# The Changing Face of Anterior Cruciate Ligament Management

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#### Discuss factors associated with ACL injury

Discuss factors and reasoning for rehabilitation vs surgical treatment

Discuss ACL prevention strategies

Discuss the long term sequelae of ACL injury

Discuss management strategies for ACL injury

### The Anterior Cruciate Ligament

- The most studied ligament in the human body
- This has created a huge body of literature evaluating the
  - Biological
  - Biomechanical
  - Surgical
  - Physiotherapy
  - Long Term Sequelae
  - And Clinical Data

Historical Anecdotal Evidence Base Paradigm Shifts

- ACL Injury Management
- ACL Reconstruction
- ACL Prevention
- ACL Return to Sports

#### The Evidence

Level I to Level V Studies Meta-analyses Systematic reviews Cochrane collaborations Multi-centre trials

The overriding themes though are contradictory statements being made on ACL Injury Treatment and Management based on low to moderate quality evidence

#### ACL Injury: The Numbers

- 85 / 100 000 in the 16 39 year old age group
- 70% through non-contact mechanism
- Up to 15% elite athletes
- Up to 3% amateur athletes
- Ratio Surgery : NO Surgery is 4 : 1



#### **ACL Reconstruction Incidence: The Numbers**

- 77.4 / 100 000 in Australia AU
  - 43 75 USA us
  - 37 58 New Zealand NZ
  - 38 Denmark DK
  - 34 Norway NO
  - 32 Sweden se



Zbrojkiewicz D. et al. Med J Aust. 2015;208(8):354. Sutherland K. et al. ANZ J Surg. 2019;89:1151.

#### **ACL Reconstruction over Time**

- From 2000 2015 in Australia
  - 43% Surgery increase
  - 68% Male (32% Female)
  - Age < 25 years
    - 74% Increase
  - Age > 25 years
    - 28% Increase



#### GENDER

- Females are at a 2 10 x greater risk of ACL rupture than males in comparable sports
- The reasons are NOT yet fully understood
  - Anatomic
  - Endocrine
  - Biomechanical
  - Biochemical
  - Genetic



#### Gender and Age

- AFL Compared with other sports
  - Females have a 3 7x higher ACL injury rate
  - Males have a 10 19x higher ACL injury rate
- Incidence
  - 20 24 year old Males (283 / 100 000)

• 15-19 year old Females (164 / 100 000)



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#### Account for > 70% of ALL ACL Injuries

- AFL
- Netball
- Basketball
- Soccer
- Rugby Union
- Rugby League
- Skiing



- Pivoting
- Cutting
- Jumping
- Rapid deceleration
- Rapid acceleration

### Mechanisms of Injury

- Non-contact 70%
  - Pivoting
  - Cutting
  - Jumping
  - Slight flexion
  - Valgus position









- Earlier sports specialisation
- Longer playing seasons
- Higher levels of competition
- Prolonged and more intense training



• Lack of free play

#### Knee Anatomic Risk Factors for ACL Injury

- Intercondylar notch stenosis
- Increased tibial slope
- Reduced tibial eminence
- Poor tibio-femoral congruity
- Reduced ACL size



#### The Holy Grail of Treatment

#### Predicting those patients who will respond favourably to

# Early ACLR

or

## **Non-surgical Management**





#### **MISCONCEPTIONS of Treatment**

- SURGERY "FIXES THE PATIENTS KNEE"
  - Creates a false perception that there will be NO complications and return to sport
- THE PATIENT UNDERSTANDS THEIR INJURY
  - 91% Expect to RTS at pre-injury level
  - 98% Expect NOT to get osteoarthrosis

#### **MISCONCEPTIONS of Treatment**

• Best surgery + best rehabilitation guarantees NO subsequent injury

 Having an early ACLR means there will NOT be a secondary injury to other intra-articular structures

#### **Treatment Options**

- 1. Rehabilitation only
- 2. Early ACL reconstruction
- 3. Delayed ACL reconstruction
  - Failure of Rehabilitation
  - Patient Factors





systems?

Shifting the ACL narrative: What happens when the best evidence challenges deeply engrained beliefs, opinions, trends and systems?

#### **Provision of Treatment**

- Shared decision making process
  - Patient
  - Provider
- Based on evidence based practice
  - Low level of evidence
- Secondary stakeholders
  - Family
  - Coaches

#### Blog Sports Medicine

It is time to stop wasting time and money debating graft types and surgical approaches for ACL injuries: The secret probably lies in optimising rehabilitation Posted on September 20, 2017 by BJSM

#### Provision of Treatment

- Determination of
  - Patient's (Parents) activity level
  - Patient goals
  - Patient expectations
  - Personal factors
  - Situational factors
    - Level of competition
    - Time of season
    - Playing status
    - Role in the team



### Ethical Considerations to consider for the Patient

- Applies generally to the paediatric population
  - Parents
  - Coaches
  - Level of competition and ability
  - Short term goals
  - Long term welfare



### Responses to ACL Injury

- 1. Copers
  - Return to pre-injury level without surgery and subjective instability
- 2. Adapters
  - Reduce their level of activity to avoid subjective instability
- 3. Non-Copers
  - Unable to return to their pre-injury activity level because of:
    - Subjective instability
    - Giving way episodes

#### What Determines a Successful Outcome

- Irrespective of treatment
  - No surgery or
  - Surgery
- Knee stability
- Return to sport
- NO further injury
- Delayed onset of osteoarthrosis



#### What Determines a Successful Non-Surgery Outcome

- Staged and phase adjusted Physiotherapy
  - Aims to address:
    - Impairments
    - Achieve Functional Stability
    - Allowing Return to Sport



### What Determines a Successful Non-Surgery Outcome

- Acute phase
  - Elimination of symptoms
    - Pain
    - Swelling
  - Impairments
    - Range of movement
    - Quadriceps activation
    - Strength



#### What Determines a Successful Non-Surgery Outcome

- Neuromuscular training
- Perturbation training
  - Improve knee stabilisation
  - Optimisation of muscle strength
  - Return to pre-injury sports
    - Sports-specific exercises
    - Psychological readiness

- RCT 121 patients
  - Isolated ACL injury
  - At 2 and 5 year follow-up
    - NO SUPERIORTY OF EITHER TREATMENT
  - However:
    - 40% of patients in non-surgical group went onto delayed ACLR
    - 32% of patients required subsequent meniscal surgery
    - 34% of patients who had ACLR had meniscal surgery
      - 10% patients who had ACLR required subsequent meniscal surgery

MFC

**Medial Meniscus Longitudinal Tear** 

MTP

#### • COMPARE RCT

- 167 Patients
  - Group 1: early ACLR (82 patients)
  - Group 2: rehabilitation +/- delayed ACLR (82 patients)
    - Forty-one patients had delayed ACLR
  - Follow-up at 2 years 98%
  - Fifty percent of Group 2 patients did NOT require reconstruction
  - Group 1 had better
    - KOOS
    - QOLS
    - Lysholm Score

#### • KANON Trial

- The seminal non-surgical vs surgical ACL treatment study
- Group 1: Early ACLR + exercise therapy
- Group 2: Exercise therapy alone
- Group 3: Exercise therapy + delayed ACLR
- NO DIFFERENCES
  - Activity levels
  - Patient reported outcome measures (PROMs)
  - Radiographic joint changes
  - Those patients requiring meniscal surgery within 5 years of injury

#### <u>Clinical practice though does NOT seem to have changed as ACLR is increasing NOT decreasing</u>

- Cohort Study, Level 2
- 105 participants at 5 years
  - 81 early ACLR
  - 22 rehabilitation
  - 2 delayed ACLR
- NO significant differences with
  - Quadriceps strength
  - Single leg hop test
  - Activity level
  - Subjective symptoms
  - Knee related quality of life
  - Presence of osteoarthrosis

- SIGNIFICANT differences in favour of surgery with
  - Global ratings of knee function
  - Lower fear
- BUT more likely to have a knee effusion

### What Determines a Successful Surgical Outcome

- No graft rupture
- Return to pre-injury sports
- Knee stability
- NO further injury



### When to Consider Surgery

- Early Anatomical Reconstruction
  - Meniscal cartilage tear
  - Multiple ligament injury
  - Increased posterior slope
  - Varus malalignment
  - Persistent or increased knee instability



### Findings at Surgery

- Meniscal cartilage injuries
  - 23% 42%
- Articular cartilage lesions
  - 25%
- Combined meniscal cartilage and chondral lesions
  - 15%



#### MOON Knee Group – 6 year Follow-Up

- 2999 patients
  - Twenty percent had undergone at least 1 subsequent surgery
    - Meniscus 12%
    - Revision ACLR 8%
    - Arthrofibrosis 8%
    - Articular Cartilage 7%



#### MOON Knee Group: 6 Year Follow-Up

- Meniscal Cartilage Injury
  - Risk Factors
    - Medial meniscus repair
    - Hamstrings graft (autograft or allograft)
    - Younger Age
    - Higher Marx activity
    - Smoking cessation

- Articular Cartilage Injury
  - Risk Factors

    - Hamstrings graft (autograft or allograft)
    - Meniscal repair
    - Higher Marx activity
    - Grade 3/4 articular cartilage defect

#### Surgery Outcomes with Pre-Surgery Rehabilitation

- Cohort Study
  - 2187 patients with resolution of impairments
  - Group One: Neuromuscular training then ACLR
  - Group Two: Immediate ACLR
  - At 2 years
    - Group one had better
      - Patient reported outcomes (KOOS and IKDC)
    - Group one had better
      - Return to sports (72% compared with Group Two 63%)

#### **Reinjury Following ACLR**

- Second injury: 30%
- Third injury: 27%
- Meniscal cartilage injury: 90%


#### Reasons for Graft Failure

- Patient
  - Trauma
  - Poor biology
  - Poor preparation for RTS
  - Poor rehabilitation

- Surgeon
  - Graft choice
  - Poor surgical technique

Osteophy

**ACL Graft Failure** 

#### **Delayed ACL Reconstruction**

- Patients who opt for rehabilitation then proceed with surgery do so:
  - Time consuming
  - Boring
  - Not satisfied with their non-surgical outcomes
  - Belief they will not achieve full potential or return to sport without surgery
  - Fear that their knee will undergo further damage

# SPECIAL CONSIDERATIONS

#### **Partial ACL Tears**

- Make up 10% 27% of isolated ACL injuries
- Progression occurs in up to 14% 56% of patients (1.5 5.3 years)
  - Age  $\leq$  20 years
  - Participation in pivoting and contact sports

#### Partial ACL Tears

- Clinical Examination
  - Firm endpoint with anterior drawer
  - Firm endpoint with Lachman's test
  - < 4-5mm side-to-side difference
  - Negative pivot shift
- Imaging
  - MRI scan confirmation
    - Partial tear
    - Single bundle tear (Anteromedial or Posterolateral)



#### Partial ACL Tear: Treatment

- Rehabilitation
- Rehabilitation + Planned ACL Reconstruction
- Early or Delayed ACL Reconstruction
  - Single bundle
  - Full



#### Paediatric ACL Injury Management

• Irrespective of the decision made

The patient and their family with an ACL rupture should be presented with all appropriate surgical and non-surgical treatment options and then counselled with respect to all associated risks and benefits

#### Paediatric ACL Injury Management: NO Surgery

- Less than 14 years of age
- Partial ACL tear
  - Clinical examination
  - MRI scanning
- ≈ 50% cope well



Ekas et al. Am J Sports Med. 2019;47(1):22.

#### Paediatric ACL Injury Management: SURGERY

- Delaying > 12 weeks increased the risk of
  - Meniscal tears (17% 44%)
    - of which (11% 100%) were irreparable
  - No conclusion could be drawn on articular cartilage defects
  - Residual knee instability (20% 100%)
  - Low rates of return to sports (6% 50%)



# POST TREATMENT MANAGEMENT

#### Return to the Sport – The Numbers

- 4.7x higher risk of knee reinjury in level 1 sports (pivot / contact) vs those who do not return to sports
- ACL graft rupture rate is 4% 25%
- ACL revision rates are increasing by 5% 6% / year
  - Dependent on age
    - 6.3x greater risk for those <20 years compared with > 20 years
- ACL injury on the contralateral side is 7%



#### Return to Sport – Psychological Factors

- The main reasons for not returning to sport are:
  - 28% Not trusting the knee
  - 24% Fear of a new injury
  - 22% Poor knee function
  - Females have a perceived more negative outlook

#### Return to Sport – Psychological Factors

- Psychological Readiness
  - More likely to return to their pre-injury level
  - Faster return
  - Perception of superior performance
  - Low level of fear
  - High self-efficacy
  - High internal locus of control



#### When should patients return to sport (RTS)?

- Rehabilitation is Important irrespective of treatment
- Time is strongly correlated with passing RTS testing
  - Nine months is considered the minimal timeframe for RTS following ACLR
  - There is NO consensus on RTS following non-surgical treatment
- HOWEVER
  - There needs to be a shift away from time based criterion to functional based criteria
- Patients <18 years of age SHOULD have a minimum of 12 months of rehabilitation

#### Return to Sport – The Testing

- Subjective Measurements
  - Questionnaires
- Objective Measurements
  - Clinical examination
  - Machine testing
  - Clinical testing

#### What needs to be addressed to RTS?

- Quadriceps strengthening (and Gluteal Strengthening)
- Functional performance testing
- Structured agility
- Jump landing drills
- Resistance training
- Graded activity
- Neuromuscular training
- Proprioceptive training

#### Return to Sport following Non-surgical Treatment

- Fifty-five patients
- At 12 years
  - 89% were participating in sport
  - 33% returned to pivoting sports
- Return to sport was related to
  - Subjective stability
  - Quadriceps and Hamstrings strength of the injured leg
- Return to pivoting sports was related to
  - Objective and subjective stability
  - Quadriceps strength

### Return to Sport following REHABILITATION

#### • P-RCT

- Mean Tegner activity score 9 (high activity level)
- Isolated ACL Injury
  - Rehabilitation only
  - Early anatomical ACLR
  - Delayed ACLR (≥ 12 months)
- At 2 and 5 Years
  - Non-surgical group
    - Increased laxity
    - Increased meniscal surgery
  - Delayed ACLR
    - Doubled risk for meniscal tears

#### Return to Sports Following REHABILITATION ONLY

- Matched and Pair Study
  - Non-Surgery vs Surgery
    - Earlier return 3-4 months (6-12 months surgery)
    - Higher return to level II sports 89% (78% surgery)
    - Confirmed by other studies level II and level III sports

### Return to Sport following ACLR

- 65% Patients Return to Sport
- 55% Pre-Injury Level
- Successful Return
  - Level of competition (elite > non-professional > weekend warrior)
  - Male gender
  - Younger age
  - Positive psychological response
  - Type of sport

# ACL INJURY PREVENTION

#### **Injury Prevention Programs**

- The aims are to
  - Target movement patterns
    - Incorporating strength
    - Plyometrics
    - Sports specific agility training
  - Education
    - Cutting / landing techniques that avoid high risk knee positions
- Require little or no equipment
- Performed as part of regular team or individual training (2-3x week)
- In patients <12 years of age there is less emphasis on muscular training and hypertrophy

#### **Injury Prevention Programs**

- Bruder et al 2020
  - Identified FIVE clusters of critical elements to reduce ACL Injury (in AFLW)
    - 1. Movement skills
    - 2. Football specific preparation
    - 3. Education
    - 4. Strength and conditioning
    - 5. Individual preparation

#### Neuromuscular Control

- Four key areas that are MODIFIABLE RISK FACTORS
  - 1. Ligament dominance
  - 2. Quadriceps dominance
  - 3. Leg dominance
  - 4. Trunk dominance
- Lower limb asymmetry
- Side-to-side differences in muscle strength
- Flexibility
- Recruitment patterning



Hewett et al. N Am J Sports Phys Ther. 2010;5:234

#### **Neuromuscular Training and Proprioception**

- 50- 80% effectiveness
- Reduction in the number of athletes who sustain primary ACL injury
- Reduction of new ACL injuries in those patients who return to sport following a primary ACL injury
- Lower body strength exercises
- Landing stabilisation

### Training Load and Fatigue

- Increased training loads that exceed a patients average training load over a 1 month period INCREASES the risk of injury
- Fatigue during game play
  - Contradictory results from multiple studies

Blanch P. et al. Br J Sports Med 2016;50(8):471. Lucarno S. et al. Am J Sports Med 2021; Online First: 1-9 Van Melick N. et al. Knee Surg Sports Traumatol Arthrosc 2019;27:549.

## Bracing

- Static braces show NO benefit and can be detrimental following ACL Injury
  - Rigid knee splints
  - Hinged ROM braces
  - Cloth / Neoprene braces
- Dynamic knee braces
  - Össur Rebound ACL brace may change the playing field
  - No studies comparing these braces



# LONG TERM CONSEQUENCES







#### Long Term Complications

- Seven fold 
  for osteoarthrosis development at ten years following ACL injury
- Eight fold 1 for osteoarthrosis development at ten years following ACLR
- Osteoarthrosis was found to be significantly higher for those who underwent ACLR

#### SURGICAL TREATMENT DOES NOT REDUCE OSTEOARTHROSIS PREVALENCE

### Knee Osteoarthrosis after ACL Injury

- Patello-Femoral Joint OA following ACLR
  - 50% median at 10– 15 years
- TKJR 7x more likely after ACL injury compared with NO ACL injury
- 32 37 years post ACL injury
  - 62% had tibio-femoral osteoarthrosis
  - 7% had undergone TKJR
  - Patients who had ACLR had a lower prevalence of tibio-femoral osteoarthrosis
    - However NO difference in PROMS between groups



#### PUTTING IT ALL TOGETHER

- ACL Injury and Reconstruction are INCREASING
- ACL Injury PREVENTION PROGRAMS are of VITAL IMPORTANCE
  - Prevention is better than Cure
- Involve the Patient (and Parents) in the Decision Making Process for Treatment
- REHABILITATION is a KEY TREATMENT
  - It should NOT be considered as an ADJUNCT
- SURGERY is a KEY TREATMENT
  - It should NOT be considered as a Guarantee of Success
- OSTEOARTHROSIS will happen IRRESPECTIVE of Treatment

#### PUTTING IT ALL TOGETHER

- Return to Sports Testing should INVOLVE FUNCTIONAL ELEMENTS
  - Psychological Readiness
  - Sports Specific Activities
  - Objective Clinical Examination Assessment
  - Objective Sports Assessment
- RE-INJURY or Injury to other intra-articular structures is LIKELY
- MANAGE PATIENT (and Parent) EXPECTATIONS ALWAYS

#### Factors I Consider Important

- Patient Age
- Patient Sports
- Patient Sports Level
- Patient Occupation
- Partial or Full ACL Rupture
- Other Intra-articular Injuries
- Other Ligament Injuries

- Instability
- Giving Way
- Mechanical Symptoms
- Patient (Parent) EXPECTATIONS

### So What DO I DO (Basic Algorithm)



# THE END

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![](_page_71_Picture_3.jpeg)