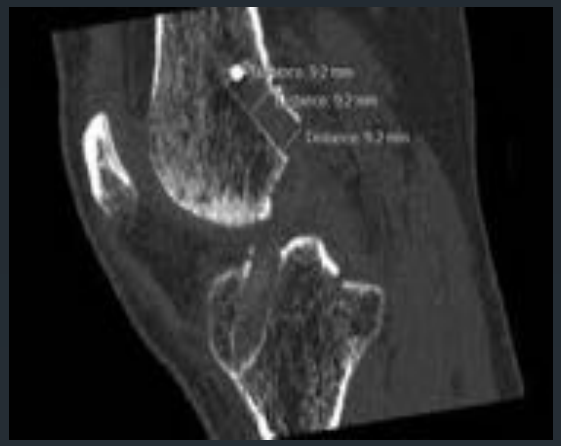


PRINCIPLES OF

REVISION

ACL RECONSTRUCTION

MUKUL MOHINDRA
FNB (Arthroscopy & Sports medicine)

TEST

- Most common cause of failure
- Anterior placed tibial tunnel limits
- Anterior placed femoral tunnel limits
- Best X ray view to pick up early degenerative changes post ACL reconstruction
- Localized anterior arthrofibrosis is also called as
- Knee flexion needed for stair climbing

How many ACL reconstructions are we doing every year ??

INTRODUCTION

SPORTS INJURY CENTER!

800-1000!!

Mall NA, Chambers PN et al. Incidence and trends of anterior cruciate ligament reconstruction in the United States. Am J of Sports Medicine. 2014 Oct;42(10):2363-70

INTRODUCTION

Thomas NP, Kankate R et al. Revision ACL reconstruction using a 2 staged technique with bone grafting of tibial tunnel. Am J of Sports Med 2005;33:1701-9.

INTRODUCTION

SPORTS INJURY CENTER!

30-200!!

UNITED STATES

3000-20000

What constitutes a
FAILURE ??

FAILURE !!

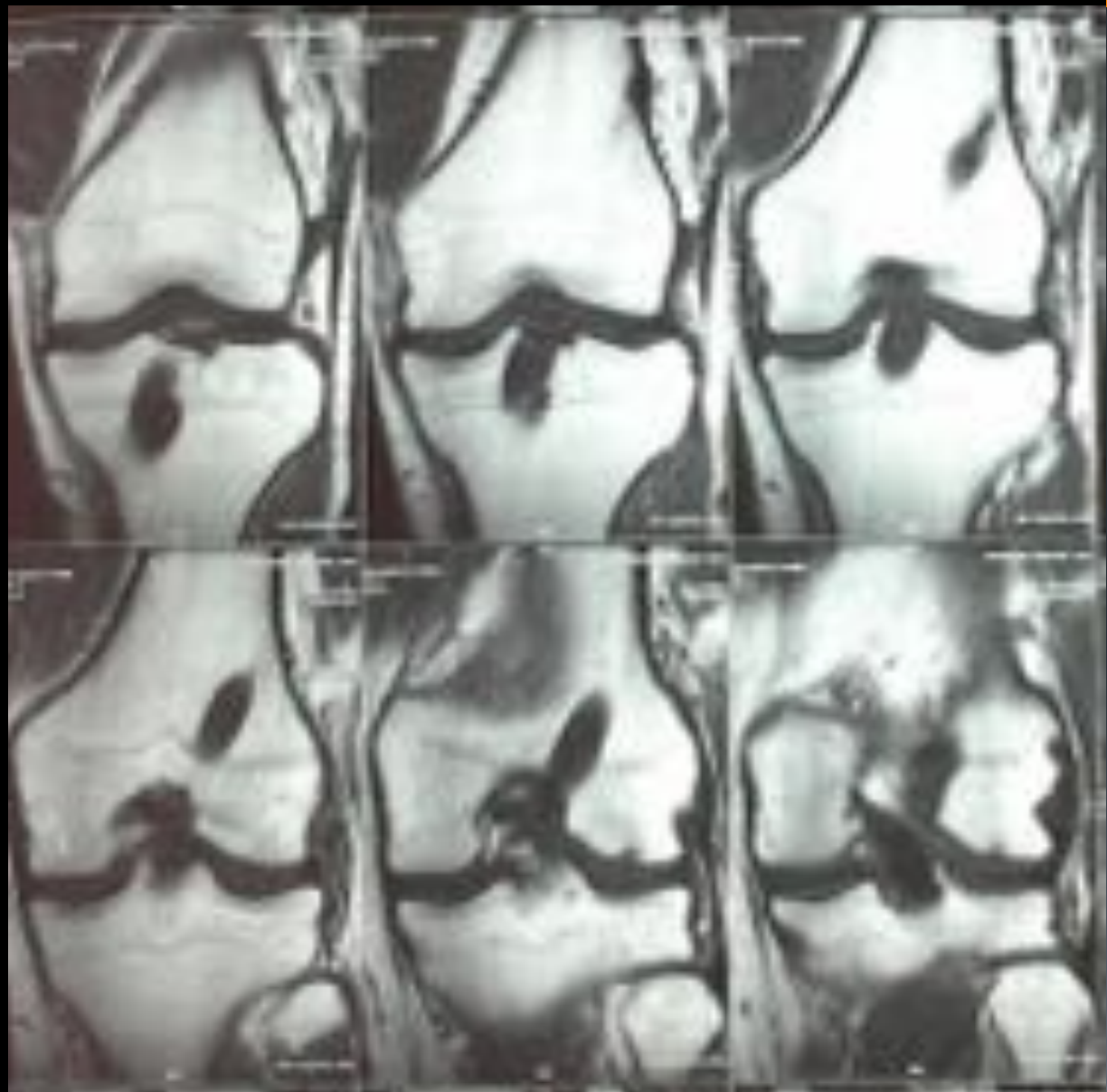
Four BROAD CATEGORIES

- Recurrent instability
- Decreased ROM
- Extensor mechanism dysfunction
- Degenerative joint disease

FAILURE ??

RECURRENT INSTABILITY

- Vertically placed tunnels
- Failure to address associated ligament injuries [15 %]
- Tensioning/ fixation related issues
- Re-ruptures
  - Fresh traumatic injury
  - Limb mal-alignment
  - Abnormal anatomy
  - Graft impingement



FAILURE ??

DECREASED ROM

CAPTURED KNEE - An anteriorly placed femoral tunnel shortens effective graft length and limits ROM (extension)

NUTCRACKER KNEE - An anteriorly placed tibial tunnel limits extension with graft impinging on notch

Cyclops [1-10%]: Localized anterior Arthrofibrosis

first described by Muellner et al (1999)

Arthrofibrosis [2-35%]

Loss of > 10° extension, > 25° flexion, Patellar mobility

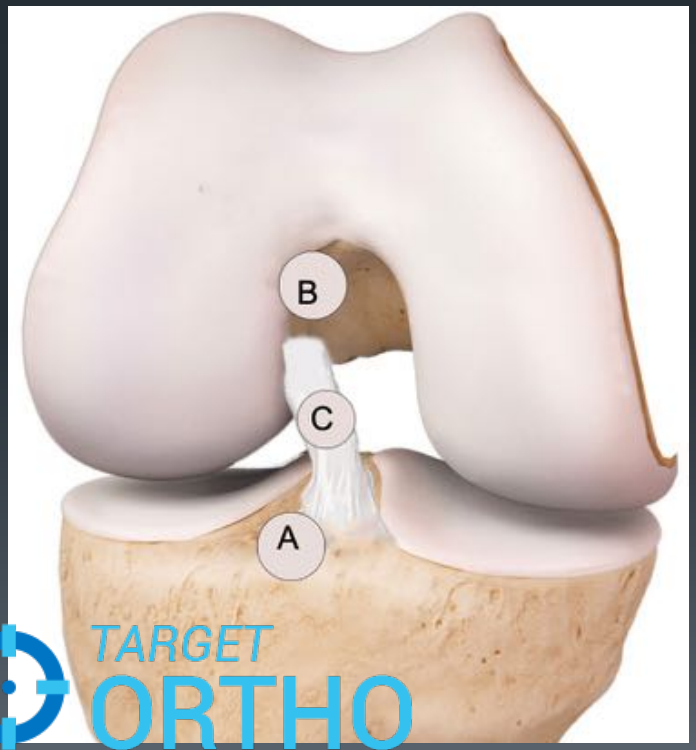
CRPS

Poor patient compliance

Prolonged immobilization

CYCLOPS

The cyclops lesion is a pedunculated or nonpedunculated nodule of fibrovascular tissue. The arthroscopic appearance with its overlying blood vessels gives the appearance of a “cyclops.” The most common site is the anterolateral aspect of the tibial insertion site of the ACL graft.



“cyclopoid” lesions

FAILURE ??

EXTENSOR MECHANISM Df

Patellar fracture during graft harvest

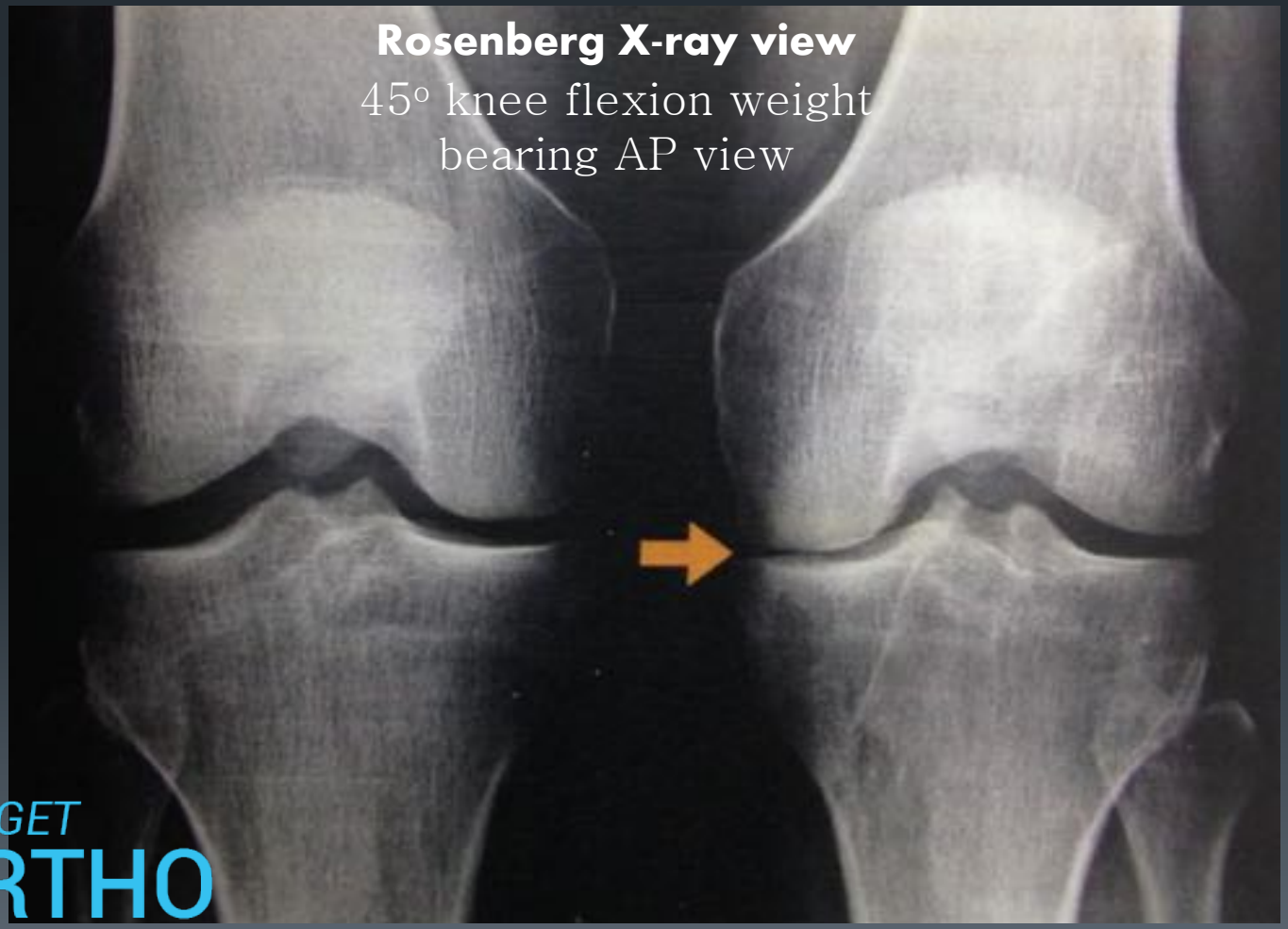
Quadriceps inhibition

VMO → Patellar instability

Cruciate ligament reflexes
(ACL Reflex)

FAILURE ??

DEGENERATIVE ARTHRITIS



CATEGORIZE YOUR PATIENT

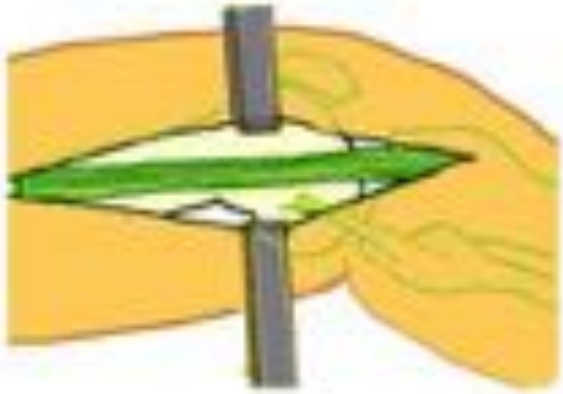
FAILURE ANALYSIS

Chance for CORRECTION!

TARGET ORTHO

CASE

ALL RECONSTRUCTION [Lemaire Technique]



A 1 cm wide band of fascia lata is harvested while maintaining its insertion on the tibia

A semi-circular tunnel is created with a special curved rasp

The fascia lata band is slipped under the fibular collateral ligament and then threaded through the tunnel

The fascia lata band is tightened and stitched back unto itself

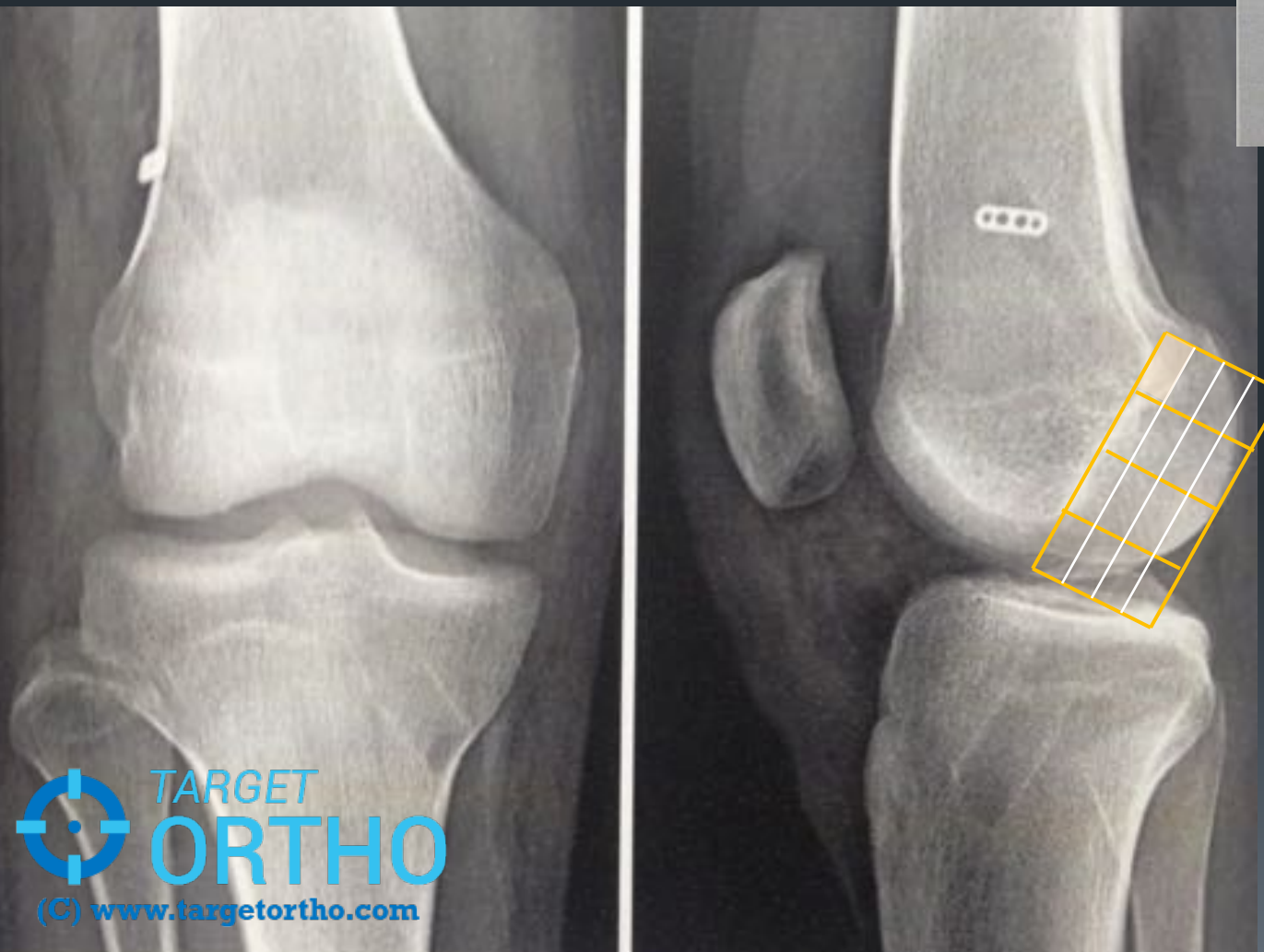
FAILURE ETIOLOGY

The commonest cause of failure is error in surgical technique with 77-95% failures attributed to faulty technique.

More than 50% of failures can be attributed to mal-positioned tunnels!

Allen CR, Giffin JR et al. Revision anterior cruciate ligament reconstruction. Orthop Clinic North Am 2003;34:79-98.

NORMAL !!



REVISION ACL

TECHNICAL CONSIDERATIONS

REViSiON ACL RECONSTRUCTION
is in *NO WAY*
just an ACL RECONSTRUCTION !!

CHALLANGES

CHALLENGES in REVISION

- **Graft selection**
- **Hardware considerations**
- **Tunnel positioning**
  - *Tunnel mal-placement*
  - *Tunnel dilatation*
- **Graft fixation**
- **Cartilage injury management**

Chondral changes are present in 90% of revision cases!

Cheatham SA, Johnson DL et al. Anatomic revision ACL reconstruction. Sports Med Arthrosc. 2010;18:33-9.

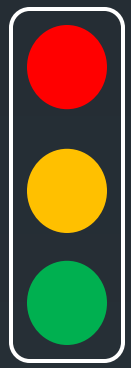
GRAFT ??

GRAFT SELECTION

Synthetic ligament substitutes

Allografts (with LARGE bone plugs)

AUTOGENOUS grafts



c/l Hamstrings ≥ i/p Quadriceps > i/p B-PT-B

My preference!

HARDWARE ??

HARDWARE CONSIDERATIONS

- Pre-op radiography is must for type and localization of existing hardware
- ?? Hardware removal: remove old devices only if they compromise new tunnel placement or graft fixation else large bone defects may be created
- Must arrange complete set of screw drivers pre hand
- Biodegradable screws can be over drilled!
- Countersunk Transfix- consider two stage surgery!

TUNNELS ??

TUNNEL POSITIONING

Correctly placed tunnels (with soft tissue grafts) less than 8 mm diameter can simply be re used after removal of intra tunnel tissue with shaver!

LANDMARKS

FEMORAL TUNNEL- Lateral intercondylar ridge & bifurcate ridge

In DB cases Hyper flexion of knee is must for tunnel divergence, increasing length and decreasing posterior wall blow out risk.

Drill outside in if originally it was inside out & vice versa, to ensure perforating virgin bone!

TIBIAL TUNNEL

On outside, start on tibial cortex little more lateral, relative to standard.

The guide pin should enter joint just posterior and lateral to old tunnel. Best is to use PCL as reference!

a)

TUNNELS ??

TUNNEL POSITIONING

CHECKLIST!

Imperative to perform Anterior impingement test!

In Hyperextension knees-

make sure your tibial tunnel is more posterior to avoid notch impingement!

TUNNELS ??

MAL-PLACED TUNNELS

Incompletely incorrect

Completely incorrect

Neglect and start all new!

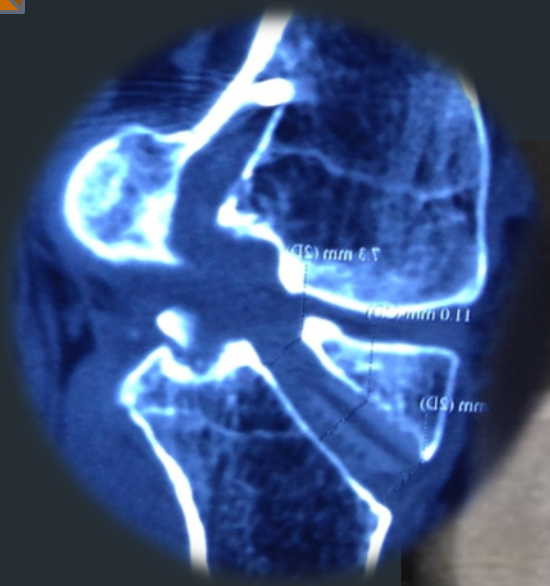
Drill new tunnel 4-5 mm and serially dilate

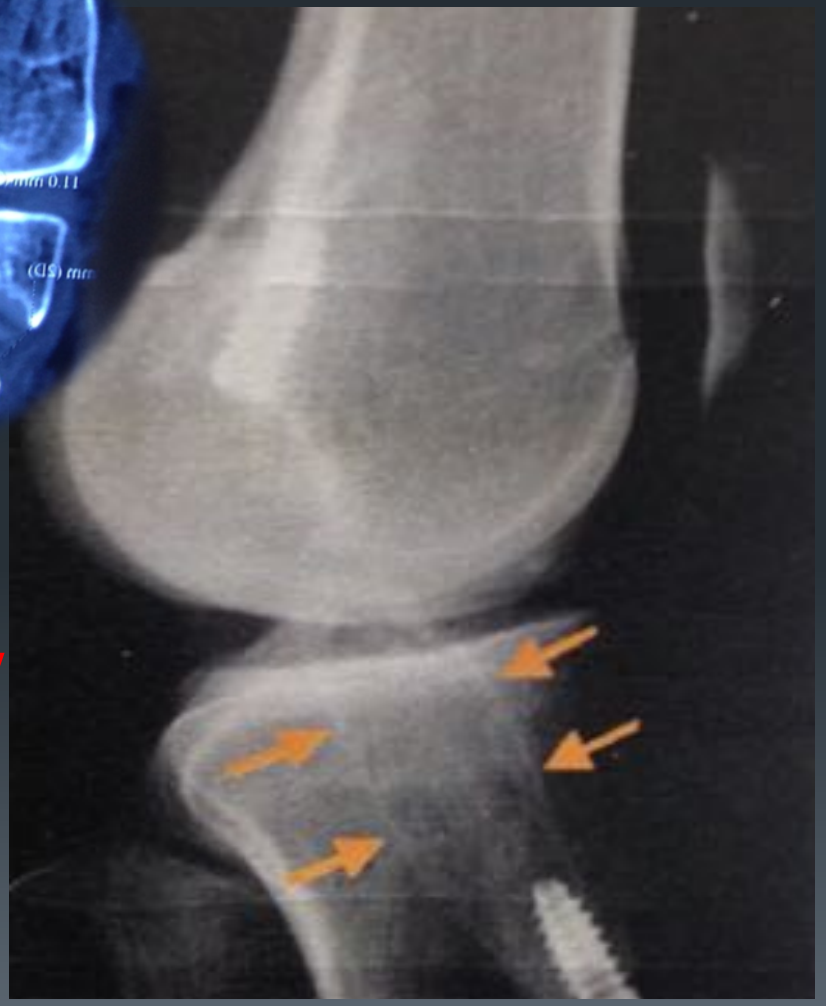
Use bio-interference screw/ cancellous bone plug to obliterate old tunnel

Consider two staged surgery

DILATATION ??

WIDENED TUNNELS





Biological factors

Mechanical factors

ETIOLOGY

Biological factors

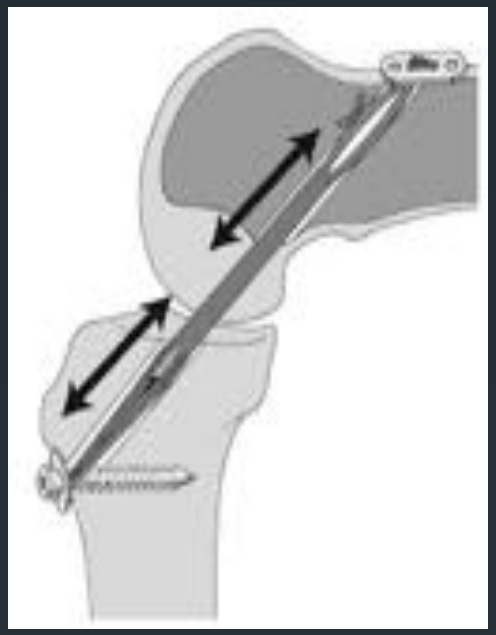
Increased cytokine levels post surgery
Reaction to graft: *use of allograft tissue*

Synovial fluid propagation within the tunnels: more with *screws placed in vicinity of joint line or completely debrided tibial stump and*
less with *bone block grafts*

Sarwa et al. Bone tunnel enlargement after ACL reconstruction using hamstring tendons. Knee Surg Sports Traumatol Arthrosc 2001;9:206-210.

ETIOLOGY

Mechanical factors



Motion of the graft within the tunnel

"Bungee- Cord effect"

"Windshield Wiper Effect"

Hoher J, Moller HD, Fu FH. Bone Tunnel enlargement after Anterior Cruciate ligament reconstruction: fact or Fiction? Knee Surg Sports Traumatol Arthrosc 1998;6:231-240.

Accelerated rehabilitation

Garofalo et al. Femoral tunnel placement in ACL reconstruction: Rationale of the two incision technique. J orthop Surg Res 2007; 2:10.

Jensen et al. Does the positionof the femoral tunnel affect the laxity or clinical outcome of ACL reconstrcted knee? A clinical, prosp randomized study. Arthroscopy 2007;23: 1326-1333.

DILATATION ??

WIDENED TUNNELS

Excessive enlargement on CT!

TWO staged surgery

First stage

Evaluate menisci and cartilage

Pack cancellous pegs/ chips from illiac crest into tunnels

3-6 months later

Second stage

Revision ACL reconstruction

FIXATION ??

GRAFT FIXATION

APERTURE [IF Screw]	CORTICAL [TR]
Better graft isometry due to fixation closer to the joint line	Technically easier
Graft length reduced only to intra articular portion	More pull out strength and better in reduced BMD
Better stiffness and less dilatation of tunnels	Useful in posterior wall blowouts

FOR REVISIONS

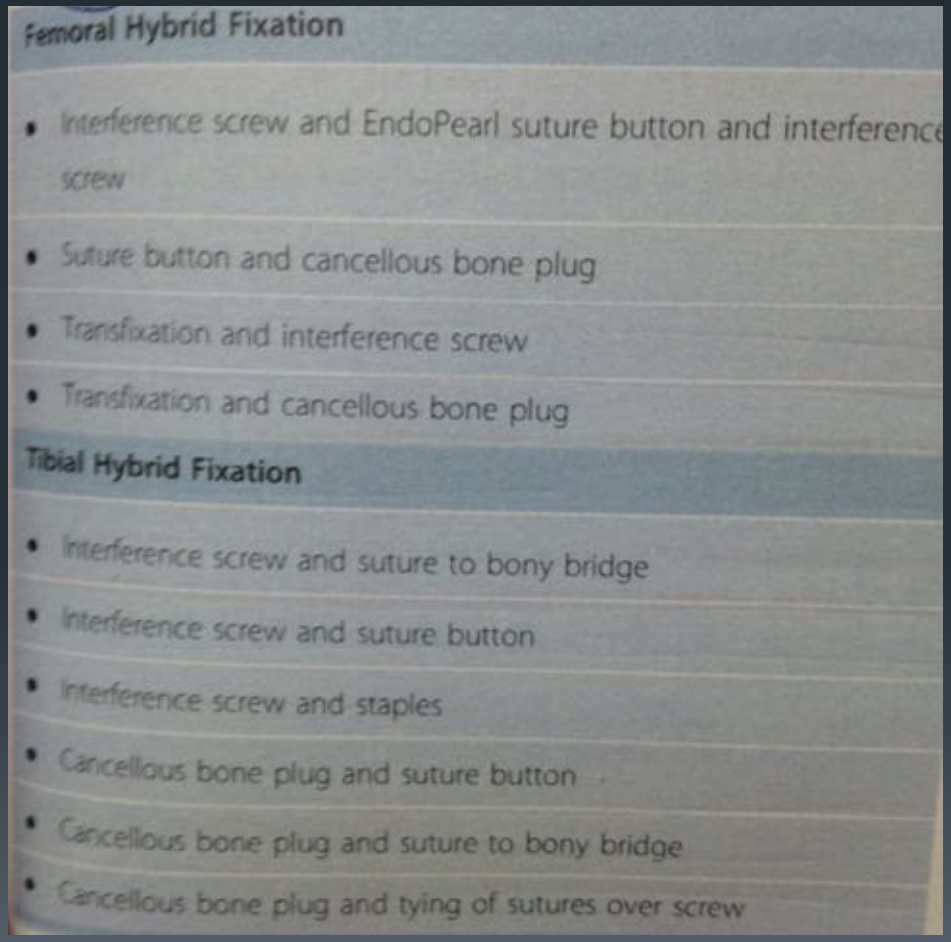
HYBRID FIXATION should be the rule especially on TIBIAL SIDE !!

REASONS

- Bone density on tibial side is lower
- Pulling forces on ACL simulate more the direction of tibial tunnel while the forces on femoral tunnels are angled to the intra articular direction

FIXATION ??

GRAFT FIXATION



Femoral Hybrid Fixation

- Interference screw and EndoPearl suture button and interference screw
- Suture button and cancellous bone plug
- Transfixation and interference screw
- Transfixation and cancellous bone plug

Tibial Hybrid Fixation

- Interference screw and suture to bony bridge
- Interference screw and suture button
- Interference screw and staples
- Cancellous bone plug and suture button
- Cancellous bone plug and suture to bony bridge
- Cancellous bone plug and tying of sutures over screw

FAQs

Frequently asked questions

SINGLE stage
or
TWO staged surgery??

Single Bundle
or
Double Bundle??

REHABILITATION

POST OP PROTOCOL

Immediately after surgery- knee brace locked in extension allowing full weight bearing. Isometric quadriceps exercises started.

Brace to be worn for 4 weeks
2 weeks full time, next 2 weeks at night.

Full ROM to be achieved by 6-8 weeks

After 8 weeks strengthening and proprioceptive exercises

By 3 months- jogging, in line running, stair climbing, driving

By 6 months- Sports specific drills

By 9 months- return to sport!

ARTHROFIBROSIS

Inflammatory process that leads to diffuse proliferative scar tissue formation that results in progressive loss of motion in both flexion and extension (c.f. in focal lesion, motion loss will reach a limit and plateau).

Normal knee ROM varies from 5 degree hyper extension to around 145 degree flexion (165 degree in squatting societies).

Loss of > 10º extension, > 25º flexion, reduced Patellar mobility

- Functional arc for routine ADLs: 10-125 degrees
- Sitting and stair climbing needs 125 degree knee flexion
- Millet et al's Goal: Full extension to 120 degree flexion

CAUSES OF MOTION LOSS

Causes of motion loss (13)

Loss of Extension	Loss of Flexion
Malpositioned or nonisometric graft (anterior tibial tunnel, anterior femoral tunnel)	Suprapatellar adhesions
Notch impingement	Patellar entrapment
ACL nodule	Medial and lateral gutter adhesions or fibrosis
IPCS	Improper graft position
Captured joint capsule after meniscal repair	IPCS
Posterior capsular scarring	Reflex sympathetic dystrophy
Hamstring tightness	Soft tissue calcifications of capsule or MCL
MCL calcification	Postinfection
Postoperative infection	Quadriceps contracture or myositis
Reflex sympathetic dystrophy	—

CLASSIFICATION

Sprague et al. (11) arthrofibrosis classification system

Group	Pathoanatomy Present at Arthroscopy
1	Discrete bands or single sheet of adhesions traversing suprapatellar pouch
2	Complete obliteration of suprapatellar pouch and peripatellar gutters
3	Group 2 combined with extracapsular involvement (bands of tissue from proximal patella to anterior femur)

CLASSIFICATION

Shelbourne et al. (12) arthrofibrosis classification system

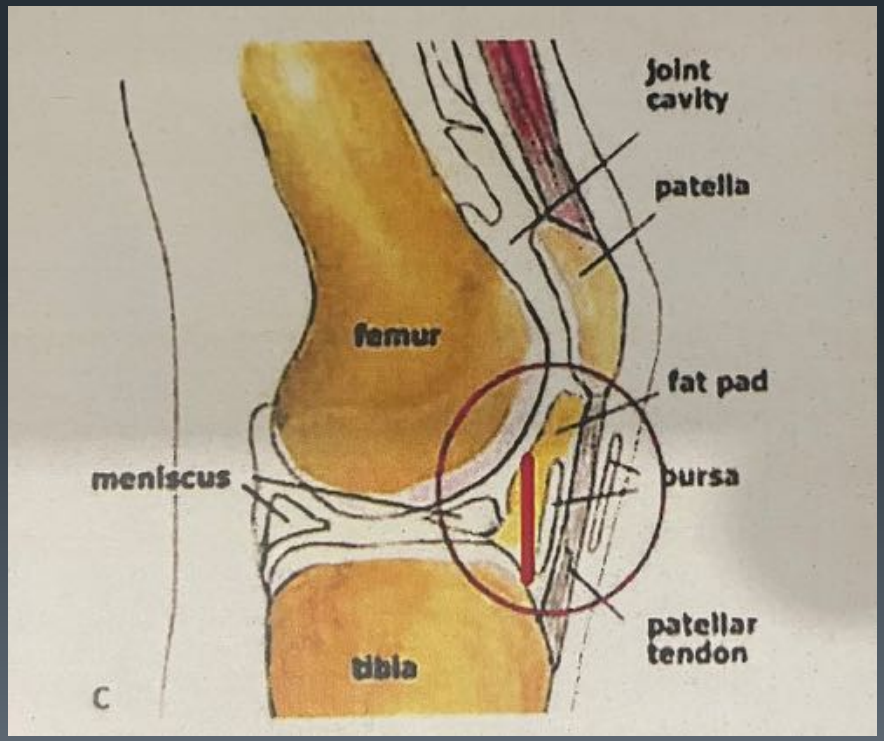
Type	Range of Motion Compared with the Normal Contralateral Side
1	Normal flexion, extension loss <10°
2	Normal flexion, extension loss >10°
3	Flexion loss >25°, extension loss >10°
4	Flexion loss >30°, extension loss >10° with patella infera

SURGICAL TIPS AND TRICKS

THE PLAN

- Do not intervene if there is active inflammation
- Flexion loss is better tolerated than extension so aim accordingly
- Do not manipulate prior to Arthroscopic release
- First consider distension of capsule before inserting scope (inject 120-180 ml saline)

- First surgical step is to re establish supra patellar pouch which extends 4 cm proximal to patella
- Next medial and lateral gutters are established
- Then Anterior interval release is performed (remove hypertrophied infra patellar fat pad and scar tissue)



THE PERFECT END

- Assess tightness of medial and lateral retinaculum and perform appropriate releases
- Remove adhesions if any in intercondylar notch
- If extension limitation still remains, posterior capsule is to be released (arthroscopic/ open approach)
- Must to place a drain
- CPM to be started right the next day

THANK YOU!

TEST

- Most common cause of failure: Tunnel malplacement
- Anterior placed tibial tunnel limits: Extension
- Anterior placed femoral tunnel limits: Extension
- Best X ray view to pick up early degenerative changes post ACL reconstruction: Rosenberg
- Localized anterior arthrofibrosis is also called as CYCLOPS
- Knee flexion needed for stair climbing 125 degrees