Preventing Osteoarthritis Following Joint Injuries

Joseph A Buckwalter

Excessive mechanical loadings, single or repetitive, cause progressive degeneration of an articular surface and subsequent development of the clinical syndrome of post-traumatic osteoarthritis (PTOA). Joint injuries are common and often affect young adults: each year one in 12 people between the ages of 18-44 seeks medical attention for treatment of joint injury, and more than 12% of all lower limb osteoarthritis is caused by joint trauma. The onset of PTOA may occur as soon as three months after a severe injury, or decades after much less severe injuries, or after injuries that leave the joint with residual instability or incongruity. Despite advances in surgical treatment and rehabilitation of injured joints, the risk of PTOA following ligament tears and intra-articular fractures has not decreased in the last 50 years. Advances in understanding of the risk factors and putative thresholds for mechanical damage to articular cartilage, and of the biologic mediators that cause progressive loss of articular cartilage after injury, will lead to better treatments of joint injuries and improved strategies for restoring damaged joint surfaces.

I. Incidence and Impact of PTOA
   a. Results of current joint injury treatments – 20% to > 70% risk of PTOA
   b. Impairment due to PTOA equal to end-stage kidney disease and heart failure
   c. PTOA prevalence > 12% of all lower extremity osteoarthritis

II. Mechanical Injury – Risk Factors & Thresholds (What is excessive mechanical loading?)
   a. Acute mechanical damage to cells and matrix
      i. Cell death
      ii. Rupture of matrix macromolecular framework
   b. Acute mechanical stress & osteoarthritis
      i. CT measures of the energy of an acute articular surface injury & risk of osteoarthritis – threshold effect
      ii. MRI measures of articular surface damage & risk of osteoarthritis
   c. Cumulative mechanical stress & osteoarthritis – risk factors
      i. Incongruity
      ii. Instability
      iii. Incongruity & Instability

III. The Role of Age in Post-Traumatic Osteoarthritis
   a. Increased risk of PTOA with increasing age – studies of intra-articular fractures and meniscal injuries
   b. Decreased chondrogenic capacity of chondrocytes and mesenchymal stem cells

IV. Biologic Mediators of Progressive Cartilage Loss After Mechanical Injury
   a. Reactive oxygen species & matrix fragments
      i. Stimulation of progressive loss of cells
      ii. Progressive degradation of matrix & loss of mechanical properties
   b. Inhibition of Mediators – prevent progression of tissue damage
V. Prevention of PTOA? Better treatments of joint injuries and improved strategies for repairing or restoring articular surfaces
   a. Biological
   b. Mechanical

References


Post ACL reconstruction gonarthrosis induced by other than knee local findings

João Ellera Gomes, M.D., Ph.D.

Soccer is, without question, the most popular sport in Brazil. The warm climate and the low equipment costs highly contributed to its popularity. Besides that, and maybe the most important explanation for this popularity is that it has no excludent biotype, which means, in the same team we may have a very tall athlete playing side by side with another one that can be almost a dwarf. This lack of physical pattern turns soccer into the most democratic sport, at least regarding the body shapes.

There are, however, a sort of unseen structural differences among the athletes that were highly related with ACL ruptures and re-ruptures and knee degenerative changes after reconstructions. The asymptomatic restrained hip joint is a clinical entity much more frequent than we used to believe in the past, mainly because there is a lack of training in recognizing the problem and its association with ACL injuries.

The restrained hip joints can be detected in three moments of the athlete’s life: at the beginning, when stretching exercises and orientation can be of same help in the prevention, with even advices of changing the sport in very restrained hip joints. The second moment occurred in association with the ACL injury, when the type of reconstruction must be decided upon the amount of hip joint restriction. More restrictive surgeries like an intra plus extra reconstruction can indeed provide additional knee protection against the over-torque imposed by the restrained hips during rotation activities.

However, there are strong evidences that restrictive knee surgeries plus restrained hip joints may contribute to knee osteoarthritis, even being effective in preventing ACL ruptures in cutting manoeuvres during soccer. Finally, the hip reduced range of motion can be detected in those athletes with non contact reruptured ACL. In those athletes, the lack of the usual reasons that contributed for this event forces the examiner to search for potentially related outside knee causes.

For those reasons, the progression of the degenerative changes around the knee secondary to ACL injuries and reconstruction can be divided in two groups: those who suffered a contact injury and those who suffered a non contact injury. The first group tend to have a more benign evolution, not too far from those athletes without ACL lesions. The non contact group, however, probably because the over-stress forces generated by the restrained hip joint, tends to present a quicker evolution for gonarthrosis. Alternatives for those athletes with ACL rupture and restrained hip joint
were functional and surgical. By functional we mean changing the athlete position in the field, from centerhalf to lateral, for example. By surgical we mean trying to improve hip range of motion through a bone and capsular resection, a potentially dangerous procedure in hip asymptomatic patient.

Finally, no local technology alone can be effective when distant hidden problems may compromise the treatment. The human body can’t be seen as separated compartments without a close relationship. Biological cellular therapy is shining in the horizon as the future gold standard, if we don’t search and approach those traps, we will not succeed in helping our patients.
NEW CONCEPTS IN POST TRAUMATIC OSTEOARTHRITIS
ASSOCIATE PROFESSOR LEO PINCZEWSKI
North Sydney Orthopaedic and Sports Medicine Centre, Sydney, Australia

Stated Aim of Treatment after ACL rupture
- Restore normal stability and function without further meniscal damage
- Thereby minimising the development of Osteoarthritis

1. Non operative Treatment
- Rehabilitate the injured joint and patient, acute, subacute & sport specific stages
- Future restriction of activity within the ‘Envelope of Stability’ of the joint (Dyer)
- Fails due to non compliance, either intentional or unintentional trespass beyond this ‘envelope of stability’
- What of the active sportsperson who desires a high level of activity (‘at risk’, Daniel), or fails conservative treatment?

2. Operative Treatment
Clinical Literature Agrees that ACL Reconstructive Surgery
- allows for higher level of physical activity
- reduces clinical laxity measurements
- reduces meniscal damage
- BUT increases incidence of osteoarthritis*
  chronic 50-100% at 7 years

PROSPECTIVE COMPARISON OF PT AND HT GRAFT FOR ACL RECONSTRUCTION OVER 15 YEARS.
Toby Leys, Lucy Salmon, Alison Kok, James Linklater, Leo Pinczewski.
- Aim to report the long-term results of isolated endoscopic ACL surgery, therefore represents “best case” scenario
- 180 patients, 90 with PT graft and 90 with HT graft
- Reviewed prospectively and at 2, 5, 7, 10 and 15 years after surgery
- Subjects who received the PT graft had significantly worse outcomes compared to those who received the HT graft at 15 years for the variables of radiologically detectable osteoarthritis (p=0.04), motion loss (p=0.03), single leg hop test (p=0.001), participation in strenuous activity (p=0.04), and kneeling pain (p=0.04). There was no significant difference between the HT and PT groups in overall IKDC grade (p=0.35).
- Radiologically detectable osteoarthritis at 15 years was associated with the PT graft (odds ratio 2.8).
- Significantly more radiologically detectable OA in PT compared to HT at 5, 7, 10 and 15 years p<0.05

RADIOLOGICAL LANDMARKS FOR PLACEMENT OF THE TUNNELS IN SINGLE-BUNDLE RECONSTRUCTION OF THE ANTERIOR CRUCIATE LIGAMENT
- 200 patients undergoing isolated ACL reconstruction prospectively followed for 7 years with full IKDC and radiographs.
- Vertical grafts are associated with greater rotary instability (p<0.01) and abnormal radiographs at 7 years (p=0.01).
- Patients who had an ACL graft rupture had more posterior placement of the tibial tunnel (p=0.005).
NEW CONCEPTS IN POST TRAUMATIC OSTEOARTHRITIS
ASSOCIATE PROFESSOR LEO PINCZEWSKI
North Sydney Orthopaedic and Sports Medicine Centre, Sydney, Australia

LONG TERM OUTCOME OF ENDOSCOPIC ACL RECONSTRUCTION WITH PATELLAR TENDON AUTOGRAFT. MINIMUM 13 YEAR REVIEW.
Lucy Salmon, Vivianne Russell, Katherine Refshauge, Dieary Kader, Chris Connolly, James Linklater, Leo Pinczewski, AJSM 34. 2006
13 year longitudinal study of clinical outcome of the endoscopic ACL reconstruction with patellar tendon autograft. Study group included 42% with meniscectomy at index surgery.
Predictors of poor radiographic grade at 13 years
• medial meniscectomy
• increased laxity on Lachman
• increased extension loss
Therefore in order to minimise OA - minimize concurrent intra-articular damage and anatomically placed ACL graft.

Prevention is better than a cure...

THE RELATIONSHIP BETWEEN CHRONICITY OF ACL DEFICIENCY AND INTRA-ARTICULAR INJURY. AN ANALYSIS OF 5086 PATIENTS.
Kesavan Sri-Ram, Lucy Salmon, Justin Roe, Leo Pinczewski, North Sydney Orthopaedic and Sports Medicine Centre
• From a prospectively collected database 5086 patients undergoing primary ACL reconstruction, using hamstring graft data collected included the interval between injury and surgery, type and location of meniscal tears (requiring meniscectomy) and location and severity of chondral damage (ICRS grading system). Patients were grouped according to time interval and age.
• Overall, an increasing incidence of medial meniscal injury and chondral damage occurred with advancing chronicity of ACL deficiency. The incidence of medial meniscal injury requiring meniscectomy increased from 18% of patients undergoing ACL reconstruction within 4 months of injury to 59% of patients if ACL reconstruction was delayed more than 12 months (p<0.001). The increasing incidence of secondary pathology with advancing chronicity was more pronounced in the younger age groups.

% of patients requiring medial meniscectomy

- The incidence of chondral damage and medial meniscal tears increases with advancing time after ACL injury. Particularly in younger patients, ACL reconstruction should be performed within 4 months of ACL injury in order to minimise the risk of irreversible damage to meniscal and chondral structures.

SUMMARY
To minimise the development of post traumatic osteoarthritis after ACL injury
1. Preservation of meniscus is vital, therefore perform ACL reconstruction with 4 months of injury
2. Use the hamstring tendon graft over patellar tendon graft
3. Use a surgical technique that recreates anatomical placement of the ACL graft without vertical placement.