other

Type of Fracture

Femur Closed

Open -

Grade I

Grade II

Grade III A

Grade IIIB

Grade III C

Type of Fracture	Transverse
	Comminuted
	Segmental
Level of fracture	Diaphyseal
	Diaphyseal Metaphyseal junction
	Intraarticular
	Intertrochanteric.
Tibia	Closed
	Open
	Grade I
	Grade II
	Grade III A
	Grade IIIB
	Grade III C
Type of Fracture	Transverse
	Communited
	Segmental
Level of fracture	Diaphyseal
	Diaphyseal Metaphyseal junction
	Intraarticular Knee
	Intraarticular Ankle.

Classification

Associated other injuries Lower Limb

Upper Limb

Spine

Head injury Chest

injury Abdominal

injury

Associated injury in the same limb Vascular injury

Nerve injury

Crush injury of foot

Metatarsal fractures

Calcaneal fractures

Pelvis and sacral injury

Associated ipsilateral injuries specific to knee Patellar fractures

Avulsion of tibial tuberosity

Cruciate ligament injury

Meniscal injury

Time of presentation :

Time of operation :

Duration :

Procedures done before final fixation:

Type of surgery :

Femur : Ex Fix

Plating

open nailing

closed nailing

Tibia	:	Ex Fix
		Plating
		closed nailing
		open nailing
		Ilizarov
Average time duration of surgery	:	
Order of fixation	:	1st
		2nd
Post op complications	:	DIC
		Fat Embolism
		Infection
		Implant failure
		Delayed union
		Mal union
		Nerve injury
		Amputation
		Death
Additional procedures	:	Wound debridement
		Wound coverage
		Exchange of implant
		Re-alignment procedures
		Implant removal
		Bone grafting

Ligament reconstruction

Menisectomy

Any other

Post op protocol : Knee mobilization started at:

Weight bearing:

Any additional splintage

Bony union : Femur:

Tibia:

Range of movement : Hip:

Knee:

Ankle:

Deformity at the fracture site : Femur:

Tibia:

FUNCTIONAL OUTCOME

: EXCELLENT

: GOOD

: ACCEPTABLE

: POOR

Dates of follow up :

Duration :

X-ray : **Femur :**

Tibia :

PATIENT INFORMATION SHEET

TITLE OF THE STUDY : **ANALYSIS OF CLINICAL OUTCOME OF KNEE SPARRING FIXATION AFTER TEMPORARY KNEE SPANNING EXTERNAL FIXATION.- RETROSPECTIVE CUM PROSPECTIVE STUDY**

We are conducting a study on **"ANALYSIS OF CLINICAL OUTCOME OF KNEE SPARRING FIXATION AFTER TEMPORARY KNEE SPANNING EXTERNAL FIXATION"** among patients admitted in the Institute of Orthopaedics & Traumatology, Rajiv Gandhi Government General Hospital, Chennai.

The purpose of this study is to analyze the clinical outcome of knee sparring fixation after temporary knee spanning external fixation.

We are selecting certain cases based clinical pattern of fractures around the knee that need to be treated through temporary knee spanning external fixation initially, then conversion into knee sparring external or internal fixation later and if you are found eligible, we perform surgical procedure for the conversion from temporary knee spanning external fixation into knee sparring external or internal fixation or if you are already operated for the conversion we will evaluate the outcome of surgery, which in any way do not affect your final report or management.

The privacy of the patients in the research will be maintained throughout the study. In the event of any publication or presentation resulting from the research, no personally identifiable information will be shared.

Taking part in this study is voluntary. You are free to decide whether to participate in this study or to withdraw at any time; your decision will not result in any loss of benefits to which you are otherwise entitled.

The results of the special study may be intimated to you at the end of the study period or during the study if anything is found abnormal which may aid in the management or treatment.

Signature of Investigator   Signature of Participant

Date :

PATIENT CONSENT FORM

Study Detail : **ANALYSIS OF CLINICAL OUTCOME OF KNEE SPARRING FIXATION AFTER TEMPORARY KNEE SPANNING EXTERNAL FIXATION.- RETROSPECTIVE CUM PROSPECTIVE STUDY**

Study Centre : Rajiv Gandhi Government General Hospital, Chennai.

Patient's Name :

Patient's Age :

Identification Number :

Patient may check (√) these boxes

a) I confirm that I have understood the purpose of procedure for the above study. I have the opportunity to ask question and all my questions and doubts have been answered to my complete satisfaction. ☐

b) I understand that my participation in the study is voluntary and that I am free to withdraw at any time without giving reason, without my legal rights being affected. ☐

c) I understand that sponsor of the clinical study, others working on the sponsor's behalf, the ethical committee and the regulatory authorities will not need my permission to look at my health records, both in respect of current study and any further research that may be conducted in relation to it, even if I withdraw from the study I agree to this access. However, I understand that my identity will not be revealed in any information released to third parties or published, unless as required under the law. I agree not to restrict the use of any data or results that arise from this study. ☐

d) I agree to take part in the above study and to comply with the instructions given during the study and faithfully cooperate with the study team and to immediately inform the study staff if I suffer from any deterioration in my health or well being or any unexpected or unusual symptoms. ☐

e) I hereby consent to participate in this study. ☐

f) I hereby give permission to undergo detailed clinical examination, Radiographs ,blood investigations and surgical procedure as required. ☐

Signature/thumb impression Signature of Investigator

Patient's Name and Address: Study Investigator's Name: **DR.A.SYED ABDHAHIR**

<u>ஆய்வு தகவல் தாள்</u>

ஆராய்ச்சியாளர் பெயர் : அ. சையது அப்தாகிர்

தலைப்பு : தற்காலிக முழங்கால் வெளி கம்பி பொருத்துதலுக்கு பின்னர் செய்யப்படும் நிலையான முழங்கால் தவிர்த்த உள்/ வெளி கம்பி பொருத்தும் அறுவை சிகிச்சை மேற்கொண்டு , செயல்பாட்டு விளைவினை அளவிடும் மருத்துவ ஆய்வு .

சென்னை அரசு பொது மருத்துவமனையில் முழங்கால் _எலும்பு முறிவுக்கு சிகிச்சைக்காக சேர்க்கப்படும் நோயாளிகளில் மேற்கொள்ளப்படும் மருத்துவ ஆய்வு .

இந்த மருத்துவ ஆய்வின் நோக்கம் தற்காலிக முழங்கால் வெளி கம்பி பொருத்துதலுக்கு பின்னர் செய்யப்படும் நிலையான முழங்கால் தவிர்த்த உள்/ வெளி கம்பி பொருத்தும் அறுவை சிகிச்சை செய்வதன் மூலம் பெறப்படும் செயல்பாட்டு விளைவினை கண்டறிதல் .

ஊடு கதிர் நிழற்படம் வைத்து சில குறிப்பிட்ட வகையான முழங்கால் எலும்பு முறிவு கொண்ட நோயாளிகள் மட்டும் ஆய்வுக்கு எடுத்து கொள்ளப் படுவார்கள். தேர்ந்தெடுக்கப்பட்ட நோயாளிகள் மயக்க மருந்து நிபுணர் ஒப்புதல் பிறகு அறுவை சிகிச்சைக்கு மேற்க்கொள்ளப்படுவார்கள்.

அறுவை சிகிச்சைக்கு முன் மற்றும் அறுவை சிகிச்சைக்கு பின் எடுக்கப்படும் ஊடு கதிர் நிழற் படங்கள், ஆராய்ச்சிக்கு பயன்படுத்தப்படும்.

மேலும் அறுவை சிகிச்சைக்குப்பின் 6 , 10 , 12 வார காலங்களில் நோயாளியின் அறுவை சிகிச்சைக் காயம் மற்றும் ஊடு கதிர் நிழற்படம் எடுக்கப்பட்டு எலும்பு சேர்ந்துவிட்டதா என்றும் கால் செயல்பாட்டு அளவும் ஆராயப்படும் .

மேலும் இதற்கு முன்னால் நடந்த ஆய்வில் எந்த பக்க விளைவுகளும் இல்லை என்று உறுதிப் படுத்தியுள்ளது.முடிவுகளை அல்லது கருத்துக்களை வெளியிடும் பொழுது அல்லது ஆய்வின் பொழுது தங்கள் பெயர் , அடையாளங்கள் வெளியிடப்படமாட்டாது என்பதையும் தெரிவித்து கொள்கிறோம்.

பங்குபெறுபவர் பெயர் : ஆய்வாளர் பெயர் :

கையோப்பம் : கையோப்பம் :

இடம் : தேதி :

சுயஒப்புதல் படிவம்

தலைப்பு : தற்காலிக முழங்கால் வெளி கம்பி பொருத்துதலுக்கு பின்னர் செய்யப்படும் நிலையான முழங்கால் தவிர்த்த உள்/ வெளி கம்பி பொருத்தும் அறுவை சிகிச்சை மேற்கொண்டு , செயல்பாட்டு விளைவினை அளவிடும் மருத்துவ ஆய்வு .

பெயர் : தேதி :

வயது : வெளி நோயாளி எண் :

பாலினம் : ஆராய்ச்சி சேர்க்கை எண் :

முகவரி :

நான் ______________________________ இந்த படிவத்தில் உள்ள தகவல்களை படித்தேன். (அல்லது எனக்கு படித்து காட்டப்பட்டது). நான் இந்த மருத்துவ ஆராய்ச்சி பற்றி எந்த தயக்கமும் இன்றி தகவல்களை கேட்டு பெற்று கொண்டேன். நான் 18 வயதை கடந்தவர் என்றும், இந்த ஆராய்ச்சியில் முழு சுதந்திரத்துடன் பங்கேற்க சம்மதம் என்றும் தெரிவித்து கொள்கிறேன்.

1. நான் இந்த ஒப்புதல் படிவத்தை படித்து இதில் உள்ள தகவல்களை நன்கு புரிந்து கொண்டேன்.
2. எனக்கு இந்த ஒப்புதல் ஆவணம் பற்றி நன்றாக விளக்கப்பட்டது.
3. எனக்கு இந்த ஆய்வின் தன்மையை பற்றி விளக்கப்பட்டது.
4. என்னுடைய உரிமை மற்றும் பொறுப்புகள் ஆராய்ச்சியாளர்களால் விளக்கப்பட்டது.
5. நான் இந்த ஆராய்ச்சியில் இருந்து எந்த நேரமும் பின் வாங்கலாம் என்பதையும், அதனால் எந்த பாதிப்பும் ஏற்படாது என்பதையும் புரிந்து கொண்டேன்.
6. இந்த ஆய்வின் மூலம் பெறப்பட்ட என்னுடைய முடிவுகளை வெளியிட விளம்பரதாரர் கட்டுப்பாட்டு அதிகாரிகள், அரசு அதிகாரிகள், நன்னெறி குழு(IEC)க்களுக்கு அனுமதி அளிக்கிறேன்.
7. என் ஆய்வு விவரங்களை பொதுவாக வெளியிடும் பொழுது என்னை பற்றிய அடையாளங்கள் ரகசியமாக வைக்கப்படும் என்பதையும் புரிந்து கொண்டேன்.
8. என் சந்தேகத்திற்கு உரிய பதில்களை திருப்தியுடன் பெற்று கொண்டேன்.
9. நான் இந்த ஆராய்ச்சியில் பங்கு பெற முடிவு செய்திருக்கிறேன்.

எனக்கு இந்த ஆய்வின் போது எழும் சந்தேகங்களை ஆராய்ச்சியளரிடம் கேட்டு தெரிந்து கொள்ள வேண்டும் என்பதை அறிவேன். நான் இந்த படிவத்தில் கையொப்பம் இடுவதன் மூலம், இந்த ஆய்வை பற்றி எனக்கு நன்றாக விளக்கப்பட்டது எனவும் ஒப்புதல் அளிக்கிறேன். எனக்கு இந்த ஒப்புதல் ஆவணத்தின் நகல் வழங்கப்படும்.

....	....	....
நோயாளியின் பெயர்	கையொப்பம் / கைரேகை	தேதி
....	....	....
சாட்சியின் பெயர்	கையொப்பம் / கைரேகை	தேதி
....	....	....
ஆராய்ச்சியாளரின் பெயர்	கையொப்பம்	தேதி

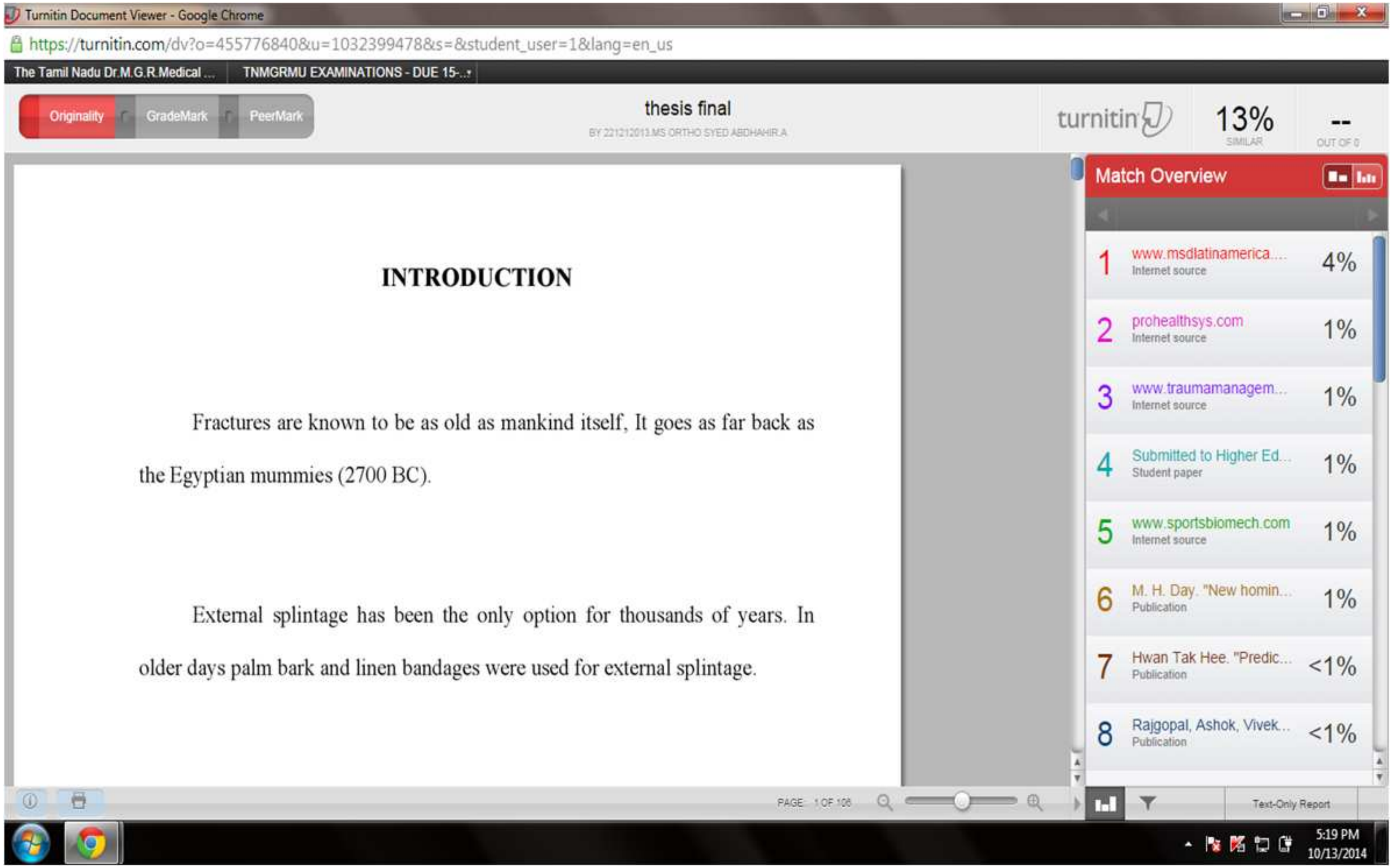
MASTER CHART

S.No	Age/ sex	IP no	Mode of injury	AO classification	fraser type	schatzker type	Associated injuries	Duration of ex fix in days	Procedure	follow up-months	Complications	KSS total
1	25/m	43334	FFH	41A1			# SOH Lt,Rt calcaneal #, haemopneumothorax	22	screw fixation	15	-	93
2	64/m	50433	pedestrian	33A3, 42A3	IIb		grade 1 compound fracture isolated tibia and closed fracture shaft of femur Rt	23	LCP for femur and IL nailing for tibia	14	infection,Non union	64
3	38/m	11614	FFH	41C2		6	fibular head # right	16	L butress plating for lateral column	6	infection, wound gap	31
4	28/M	33086	MCA	42C3			Posterior dislocation of right hip with femur head fracture, Grade I compound forearm fracture right side	8	ex fix for tibia and tibio fibular screw	16	Infection	93
5	45/m	20241	MCA	41C2		6	-	34	Buttress plating	3	compartment syndrome, infection	79
6	45/M	67796	MCA	33C2			# ulna(Rt) proximal 1/3rd on k-wire, pneumothorax	9	LCP	1	-	74
7	27/m	14271	MCA	32B2, 42A3	I		Patella # right side	12	IL nailing for femur	3	-	81
8	22/M	63127	MCA	33B3			-	14	cancellous screw fixation	4	-	92
9	40/M	23601	MCA	33C2			-	68	LCP	11	Infection	62
10	18/M	38012	MCA	32B2			-	66	ex fix	5	-	92
11	48/m	23961	MCA	33C2, 42C2	IIb		-	209	ilizarov for tibia	2	Infection	39
12	18/m	89880	MCA	32A2, 42C3	I		-	18	IL nailing for femur and tibia	11	Nonunion	99
13	18/m	94975	MVA	41A3			medial malleolus fracture right side	34	Hybrid external fixator for tibia	10	Infection	99

MASTER CHART

14	47/m	88768	MCA	32C1, 33B1, 41C1	IIa		distal radius # right	59	IL nailing for femur, LCP for tibia	9	Infection	74
15	37/M	97854	MCA	33C2			-	20	ORIF with LCP	1	-	87
16	19/m	121628	MCA	33C2			-	40	bridge plating	1	-	59
17	26/M	31461	MCA	33C3			-	29	LCP	4	-	53
18	50/m	12419	MCA	33C3			extradural haematoma	45	LCP	5	Infection	69
19	20/M	11240	MCA	32C2			-	26	LCP	1	-	78
20	35/m	10131	MVA	32B1, 41C2	IIa	6	-	34	LCP	6	Infection	51
21	29/M	33805	MCA	33A2, 41B3, 42B2	IIb	2	-	58	LCP for femur, tibial Exfix, SSG for Raw Area	1	-	60
22	32/m	76872	MCA	42C3			Grade 3b compond #Tibia left side	3	Hybrid external fixation	1	-	69
23	22/M	35309	MCA	33B1, 41C2	IIc	5	fracture Rt. Patella	31	LCP for tibia, screw for femur	4	-	67
24	27/m	50526	MVA	33C2			# ACETABULUM Rt	65	LCP	1	-	51
25	52/M	123810	MCA	32A1, 42A3	I		grade II SOH # left side, haemothorax, EDH	191	Femur IL nailing, tibia ex fix	2	-	61
26	32/M	60965	MCA	32A3, 42A3	I		Closed fracture left distal radius with fracture ulnar shaft	29	ex fix realignment	1	-	48
27	25/M	43660	MCA	33C2, 41C2	IIc	6	-	65	LCP for femur, bridge plating for tibia	1	-	43
28	24/M	46026	MCA	33B1, 42A1	IIb		popliteal artery injury -vascular graft done	83	LCP femur, tibia IL nailing	1	-	57
29	26/M	33733	MCA	33C2, 41C1	IIc	5	(R) femur head # dislocation, patella #	30	LCP for tibia and femur	12	Infection	69
30	24/m	48980	MCA	33A3			-	36	ORIF i LCP and bone grafting	38	-	93

PLAGIARISM REPORT



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INTRODUCTION

Fractures are known to be as old as mankind itself, It goes as far back as the Egyptian mummies (2700 BC).

External splintage has been the only option for thousands of years. In older days palm bark and linen bandages were used for external splintage.

In 1987 Clayton Park Hill developed the modern external fixator. He used unilateral external fixator with two pairs of screws on either side of the fracture. Dr. Roger Anderson used a frame with Trans fixation pins in1934. Even now external fixators play a major role in fracture fixation.

Primary total care of all bone fractures in multiple injured patients may benefit sometimes. However this mode of treatment is not a good option, rather it might be dangerous for some. To avoid such complications, the concept of damage control orthopedics was developed.

"Damage control" is a term used to explain procedures performed to keep a compromised ship afloat. In medicine general surgeons first utilized this term

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CERTIFICATE OF ETHICS COMMITTEE APPROVAL

INSTITUTIONAL ETHICS COMMITTEE
MADRAS MEDICAL COLLEGE, CHENNAI-3

EC Reg No.ECR/270/Inst./TN/2013
Telephone No. 044 25305301
Fax : 044 25363970

CERTIFICATE OF APPROVAL

To
Dr. A. Syed Abdhahir,
Postgraduate MS (Orthopaedics),
Institute of Orthopaedics and Traumatology ,
Madras Medical College,
Chennai – 600 003.

Dr. A.Syed Abdhahir

The Institutional Ethics Committee has considered your request and approved your study titled **"Prospective and Retrospective Study on Analysis of Clinical outcome of knee sparing fixation after temporary knee spanning external fixation "** No.20072014.

The following members of Ethics Committee were present in the meeting held on 01.07.2014 conducted at Madras Medical College, Chennai-3.

1.	Dr.C.Rajendran, M.D.,	: Chairperson
2.	Dr.R.Vimala, M.D., Dean, MMC, Ch-3	: Deputy Chairperson
3.	Prof.B.Kalaiselvi, M.D., Vice-Principal, MMC, Ch-3	: Member Secretary
4.	Prof.R.Nandhini, M.D., Inst.of Pharmacology, MMC	: Member
5.	Dr.G.Muralidharan, Director Incharge, Inst.of Surgery	: Member
6.	Prof.Md.Ali, M.D., D.M., Prof & HOD of MGE, MMC	: Member
7.	Prof.K.Ramadevi, Director i/c, Inst.of Biochemistry, MMC	: Member
8.	Prof.Saraswathy, M.D., Director, Pathology, MMC, Ch-3	: Member
9.	Prof.Tito, M.D., Director i/c, Inst.of Internal Medicine, MMC	: Member
10.	Thiru S.Rameshkumar, Administrative Officer	: Lay Person
11.	Thiru S.Govindasamy, B.A., B.L.,	: Lawyer
12.	Tmt.Arnold Saulina, M.A., MSW.,	: Social Scientist

We approve the proposal to be conducted in its presented form.

Sd/ Chairman & Other Members

The Institutional Ethics Committee expects to be informed about the progress of the study and SAE occurring in the course of the study, any changes in the protocol and patients information/informed consent and asks to be provided a copy of the final report.

Member Secretary

MEMBER SECRETARY
INSTITUTIONAL ETHICS COMMITTEE
MADRAS MEDICAL COLLEGE
CHENNAI-600 003