

# Treatment of Knee Arthritis

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# Learning Objectives

- History Taking
- Clinical Examination
- Imaging
- Treatment
  - Meds, Lifestyle, Referrals
  - Injection / Aspiration Techniques



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# What is primary OA?

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



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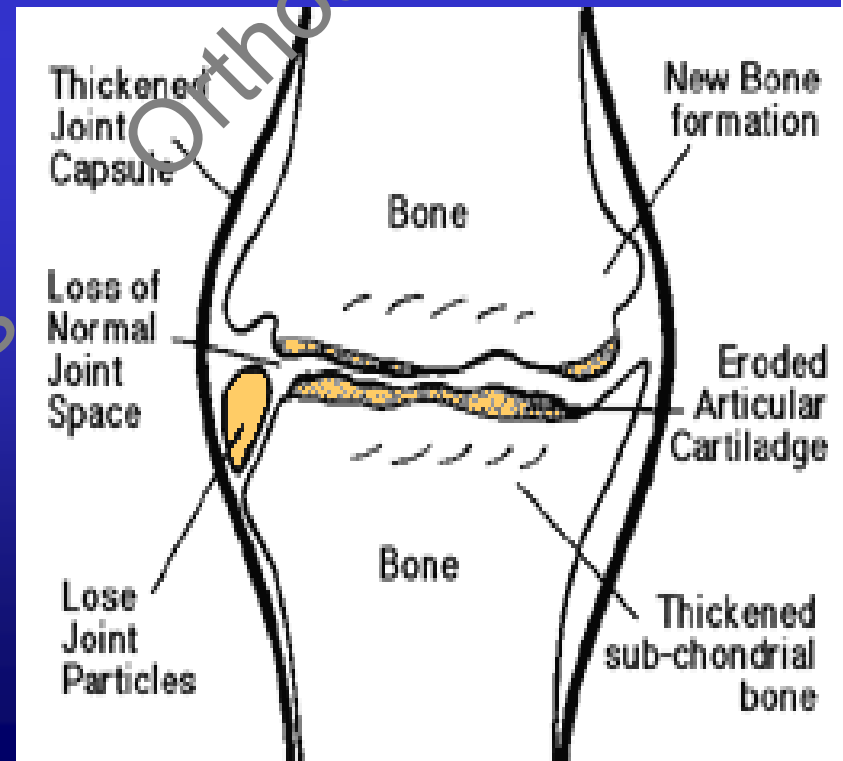
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# Arthritis

## Chronic Disorder

### Articular cartilage

- Softening, Disintegration
- New growth at joint margins
- Capsule thickened



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# Bone

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



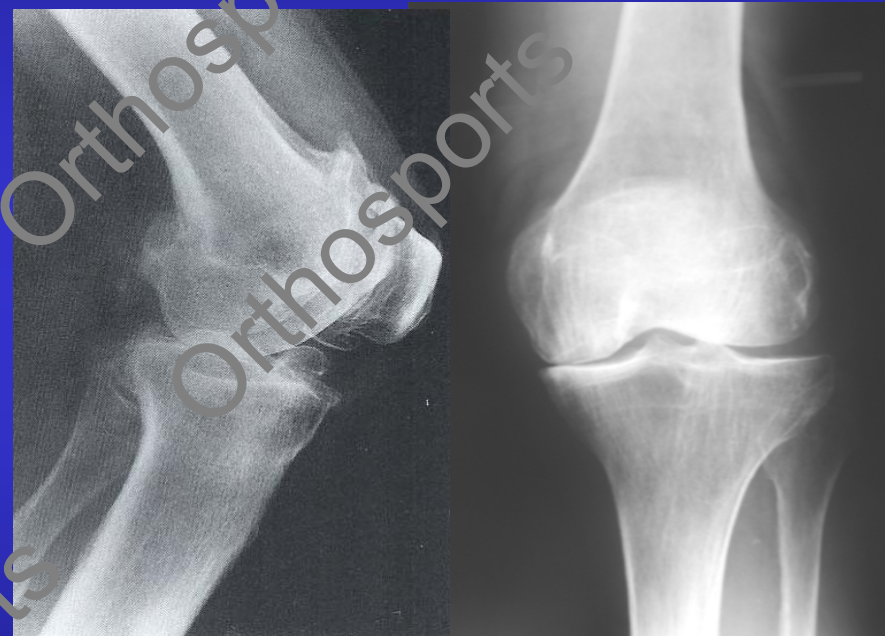
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# OA

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



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# 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)



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# Cartilage

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



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# OA

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



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# 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



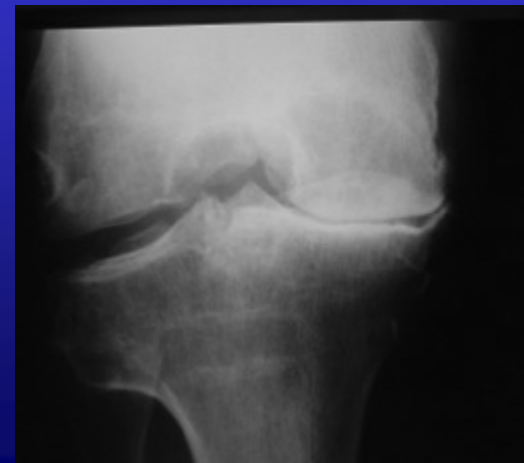
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# Pattern of Progression of OA

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



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# Classification

- No useful clinical classification
- Outerbridge classification describes areas of chondral damage – NOT prognostic
- Treat symptoms rather than Xrays



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# What we hope to avoid



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# What we hope to avoid



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# Osteoarthritis

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



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# History Taking

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



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# Pain

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



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# Symptoms

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



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# 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



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# Clinical Examination

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

LOOK – FEEL – MOVE



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# Functional Anatomy / Assessment

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



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# Clinical Assessment

- Body habitus
- Gait – antalgic, thrust, stiff etc
- Swelling
- Scars
- Muscle Wasting
- Tenderness
- Instability
- Neurovascular status



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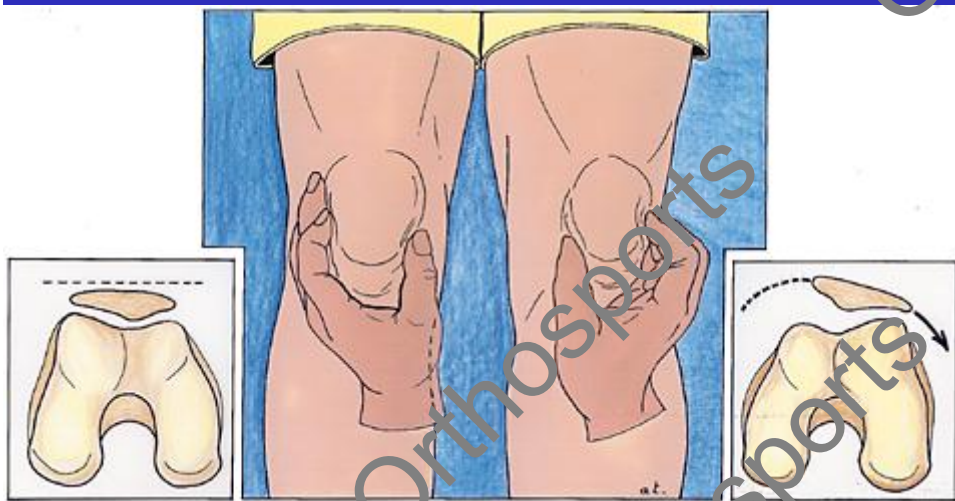
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# Check for effusion

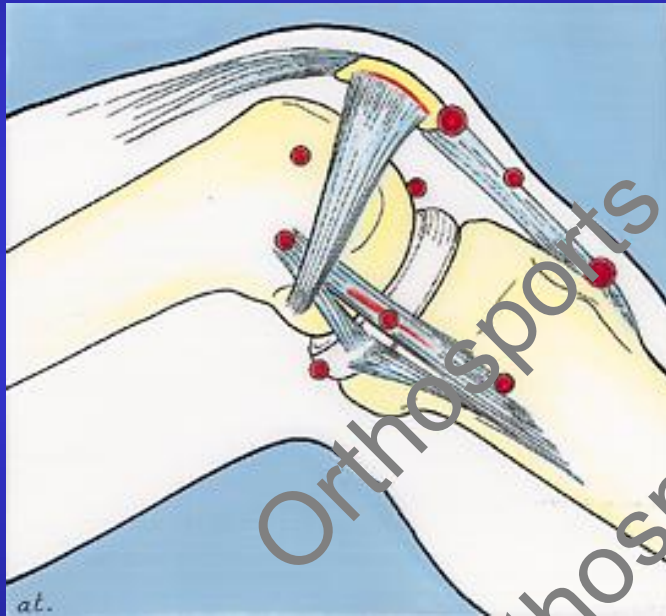


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# Palpation

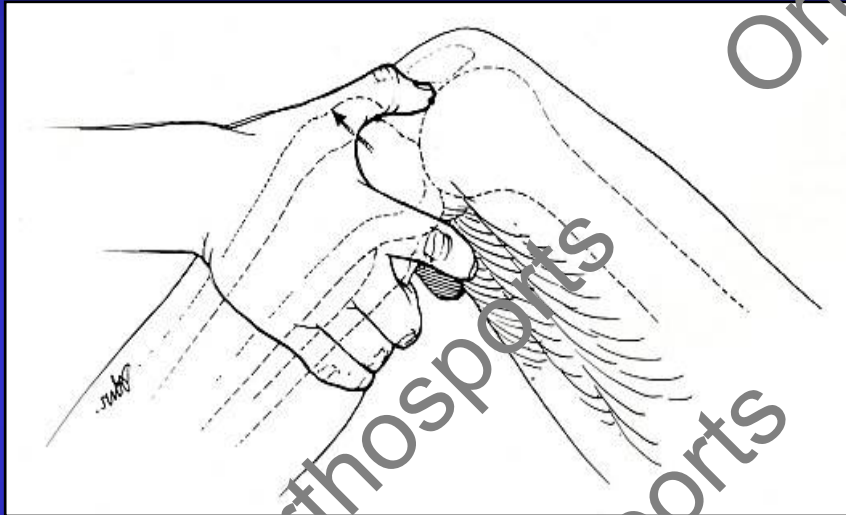


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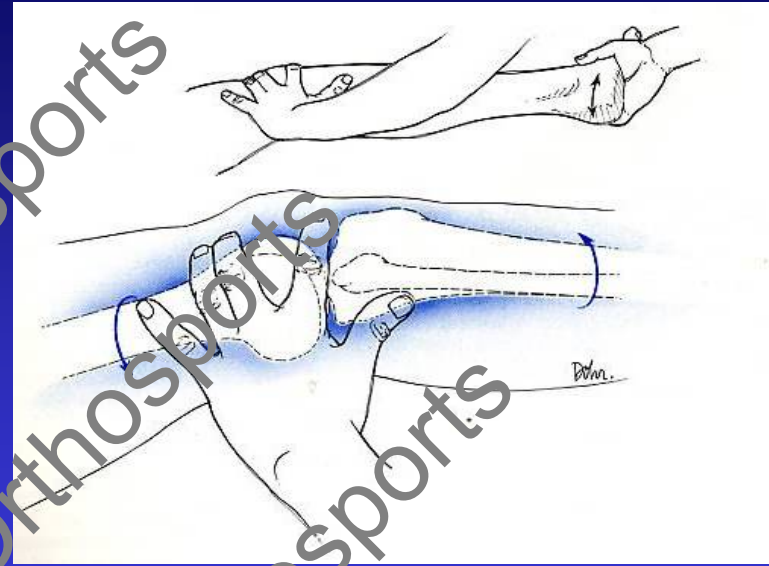
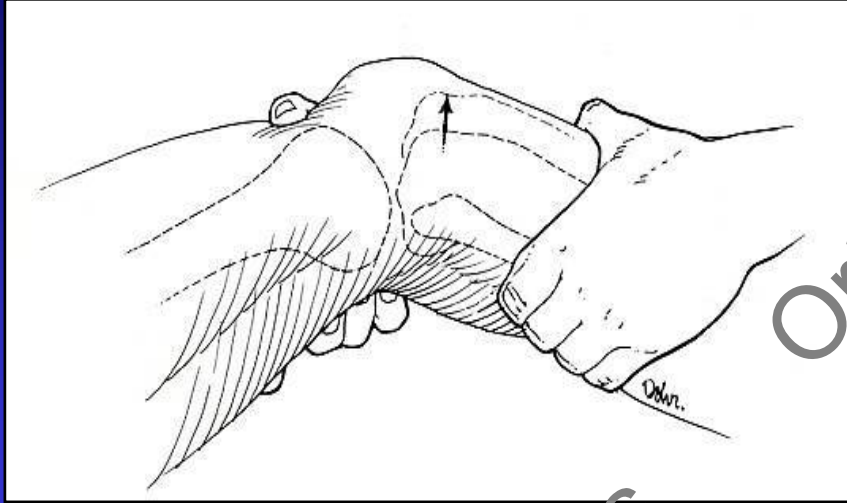
# Anterior Drawer



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# PCL: Posterior Drawer Test

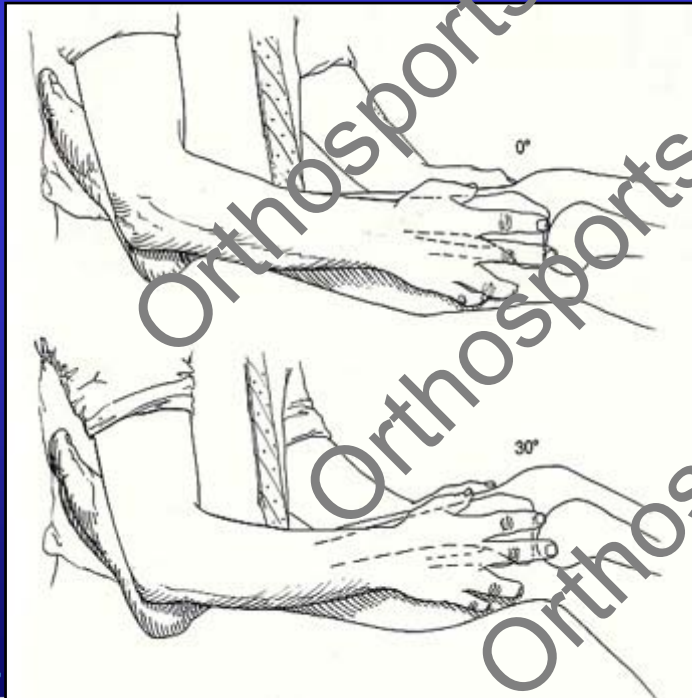


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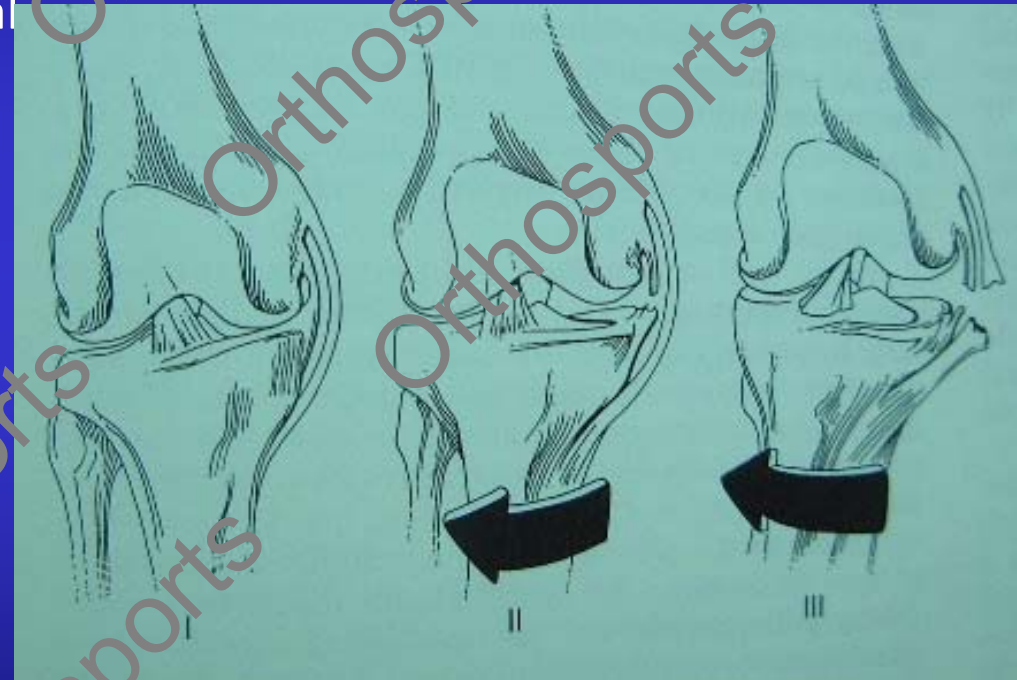
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# Ligament Injury Classification

- Grade I
  - Stretch or tear of individual fibres without instability
- Grade II
  - Partial tear with minor instability
- Grade III
  - Complete disruption of ligament continuity



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# Ligament Injury Classification

- Grade III Tears
  - grade I: <5mm opening
  - grade II: 5-10mm opening
  - grade III: >10mm opening



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# McMurray's Test

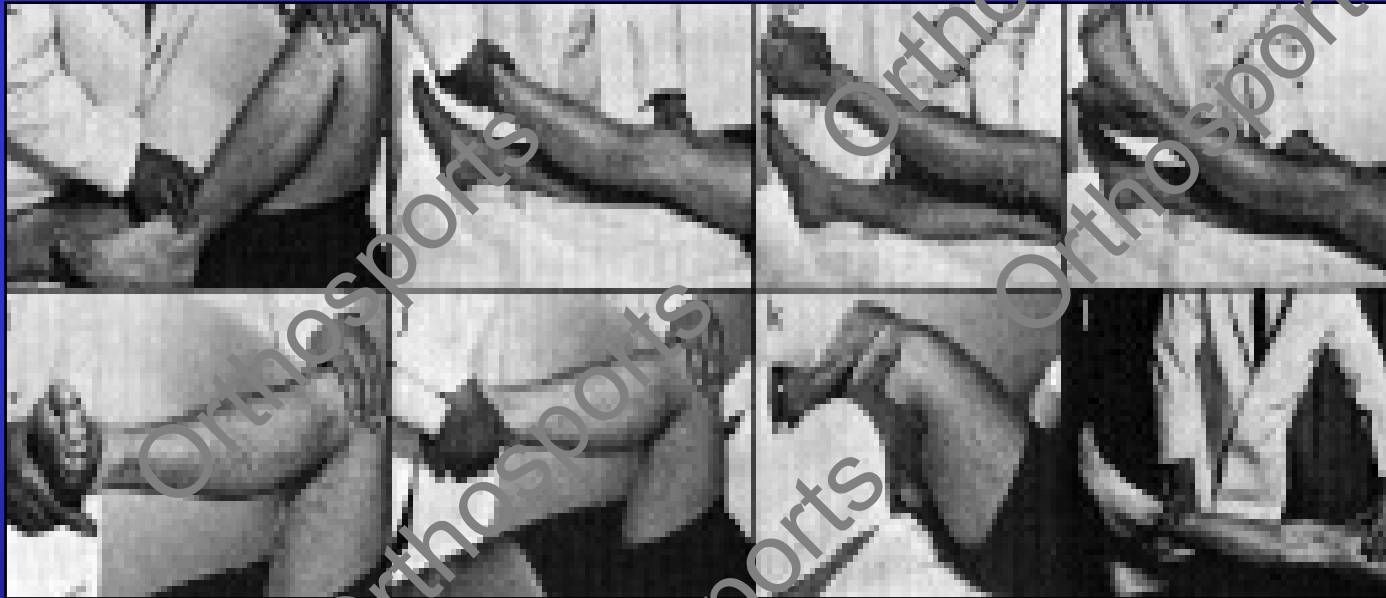


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# Meniscal Tears:



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# Investigation

- Xray
- Xray
- Xray
- Xray
- Xray



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# Osteoarthritis: Imaging

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



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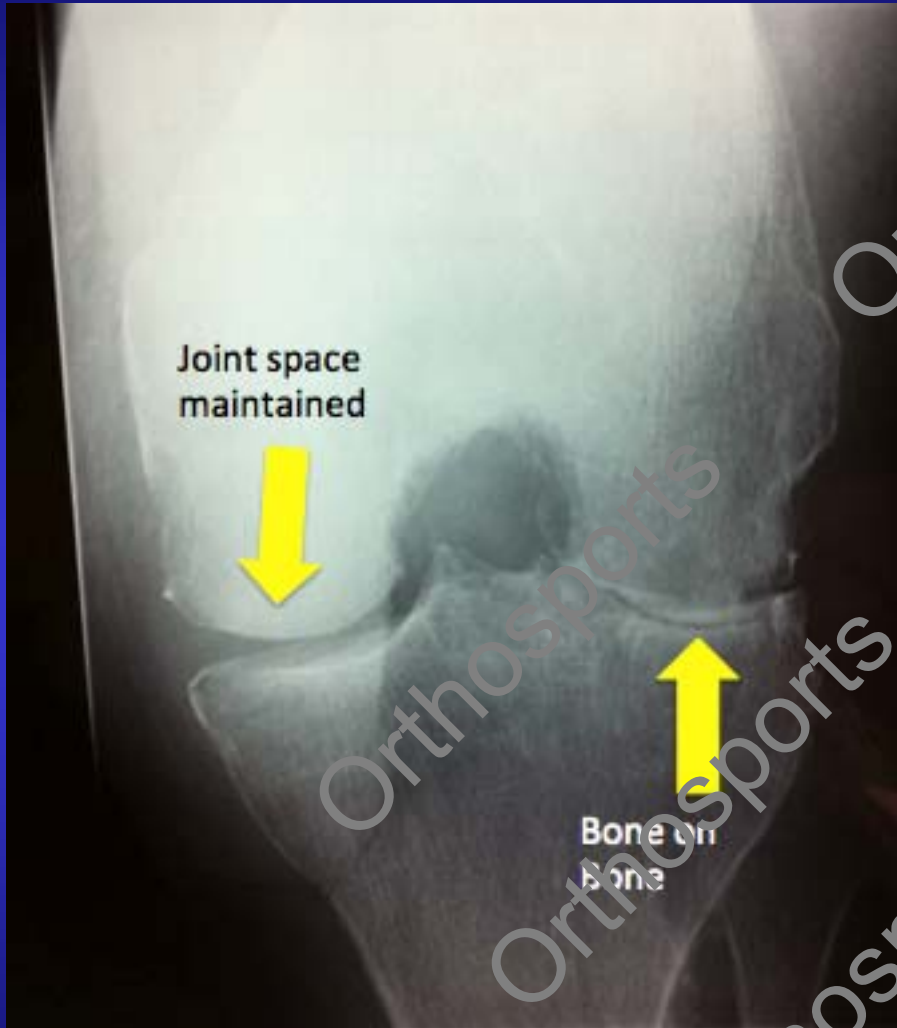
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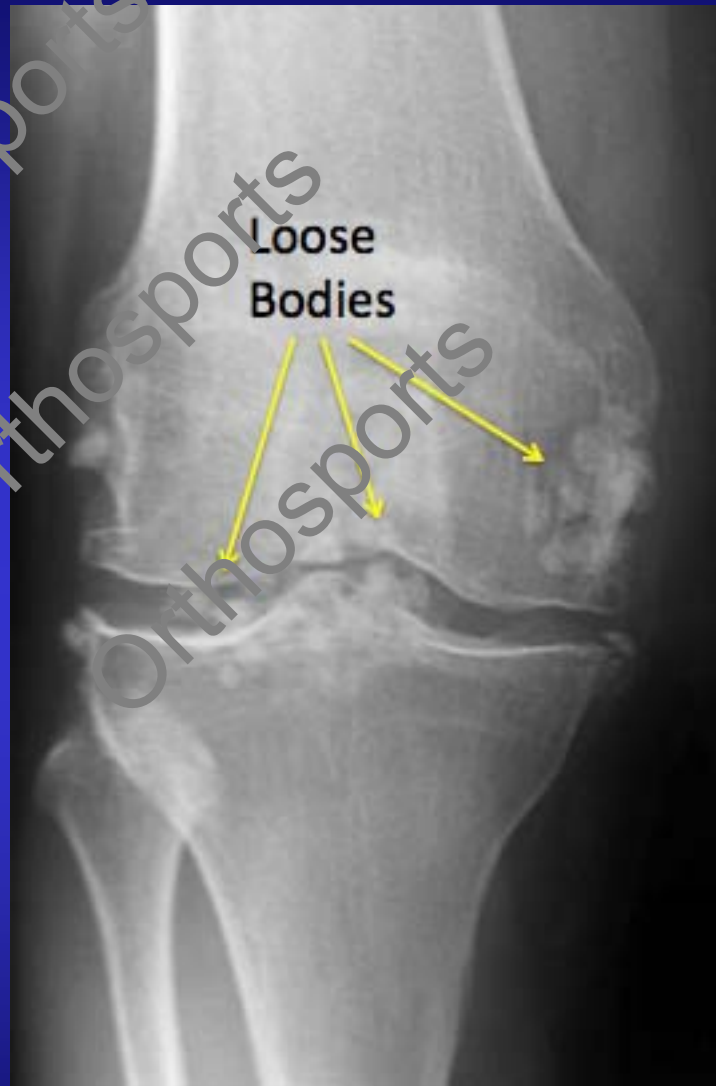
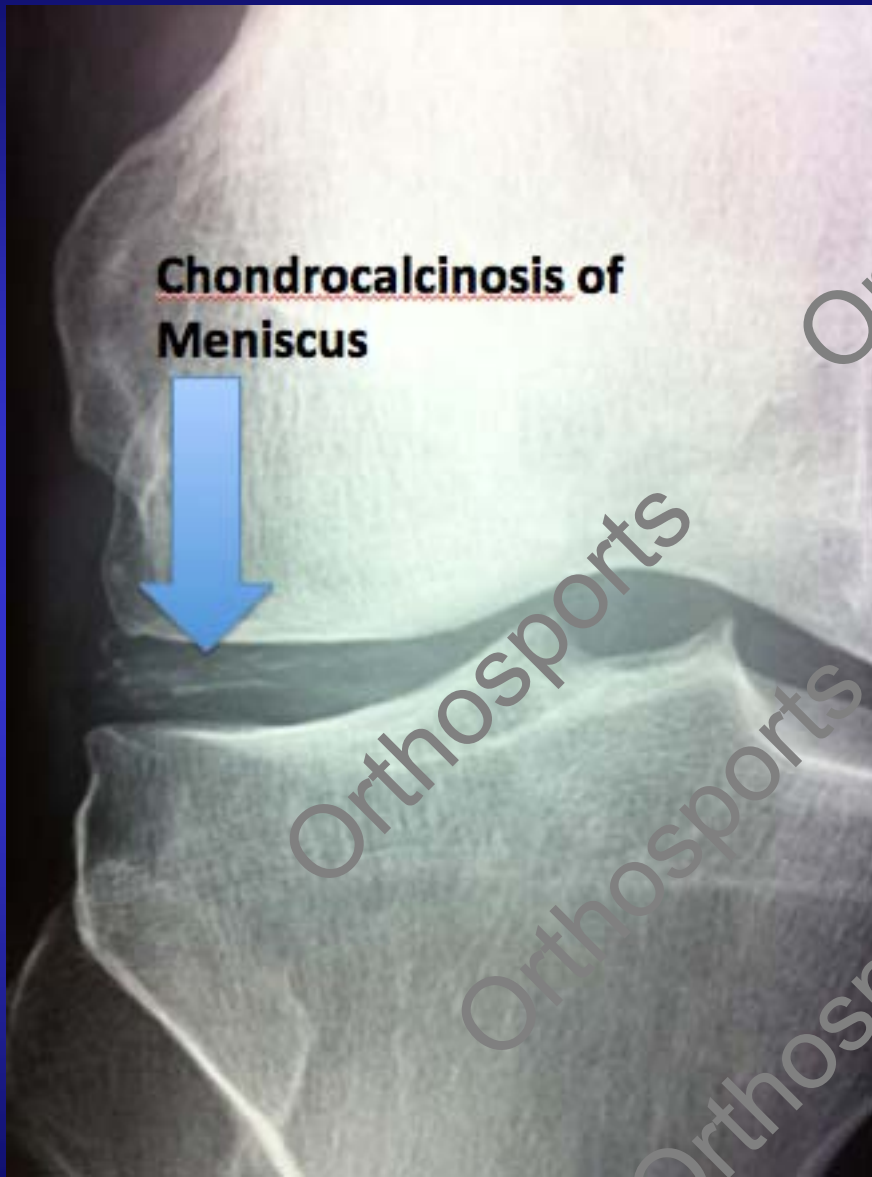


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# Investigations / imaging

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



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# Treatment

- Slow progression of disease allows stepwise algorithm
- Physiological age important



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# Non surgical

- Lifestyle modification
- Bracing
- Orthotics
- Rehab
- Medications
- Intolerable lifestyle changes dictate Rx



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# 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.



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# 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



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# Recommended

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



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# Lifestyle

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



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# Shoes

- Energy absorbing
- Wedges
  - (5 degrees or about 7mm)
- Limited by 2° correction at foot level



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# Bracing

- Effective
- Expensive
- Not tolerated in Australia



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# Supports

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



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# Medications

- Paracetamol
- Aspirin
- NSAIDS
- Oral 'supplements'
- Narcotics



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# 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



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# Chondroprotective supplements

- Glucosamine and chondroitin sulfate
- Endogenous molecules in art. cartilage
- Synergistic when taken together
- Gluc – stimulates chondrocyte and synoviocyte metabolism
- Chond – inhibit degradative enzymes and prevent fibrin thrombi in periartic. tissues



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# 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



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# Corticosteroid injection

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



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# Corticosteroid injection

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



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# Steroid Injections

## Contraindications

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



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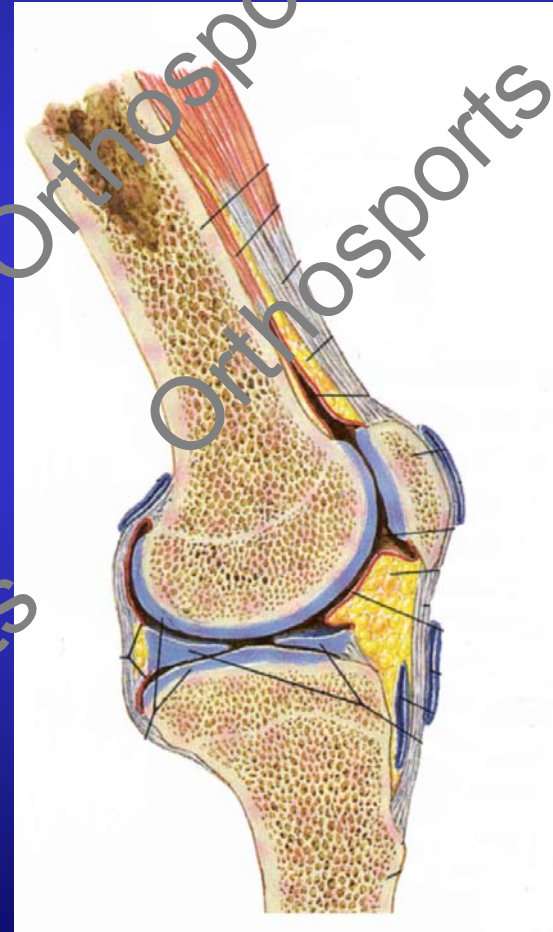
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# KNEE INJECTION

Extended lateral approach

- Target
  - Retro-patellar space



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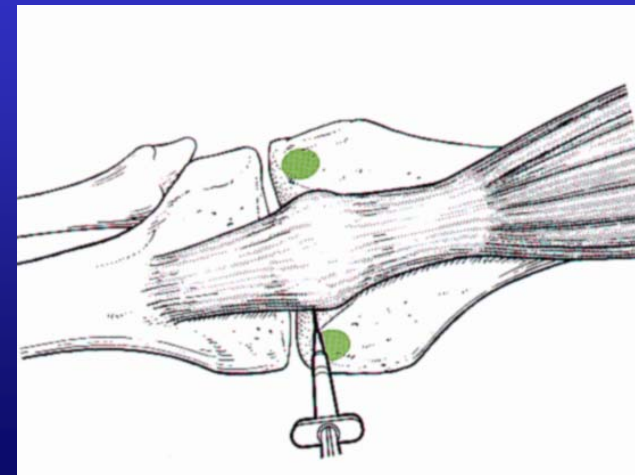
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# KNEE INJECTION:

## Knee extended: Medial Approach

- Patient relaxes quads.
- Examiner pushes patella medially
- Needle Position:
  - midway between superior and inferior pole of patella
  - Needle Horizontal



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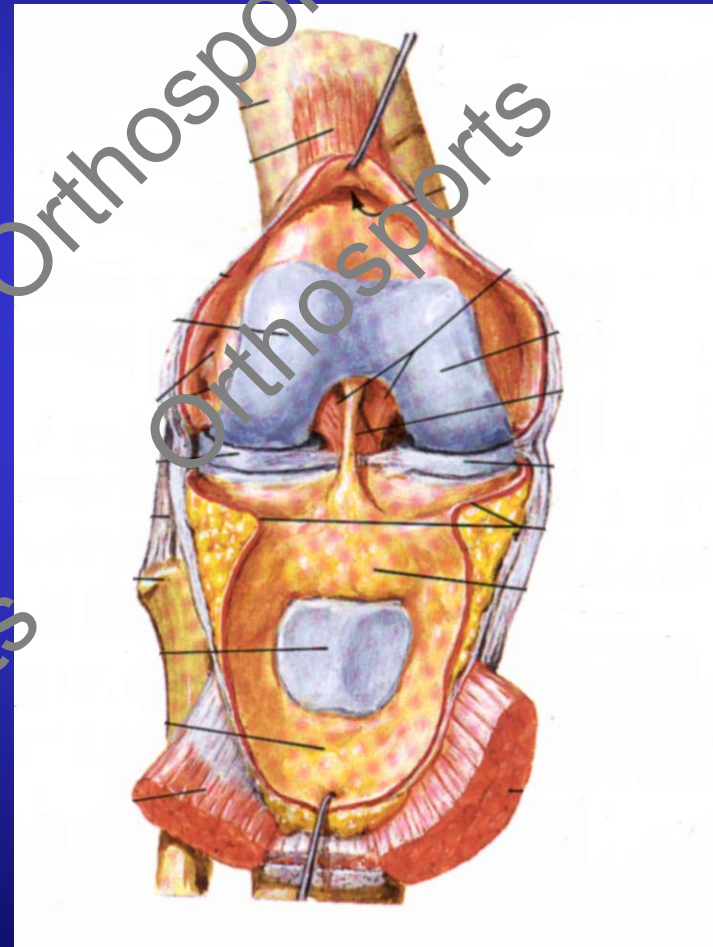
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# KNEE INJECTION:

## Flexed Medial Approach

- Target:
  - Intercondylar notch
- Landmarks:
  - Hollow along the joint line just medial to the patellar tendon



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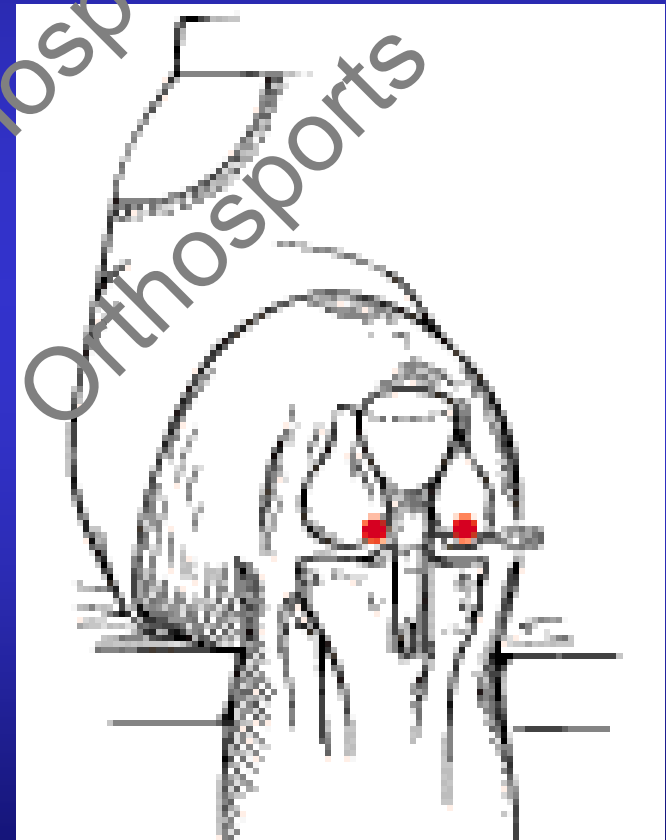
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# KNEE INJECTION:

## Flexed Medial Approach

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



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# Viscosupplementation

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



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# Viscosupplementation

- Helps jt distribute load and lubricate
- Antiinflammatory, nociceptive reduction
- Response variable
- More expensive than steroids



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# Synvisc

- 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



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# Synvisc

- Aspirate large effusions
- LA infiltration to find jt
- Avoid 'activity' for 48 hrs
- C/I 'known hypersensitivity'



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# 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.

Relationship between x-ray grade and overall response

	Medical x-ray grade	Number of Knees	% Better or Much Better
	I	68	91%
	II	138	80%
	III	180	76%
	IV	57	58%

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# 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)



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# 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



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# How does it work?

- Can be derived from
  - Muscle
  - Fat
  - Marrow
  - Blood
    - May need enhancement in the lab



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# 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



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# Does it 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



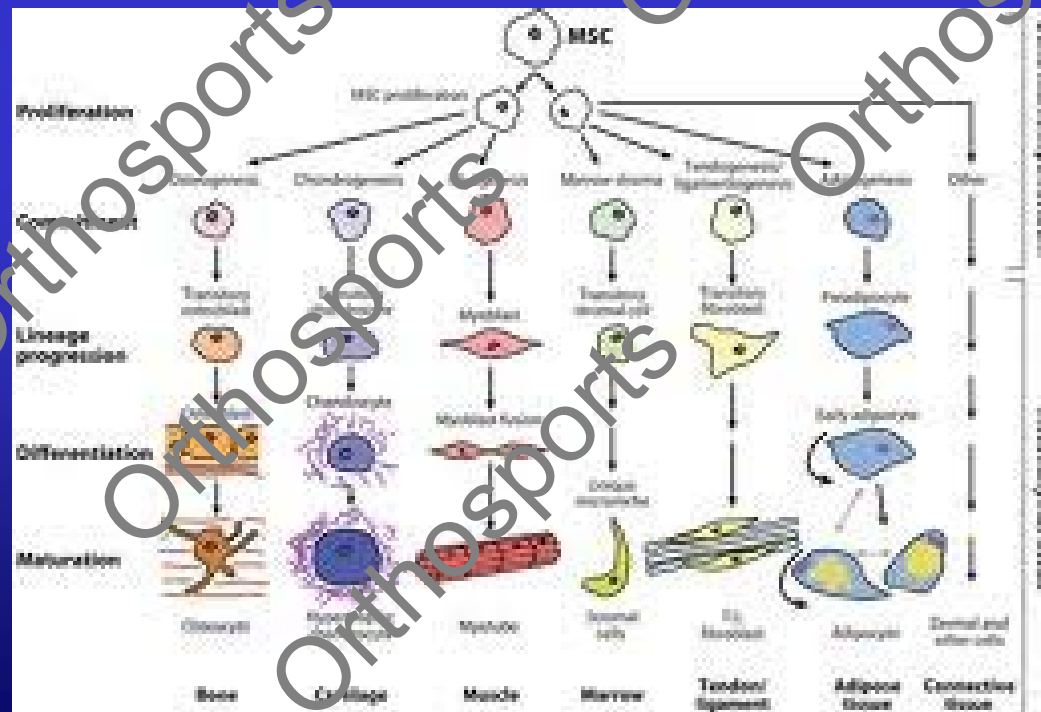
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# MSC

- Need to correct malalignment and instability
  - HTO
  - ACL reconstruction



Singer NG, Caplan AL. 2011.  
Annu. Rev. Pathol. Mech. Dis. 64:57-78



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# Can we stop the deterioration

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



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# Surgical

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



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# Arthroscopy

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



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# Experimental work

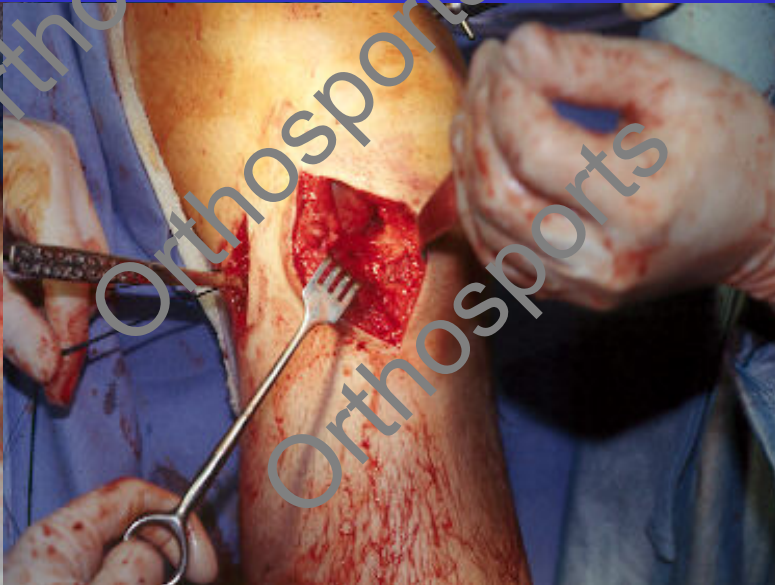
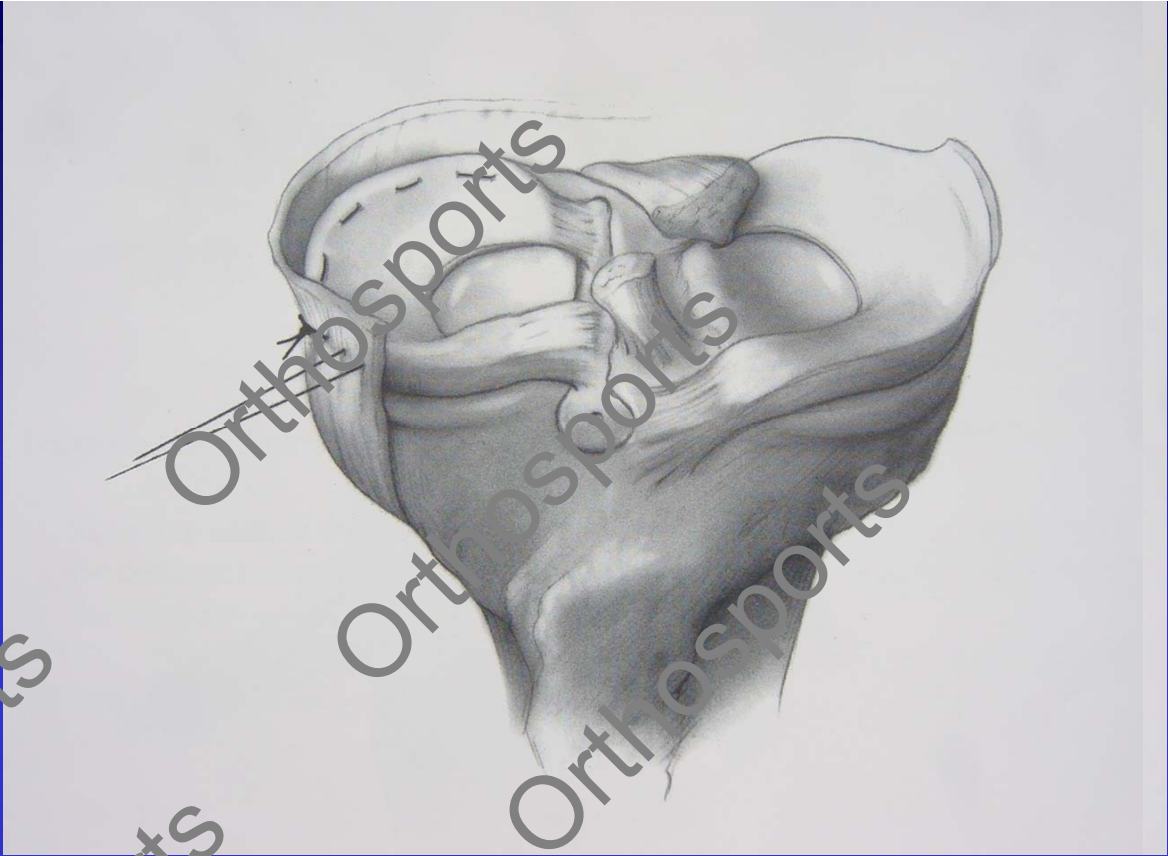
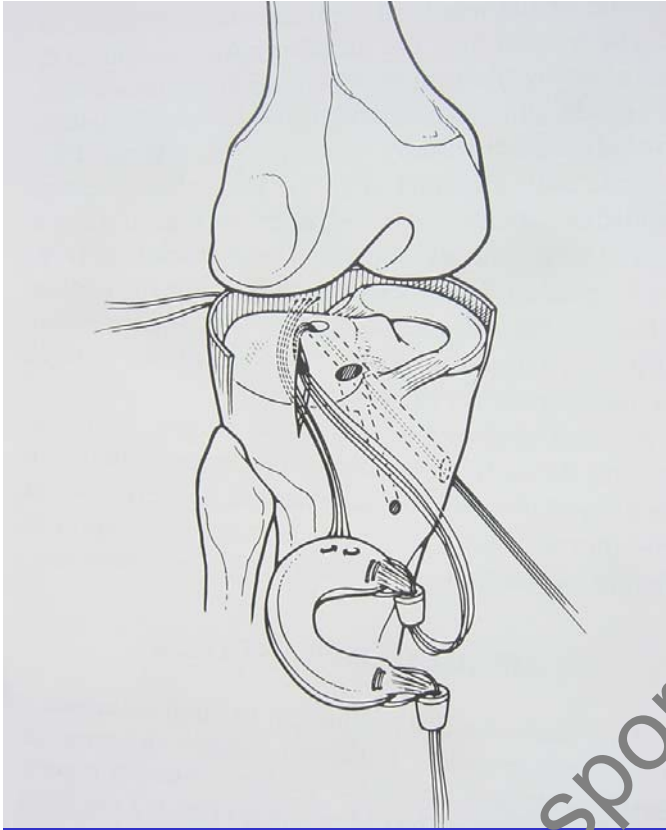
- Chondral grafting
- Meniscal transplants
- Spacers



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# Osteotomy

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



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# HTO

Some favourable results reported...

- 80% good results at 5 years
- 60% good results at 10 years

(Coventry)



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# Uni Knee

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



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# TKR

- Definitive treatment
- “high” complication rate
- Limited lifestyle afterwards
- Polyethylene wear



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# Preparing for TKR

- Bike
- Cross Trainer
- Boxing
- Swimming
- Paddling
- Rowing
- Hydrotherapy
- Grinder
- Table Tennis



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**Knee Arthritis  
Non Surgical Management**

# Knee Replacement is a good operation

- >95% success rate
- Cost effective
- Restores function
- Reduces burden on the community
- Lasting ~15yrs



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# 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

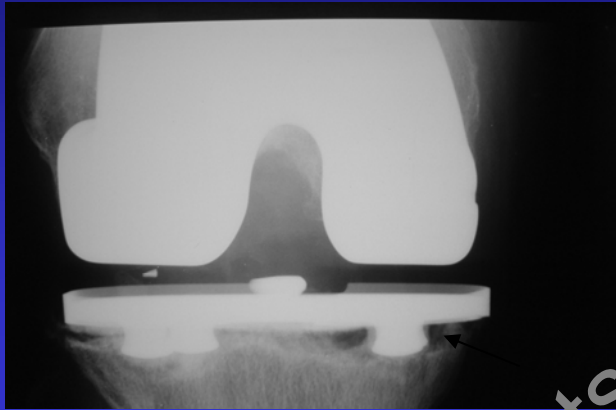


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# TKR Complications



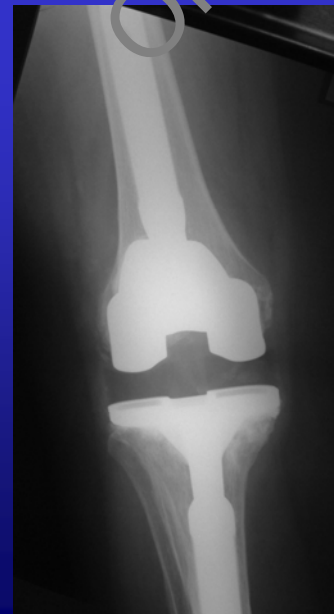
osteolysis



wear



instability



loss of bone stock



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# 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



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# Malalignment leads to increased failure of implants

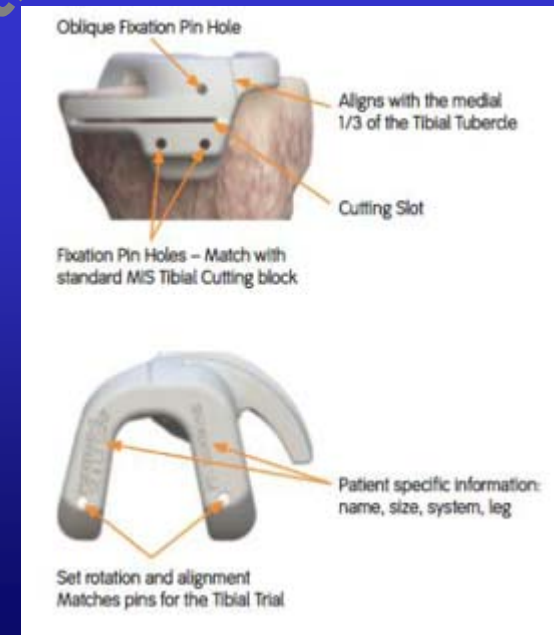
- Computer navigation helps with coronal alignment only
- Rotation very important for patella tracking
- Rotation, sizing and AP translation much better





# 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

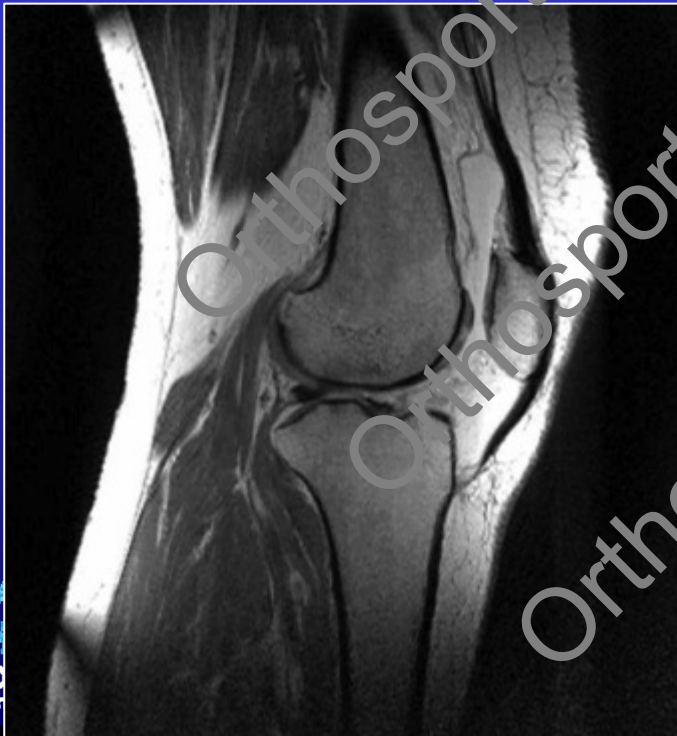
- MRI (or CT)
- Long leg alignment to reproduce mechanical axis
  - Morphology of the knee itself
- 3D computer model made by segmenting the scan
  - Gives patient anatomy
  - Landmark identification – same as those for any knee replacement



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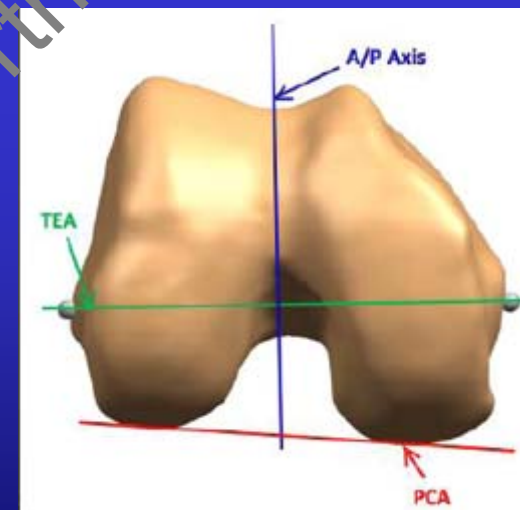
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Knee Arthritis  
Management

# 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









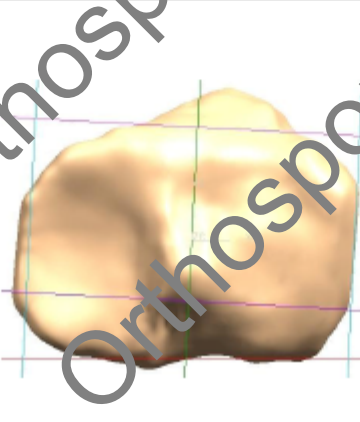

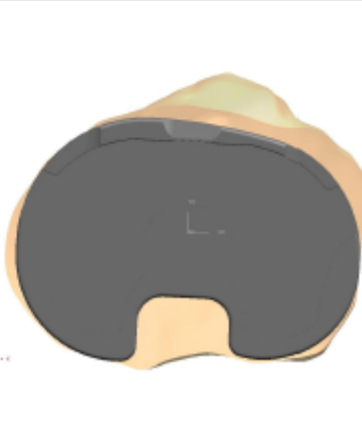
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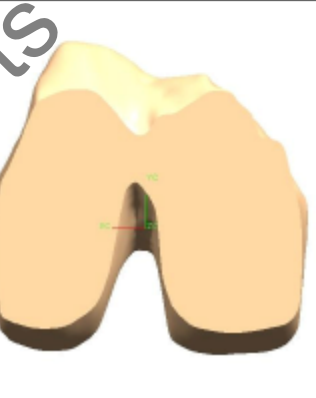

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## Tibia Alignment

<p>Lateral</p> <p>Proximal Resection:</p> <p>7.5 mm from Medial</p> <p>9 mm from Lateral</p> <p>Posterior Slope:</p> <p>3 deg</p>			
<p>Anterior</p> <p>Proximal Resection:</p> <p>7.5 mm from Medial</p> <p>9 mm from Lateral</p> <p>Tibia Varus/Valgus Deformity</p> <p>Mechanical Axis of Shaft</p> <p>WL Implant Width:</p> <p>Vertical Lines</p>			
<p>Proximal (90 deg flexion)</p> <p>Rotation:</p> <p>Medial 1/3 of Tibia Tuberde</p> <p>Proximal Resection:</p> <p>7.5 mm from Medial</p> <p>9 mm from Lateral</p> <p>WL Implant Width:</p> <p>Vertical Lines</p> <p>Posterior Implant Boundary</p> <p>Most Posterior Horizontal Lines</p>			

## Femur Alignment

<p><b>Lateral</b></p> <p>Distal Resection:</p> <ul style="list-style-type: none"> <li>10.5 mm from Medial</li> <li>9 mm from Lateral</li> <li>1 mm into Sulcus</li> </ul> <p>Posterior Resection:</p> <ul style="list-style-type: none"> <li>11 from Medial</li> <li>12 from Lateral</li> </ul> <p>Anterior Resection:</p> <p>Flush to Anterior Shaft</p>			
<p><b>Anterior</b></p> <p>Distal Resection:</p> <ul style="list-style-type: none"> <li>10.5 mm from Medial</li> <li>9 mm from Lateral</li> <li>1 mm into Sulcus</li> </ul> <p>Femur Valgus:</p> <p>Mechanical Axis-Coronal Plane</p> <p>WL Implant Width:</p> <p>Vertical Lines</p>			
<p><b>Distal (90 deg flexion)</b></p> <p>Rotation:</p> <p>AP Axis</p> <p>Posterior Resection:</p> <ul style="list-style-type: none"> <li>11 mm from Medial</li> <li>12 mm from Lateral</li> </ul> <p>WL Implant Width:</p> <p>Vertical Lines</p> <p>Implant Boundary</p> <p>Most Posterior Horizontal Lines</p>			

thrititis

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# Models Produced



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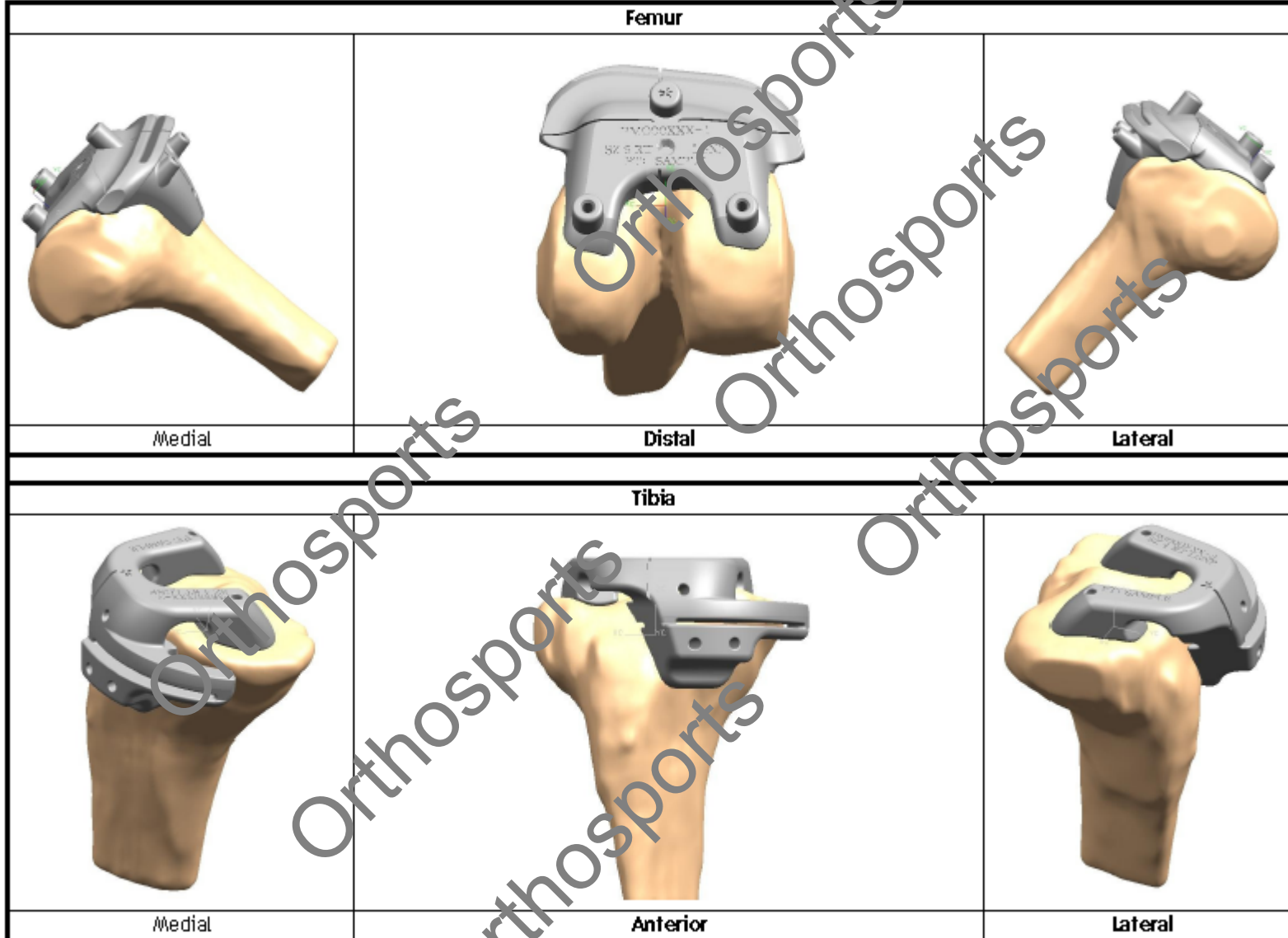
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### Visionaire Cutting Block Placement



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# Nylon blocks produced to fit the models



Final design manufactured



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# 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



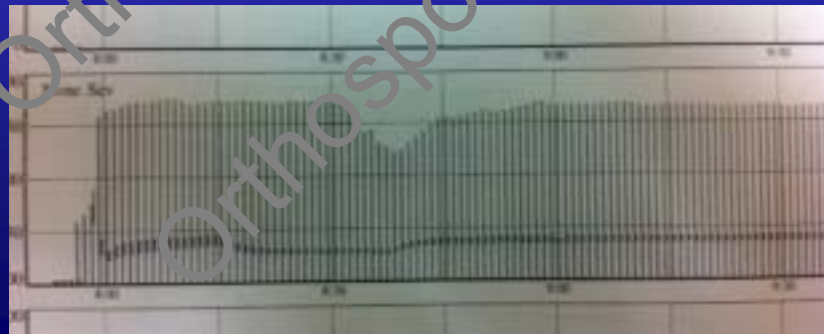
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# During the operation

- 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



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# 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



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Instrumentation designed to patient specific anatomical features and supplied sterile



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# 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



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# 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)



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# Pt Matched TKR Summary

- Exciting new technology
- Early results look great
- Room for improvement
- Should reduce complications significantly



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# Treatment Algorithm?

Conservative treatment



Arthroscopic debridement, microfracture, ?chondral resurfacing, ?meniscal replacement



HTO or Unicompartmental resurfacing



Total Knee Replacement...



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