

THE TREATMENT OF KNEE LIGAMENT INJURIES

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AIMS

- ACL
- PCL
- MCL
- Lateral & Posterolateral Corner
- Multi-Ligament Injuries
- Take Home Messages

Anterior Cruciate Ligament

Natural History

- Does not heal after injury
- Resemble fibrocartilage cells not fibroblasts

Anterior Cruciate Ligament

- If untreated
 - Instability
 - Complex Meniscal Tears
 - Not amenable to repair
 - Degenerative changes (Jomha et al 1999)
 - 90% on XR at 5-9 yrs
 - Medial > Lateral

Natural History

Anterior Cruciate Ligament

Non-Operative Treatment

- Physio
- Closed chain exercises
- Satisfactory results in low demand patients (80% or more patients)

Anterior Cruciate Ligament

Operative Treatment

- Aim
 - Restore functional stability, without compromising ROM
- Indications
 - Symptomatic Instability
 - Unstable repairable meniscal lesion plus ACL insufficiency (Gilquist 1992)
 - Grade III MCL or LCL (Spindler and Walker)
 - ?To prevent OA (Shelbourne, Johnson)
 - No definite evidence

Anterior Cruciate Ligament

Operative Treatment

Patient Selection

- **Young active individual**
- **Malalignment due to medial compartment OA**
- **Missed associated patholaxities ie posterolateral corner**
- **Excellent predictable results in 90% plus**
- **Drive - Brake Reaction Time equivalent to controls in 4-6/52. Nguyen et al (2000), Gotlin et al (2000)**
- **Sport – 1 year**

Anterior Cruciate Ligament

Other Factors

Occupation

People who spend a lot of time on knees
eg carpet layers and tilers

Sports

Patellar tendinopathy,
common in basketball and
tennis players

Sex

Increased Risk of ACL injury
Hamstrings used due to ease of
harvest, cosmesis, lack of PF
problems, easier rehab.
BUT, results significantly
worse in women wrt men
(Noojin et al AJSM 2000)

Open Growth Plate

Several authors confirmed
the safety of hamstring grafts
across growth plates (Lo et al
1998)

Anterior Cruciate Ligament

Operative Treatment

Timing

- Critical in prevention of stiffness
- Need full ROM
- Minimal swelling and inflammation
- In practice around 2-4 weeks (Shelbourne 1991)
- But this could be in the first week (Johnson 2003)

Anterior Cruciate Ligament

Operative Treatment

Type of Surgery

- Direct repair
 - Avulsion Fractures
- Extra-articular Reconstruction
- **INTRA-ARTICULAR RECONSTRUCTION**

Anterior Cruciate Ligament

Operative Treatment

Type of Graft

- AUTOGRAFT
 - Patellar tendon
 - Hamstrings
 - Quadriceps (Fulkerson)
- ALLOGRAFT
 - Achilles Tendon
 - Patellar Tendon
- SYNTHETIC

Anterior Cruciate Ligament

Operative Treatment

Type of Graft – BPTB

ADVANTAGES

- Early bone to bone healing (6/52)
- Consistant size and shape of graft
- Ease of harvest

DISADVANTAGES

- Anterior knee pain (upto 40%)
- Patellar tendonitis
- Fracture
- IBSN

Anterior Cruciate Ligament

Operative Treatment

Type of Graft – Hamstrings

ADVANTAGES

- Stronger and stiffer (3x normal ACL and 2x BPTB (Brown et al 2002))
- Less Donor site morbidity

DISADVANTAGES

- Slower tendon to bone healing (10-12/52)
- ?Fixation (in past) –now no difference in pullout strength or outcome (Pinczewski 1994, Weiler 1999)
- Saphenous nerve injury
- ?Hamstring weakness

Anterior Cruciate Ligament

Operative Treatment

Type of Graft – Quadriceps

ADVANTAGES

- Larger cross-sectional area of graft
- Less donor site morbidity than BPTB

DISADVANTAGES

- Bone block at one end

Anterior Cruciate Ligament

Operative Treatment

Type of Graft – Allograft

- **ADVANTAGES**

- No donor site morbidity
- Available off shelf

- **DISADVANTAGES**

- Risk of disease transmission
- Weak graft
- Longer time to incorporate
- expensive

Anterior Cruciate Ligament

Operative Treatment

Side of Graft

- **Ipsilateral**
- **Contralateral** graft harvest of BTPB
 - 662 consecutive reconstructions
 - 3 yr period
 - Superior results upto 2 yrs in group who had graft harvested from contralateral knee
(Shelbourne AJSM 2000)

Anterior Cruciate Ligament

Operative Treatment

Which Graft?

Anterior Cruciate Ligament

Operative Treatment

Which Graft?

Metaanalysis Data

- Seems to back the use of BPTB
- Yunes (2001) Arthroscopy
 - 18% increased ability to return to sport at same level with BPTB
- Freedman et al (2003) AAOS
 - BPTB had better patient satisfaction, stability and lower failure rates
 - But increased anterior knee pain and MUA and lysis of adhesions

Anterior Cruciate Ligament

Operative Treatment

Which Graft?

Metaanalysis Data

- Various flaws with metaanalyses in general
- Initial poor fixation methods of Hamstrings perhaps influenced results
- Now superior fixation methods
- “No difference in ability to get back to Australian Rules Football” Bartlett et al 2001

Anterior Cruciate Ligament

Operative Treatment

Which Graft?

Randomised Controlled Trials

- “No difference at 2 years between BPTB and Hamstrings”
 - Janssen et al AAOS 2003
- “No difference in Lysholm, single hop, Tegner, IKDC, ROM or subjective knee pain or ability to knee walk at 2 years” “Significant difference with respect to objective knee pain and ability to knee walk”
 - Ejerhed et al AAOS 2003
 - O’Neill et al JBJS (Am) 2001
 - Aglietti et al 2000, Marder et al, 1999

Anterior Cruciate Ligament

Operative Treatment

Which Graft?

Hamstrings have less complications with similar functional results and better rehabilitation

Anterior Cruciate Ligament

Operative Treatment

The Operation

In terms of functional success graft choice is not critical

The most important factor is correct placement of tunnels and adequate fixation of the soft tissues

Anterior Cruciate Ligament

Operative Treatment

The Operation

Femoral Tunnel

- 11 O'Clock in right knee,
- 1 O'Clock in left knee,
- At back of the intercondylar notch.

If too anterior

- Restriction of flexion,
- Permanent loss of motion,
- Graft failure due to stretching.

Anterior Cruciate Ligament

Operative Treatment

The Operation

Tibial Tunnel

- Posterior 1/3 of the ACL tibial footprint

If too anterior

- Block to extension,
 - Impingement,
 - Graft Rupture.
-
- After fixation of one end of the graft, need to cycle knee thru full ROM to ensure no XS graft movement or impingement

Anterior Cruciate Ligament

Operative Treatment

Technical points

Commonest problems with BPTB is related to harvesting graft

Best results by harvesting via 2 transverse incisions

(Sivardeen et al 2004)

Boat shaped bone graft prevents # patella (Johnson 2003)

Anterior Cruciate Ligament

Operative Treatment

Technical points

Care with Hamstrings

Cut bands to gastrocnemius

The Dropped Graft

Anterior Cruciate Ligament

Operative Treatment

Other Factors

- **Age and Degenerative changes** should not be contraindication (Shelbourne AJSM 1993)
- No real difference between **arthroscopic and mini-arthrotomy** technique (Shelbourne Arthroscopy 1993)
- No need for routine **thromboprophylaxis**
- Important for **short time** on waiting list (Shelbourne AJSM 2000)

(Best Practice BOA 2001)

Anterior Cruciate Ligament

Operative Treatment

Rehabilitation

Critical to optimise results of surgery and prevent complications

Pre-op	Optimise ROM, proprioception and strength
6/52	Pre-Gym: Swelling and ROM
6/52-3/12	Gym: Strength and Proprioception
3/12-6/12	Functional Phase
6/12-12/12	Return to Sport

Posterior Cruciate Ligament

Natural History

- Does have the intrinsic ability to heal
- MRI study looking at PCL injuries acutely and at ave of 3.2 years , showed all partial and most complete (86%) regained continuity
 - (Shelbourne AJKS 1999)

Posterior Cruciate Ligament

Natural History

- The time to healing unknown, but the development of a firm endpoint and painless posterior drawer $\sim 2/52$ (Shelbourne AJSM 1999)
- 68% returned to pre-injury level of sport at ave of 6/52 post injury and 80% satisfied with function (Parolie 1986)

Posterior Cruciate Ligament

Natural History

Thus the PCL shows good clinical and radiological evidence of healing

Posterior Cruciate Ligament

Assessment

- 80-90% of PCL injuries associated with Postero-Lateral Corner injuries (Cosgarea JAAOS 2001)
- Important
 - P/L Corner injuries will stretch PCL repair
 - P/L corner injuries do significantly better with early operative treatment

Posterior Cruciate Ligament

Non-Operative Treatment

Isolated Partial Tear (Gd I or II)

- Splint Briefly
- Protected WB followed by early ROM and quads strengthening rehabilitation program
- Expect return to sport by ~4/52

Posterior Cruciate Ligament

Non-Operative Treatment

Isolated Complete Tear (Gd III)

- Splint in full extension 2-4/52
 - Decreases tension in A/L bundle
 - Minimises antagonistic effect of the hamstrings
- Early rehab – ROM and Quads
- Later - Hamstrings

Posterior Cruciate Ligament

Operative Treatment

Indications

- Displaced Bony Avulsion
- Functionally Unstable Knee
- Multi-Ligament Injury

Posterior Cruciate Ligament

Operative Treatment

Displaced Bony Avulsion

- Most authors would repair (Cosgarea JAAOS 2001)
- Usually involve tibial insertion and can be seen on lateral XR
- Posterior approach, pt prone and screw it in (?washer)
- Once healed (6-8/52) – aggressive rehabilitation

Posterior Cruciate Ligament

Operative Treatment

Functionally Unstable

- Suture Repair
- Single Bundle Reconstruction
- Double Bundle Reconstruction
- Tibial Inlay

Posterior Cruciate Ligament

Operative Treatment

Functionally Unstable

- For insertion site avulsions
- Acute period (less than 3/52)
- Avulsion from femoral site
- Non-absorbable sutures and drill holes
- Not for Mid-substance

Suture Repair

Posterior Cruciate Ligament

Operative Treatment

Functionally Unstable

- 1 Femoral Tunnel
- At site of A/L bundle
- Most patients have functional improvement, but there is often some clinical laxity (Cosgarea JAAOS 2001)

Single Bundle Reconstruction

Posterior Cruciate Ligament

Operative Treatment

Functionally Unstable

- Replaces both A/L and P/M bundles
 - Biomechanically superior
 - But difficult operation
- Technically 2 tunnels at femur, both grafts routed through 1 tibial tunnel
- Limited Results

Double Bundle Reconstruction

Posterior Cruciate Ligament

Operative Treatment

Functionally Unstable

- Berg et al Arthroscopy 1995
- Avoids problems of long tibial tunnel
 - Graft round sharp angle
 - Neurovascular structures

Tibial Inlay

Medial Collateral Ligament

Natural History

- Cells Characteristic of fibroblasts
- Intrinsic ability to heal

Medial Collateral Ligament

Natural History

- Animal models show MCL can heal with scar tissue structurally similar to the strength and stiffness of the native MCL (Anderson et al 1992)
- Proximal tears
 - Heal very quickly
 - Can lead to joint stiffness and decreased ROM compared with distal tears
 - Related to vascularity
(Robins et al AJSM 1993)

Medial Collateral Ligament

Natural History

Prolonged immobilisation leads to poor results

Due to

- Loss of collagen fibre orientation

- Decrease in strength of the bone-ligament junction (Woo et al 1990)

Medial Collateral Ligament

Treatment

- Minimal immobilisation
- Protected early ROM
- Operative treatment no better than Non-operative treatment (Sandberg et al 1987)
- May need operative reconstruction in the multi-ligament injury and symptomatic instability

Lateral Collateral Ligament

Treatment

- Isolated injuries uncommon
- Treatment generally non-operative
- Operative Treatment controversial
 - Combination injuries
 - Symptomatic instability – often associated P/L

Postero-lateral Corner

Introduction

- Important group of injuries
- Often missed even by the experts
- Significant morbidity

Postero-lateral Corner

Pathology

- Lack of static posterolateral structures at foot strike combined with convex opposing surfaces of LFC and LTC leads to lateral compartment opening even in normal gait
- Significant disability
- If not picked up with concurrent ACL or PCL injury leads to failure of these grafts (Harner AJSM 2000)

Postero-lateral Corner

Anatomy

- Lateral Collateral Ligament (varus opening)
- Popliteus Muscle and Tendon Complex
(posterolateral rotation)
- Arcuate Ligament
- Popliteofibular Ligament Complex (external rotation)
- Lateral capsular ligament (varus opening)
- Long and short head of biceps
- Iliotibial Band

Postero-lateral Corner

Treatment

Grade 1–2 Injuries (Partial Tears)

Non-operative

Knee immobiliser in full extension for 3-4/52

Quads

After 3-4/52 – ROM

Closed chain quads

Active hamstrings only after 6-10/52

Acute Isolated Injuries

Postero-lateral Corner

Treatment

Grade 3 Injuries (Full Tears)

Operative (Kannus AJSM 1989)

Early repair <3/52 (Laprade 1997)

Anatomic repair of Individual Structures

Suture to bone, anchors, augmentation

Acute Isolated Injuries

Postero-lateral Corner

Treatment

Grade 3 Injuries (Full Tears)

If immobilise post-op do so in 60 degrees of flexion and in IR for 3-6/52

Quads and closed chain exercises

Avoid hamstrings for 4/12 post-op

Acute Isolated Injuries

Postero-lateral Corner

Treatment

Critical to assess alignment
Full length AP XR

If normal alignment

- **Anatomic repair or reconstruction with allograft or autograft**

If varus

- **? HTO**
- **Then reassess**

Chronic Isolated Injuries

Multi-Ligament Injuries

Assessment

? Dislocated

? Dislocated and reduced

Bruising swelling below knee (capsular injury)

Neuro-Vascular Status

upto 50% (Miller)

?Intimal Tear

?Need for angiogram

Multi-Ligament Injuries

Assessment

MRI

Wait 1-2/52

Vascular monitoring

Post-operative stiffness

Capsular healing (arthroscopically assisted)

Limited use of the pump

Fluid extravasation

Multi-Ligament Injuries

Treatment

Controversial with injuries affecting involving medial side

More consensus when affecting lateral side, and both medial and lateral sides

Multi-Ligament Injuries

Treatment

Shelbourne (2001)

PCL and MCL can heal

Risk of arthrofibrosis in knee

(do not do both ACL and PCL acutely)

Let MCL heal, Tx in hinged brace

Rehab - ROM and quads

Reassess

?ACL reconstruction later if required

Medial

Multi-Ligament Injuries

Treatment

Shelbourne (2001)

If MCL does not heal

Tx at time of ACL Reconstruction

Do not reconstruct PCL acutely unless at least 2+ laxity

Medial

Multi-Ligament Injuries

Treatment

Harner (2001), Fanelli (2001)

Wait 1-2 weeks

Repair all structures

ACL/PCL/MCL

Early ROM

Medial

Multi-Ligament Injuries

Treatment

Schenck (2001), Laprade (2002)

Posterolateral corner injuries do poorly unless addressed acutely

Need to reconstruct all other ligaments acutely

Richmond (2001)

Reconstruct posterolateral corner early

Address cruciates later

Lateral

Multi-Ligament Injuries

Treatment

Fanelli (2001)

**Repair and reconstruct all ligaments
and go for early ROM**

Richmond (2001)

**Reconstruct posterolateral corner early
Let MCL to heal by bracing
Address cruciates later**

Medial and Lateral

Take Home Messages

**Treatment of ACL - physio then ?op
if still symptomatic**

**In future – Operation for almost
anyone with an ACL rupture**

Take Home Messages

Critical to assess alignment and other evidence of ligament laxity

Take Home Messages

**Type of Graft is not crucial,
but position is ...**

Take Home Messages

**Most PCL and MCL injuries treat
non-operatively**

Take Home Messages

Postero-lateral corner needs to be identified and treated early

If chronic think osteotomy

Take Home Messages

Multi-ligament Injury Think Vascular

**Can Go for Aggressive or
Relatively Conservative Approach**

Thank You