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IAS NEWSLETTER

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ARTICLES IN THIS ISSUE

Fixation of tibial spine avulsion fracture by suture pullout - a case series

Slope corrective osteotomy in malunited fractures around knee

EXPERTS OPINE

Dr Rajkumar Amaravati

MCL anatomy, Repair & Reconstruction techniques

Anatomy:

The medial side of the knee is mainly composed of three ligaments: Superficial MCL, Deep MCL & Posterior Oblique ligament(POL).
MCL arises just behind the MEdial epicondyle & attaches about 6cm below the medial joint line while the deep component inserts around 12mm below the joint line.

Operative indications:

Grade III MCL injuries, Open injuries & bony avulsions.

Repair:

Indicated for Acute in Stener Lesions-Tibial avulsion of MCL that is displaced over the pes anserine tendons & Femoral sided tears. Repair should be done for the Deep part & superficial part separately.

Reconstruction:

Indicated for chronic MCL insufficiency.
Two tibial & one femoral tunnel-Martin Lind technique
Two tibial and Two femoral tunnels- La Prade technique

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FIXATION OF TIBIAL SPINE AVULSION FRACTURE BY SUTURE PULLOUT

A CASE SERIES

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Abstract:

Anterior cruciate ligament avulsion from the tibia with a bony fragment of the tibial spine is an uncommon injury of the knee joint and occasionally encountered in orthopaedic practice.

In this article we present our series of 9 patients who underwent arthroscopic fixation using high-strength nonabsorbable sutures utilizing intravenous cannula needles as suture passers and retrievers.

Introduction:

Avulsion of the tibial eminence was first delineated by Poncet in 1875(1). This injury constitutes 2% to 5% of the knee and 14% of anterior cruciate ligament (ACL) injuries. The higher prevalence is seen in skeletally immature patients in the age group of 8 to 14 years(2,3,4,5). The reason is, during the years of growth, the strength of the ligaments is more than the ossifying tibial eminence bone. Recently there has been a trend in the increase in the number of these fractures in adults also(3). Hayes et al observed that 40% of tibial eminence fractures which were reported in the literature occurred in adults(4). In adults mode of injuries are usually high-energy trauma like RTA, Sports, etc, so concomitant injuries to collateral ligaments and menisci occur more in the adult age group(5). The Meyers and McKeever classification is the most commonly used classification of tibial spine fractures(3). This injury produces disabilities in form of flexion deformity, loss of extension and instability of the knee joint as ACL is also involved, so it is important to fix this injury (especially type 3 and 4) to prevent such complications(5). Various techniques are described to achieve secure fixation of the avulsed fragment in type III and IV fractures. In the last decade, the arthroscopic pull-out suture technique seems to have gained popularity over other techniques.

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Methods:

Patients with ACL avulsion fracture (type III and IV, less than 4weeks old) were included in the study. Age groups ranging from 13 to 45 were included. Diagnosis is confirmed by plain radiograph and Magnetic resonance imaging (MRI). Follow-up period ranging from 5 months to 36 years.

Surgical Technique:

Under spinal anesthesia, diagnostic arthroscopy was performed through the standard anterolateral portal, and the type of fracture was confirmed (Fig 1A). The fracture bed is cleared from hematoma. After making an anteromedial portal associated meniscal injuries were managed. Interposing intermeniscal ligament was retracted by traction suture (Fig 1B). A 3 cm incision was made over the anteromedial aspect of the proximal tibia and using ACL jig, a K wire(1.8mm) was drilled aiming to the lateral edge of the fracture crater. In the same way, one more k wire was drilled aiming to the medial edge. Then k wires were pulled out and replaced by 14-gauge I.V. cannula loaded with looped 2-0 ethilon suture loops (Fig 1C). The fracture was then reduced and fixed with percutaneous k wire. Next, an 18-gauge cannula loaded with no. 1-0 PDS was passed into the joint from medial to the lateral side, once it was seen inside the joint the tip was advanced into a medial loop then piercing the anterior third of ACL at the junction of ACL and avulsed bone once the tip of the needle was visualized, Then PDS was advanced into a lateral loop and was pulled out through anteromedial loop.

The same step was repeated by taking a bite at the posterior third of the ACL. Then these PDS sutures were replaced by no-2 ultra-braided fibre wire by shuttling technique (Fig 1D). Then the needle and suture loops were pulled out of the tibial tunnel which also pulled the fibre wire. Sutures were then tied one by one over the bony bridge of the tibia keeping the knee in 30-degree flexion. The K-wire used for a temporary reduction was removed, ACL was checked for adequate tension and surgical incisions were closed in layers (Fig 1E).

Postoperatively, the knee was immobilized in an extension brace for 3 weeks and the patient was allowed non-weight bearing ambulation after three weeks. Full weight-bearing was started after 6 weeks after fracture union.

Results:

The study consisted of 9 patients whose age varied from 14 years to 45 years. The right knee was involved in 6 patients and the left knee in three patients. 7 patients were type III fracture and 2 patients were type IV fracture. The mode of injury was a road traffic accident in 5 patients and a sports injury in four patients. All fractures showed union at the follow-up of 3 months. At the end of follow-up (6months) mean Lysholm score is 93.26 and the IKDC score is 94.35. None of the patients had flexion or extension deficit. However, one patient had knee stiffness at end of the two-month follow-up which was resolved by aggressive physiotherapy.

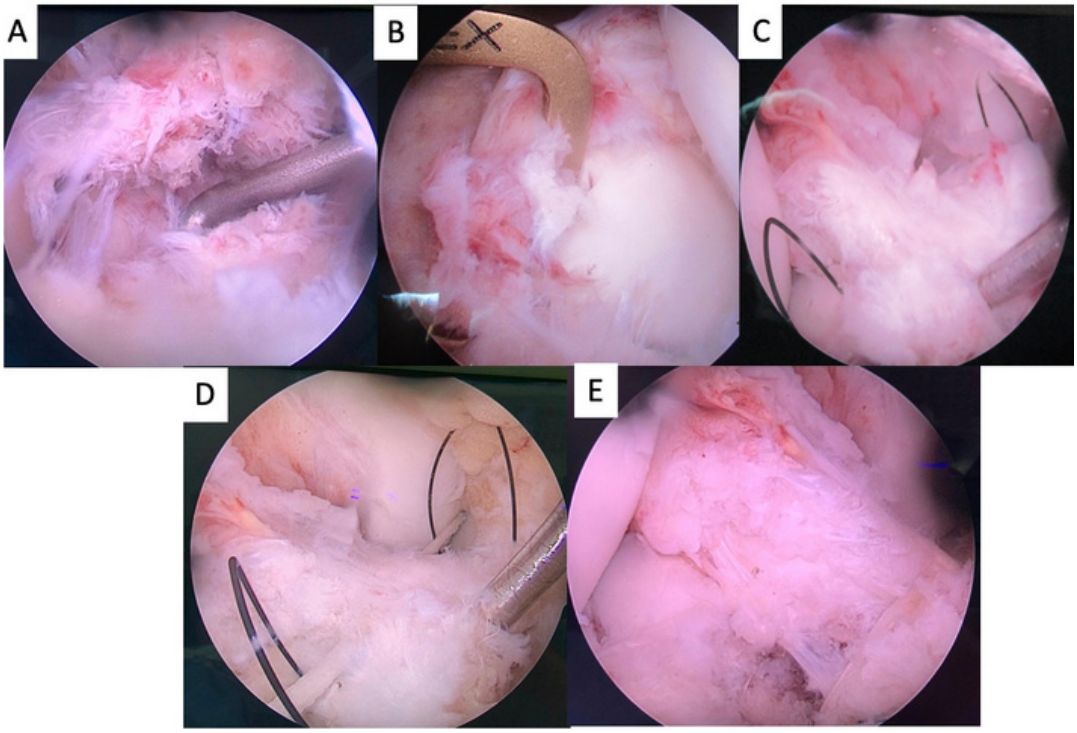

Fig 1: Surgical technique

A: ACL avulsion during diagnostic arthroscopy, B: Enrapped intermeniscal ligament, C: Ethilon loops on either side of fracture crater and a k wire fixing the fracture after reduction, D: Fiber suture passed from medial to lateral by taking a bite in ACL substance, E: Completed Fixation by pull out stitches

Discussion:

Avulsion fracture of the tibial spine is well described in the literature in both pediatric and adult populations. These fractures are also called ACL avulsion fractures. The higher incidence of these fractures in children is because of incompletely ossified tibial eminence and also because of the elasticity of ligaments in young people (6). In adults, these injuries are commonly related to high energy trauma usually road traffic accidents, and have a high incidence of associated injuries (1).

Although a variety of implants (screws, staples, wires, anchors, and sutures) have been used for arthroscopic fixation of the tibial spine, currently arthroscopic suture pull-out fixation seems to be the most preferred fixation method in all age groups(7).

The iv cannula used in our cases is of narrow diameter and may not cause growth disturbances in the pediatric age group. Several authors have determined that a physeal lesion of size less than 7 to 10% of the physeal diameter is not likely to cause growth changes (8).

The majority of the patients in our study were males and adult patients were more than pediatric patients. Motor vehicle accidents could be attributed to a higher incidence of adult patients than the pediatric age group. Associated injuries of the meniscus, cartilage, and co-lateral ligament are up to 60%. And more than 65% of the patients have entrapped intermeniscal ligaments. Postoperative laxity could be because of initial stretch before fracture or unrecognized intrasubstance tear(9). Postoperative stiffness is the most common complication noted by many authors

However recently reduction of this complication is because of early mobilization. Our series of cases had excellent functional outcome at the end of follow-up. A shorter follow-up period and a small number of cases is the limitation of our study.

Conclusion:

Arthroscopic fixation of ACL avulsion fractures by pullout stitches gives excellent clinical outcomes in all age groups.

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SLOPE CORRECTIVE OSTEOTOMY IN MALUNITED FRACTURES AROUND KNEE

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Introduction:

The posterior tibial slope (PTS) represents the posterior inclination of the proximal tibia. There is a wide variation of the PTS with respect to sex, race and even medial and lateral condyles. It is due to this reason the PTS is referred to as the fingerprint of the tibial bone [1]. With an increasing insight on the biomechanics of the knee joint and more clinical studies based on the sagittal alignment of the knee, the relation between PTS and ACL injury has been brought to light. A high PTS (>12) is associated with an 11-fold increase in ACL graft failure rate in adolescence and can be managed by anterior closing wedge osteotomy (Fig.1). Slope can be altered in malunited fractures around the knee and can present with instability.

Case 1:

A 47-year-old male presented to us with left knee pain, instability and limp. He sustained RTA 1 year back and underwent native treatment, now presented with genu varum,with malunited proximal tibia fracture with reversal of posterior tibial slope. On physical examination, broadening of proximal tibia, genu varum with varus instability, anteroposterior instability, hyperextension of knee joint, and posterior tibial sag were present. Varus thrust gait was present. Initially , through standard arthroscopic portals, diagnostic arthroscopy was performed.

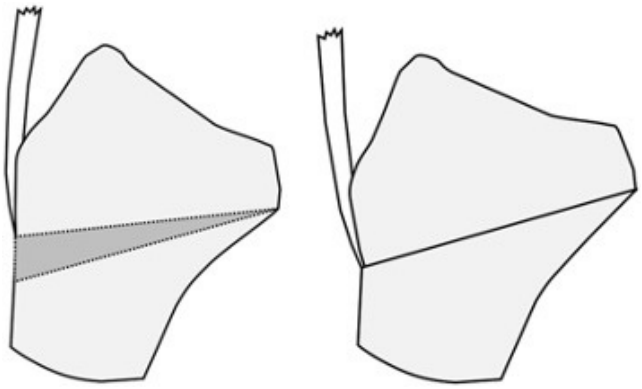

Fig 1: Diagram depicting Anterior Open wedge Osteotomy

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A medial approach to the proximal tibia was then performed, keeping the MCL intact. Two parallel guide pins were placed from anterior to posterior in the tibia using a parallel drill guide. To allow a visual guide during PTSA correction, we positioned one pin proximally and one pin distally to the planned osteotomy. Correction of varus malalignment was accomplished by manipulating the horizontal plane of the HTO and posterior slope correction by the sagittal plane. A tricortical iliac bone graft was placed in such a way that the anterior and medial defects is filled. A 4 hole Tomofix plate is used for additional support(Fig2).

Case 2:

A 35-year-old man presented to us with chronic left knee pain and instability. He sustained trauma 5 years back, for which surgery was done to his left femur (IMIL nailing).

On physical examination, LLD of 2 inches was noted, he had a varus thrust gait & positive anterior drawer and Lachman tests. Alignment X-rays showed 5 degrees of varus with 30 degrees of PTSA with an intramedullary nail in the left femur. A significant MRI finding was a complete ACL tear. The posterior tibial slope was measured using the angle between a line perpendicular to the posterior cortex of the tibia and a line tangential to the tibial plateau.

A single-stage procedure was planned to include an arthroscopic ACL reconstruction and a biplanar medial opening wedge HTO to correct varus malalignment. Initially, through standard arthroscopic portals, diagnostic scopy was performed. ACL reconstruction using hamstring grafts after HTO. A medial approach to the proximal tibia was then performed, keeping the MCL intact. Two parallel guide pins were placed from anterior to posterior in the tibia using a parallel drill guide. To allow a visual guide during PTSA correction, we positioned one pin proximally and one pin distally to the planned osteotomy. Correction of varus malalignment was accomplished by manipulating the horizontal plane of the HTO and posterior slope correction by sagittal plane(Fig 3).

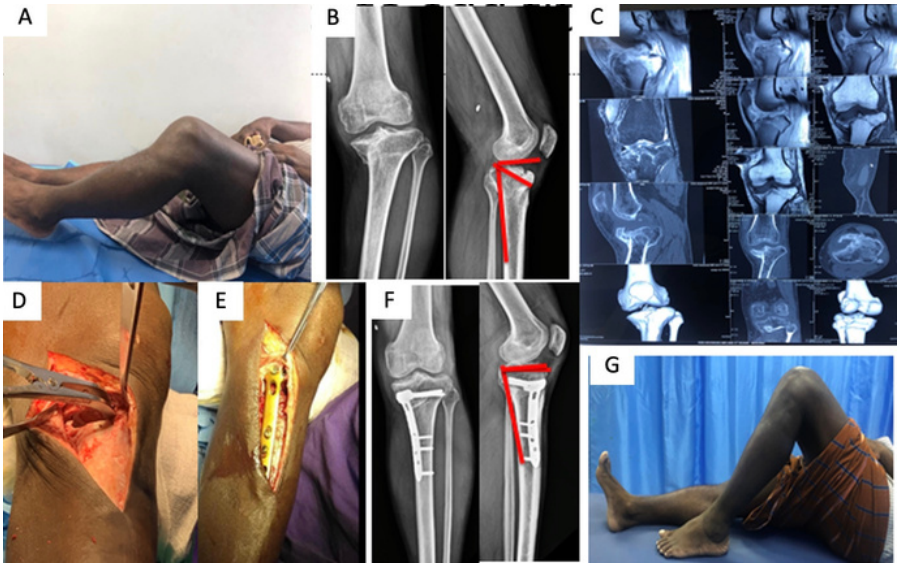

Fig 2: A: Pre operative clinical image, B & C: Plain radiographs & MRI showing increased tibial slope, D&E: Intraoperative images, F: Postoperative Radiographs showing slope correction, G: Follow-up images

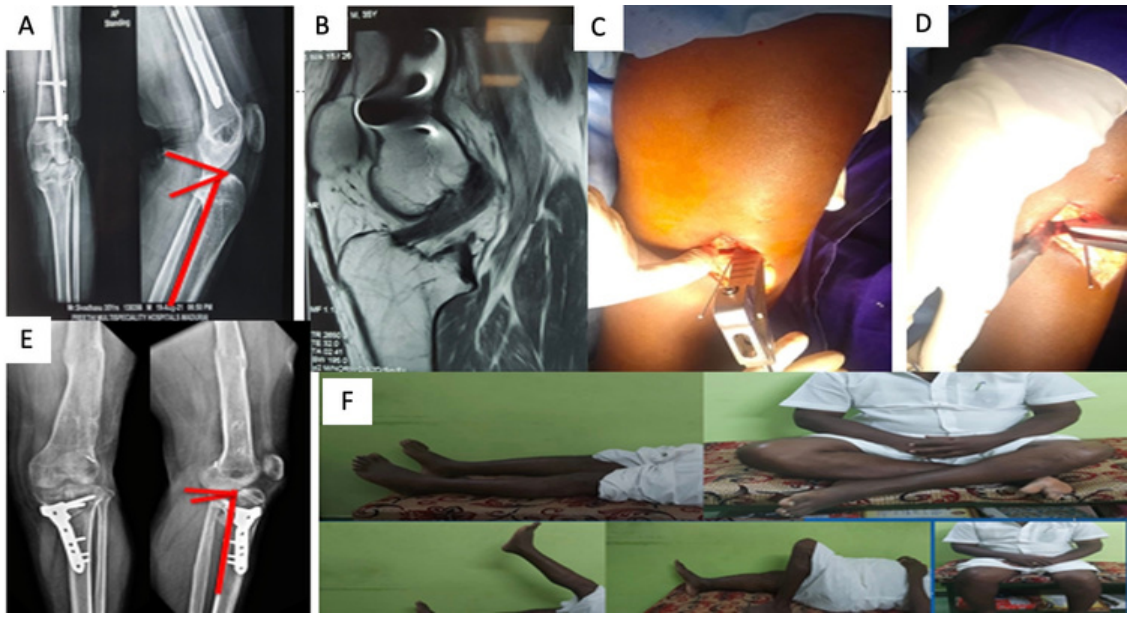

Fig 3: A & B Plain radiographs & MRI showing increased tibial slope, C& D: Intraoperative images, E: Post operative Radiographs showing slope correction,F: Follow-up images

A tricortical iliac bone graft was placed in such a way that the posterior opening is filled with a 15mm bone graft and medial opening with 8 mm. A T plate with a metal wedge is used for additional support. The plate was secured so that its distal aspect was angled slightly anterior to the anterior cortex of the tibia, allowing for posterior translation of the plate and a resultant decrease of the PTSA.

Case 3:

A 16-year-old male presented to us with deformity and pain over the right knee for the past 2 years progressive in nature. He complained of instability of the knee joint and inability to run or participate in sporting activity. He had a history of RTA 4 wheeler accident 4 years back and sustained closed shaft of femur fracture treated primarily with plating. Later underwent implant removal. On examination, he had gross anterior instability(grade 3) and ROM was near normal.

He had a varus trust gait with two centimetre shortening without any distal neurovascular deficit.

Evaluation with scanogram revealed no gross varus or valgus alignment but lateral projection showed a grossly increased posterior tibial slope (38 degress) measured using the posterior tibia cortex as reference . Further imaging with MRI and CT confirmed increased tibial slope with healed PCL avulsion fracture. Under epi-spinal anaesthesia, supine position, clinical findings were confirmed. Diagnostic arthroscopy showed medial patellar facet chondral injury and lax cruciates. Through posteromedial approach , posterior opening wedge osteotomy was done with knee in extension and ipsilateral tricortical iliac crest bone grafting with 2.5cm bone block impacted at osteotomy site and stabilized with distal radius T-plate. Fixation was found to be stable and confirmed under c-arm. Patient started on range of movements and quadriceps exercises on day 1.Weight bearing from 6 weeks. He showed good to excellent outcome at 6 months and one year follow up(Fig 4).

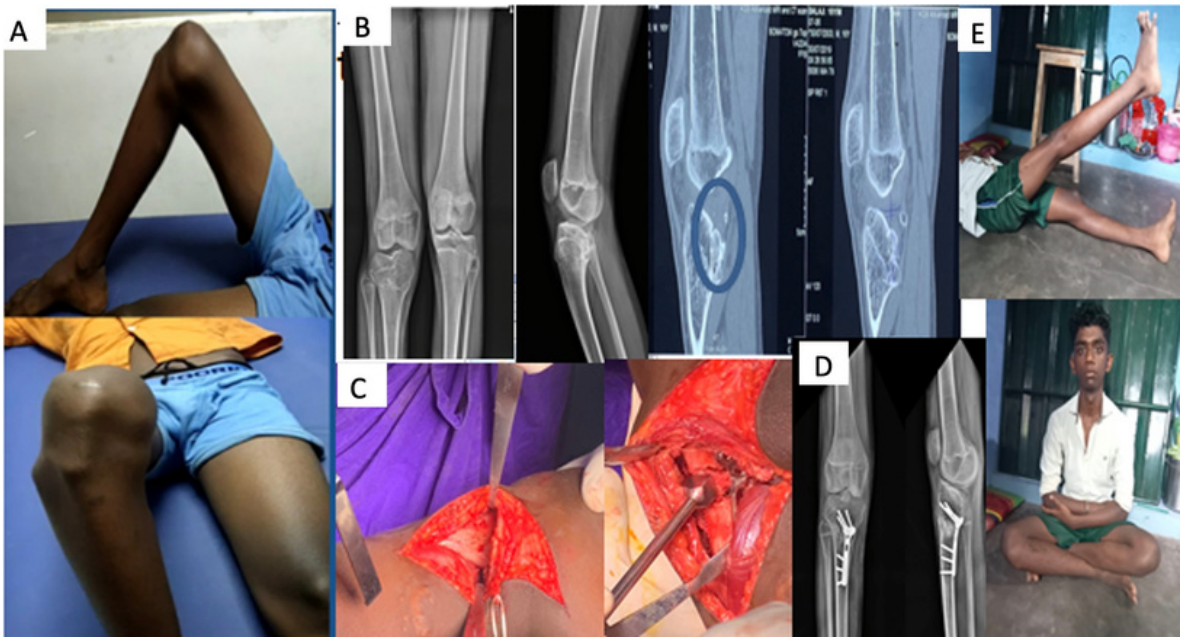

Fig 4: A: Pre-operative images, B: Plain radiographs & CT showing increased tibial slope, C: Intraoperative images, D: Post operative Radiographs showing slope correction, F: Follow-up images

Discussion:

Anatomically the tibial plateau declines at an angle of 9-11 degree medially and 6-8 degree laterally. To understand the importance of tibial slope an understanding of the normal biomechanics of knee is important. During normal walking, the tibio-femoral contact force induces an anterior directed force on the tibial and this is mainly due to the posterior tibial slope of the tibial plateau [2][3]. The combination of tibio-femoral contact force and PTS leads to an anterior shear force that leads to increase in both ATT and force transmitted to the ACL[3][4][5]. The posterior tibial slope is very important in maintaining knee stability, an increase in posterior tibial slope (PTS) directly affects the anterior tibial translation (ATT). A 10 degree increase in PTS leads to 6mm increase in ATT[6][7]. Its importance is stressed mainly in high tibial osteotomies where an increase in PTS is possible.

With respect to the measurement of the posterior tibial slope, a wide variety of methods have been discussed in the literature. Noyes et al[8]described various techniques on plain radiograph out of which the posterior tibial cortex line was more useful. Karimi et al[9]used MRI to individually measure the medial and lateral condyle PTS separately. Hoch et al[10] described a 3D measurement technique where the tibial plateau from the rim can be measured separately. In this study, we used a plain radiograph and posterior tibial cortex as a reference to measure PTS.
The technique of high tibial osteotomy and fixation modalities has wide variations. Gokhan Polat et al[11] in his study compared three groups of patients, opening wedge osteotomy and puddu plate fixation, transverse osteotomy and external fixation and closing wedge osteotomy and staple application. Peng Wu et al[12]in his meta analysis compared conventional and navigated HTO and Yunhe Mao et al explained a 3D printed patient specific model technique.

In all of these studies irrespective of the method of fixation or technique there was no significant difference in functional outcome in long term follow up.

There is a discussion or controversy between opening and closing wedge osteotomies. Although many authors have shown good results with closing wedge osteotomies, they were predominantly done for recurvatum deformities with reversal of PTS. For increased PTS closing wedge has to be done anteriorly, this has certain pitfalls such as the requirement of multifocal osteotomy in severe deformities and the involvement of the tibial tuberosity with patellar tendon at the osteotomy site. One more point in favour of open wedge osteotomy is the maintenance of length. Moreover, exact control over the PTS can be achieved better in opening wedge osteotomies.

The main reason for the difficulty in maintenance of PTS during opening wedge osteotomy is the obliquity of the anteromedial tibial cortex [8]. The success of the osteotomy mainly depends on the maintenance of the opening by the use of two lamina spreaders one over the anterior and another over the posterior aspect of the osteotomy site. To decrease the PTS the osteotomy has to be done with the knee in extension and posterior opening should be more. If an increase in PTS is required then the knee should be in flexion with an increased opening on the anterior aspect of the osteotomy. Always assess the knee flexion and extension and stability intraoperatively for optimal outcome. Sundarajan et al showed good outcomes with medial opening wedge HTO for malunited proximal tibia fractures[13].

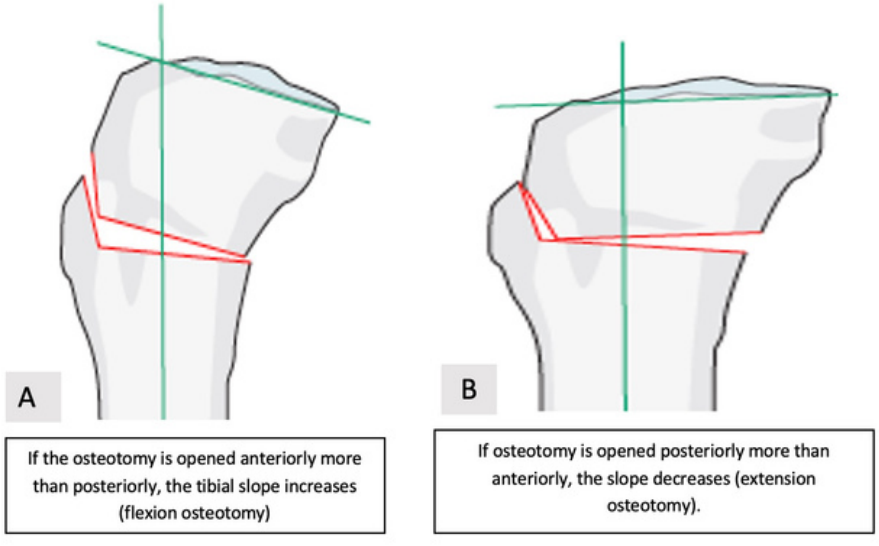

Fig 5: Tibial slope in Open Wedge HTO. A: Increasing tibial slope, B: Decreasing tibial slope

Increasing tibial slope in open-wedge valgization osteotomy: (Fig 5)

•Eccentric opening of the osteotomy gap more anteriorly & Opening of the osteotomy with the knee in flexion.
•Application of two osteotomy spreaders in the horizontal gap.
•Attention to bone surface contact in the anterior ascending cut of the osteotomy.

Decreasing tibial slope in open-wedge valgization osteotomy:

•Eccentric opening of the osteotomy gap more posteriorly
•Opening of the osteotomy with the knee in extension.
•Application of one osteotomy spreader in the posterior part of the horizontal cut.
•If indicated, minimal bone resection in the anterior cut of the osteotomy.
•Intraoperative assessment of anterior translation (drawer test) and knee extension.

Conclusion:

- PTS has pivotal role in the stability of knee joint.
- Anterior closing wedge osteotomy to decrease PTS has role in failed ACLR surgeries.
- MOWHTO with eccentric distraction is valid option for correction of slope in malunited fractures around knee.
- If osteotomy is opened more posteriorly, the slope decreases (extension osteotomy).
- If the osteotomy is opened more anteriorly, the tibial slope increases (flexion osteotomy).

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