Treatment of Knee Arthritis

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Learning Objectives

• History Taking
• Clinical Examination
• Imaging
• Treatment
  – Meds, Lifestyle, Referrals
  – Injection / Aspiration Techniques
What is primary OA?

- Biological changes
- Biochemical homeostasis loss
- Biomechanical failure of cartilage
- Altered joint forces
Arthritis

Chronic Disorder

Articular cartilage
  • Softening, Disintegration
  • New growth at joint margins
  • Capsule thickened
Bone

• Focal trabecular degeneration
• Subchondral cysts
• Reactive sclerosis
  • With increased vascularity
• Endochondral ossification (like kids)
  • producing osteophytes
OA

- Genetic
- Metabolic
- Hormonal
- Usage
- Mechanical Stresses
- Pre-existing disease
- Cartilage injury
OA

• Increases with age
• Activity level NOT related to arthritis incidence

• 25% pts 45-64 yrs
• 85% pts >65 yrs
  – have premature arthrosis of the knee (as seen on xray)
Cartilage

- Type II collagen
- Cross linked type IX collagen
- 80% water
- 20-40% dry weight of glycosaminoglycans
- Chondrocytes and a composite gel
OA

- Increase water content
- Loss of glycosaminoglycans
- Reduced tensile strength and resilience
OA Knee

• OA of the knee is very common
• Begins as mono-compartment disease in 70% of cases (higher in Asians)
• Stays in one compartment for up to 20 years
Pattern of Progression of OA

- Mono-compartment OA
- Intercondylar incarceration
- Rotatory subluxation
- Progressive ACL attenuation
- Bi and tri-compartment osteoarthritis
Classification

- No useful clinical classification
- Outerbridge classification describes areas of chondral damage – NOT prognostic
- Treat symptoms rather than Xrays
What we hope to avoid

Knee Arthritis
Non Surgical Management
What we hope to avoid

Knee Arthritis
Non Surgical Management
Osteoarthritis

- What is the source of the pain?
- Arthritic pain is largely due to increased stress on the unprotected bone
History Taking

- Activity level
- Employment
- Pain profile
- Joint profile
- Functional profile
- Remember referred pain
  - Back or Hip
Pain

- Location
- Rest
- Night
- Stair climbing
- After sitting
- Squatting
- Barometric pressure changes

PF jt involved
Symptoms

- Swelling
- Catching
- Instability
- Onset of symptoms
- Response to prior treatment
Disease progression

- Early OA often localised to 1 area
- Long standing OA pain more diffuse
- Can have acute change in a chronic knee
- Can get AVN
Clinical Examination

• Remove socks and expose thighs
• Try standing and walking
• Examine the good leg first

LOOK – FEEL – MOVE
Functional Anatomy / Assessment

- Gait
- Alignment
- Range of Motion
  - Hip
- Knee
  - Ankle/Foot
Clinical Assessment

- Body habitus
- Gait – antalgic, thrust, stiff etc
- Swelling
- Scars
- Muscle Wasting
- Tenderness
- Instability
- Neurovascular status
Knee Arthritis
Non Surgical Management
Knee Arthritis
Non Surgical Management
Check for effusion
Palpation

Knee Arthritis
Non Surgical Management
Anterior Drawer
Knee Arthritis
Non Surgical Management
PCL: Posterior Drawer Test

Knee Arthritis
Non Surgical Management
Ligament Injury Classification

- **Grade I**
  - Stretch or tear of individual fibres without instability

- **Grade II**
  - Partial tear with minor instability

- **Grade III**
  - Complete disruption of ligament continuity
Ligament Injury Classification

• Grade III Tears
  – grade I: <5mm opening
  – grade II: 5-10mm opening
  – grade III: >10mm opening
McMurray’s Test
Meniscal Tears:
Investigation

- Xray
- Xray
- Xray
- Xray
- Xray
Osteoarthritis: Imaging

- MRI
  - Dx unclear with plain XR
  - localised chondral lesions
  - atypical meniscal tears
  - OCD, SONK
- Bone Scan
  - Dx unclear; SONK

Knee Arthritis
Non Surgical Management
Knee Arthritis
Non Surgical Management
Knee Arthritis
Non Surgical Management
Knee Arthritis
Non Surgical Management
Investigations / Imaging

- Plain radiography
- Stress radiography
- Ultrasound
- CT Scan
- MRI Scan
- Bone Scan
Treatment

• Slow progression of disease allows stepwise algorithm

• Physiological age important
Non surgical

- Lifestyle modification
- Bracing
- Orthotics
- Rehab
- Medications

- Intolerable lifestyle changes dictate Rx
The following are classified as Recommended:

- **Overweight patients** (BMI>25) should lose a minimum of 5% of their body weight.

- **Low impact aerobic fitness exercises**

- **Preop preparation for surgery important**
What exercise can I do doc?

- Muscle strengthening - improve a specific functional loss
- Aerobic exercise leads to better long term functional outcome - preferred
- Beneficial effects of exercise lost 6 months after exercise terminated.
Avoid

• Range of **motion and flexibility exercises**
  • Building up muscle to act as a shock absorber works well but trying to improve motion causes irritability of the joint and almost never works.

• **Lateral heel wedges** for medial knee OA
  • This is a time honoured tradition but has been shown not to work in several good clinical trials.

Knee Arthritis
Non Surgical Management
Recommended

• Participate in education programmes
  – walk instead of run, lifestyle modification etc
• Quadriceps strengthening exercises
• Patella taping for short term pain relief
Lifestyle

• High stool (avoid standing)
• No high impact
• Lose weight
• Reduce squatting and stairs
• Raised toilet seat
Shoes

- Energy absorbing
- Wedges
  - (5 degrees or about 7mm)
- Limited by $2^0$ correction at foot level
Bracing

- Effective
- Expensive
- Not tolerated in Australia
Knee Arthritis
Non Surgical Management

Supports

• Walking stick
  – Top of GT when wearing shoes
• Very good for acute exacerbations
• ? Loss of independence
Medications

- Paracetamol
- Aspirin
- NSAIDS
- Oral ‘supplements’
- Narcotics
NSAIDS

• Reversibly inhibit cyclo-oxygenase side of arachidonic acid metabolism
• Blocks inflammatory agents
  • Prostaglandins, leukotrienes
  • Not good for stomach mucosa, renal blood flow, Na balance
• Hepatic biotransformation, renal excretion
• Side effects usually dose related
• Yearly FBC, LFT’s, creatinine, stool blood testing
Chondroprotective supplements

- Glucosamine and chondroitin sulfate
- Endogenous molecules in articular cartilage
- Synergistic when taken together
- Gluc – stimulates chondrocyte and synoviocyte metabolism
- Chond – inhibit degradative enzymes and prevent fibrin thrombi in periarticular tissues
Recent studies show probably not effective

- **Glucosamine**
  - 87% oral dose absorbed in gut
  - No significant side effects or toxicity
  - 1g a day

- **Chondroitin**
  - 70% absorbed
  - 1200mg a day

Rose Hip Vital perhaps an option
Corticosteroid injection

- When NSAIDS fail or C/I
- >6/52 symptoms
- Minimal systemic effects
- Microcrystalline (triamcinolone) slower absorption and more prolonged BUT can give crystalline synovitis
- I use betamethasone sodium phosphate (Celestone)
Corticosteroid injection

- Effect variable
- Max 4/year
- Less effective each time
- Subcut fat atrophy and pigmentation changes
- Infection rates very low
- MUST USE ASEPTIC TECHNIQUE
Steroid Injections

Contraindications

- Septic arthritis
- Skin infections
- Intraarticular fracture at site
- Coagulation disorders
- Poorly controlled diabetic (relative CI)
- History of Tb (relative CI)
KNEE INJECTION

Extended lateral approach

- Target
  - Retro-patellar space
KNEE INJECTION:
Knee extended: Medial Approach

• Patient relaxes quads.
• Examiner pushes patella medially.
• Needle Position:
  – midway between superior and inferior pole of patella
  – Needle Horizontal
KNEE INJECTION:

Flexed Medial Approach

- **Target:**
  - Intercondylar notch

- **Landmarks:**
  - Hollow along the joint line just medial to the patellar tendon
KNEE INJECTION: Flexed Medial Approach

- Patient sitting: BEWARE syncope!!!
- Needle Position:
  - 30° laterally and slightly superiorly
- Resistance:
  - caused by bone or cruciates redirect
Viscosupplementation

- High MWt solutions supplement the reduced hyaluronate concentrations
- Made from Rooster combs
- Synvisc, Hyalgan, Orthovisc, Neovisc
- 3 and 5 weekly injections
- Effects:
  - Physical, Anti-Inflammatory, Anabolic, Analgesic, chondroprotective
Viscosupplementation

• Helps joint distribute load and lubricate
• Antiinflammatory, nociceptive reduction
• Response variable
• More expensive than steroids
Synvisco

- Kinetics mean that it can’t just be replacement of physical effects
- Half life probably hours
- Leucocytes: inhibition of
  - phagocytosis, adherence and mitogen stimulation
- Stimulate synovial fibroblasts
Synvisc

- Aspirate large effusions
- LA infiltration to find jt
- Avoid ‘activity’ for 48 hrs
- C/I ‘known hypersensitivity’
Patient Selection

Patients with early and intermediate disease had better results than those with end-stage disease.

>75% of knees were reported as better or much better and resulted in better or much better activity levels.

<table>
<thead>
<tr>
<th>Medical x-ray grade</th>
<th>Number of Knees</th>
<th>% Better or Much Better</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>68</td>
<td>91%</td>
</tr>
<tr>
<td>II</td>
<td>138</td>
<td>80%</td>
</tr>
<tr>
<td>III</td>
<td>180</td>
<td>76%</td>
</tr>
<tr>
<td>IV</td>
<td>57</td>
<td>58%</td>
</tr>
</tbody>
</table>

Knee Arthritis
Non Surgical Management
VISCOSUPPLEMENTATION

• PRACTICAL POINTS
  – Contra-indications
    • Chicken or egg allergy
  – Duration of effect
    • 6 - 9 months
  – Complications:
    • Local reactions: 1 - 3 %
      – Transient erythema, pain, swelling
    • Rare systemic reactions (reported not proven)
Mesenchymal stem cells

- Sexy, enticing, Perhaps Media driven
- Totally experimental !!
- Assists tissue to repair / regenerate
- Can’t help bone on bone arthritis
- Must have good alignment
How does it work?

- Can be derived from
  - Muscle
  - Fat
  - Marrow
  - Blood
- May need enhancement in the lab
How does it work?

• Modifies immune response
• Anti-inflammatory
• Secretory signaling
• Chondrocyte and capillary generation
• Down regulation of pro-inflammatory cytokines
• Pluripotent cells probably not that relevant
Does is work?

• Horse and goat models
• Human trials still underway
  – Very small numbers

• About $9000 out of pocket per injection
  – Requires GA and Day surgery admission
MSC

• Need to correct malalignment and instability
  – HTO
  – ACL reconstruction
Can we stop the deterioration

- Celestone – short term symptomatic relief
- Hyaluronic acid – longer relief
- PRP – doesn’t work
- Mesenchymal stem cells - experimental
Surgical

- Arthroscopy
- Osteotomy
- Arthroplasty
- Meniscal transplantation
- Cartilage grafting
Arthroscopy

- Acute change in symptoms
- Well localised pain
- Dilutes inflammatory cytokines
- Removes mechanical symptoms
  - 60% Better
  - 20% Same
  - 20% Worse 3/12
Experimental work

- Chondral grafting
- Meniscal transplants
- Spacers
Knee Arthritis
Non Surgical Management
Osteotomy

- Younger patients
- Higher demands
- Less used nowadays
- Better for medial OA
HTO

Some favourable results reported...

- 80% good results at 5 years
- 60% good results at 10 years
  
  (Coventry)
Uni Knee

- Limited indications
- Works well in well selected patients
- Some need revision to TKR
TKR

• Definitive treatment
• “high” complication rate
• Limited lifestyle afterwards
• Polyethylene wear
Preparing for TKR

- Bike
- Cross Trainer
- Boxing
- Swimming
- Paddling
- Rowing
- Hydrotherapy
- Grinder
- Table Tennis
Knee Replacement is a good operation

- >95% success rate
- Cost effective
- Restores function
- Reduces burden on the community
- Lasting ~15yrs
### TKA Activity Recommendations (ISAKOS, 2001)

#### Yes
- Slow Aerobics
- Cycling
- Ballroom dance
- Diving
- Golf
- Hiking
- Rowing
- Sailing
- Swimming
- Walking
- Shuffleboard

#### If Previous Exp.
- Slow Aerobics
- Bowling
- Canoeing
- X country skiing
- Stationary skiing
- Square dancing
- Doubles tennis
- Weight machines
- Walking rough surfaces

#### No
- Fast aerobics
- Baseball
- Basketball
- Football
- Gymnastics
- Handball
- Hockey
- Jogging
- Singles Tennis
- Squash
- Volleyball
- Racquetball
TKR

Good, but not without problems:

- Incomplete pain relief
- Loss of motion
- Loss of function
- Activity restriction
- Difficult revisions
- Wear problems
- Altered joint mechanics
TKR Complications

osteolysis

wear

instability

loss of bone stock
Knee Replacement is a good operation

- Problems
  - Blood loss
  - Fat Embolism
  - Fracture from pins for computer guidance
  - Component malrotation
  - Component Malalignment
  - Cost
  - Inventory
  - Lack of planning
Malalignment leads to increased failure of implants

- Computer navigation helps with coronal alignment only
- Rotation very important for patella tracking
- Rotation, sizing and AP translation much better
Customised patient specific cutting blocks

The idea is to make the operation more accurate, more reproducible and create less complications.
Routine Imaging

- Weight Bearing AP
- Lateral
- Notch View
- Skyline Patella
Imaging for this technique

- MRI (or CT)
- Long leg alignment to reproduce mechanical axis
  - Morphology of the knee itself
- 3D computer model made by segmenting the scan
  - Gives patient anatomy
  - Landmark identification – same as those for any knee replacement
Knee Arthritis
Non Surgical Management

MRI Scan
Full Leg X-Ray
Imaging uploaded to the web

- Engineer makes a plan for the operation
- Surgeon reviews the plan
- Adjusts for flexion deformity
- Changes size, cuts etc
- Plan approved
- Bone models produced
- Blocks produced
### Tibia Alignment

<table>
<thead>
<tr>
<th>Lateral</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Proximal Resection:</td>
<td></td>
</tr>
<tr>
<td>7.5 mm from Medial</td>
<td></td>
</tr>
<tr>
<td>9 mm from Lateral</td>
<td></td>
</tr>
<tr>
<td>Posterior Slope:</td>
<td>3 deg</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Anterior</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
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<td></td>
</tr>
<tr>
<td>Tibia Varus/Valgus Deformity</td>
<td>Mechanical Axis of Shaft</td>
</tr>
<tr>
<td>ML Implant Width:</td>
<td>Vertical Lines</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Proximal 90° (leg flexion)</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Rotation:</td>
<td></td>
</tr>
<tr>
<td>Medial 1/3 of Tibia Tubercle</td>
<td></td>
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<tr>
<td>ML Implant Width:</td>
<td>Vertical Lines</td>
</tr>
<tr>
<td>Posterior Implant Boundary:</td>
<td>Most Posterior Horizontal Lines</td>
</tr>
</tbody>
</table>
### Femur Alignment

<table>
<thead>
<tr>
<th>Lateral</th>
<th>Distal Resection:</th>
</tr>
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<tbody>
<tr>
<td>10.5 mm from Medial</td>
<td></td>
</tr>
<tr>
<td>9 mm from Lateral</td>
<td></td>
</tr>
<tr>
<td>1 mm into Sulcus</td>
<td></td>
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**Posterior Resection:**

11 mm from Medial
12 mm from Lateral

**Anterior Resection:**

Flush to Anterior Shaft

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**Femur Valgus:**

Mechanical Axis - Coronal Plane

**ML Implant Width:**

Vertical Lines

**Distal (90° dog leg):**

**Rotation:**

AP Axis

**Posterior Resection:**

11 mm from Medial
12 mm from Lateral

**ML Implant Width:**

Vertical Lines

Implant Boundary

Most Posterior Horizontal Lines
Models Produced
## Visionaire Cutting Block Placement

<table>
<thead>
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<th>Femur</th>
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<td>[Image]</td>
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<th>Tibia</th>
<th>Medial</th>
<th>Anterior</th>
<th>Lateral</th>
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<td>[Image]</td>
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### Knee Arthritis
Non Surgical Management
Nylon blocks produced to fit the models

Final design manufactured

Knee Arthritis
Non Surgical Management
The Surgery

• The blocks DO NOT replace surgical thinking
• Every step still checked by the surgeon
• Traditional equipment can still be used even with the blocks
• The blocks can be discarded if the surgeon feels they are wrong
During the operation

- Routine exposure of the knee
- Less violation of intramedullary canals and so less fat embolism
- No pins as for computer guidance
- Everything double checked in routine fashion
Femoral side excellent

- “Locks” into place
- Perfect fit and control of rotation
- Size of implant known and planned for

- Tibia not yet quite as good but can be double checked using jigs more easily than the femur anyway
Instrumentation designed to patient specific anatomical features and supplied sterile
Much more efficient

- Fewer operative steps
- Set up and change over time much better
- COST – make the blocks $450
- Less sterilisation - saves money ($130 per tray, 5 less trays), less courier costs
- Saves $750
Who can have it?

Any primary TKA patient is a candidate for Patient Matched Instrumentation

(as long as they can have a MRI or CT)
Pt Matched TKR Summary

- Exciting new technology
- Early results look great
- Room for improvement
- Should reduce complications significantly
Knee Arthritis
Non Surgical Management

Treatment Algorithm?

Conservative treatment

\[ \downarrow \]

Arthroscopic debridement, microfracture, chondral resurfacing, meniscal replacement

\[ \downarrow \]

HTO or Unicondylar resurfacing

\[ \downarrow \]

Total Knee Replacement...
Knee Arthritis
Non Surgical Management

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