

# Osteochondritis Dissecans in Children

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## Objectives

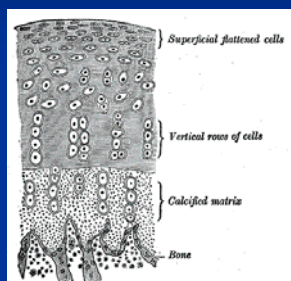
1. To diagnosis and evaluate OCD lesions
2. To develop an approach to treatment
3. To identify different methods of surgical management

## Osteochondritis Dissecans

- "Lesion of dissection" as opposed to desiccation
- Subchondral bone death leading to secondary damage to the overlying cartilage and subsequently mechanical instability

- Acute chondral injuries typically occur through zones of provisional calcification
- Better healing potential because reimplanting the segment restores this anatomic layer

## Articular Cartilage Architecture



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## Etiology

- Repetitive trauma
  - Knee- 80% participate in high level of activity
  - Elbow- Compression, valgus in athletes
  - Talus- 70-80% medial and 95% lateral
- Ischemia
- Genetic predisposition

- Juvenile and adult forms
  - Are they the same pathologic process that begins in childhood or adolescence but only becomes manifest when the segment becomes unstable?

## Incidence

- Usually early adolescence (ages 10-20)
- Males:females 3-4:1
- Bilateral 30%
- Prevalence 30-60 per 100,000 in the knee

## Osteochondritis Dissecans

- Knee
  - Lateral aspect of medial condyle 50-62%
    - Adjacent to tibial spine, insertion of PCL, and medial aspect of patella in full flexion
  - Lateral femoral condyle 16-22%
  - Patella 6-16%
  - Central medial femoral condyle 19%
- Talus
  - Posteromedial 33-56%
  - Anterolateral 44-66%
- Capitellum

## Clinical Presentation in the Knee

- Insidious onset of pain aggravated by activity
- Intermittent joint effusion
- Giving way, catching or locking
- Symptoms suggestive of PFPS
- Clinical signs- atrophy, effusion, tenderness, and limitation of motion
- Wilson's sign- flex, IR knee, extend and ER
  - (Not reliable according to Conrad and Stanitsky)

## Diagnosis

- Differential:
  - Osteochondritis dissecans
  - Acute trauma
  - Irregular ossification
  - Normal anatomic variant

## Juvenile OCD vs Adult OCD

Prognosis  
 50% JOCD heal  
 22% have ongoing symptoms after treatment

## Imaging

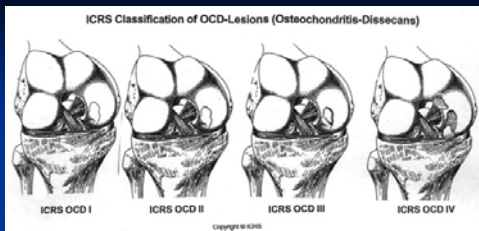
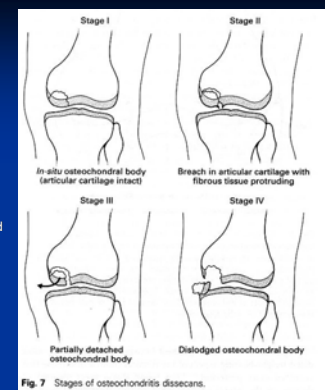
- X-ray
  - Corticated, rounded fragment separated by radiolucent line
  - Tunnel or notch view



## Staging

- Multiple iterations of the same principles
  - Subchondral bone affected alone
  - Abnormality of overlying cartilage
  - Complete detachment and displacement

- Clanton and deLee
- Stage 1 In situ
  - Stage 2 In situ - unstable
  - Stage 3 Partially detached
  - Stage 4 Detached



### International Cartilage Repair Society

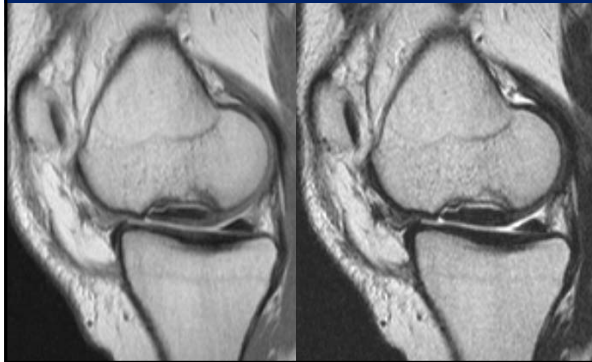
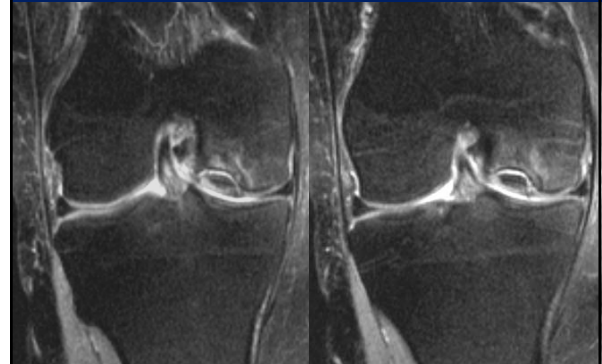
- ICRS OCD I - stable with continuous but softened area with intact cartilage
- ICRS OCD II - stable with partial discontinuity
- ICRS OCD III - in situ lesions with complete discontinuity
- ICRS OCD IV - empty defects with dislocated or loose fragments

## MRI Imaging

- Imaging findings that indicate an unstable OCD lesion De Smet et al. [1997](#)
  1. a line of high signal deep to the fragment as seen on T2-weighted images
  2. an articular fracture indicated by high signal passing through the subchondral bone plate
  3. focal osteochondral defect
  4. a 5-mm-diameter fluid-filled cyst deep to the lesion

## Hefti MRI classification

- Stage 1
  - Small change of signal without clear margins of fragment
- Stage 2
  - Osteochondral fragment with clear margins but without fluid between fragment and underlying bone
- Stage 3
  - Fluid is visible partially between fragment and underlying bone
- Stage IV
  - Fluid is completely surrounding the fragment but the fragment is still in situ
- Stage V
  - Fragment is detached and displaced



## Arthroscopic

- Staging system not specifically developed
- Looks at overlying cartilage, its congruity, degree of detachment

## Factors Affecting Management

- Identify the lesion
  - In situ or displaced
- Symptoms
  - Pain
  - Effusion
  - Locking
- MRI
  - Stable or unstable

## Factors to consider

- Age and maturity of patient
- Which joint is involved
- Location on the joint surface
- Size of the lesion
- Stage of the lesion

## Goals of intervention

- Restore viability of necrotic subchondral bone
- Maintain or restore integrity of articular surface
  - Surface congruity
  - Mechanical properties of the cartilage
- Avoid or delay onset of degenerative arthritis

## Analysis of OCD of the Knee

- Hefti et al J Pediatr Orthop B 1999
  - Multicenter retrospective cohort (collection of records of patients who were evaluated)
  - 452 patients with 509 knees in 12 countries
  - 60% male, 40% female
  - 12.6% bilateral involvement
  - 21.2% history of trauma
  - Negative Wilson test 70.9%

## Locations of Knee Lesions Hefti et al 1999

- Medial femoral condyle near fossa 50.9% - typical
- Other locations
  - Central 19.1%
  - Medial side of femoral condyle 6.9%
  - Lateral femoral condyle 16.5%
  - Patella 6.5%
  - Tibial plateau 0.2%
- Results in typical location
  - 31.4% normal, 41.7% nearly normal, 26.8% abnormal
- Results in unusual location
  - 5.7% normal, 56.4% nearly normal, 37.9% abnormal

## Analysis of OCD of the Knee

- Hefti et al J Pediatr Orthop B 1999
  - Evaluation of results
    - Normal - no pain, tenderness, effusion, swelling, lesion not visible, no gross dissection, no loose body, no OA
    - Nearly normal - minimal pain, tenderness, or effusion, lesion visible on radiograph but no gross dissection
    - Abnormal - marked pain, gross effusion, lesion >20 mm, marked sclerosis, dissection, loose body, OA

## Analysis of OCD of the Knee

- Hefti et al J Pediatr Orthop B 1999
  - Grouping of patients
    - Favorable - None-moderate effusion or swelling, fragment diameter < 20 mm, no gross dissection on investigation
    - Unfavorable - None of the above
  - Results according to situation at diagnosis
    - Favorable
      - 22.7% normal, 54% nearly normal, 23.2% abnormal
    - Unfavorable
      - 25.4% normal, 40.5% nearly normal, 34.1% abnormal

## Analysis of OCD of the Knee

- Hefti et al J Pediatr Orthop B 1999
  - Results according to age at diagnosis
    - Age group with open physes
      - 30% normal
      - 47.5% nearly normal
      - 22.3% abnormal
    - Age group with closed physes
      - 14.7% normal
      - 42.9% nearly normal
      - 42.4% abnormal

## Analysis of OCD of the Knee

- Hefti et al J Pediatr Orthop B 1999
  - Surgical procedures 355/509
    - Drilling
    - Refixation
    - Removal of loose bodies
    - Operative resurfacing

## Analysis of OCD of the Knee

- Hefti et al J Pediatr Orthop B 1999
  - Results of patients with surgical management
    - 23.9% normal,
    - 45.4% nearly normal,
    - 30.7% abnormal
  - Results of patients with conservative treatment
    - 25% normal,
    - 46.8% nearly normal,
    - 27.9% abnormal
  - Results after removal of loose bodies (59)
    - 20% normal,
    - 32% nearly normal,
    - 47% abnormal

## Treatment Options

- In situ with no instability
  - Pain- immobilize/activity restriction
    - No studies to evaluate conservative management options
  - No pain- observation
- In situ with MRI signs of instability
  - No pain ?observation
  - Pain- surgical stabilization

## Treatment Options

- Marrow stimulation
  - Transchondral drilling
  - Retrograde drilling
  - Microfracture
- Fixation
  - Screw, bone peg, bioabsorbable pins
- Open grafting and fixation

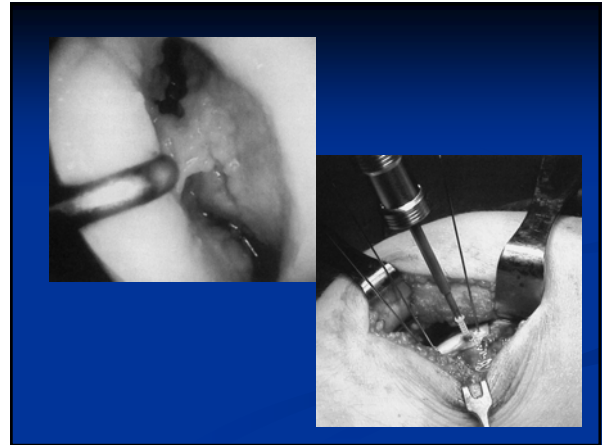
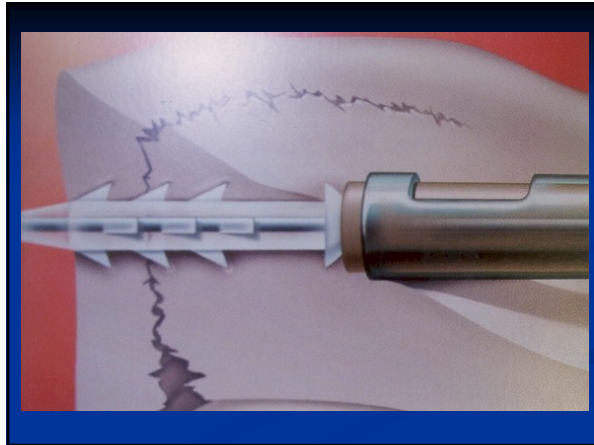


## Marrow Stimulation Techniques

- Transchondral drilling
  - Louisia S et al 2003
    - 12/17 excellent results
  - Kocher MS et al 2001
    - 23/23 healed in average 4.4 months
- Microfracture- salvage

## Fixation techniques

- Transchondral fixation
  - Arthroscopic
  - Open
- Open debridement, grafting and fixation
- Failures due to loosening and refragmentation of osteochondritic bone



## Metal vs Biodegradable?

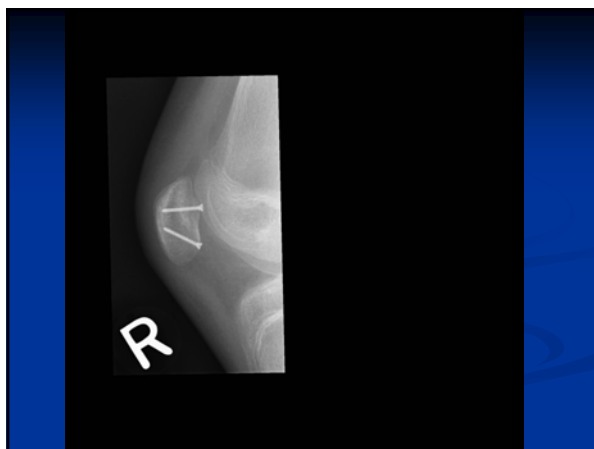
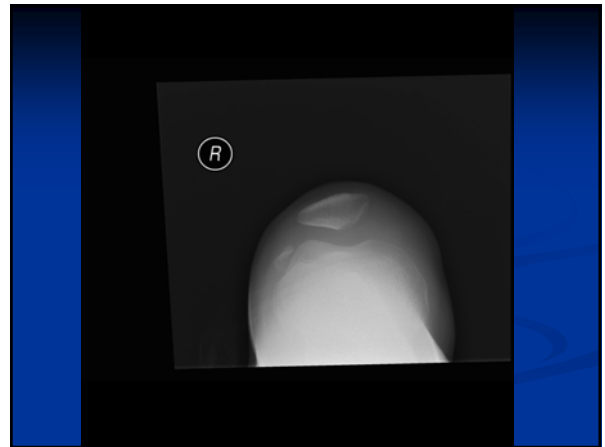
- Advantages of biodegradable
  - Absorbable
  - Won't require later removal
- Complications
  - Breakage
  - Pull out
  - Erosion of cartilage
  - Tissue reaction

## Treatment Options

- Displaced fragment
  - Use as osteochondral graft
  - Best if fresh
- Empty crater
  - Observation if size less than 4 2 cm<sup>2</sup>
  - Reconstructive techniques

## Loose Osteochondral Fragment

- Well nourished since it exists in synovial fluid
- Open reduction and fixation
- Limitations
  - Difficult to get a good fit
  - Good fixation is essential
- No studies that report on the results of this treatment



## Treatment Options

- Defect without loose osteochondral segment that can be reimplanted

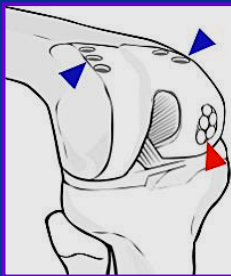
## Treatment Options

- Reconstruction
  - Autogenous osteochondral graft
    - First reported by Outerbridge 1987
    - Revived and rereported 2001
  - Graft from non-articular donor site
    - Patellar facet
    - Femoral notch

## Treatment Option

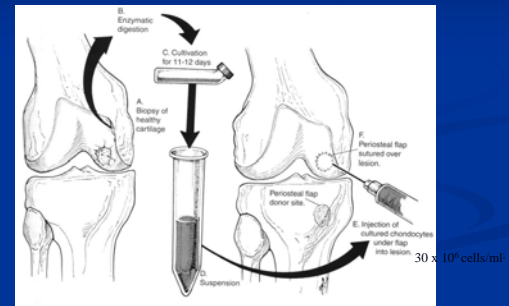
- Mosaicplasty
  - Multiple plugs of non-articular cartilage from donor site same knee inserted into crater
  - Best results with unloading osteotomy

## Current Treatment Options



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## Autologous Chondrocyte Implantation



## Autologous chondrocyte implantation

- Results reported in adolescents
  - Mithofer et al 2005
    - Case series of patients with failed prior management who had undergone at least one surgical procedure
    - Subjective patient outcomes with Lysholm and Tegner activity
      - 96% good or excellent
      - 60% return to athletics
      - Mean follow-up 47 months

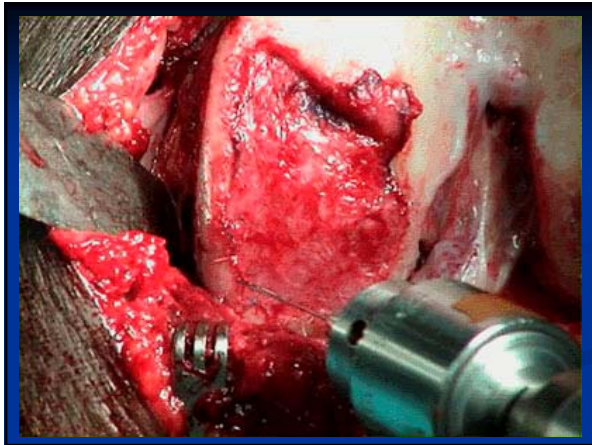
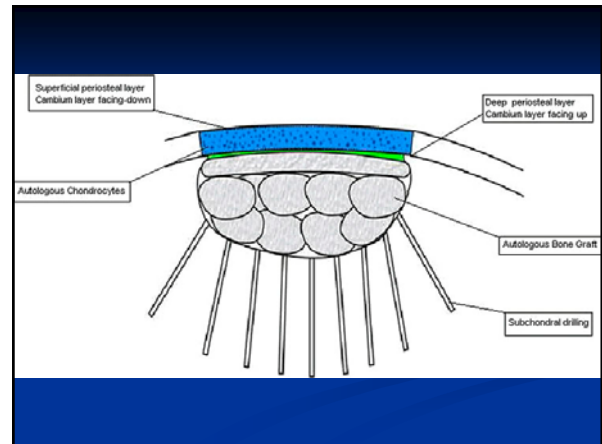
## Autologous chondrocyte implantation

- Results reported in adolescents
  - Micheli et al 2006
    - Multicenter observational prospective cohort
    - Pre and post implantation Cincinnati Evaluation Protocol
    - 88% good or excellent
    - Follow-up mean 4.3 years

## Autologous chondrocyte implantation

Prospective randomized trials in adults

- Bentley G et al 2003
  - 100 subjects, majority of lesions post-traumatic
  - Compared ACI to mosaicplasty
  - Modified Cincinnati, Stanmore scores
  - 88% good or excellent after ACI
  - 69% good or excellent after mosaicplasty
- Horas et al 2003
  - 40 subjects
  - Compared ACI to osteochondral plugs
  - Lysholm, Tegner, histomorphologic evaluation of biopsy
  - Equal decrease in symptoms, slower improvement with ACI



### Normal Cartilage Maturation Stages Following Autologous Chondrocyte Implantation

- Proliferation
  - 0-6 wk
  - Soft, primitive repair tissue
- Transition
  - 7 wk to 6 mo
  - Expansion of matrix into putty consistency
- Remodelling
  - 6-18 mo, up to 3 years
  - Matrix remodelling, tissue stiffens to normal hardness

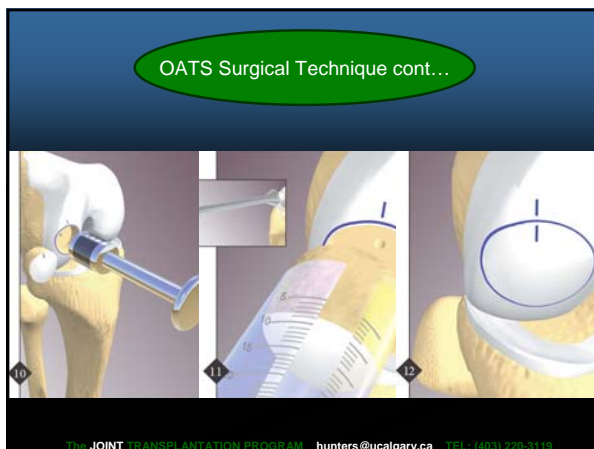
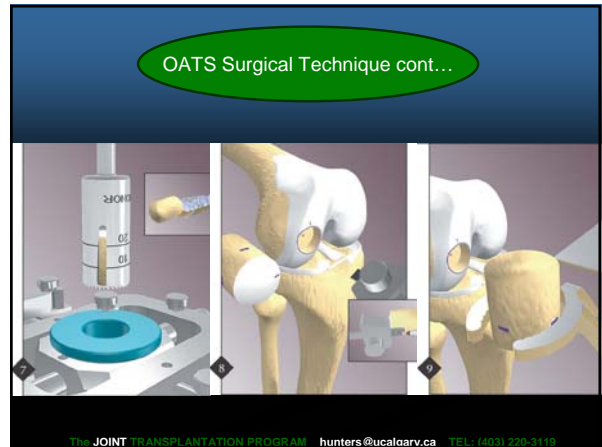
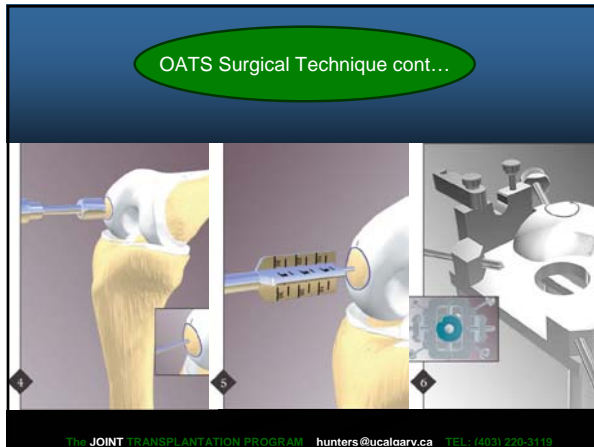
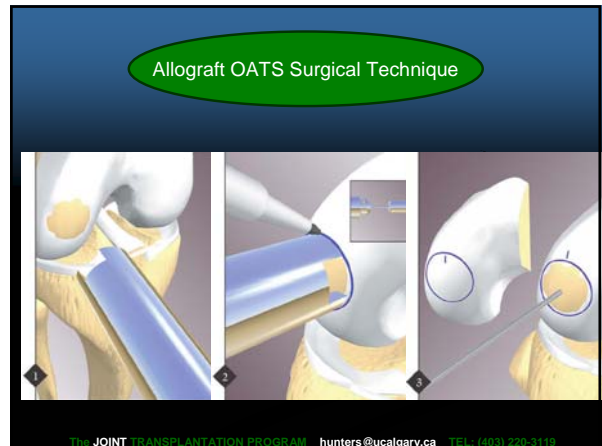
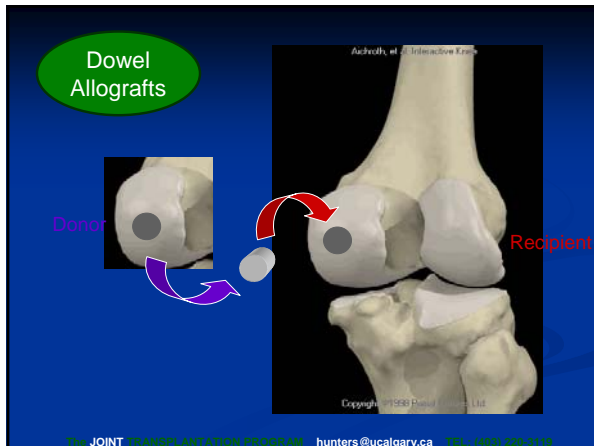
From: JONES: J Bone Joint Surg Am, November 2006

## OSTEOCHONDRAL BOWEL ALLOGRAFTS

### Allograft OATS Surgical Technique

- Little or no regenerative capacity in adult articular cartilage (no nerve innervation or blood and lymphatic supply)
- Cartilage can only survive if it is attached to bone
- An isolated defect will continue to degenerate over time

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### Recipient Criteria

- 15 - 60 years of age
- Failed previous standard treatment options
- Focal femoral lesions only (1-3 cm diameter x 1-2 cm depth)
- 80% meniscus present
- No signs of RA, osteopenia or chondromalacia
- neutral alignment and no joint instability

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## New clinical trial using biogel

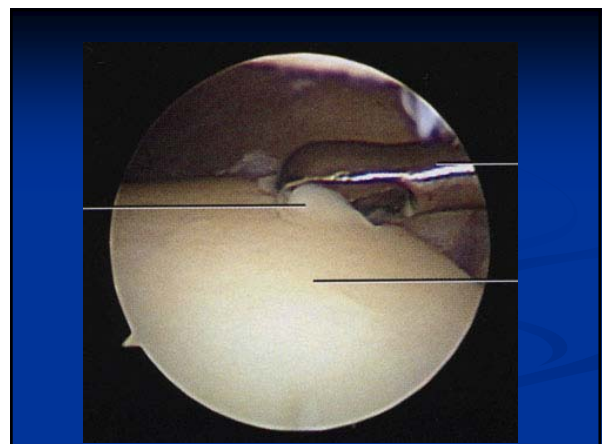
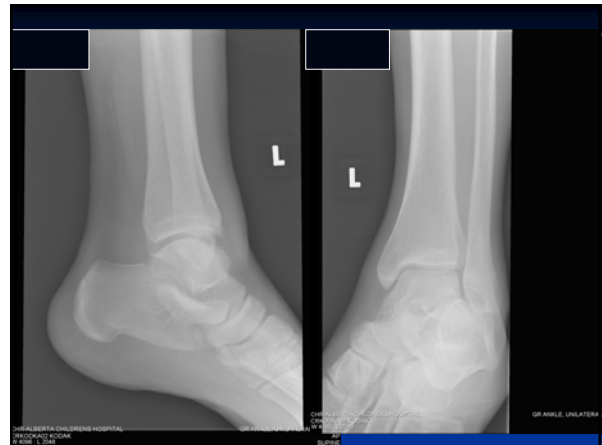
- Product of BioSyntech- BST CarGel
- Prerequisites
  - Medial femoral condyle
  - Stable, otherwise normal knee
  - Patient greater than age 18
- Randomized control study
  - Microfracture
  - Microfracture plus biogel
- Participating centres:
  - Calgary, Winnipeg, Toronto, Montreal, Halifax, ?Vancouver

Recommended Treatment	Lesion Size
Microfracture	1-2.5 cm <sup>2</sup> ; well-shouldered, protected edges
Osteochondral autograft	1-2.5 cm <sup>2</sup> ; grafts need to be perpendicular and flush to surface
Autologous chondrocyte implantation	>2 cm <sup>2</sup> ; background factors need to be addressed, patient must be compliant with rehabilitation
Osteochondral allograft	>4 cm <sup>2</sup> ; uncontained large lesion involving substantial osseous loss

Recommended Operative Treatment According to Lesion Size From: JONES: JBJS Am 2006

## OCD of the talus

- Clinical presentation
  - Pain, locking without history of trauma
  - History of recurrent sprains
  - History of sprain that is remaining symptomatic





### OCD of the Talus

- Gobbi et al 2006
  - Randomized controlled prospective study
    - Random surgeons
    - 33 patients with follow-up 24-119 mo
    - 11 chondroplasty, 9 microfracture, 12 OAT
  - AFOS, Ankle Hindfoot score, Single Assessment Numeric Evaluation, Numeric Pain Intensity
  - No differences between groups except in post op pain

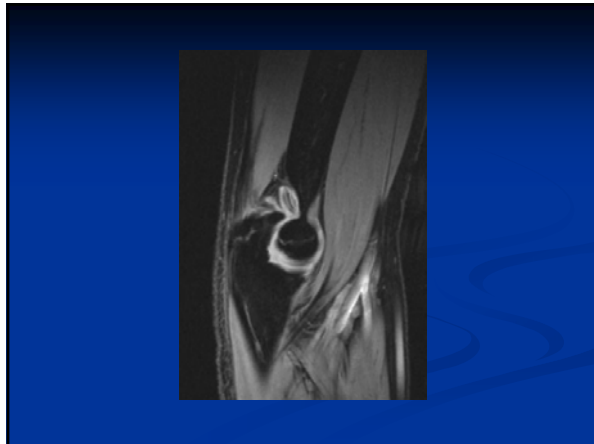
### Osteochondritis Dissecans of the Capitellum

- Different than Panner's disease
  - Fissuring, irregularity and fragmentation of the capitellum in children less than 10 years
  - Reossifies and symptoms resolve
- Mostly seen in throwing athletes and gymnasts (hockey)
- Result of valgus compression and shear forces

### OCD of the capitellum

- Clinical presentation
  - Pain in throwing athlete, gymnast, or hockey player greater than age 10
  - Recurrent locking in the elbow
  - Elbow stiffness - decrease in extension





## Osteochondritis Dissecans of the Capitellum

- Results of management
  - Takahara et al 1999
    - 50% with early lesions treated non-operatively had recurrent pain and/or healing
  - Good results with arthrotomy, removal of loose fragment and lesion debridement
    - McManama et al 1985 - 14 patients
    - Jackson et al 1989 - 9 patients
    - Baumgarten et al 1998 - 17 patients

## Osteochondritis Dissecans of the Capitellum

- Long-term follow-up
  - Bauer et al 1992
    - 23 year follow-up
    - 50% degenerative changes and loss of motion

## Case history

- 16 year old girl followed for 3 years with confirmed OCD medial femoral condyle
- Every time a surgical stabilization procedure was mentioned, she would deny pain, although she had to discontinue dancing to prevent symptoms

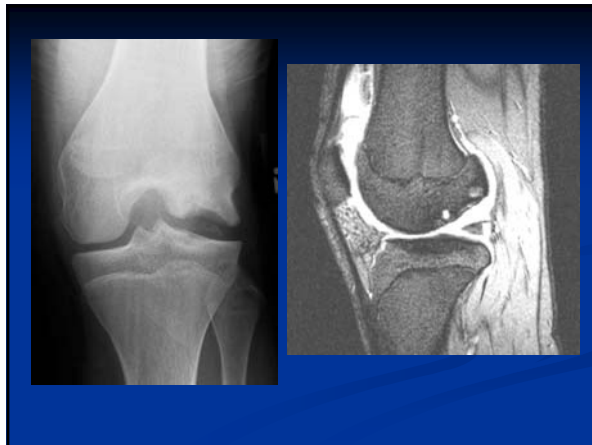


## Management

- Initial proposition - Open reduction and fixation
- After 3rd year, decision to excise fragment
- Accepted surgery!
- Now pain free and back dancing

## Case history

- 13 year old with discoid meniscus with arthroscopic remodelling
- Presents 1 year later with OCD
- 1 year later 2 displaced loose bodies



## Management

- Arthroscopic removal of loose bodies
- Debridement of crater, drilling, reshaping of osteochondral fragments, bone graft and fibrin glue under fragments fixed with bioabsorbable pins
- CPM for 2 weeks
- No sports for 6 months

- What do we do with patients that have fibrocartilaginous in cortical defect with arthroscopically confirmed intact overlying cartilage?

## Summary

- Identification of OCD requires clinical suspicion and x-rays in children
- Treatment depends on:
  - Staging with the help of MRI findings
  - Clinical findings
  - Displacement of the fragment
  - Size of the fragment
  - Match the treatment to the patient

## Summary

- Surgical management
  - In situ
    - Marrow stimulation
    - Fixation
  - Displaced or absent
    - Autogenous loose fragment
    - Autogenous osteochondral mosaicplasty
    - Autogenous chondrocyte implantation
    - OATS Osteochondral allograft dowel

## Summary

- Surgical management is indicated
  - Pain
  - Unstable lesion
  - Defects greater than 1 cm<sup>2</sup>
- Options for surgical management differ according to the joint involved
- Prognosis in children better than adults, clinical data specifically in children is lacking but 22% have abnormal joints at follow up

