ORTHOSPORTS

LATEST **ORTHOPAEDIC UPDATES** LECTURE 2011

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Time	Event	Who
07:30 – 08:00	Registration	
08:00 – 08:10	Welcome Message	Dr Doron Sher
	Diagnosing the painful shoulder	Dr Jerome Goldberg
	Subscapularis Tears	Dr Todd Gothelf
	The child with foot pain	Dr Rod Pattinson
	Disorders of the posterior tibial tendon	Dr John Negrine
09:15 – 09:35	Panel Discussion	Todd Gothelf, Jerome Goldberg, Ivan Popoff, John Negrine, Rod Pattinson
	The Lumbar Disc Prolapse: Who needs an operation	Dr Andreas Loefler
	Management of Radicular Pain	Dr Mel Cusi
	Management of Stress Fractures	Dr John Best
10:20 – 10:45	Panel discussion	Andreas Loefler, Mel Cusi, John Best
10:45 – 11:15	**Morning Tea**	
11.15 – 11.20	Email Questions	
	Hip Replacement – the choice of bearing surface	Dr Allen Turnbull
	Prevention of ACL injury	Dr Ivan Popoff
	Patient matched implants for total knee replacement	Dr Doron Sher
12.05 – 12.25	Panel Discussion	Allen Turnbull, Ivan Popoff, Doron Sher, John Best
12:40	Close	

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Thank you,
The Team at Orthosports

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PRESENTATIONS

AND

HANDOUTS

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DIAGNOSING SHOULDER PATHOLOGY AT THE FIRST CONSULTATION

HISTORY

- Age
- Hand dominance
- Occupation
- Sports/hobbies
- Medical history (esp DM)
- Previous shoulder problems/ops
- Mechanism of injury
    1. Fall onto outstretched arm
    2. Was arm forced into abd/ER
    3. Was arm forced into add/IR
- Pain location
    1. Night pain
    2. What precipitates pain
- Weakness
- Loss of motion
- Clicking
- Instability/dead arm

Beware of

- Rest pain
- Constant pain
- Neck/scapula pain
- Paraesthesia

START THINKING OF DIAGNOSIS

Under 30 years	30 to 50 yrs	Over 50 years
Impingement Instability	Impingement Biceps tendonitis Arthritis AC joint Calcific tendonitis	Rotator cuff tears Adhesive capsulitis Arthritis

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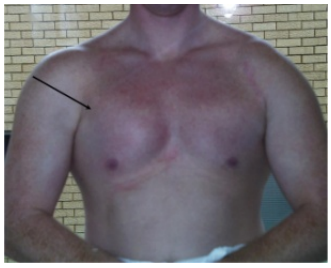
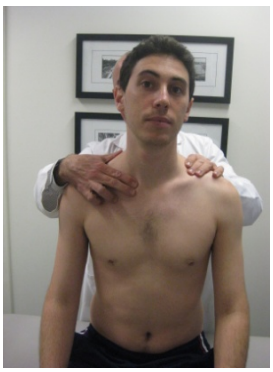
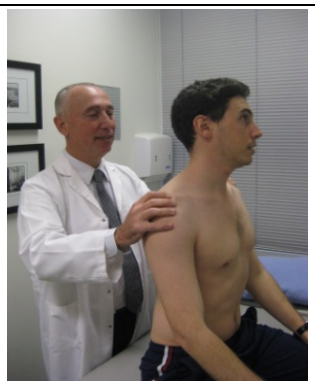
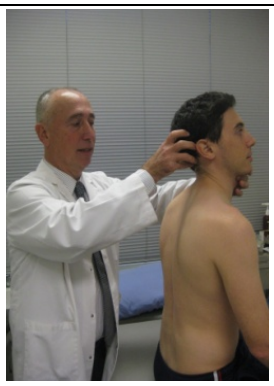
PRINCIPLE OF EXAMINATION LOOK – FEEL –MOVE

LOOK observe from front & back



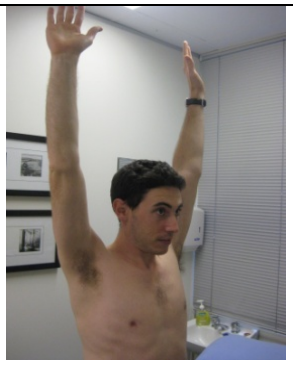
FEEL

SClav joint
Clavicle
AC joint
Coracoid process
Biceps
Greater tuberosity
Rotator cuff
Joint lines
Acromion/scap
Cervical spine

MOVE

Rhythm - anterior
Rhythm - posterior
Active Forward elevation
Passive forward elevation
Passive E.R.
Passive I.R.
Abduction

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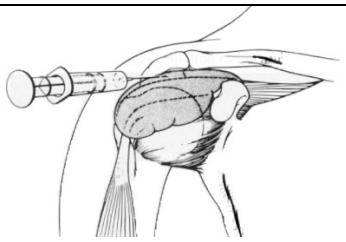
POWER

E.R
I.R.

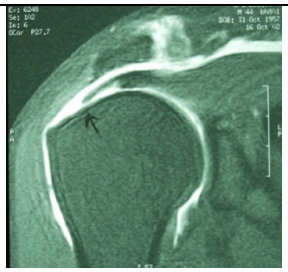
SPECIAL TESTS

impingement adduction Speed's test O'Brien's test Biceps lift Anterior apprehension Posterior apprehension Anterior relocation Posterior relocation Sulcus sign Belly press/lift off Dynamic SLAP Generalised lig laxity Adson's test		

INJECTION TESTS

Subacromial space AC joint Biceps sheath GH joint	

INVESTIGATIONS

Plain xrays Ultrasounds CT scans MR arthrogram	

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The Subscapularis Tear: Relevance and Rationale for Repair

In discussing rotator cuff tears, reference is usually made to tears of the supraspinatus and infraspinatus. These tears, also known as posterosuperior rotato cuff tears, are far more common and the symptoms and functional deficits have been well described. Subscapularis tears are far less common, with reports that they account for 8% of all rotator cuff tears.

Upper subscapularis tears can be difficult to recognize, as physical examination and investigations, including MRI are often negative. Arthroscopy has allowed for a greater recognition of this pathology. A recent study found that 30% of rotator cuff tears had upper subscapularis tears, demonstrating that these lesions are present far more commonly than previously thought.

We know that subscapularis tears can lead to pain, loss of function and weakness of internal rotation and possibly overhead function. In the long term, dynamic anterior instability can lead to the development of glenohumeral arthritis.

ANATOMY

The rotator cuff has a very important functional portion, described as a cable. The cable runs from the infraspinatus to the upper subscapularis. Tears of the supraspinatus that do not involve this cable do not result in loss of function of the shoulder. Tears within the cable will result in loss of function and weakness of the shoulder.

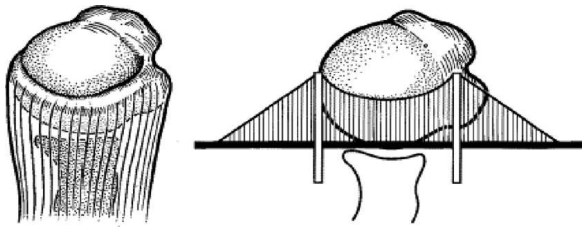

Figure 1: Cable of the Rotator Cuff acts like a suspension bridge. The two attachments are vital to function of the rotator cuff. *

The upper subscapularis inserts onto the lessor tuberosity and forms the anterior portion of the cable described above. Thus, any detachment of the upper subscapularis will result in loss of function of the rotator cuff. Tears of the rotator cuff that extend into this portion are known as anterosuperior tears.

A biomechanical study looked at upper subscapularis tears and demonstrated that a tear in the anterior cable resulted in increased anterosuperior movement with force applied, proving that disruption of this important cable results in loss of function.

PHYSICAL EXAMINATION

Physical examination tests have been described to identify subscapularis tears. Becoming familiar with these tests will allow for recognition, which can lead to early treatment and a better result for the patient. The following tests can be used:

Bear Hug Test- This is the most sensitive test, as it tests the upper subscapularis tendon, which is the portion that usually tears first. The palm of the affected arm is placed on the opposite shoulder with the wrist straight. The examiner places his hand below the patients and asks the patient to resist pulling the hand off of the shoulder. A positive test occurs when the patient is unable to resist the examiner's force.

Lift-off Test- The affected hand is placed on the lower back, thus internally rotating the arm. The patient is asked to lift the arm from the lower back without extending the elbow. The test is positive if the patient is unable to lift the arm from the back.

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Belly-press Test- This test can be done if the patient is obese or pain does not allow the lift-off tests to be performed. The affected palm is placed on the belly and the patient is asked to push inward toward the belly against the examiners resistance. Lack of strength with internal rotation results in a positive test.

Napolean Sign- This test, well-described by Burkhart, is the same as the belly-press test, except that the elbow and wrist are observed to note their position. The patient is asked to press on the belly while keeping the wrist straight and elbow out. If the subscapularis is not functioning, the patient will bend their wrist and bring the elbow back to engage the posterior deltoid to push into the belly. The position of the arm resembles that of Napolean as seen in his potraits. The test is positive if the wrist bends, and can be graded I-III to indicate the extent of the tear.

INVESTIGATIONS:

MR arthrogram is the most sensitive test to identify a subscapularis tear. A complete tear can be well recognised. However, tears that involve only the upper half of the subscapularis can be missed on MRI, making this test unreliable to identify these more common upper ½ tears.

Arthroscopic examination currently remains the most important way to identify an upper subscapularis tear.

An upper subscapularis tear is often part of a larger anterosuperior tear, involving the supraspinatus as well. Since the upper subscapularis tear involves the anterior cable of the rotator cuff, repairing the upper subscapularis is important for two important reasons: 1) This will restore anatomy and function of the anterior cable and secure the anterior part of the tear. If left unrepaired, the retracted subscapularis will pull on the repaired supraspinatus and risk re-rupture. 2) It will bring the posterior cuff tear more laterally resulting in an easier repair of the supraspinatus with less tension.

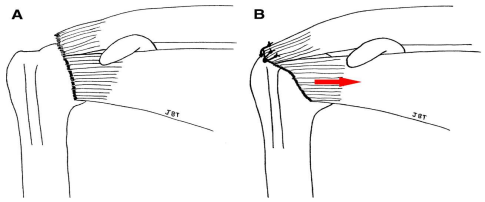

Figure 2: Repair of only the suprasinatus leaves an unrepaired subscapularis, resulting in an increased force on the repair and a greater likelihood of a re-rupture*

Studies that have addressed repair of isolated subscapularis tears have described high percentages of good and excellent results. Without treatment, a ruptured subscapularis leads to pain, loss of function and weakness. In the long term, dynamic anterior instability can lead to the development of glenohumeral arthritis.

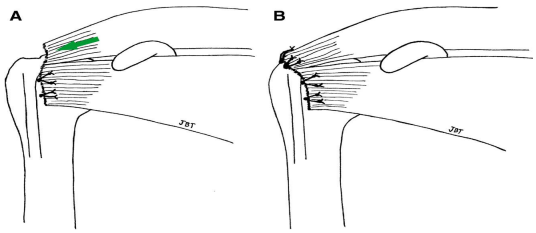

Figure 3: Subscapularis is repaired, restoring anatomy and taking tension off of repaired supraspinatus*

I recommend an arthroscopic repair of all acute subscapularis repairs in young patients, and I will do these repairs as soon as possible to maximize outcomes. Repairs of tears that are more chronic and tears in older patients will be based on function. Usually I will repair an upper subscapularis tear that is associated with a supraspinatus tear for reasons described above. Tears that are irreparable can be treated by either debridement and biceps tenotomy or by a pectoralis major transfer.

* Images obtained from recommended literature 1. And 2. below.

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Recommended Literature:

1. Ticker JB, Burkhart SS. Why Repair the Subscapularis? A Logical Rationale. Arthroscopy 2011; 8:1123-1128.
2. Burkhart SS, Esch JC, Jolson RS. The Rotator Crescent and Rotator Cable: An Anatomic Description of the Shoulder's "Suspension Bridge". Arthroscopy 1993;9:611-616.
3. Su WR, Budoff JE, Luo ZP. The Effect of Anterosuperior Rotator Cuff Tears on Glenohumeral Translation. Arthroscopy 2009; 3:282-289.
4. Lafosse L, Jost B, Reiland Y, Audebert S, Toussaint B, Gobezie R. Structural Integrity and Clinical Outcomes After Arthroscopic Repair of Isolated Subscapularis Tears. J Bone Joint Surg Am. 2007;89:1184-93.
5. Kreuz PC, Erggelet C, et al. Isolated and Combined Tears of the Subscapularis Tendon. Am J Sports Med, 2005 33: 1831.

NOTES |

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The Child with a Sore Foot

Sesamoiditis
Activity related pain with tenderness beneath the 1st metatarsophalangeal joint.
Orthotic moulded to transfer stress more proximally and unload the sesamoids during weight bearing.

Freiburg's Infraction
Idiopathic avascular necrosis of the 2nd metatarsal head with painful irritable and swollen 2nd metatarsophalangeal joint.
Orthotic to transfer stress away from the painful joint more proximally under the metatarsal necks.

Stress Fracture
Pain and swelling with point tenderness in the forefoot associated with a change in activity level.
Destress the affected bone, protected weight bearing, crutches, camwalker/aircast.

Hallux valgus
Parental concerns are universal but the child is usually asymptomatic and surgery is not indicated for children and adolescents with hallux valgus.
Appropriate shoe wear advice.

Kohler's Disease
Limp, pain and tenderness with swelling at the navicular.
Idiopathic avascular necrosis of the navicular, typically 5 y.o.'s.
Short leg walking cast for 6 weeks, outlook excellent.

Accessory navicular
Accessory ossicle within the attachment of tibialis posterior to the medial aspect of the navicular.
May have a cartilaginous synchondrosis between the accessory bone and body of the navicular causing pain when irritated.
Recommend destressing the tibialis posterior with the use of a moulded medial arch support- "orthaheel'' sports orthotics.

Apophysitis
Base of fifth metatarsal at insertion peroneus brevis to the apophyseal growth plate.
Pain with activity, tenderness.
Local measures, ice, activity modification and shoe wear advice/"orthaheel"" orthotic.

Tarsal Coalition
Failure of complete separation of the cartilage models to form joints between tarsal bones.
The joints most commonly affected are the talo-navicular and talo-calcaneal joints.
Pain, stiffness and peroneal muscle spasm with restricted motion in the subtalar joint.
Immobilization may lead symptoms to resolve and some patients come to surgical resection of the coalition.

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Heel pain
10 y.o. soccer players, extremely common, overuse apophysitis at attachment Achilles tendon.
Ice, stretches, sorbothane heel pad to destress the growth plate.

Os Trigonum
Posterior ankle pain, soccer players, positive impingement sign in plantar flexion.
Commonly hot on bone scan.
Excision of the os trigonum can be curative.

Flat feet
All infants have a fat, flat foot due to ligamentous flexibility.

Stiff flat foot
Restricted motion and muscle spasm with pain are indicative of a pathological process.

Toddlers Fracture
Typically a 2 y.o. whose accident may or may not have been witnessed who won't walk.
Look for swelling and tenderness/ increased warmth in the tibia.
X-rays may be inconclusive. Short leg cast 4-6 weeks, may weight bear when able.

NOTES |

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Tibialis posterior tendon deficiency

A fifty year old lady presents with pain and swelling behind and distal to the medial malleolus with no history of trauma. The pain is often worse first thing in the morning and over some months she has noticed her foot flattening. What is the most likely cause?

Tibialis posterior tendon deficiency (also known as adult acquired flat foot) is a mainly a condition of middle aged females. The risk factors are obesity, hypertension, diabetes, female sex and age 40 – 60. The condition can however occur at any age.

Unfortunately with 20% of Australians now classified as overweight or obese the condition is becoming far more common.

The tibialis posterior is a strong tendon with a short excursion. It is opposed by peroneus brevis. Weakness results in flattening of the medial longitudinal arch. The medial restraints become attenuated. Valgus of the hindfoot results in the Achilles tendon becoming a deforming force.

Aetiology: There is a vascular watershed behind the medial malleolus but most tears are distal. Most tears are a degenerate tendinosis (figure 1) probably overload related. Also important are an accessory navicular and congenital pes planus. Inflammatory arthropathy can also cause the condition.

Clinical presentation: Most commonly an insidious onset of pain and swelling. Start-up pain is typical. Many patients can recall a traumatic event. As the arch collapses the pain becomes more lateral as impingement occurs between the calcaneus/fibular and sinus tarsi. In the later stages the pain becomes more generalised.

Physical examination: Look for swelling over the tendon. When viewed from behind the “too many toes” sign (figure 2) indicates valgus of the hindfoot and abduction of the forefoot giving the appearance of more toes viewed laterally. Next the patient should be asked to single stance weight-bear. In the advanced stages the patients are unable to do so. In the early stages the heel will fail to invert. In longstanding deformity there is a compensatory forefoot supination and the deformity becomes fixed.

Imaging: In general it is a clinical diagnosis. All patients get weightbearing AP/lateral ankle as well as AP/ IR oblique foot x-rays. If accessory navicular is suspected get an external rotation oblique foot x-ray. Bone scan/ultrasound have been largely superseded by MRI which does unearth an occasional surprise (arthropathy)

Natural history is variable so that most of my patients get a trial of non-surgical treatment.

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Treatment (Non-surgical): Rest the tendon using a removable walking boot. An arch support is not as effective as a UCBL (university of California Biomechanics Lab) heel cup. An ankle foot orthosis or an ankle brace (figure 3) is more effective still. Weight-loss though difficult to achieve at this time is very important to strive for.

Surgical treatment: Direct repair of the tendon is rarely possible, perhaps only when a small tear is present with no deformity. Tenosynovectomy may be possible in inflammatory arthropathy. Most patients present with a flexible rather than a fixed deformity and are amenable to a reconstructive procedure rather than an arthrodesis. In general a transfer of flexor digitorum longus to the navicular accompanied by a medialising calcaneal osteotomy (figure 4) is the mainstay of treatment. It is an effective solution though is associated with along convalescence (6 weeks in plaster non weight-bearing plus 4 weeks in a walking boot).

For fixed deformity triple arthrodesis (subtalar, talo-navicular and calcaneo-cuboid joints) is the recommended treatment. When the above deformity includes ankle arthritis correction can be very challenging and no perfect solution currently exists.

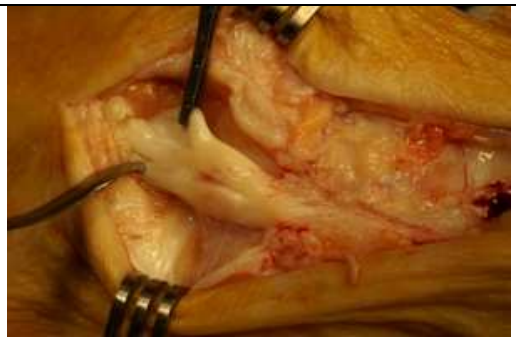

Figure 1 Tibialis posterior tendon at surgery torn and disrupted

Figure 2 “too many toes sign”

Figure 3 Protech ankle brace

Figure 4 osteotomy of calcaneus with temporary subtalar stabilization implant

NOTES |

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Lumbar Disc Prolapse: Who Needs an Operation

Lumbar disc lesions are very common. Most patients do not need surgery. Many do not need any treatment at all. They may modify their activity and pain settles within a few weeks.

Pathophysiology: Under increased pressure the soft Nucleus Pulposus is forced against or through the elastic layers of the Annulus Fibrosus. The disc become prominent and protrudes into the epidural canal, compressing or stretching the traversing nerve roots.
A number of terms are commonly used, such as bulge, herniation, protrusion, rupture and sequestration. These terms are not scientific, and pain is not proportional to the size of a disc lesion. A sequestrum is a piece of disc material, which lies freely in the epidural canal, and usually causes more pain.
A disc prolapse may cause direct pressure on a nerve or it may set up an inflammatory reaction. Compression of a lower motor neuron leads to numbness, such as when hitting ones ulnar nerve at the elbow or in Carpal Tunnel Syndrome. The inflammatory response is thought to cause the constant radicular pain, like a toothache in the leg. There is often a postural component, which may exacerbate pain in the back or the leg.

Diagnosis: Some patients recall an incident, but many are not sure how they were injured or why they have pain. Many have an episode of back pain, which precedes their leg pain. Some have only buttock or thigh pain and others have typical sciatica radiating to the foot. A good history one can suggest a disc lesion. The examination may confirm nerve root signs.
Most patients present with pain. They may be unable to sit, have a sciatic list and a limited range of motion. There may be weakness or absence of a reflex, weakness of a muscle group and positive nerve root tension signs. Coughing and sneezing often exacerbates pain. A few patients are unable to stand or walk. In very few cases they may be weak or incontinent. Such patients usually present to hospital. Persistent or recurrent symptoms may also lead to wasting and there may be sensory changes in a nerve root distribution.

Investigations: Scans are needed if there is doubt about the diagnosis or if invasive treatments, such as injections or surgery are contemplated. Many patients do not need a scan and can be managed with reassurance. The MRI is the investigation of choice. A CT scan, which is more readily available, usually shows the disc prolapse and may suffice to make the diagnosis. Nerve conduction studies are rarely indicated in the acute setting. Plain x-rays are of little help.

Treatment: Most patients feel better once they understand their pain. They need a short period of rest, some activity modifications and analgesia. They should avoid postures and activities, which cause pain. Impact sports or bending and lifting should be reduced. Patients need to know that it may take several weeks to improve.

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Hospitalization is rarely required. Traction may be no better than simple rest. Heat packs and gentle massage help to sooth spasms, which often result from persistent and sharp pain. Simple analgesia and anti-inflammatory medications help with pain. Patients should stay cautiously active and should be reviewed regularly. Most patients will improve.

A few patients have severe pain and do not respond to analgesics. If it is too early to contemplate surgery, they may benefit from a cortisone injection. This should be done by a radiologist under CT guidance. The efficacy of injections has been studied and may not be as good as patients and doctors hope. Injections are quite expensive. TENS is rarely indicated in the acute setting.

Who needs an Operation: A rare surgical emergency is the Cauda Equina Syndrome, whereby compression of the sacral nerve roots leads to perineal numbness and loss of bladder and bowel control. This requires urgent surgery. Some patients have very severe pain, which they are unable to tolerate, and surgery gives early pain relief. A few patients have progressive weakness. If this is accompanied by pain, early surgery may also be indicated.

Most patients should wait at least 6 weeks or longer, before surgery should be considered. If leg pain persists and is sufficiently severe, the patient will ask to have an operation. Some patients improve, but continue to have pain for months. They learn to compromise at home, at work and with sports. If repeat imaging shows a persistent disc prolapse, which matches the symptoms, late surgery, can often help.

Some patients are unable to work with pain, but cannot afford time off. Some have plans to travel or other reasons, why they may wish to have surgery. If patients are fully informed, they may opt for early surgery. If well selected, a discectomy is an excellent operation.

Who should not have Surgery: Patients who do not have a clear diagnosis, those without a matching disc prolapse on the scan, some with chronic pain, or those with more severe spinal conditions, like spondylolisthesis or scoliosis, are unlikely to benefit from a discectomy. They may need other treatments.

Results of surgery: Studies have shown that surgery gives early relief of pain. At one year, outcomes were better in the surgical group. On the long-term, however, the difference between surgical and non-surgical treatments diminishes. In either group there is a 5-10% chance of recurrence. For patients, who have a lumbar disc prolapse and ongoing pain, a discectomy is an excellent operation with small risks and a speedy recovery.

References:
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NOTES |

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ORTHOSPORTS

Management of radicular pain

A. BACKGROUND

1. Names and concepts
   a) Radicular pain is pain over an area supplied by a nerve root, due to impingement or inflammation. It is not a diagnosis, but a SYMPTOM only
   b) Radiculopathy refers to nerve root impingement or inflammation that produces neuralgic symptoms in the area supplied by the affected nerve root. It can produce pain / paraesthesiae / loss of power / loss of reflexes

2. Structures capable of causing radicular symptoms
   a) the sinuvertebral nerve, that supplies
      - posterior longitudinal ligament
      - superficial annulus fibrosus
      - epidural blood vessels
      - dural sleeve
      - posterior vertebral peiostium
   b) the nerve root, usually impinged or inflamed by an intervertebral disc hernia

3. Mechanisms of pain
   a) Direct toxic effect of disc material in the epidural space
   b) Inflammation of a nerve is mediated by a number of chemical substqances:
      - Phospholipase A (high concentration in herniated discs
      - Nitric oxide (in the nucleus pulposus)
      - Prostaglandin E (" ")
      - Leukotrienes (nocioceptive stimulation role)
      - Thromboxane B2 (" ")

B. EPIDEMIOLOGY

4. General
   It occurs in 3 - 5% of the general population
   More frequent in males in their 40's
   More frequent in females in their 50'2
   In 10 - 25% of cases symptoms last longer than 6 weeks

5. Sporting population
   Frequent in sporting activities that combine spinal flexion/extension with rotation

Dancers / gymnasts	Baseball pitchers
Golfers	Weightlifters
Cricket fast bowlers	Rugby union backrowers

C. DIAGNOSIS

6. Radicular pain is not a diagnosis: only a descriptive symptom
   Diagnosis of Radiculopathy is made on the basis of
   a) History
      - Usually acute, with lower back pain radiating to buttocks and lower limb
      - Made worse by flexion movements, sneezing and coughing
      - Beware of unusual symptoms: weight loss, fever, chills point to something else
      - Referred pain from L1-3 nerve roots does not reach the knee
      - Beware of *cauda equina* syndrome (surgical emergency)

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b) Clinical examination
- Neurological assessment: reflexes, power, sensation
- Distribution of pain is a poor indicator of the level of pathology

c) Investigations
- X-rays. Useful to exclude organic bony pathology. Not as a routine
- CT scan. Good to assess bone and also disc hernias
- MRI. Best modality to assess soft tissues. However, many image findings are also present in normal populations

7. Differential Diagnosis

a) Disc protrusion/extrusion (nerve root compression or irritation). In most cases (95%) it is L4/5 or L5/S1. In higher levels -L1 to L3 (5%) pain over groin, anterior thigh above knee
b) Hip pathology (similar pain distribution to L1-2 Dermatome)
c) Trochanteric bursitis (Lateral buttock and thigh pain)
d) SIJ incompetence (Posterolateral thigh, posterior calf)
e) Facet joint pain is usually low back, not radicular in distribution

D. MANAGEMENT

Initial treatment depends on the diagnosis, and more importantly the cause of symptoms

8. Disc protrusion causing nerve root irritation / compression initial management

a) Analgesia. Regular, not prn
b) Antiinflammatories. Oral NSAIDS, periradicular cortisone early (1st week) to reduce oedema locally and theoretically reduce the protruding volume
c) maintain physical activity as much as possible (ADLs)
d) Extension exercises (McKenzie programme)

9. For how long?

a) As long as there is improvement, for up to three months
b) If progress is not adequate, or symptoms increase, decompressive surgery
- Usually discectomy +/- laminotomy +/- rhyzolysis of the nerve root
- Microdiscectomy means augmentation of vision (loupes) NOT a small discectomy!
- 10% recurrence rate at least
- Long term results similar to conservative management

10. Aspects of Rehabilitation

a) Make patient self-sufficient, independent of medication and health practitioners
b) Prevention of recurrences
- General fitness
- Lumbopelvic stability
- Manual handling and postural training

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Management of Stress Fractures

Stress fractures should be considered as fatigue (overload) or insufficiency fractures (load with poor bone health). Most authors suggest that stress fractures are a continuum commencing with bone strain to fracture formation. Stress fractures should be seen separately from other causes of bone failure such as pathological fractures with malignancy or other insufficiency fractures related to poor bone health. There is an overlap with the latter.

Silent Stress Reaction ↔ Stress Reaction ↔ Stress Fracture (Grade)

Stress fractures occur over time, generally weeks or months. A further confusing feature relates to MRI imaging and the finding of bone marrow oedema, which may be painful. This may occur in an acute or sub-acute setting. It may occur due to sudden impact and is often seen in large weight bearing joints (hip / knee/ ankle) if there articular cartilage pathology.

Epidemiology

Studies vary on describing the prevalence of stress fractures. Stress fractures:

- comprise 5-10% of all sports injuries, occurring in the lower limb in 95% of cases;
- cause 25% of exercise-induced leg pain;
- are proportionally more common in female sports participants;
- in runners - 34% occur in the tibia, 24% fibula and 18% metatarsal;
- neck of femur stress fractures appear to be increasing;
- are related to
  - training errors – running volume, rapid load increase, hard surface;
  - poor footwear, poor biomechanics and muscle imbalances;
  - technical changes in sport – eg bowling technique in cricket
  - poor bone health (see below)
- osteopenia (poor bone health) may occur with
  - menstrual and hormonal irregularity;
  - diabetes and thyroid disease;
  - smoking and alcohol intake;
  - medications such as oral cortisone
  - genetic predisposition; and
  - age - in males and females.

Diagnosis

In all clinical cases the diagnosis is through clinical assessment – history, examination and appropriate investigations. When obtaining a history, the risk factors for the stress fracture should be noted. These risk factors should be addressed and either reduced or eliminated to avoid a recurrence of the injury. Point tenderness and pain on impact is common.
Plain radiology (x-rays) show a stress fracture in up to 10% of patients at the most. In the tibia this may be seen as a periosteal reaction and should be differentiated from other pathologies such as an osteoid osteoma and bone infection. Radionuclide Examination (bone scans) are highly accurate, detecting a stress fracture within a day of pain development in 95% of patients. They are time consuming, costly and expose the individual to radiation.

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MRI scans are accurate after 72 hours of pain. They do not expose the patient to radiation. They are not ideal to assess recovery (this is best done clinically). CT scans are helpful in areas where the extent of the fracture or malalignment needs clarification (eg neck of femur, pars interaticualris in the lumbar spine).

Once the assessment is completed, the stress fracture should be graded.

Grade	Clinical and Radiological Features
1 Mild	Post exercise pain only. No medications used. Minor radiological changes.
2 Moderate	Pain during exercise. Possible antalgic gait with exercise. Unicortical features on MRI/Bone Scan.
3 Severe	Pain walking. Unable to perform weight bearing sport. Possible transcortical imaging findings with x-ray changes also.
4 Advanced	Rest pain; possible night pain. Using regular medications. Using walking aids. ?Surgical opinion

Management – this is multidimensional

- Managing bone health[1]-[2]
- Accelerating fracture healing – bone stimulation
- Return to sport[3]

On impact, the load of body weight is transmitted down the lower extremities and may exceed 3-5 times the body weight in certain regions. Recovery is in phases:

- Acute Phase – Weeks 1 and 2.
- Recovering Phase – Weeks 3 onwards
- Return to Sport Phase – Weeks 8-12 onward

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[1] Med Sci Sports Exerc. 2011 May 4. [Epub ahead of print] Bone Quality and Muscle Strength in Female Athletes with Lower Limb Stress Fractures. Schnackenburg KE, Macdonald HM, Ferber R, Wiley JP, Boyd SK.

[2] J Arthroplasty. 2009 Feb;24(2):322.e1-4. Epub 2008 Apr 10. Spontaneous bilateral femoral neck fractures associated with a low serum level of vitamin D in a young adult. Nagao S, Ito K, Nakamura I.

[3] Clinics in Sports Medicine. 2006 Jan 25 (1) :17-28 Classification and Return to Play Considerations for Stress Fractures. Diehl J.J et al

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HIP REPLACEMENT THE CHOICE OF BEARING SURFACE

To view Dr Turnbull's presentation and handout please refer to the Teaching Section of our website

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Prevention of ACL Injury

The Santa Monica Sports Medicine Research Foundation
The PEP Program: Prevent injury and Enhance Performance

This prevention program consists of a warm up, stretching, strengthening, plyometrics, and sport specific agilities to address potential deficits in the strength and coordination of the stabilizing muscles around the knee joint. It is important to use proper technique during all of the exercises. The coaches and trainers need to emphasize correct posture, straight up and down jumps without excessive side-to- side movement, and reinforce soft landings. This program should be completed 3 times a week. If you are using this program with athletes that are twelve or under, please perform the plyometrics over a visual line on the field or a flat 2" cone and land each jump with two feet. Do not perform single leg plyometrics with young individuals until they demonsrate substantial control. (see addendum) The field should be set up 10 minutes prior to the warm-up. This will allow for a smooth transition between the activities.

This program should take approximately 15 -20 minutes to complete. However, when you first begin the program, it may take slightly longer due to the fact that you must first become well acquainted with the program and the transitions. Along side each exercise you will notice a box with the approximate amount of time that should be spent on each activity. This will serve as a guideline to you in order to conduct your warm-up in a time efficient manner.

Section I: Warm –up

Warming up and cooling down are a critical part of a training program. The purpose of the warm-up section is to allow the athlete to prepare for activity. By warming up your muscles first, you greatly reduce the risk of injury.

A. Jog line to line (cone to cone): Elapsed Time: 0 - .5 minute
Purpose: Allows the athletes to slowly prepare themselves for the training session while minimizing the risk for injury. Educate athletes on good running technique; keep the hip/knee/ankle in straight alignment without the knee caving in or the feet whipping out to the side. Instruction: Complete a slow jog from near to far sideline

B. Shuttle Run (side to side) Elapsed Time: .5 to 1 minute
Purpose: engage hip muscles (inner and outer thigh). This exercise will promote increased speed. Discourage inward caving of the knee joint.
Instruction: Start is an athletic stance with a slight bend at the knee. Leading with the right foot, sidestep pushing off with the left foot (back leg). When you drive off with the back leg, be sure the hip/knee/ankle are in a straight line. Switch sides at half field.

C. Backward Running Elapsed Time: 1 – 1.5 minutes
Purpose: continued warm-up; engage hip extensors/hamstrings. Make sure the athlete lands on her toes. Be sure to watch for locking of the knee joint. As the athlete brings her foot back, make sure she maintains a slight bend to the knee.
Instruction: Run backwards from sideline to sideline. Land on your toes without extending the knee. Stay on your toes and keep the knees slightly bent at all times.

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Section II: Strengthening

This portion of the program focuses on increasing leg strength. This will lead to increased leg strength and a more stable knee joint. Technique is everything; close attention must be paid to the performance of these exercises in order to avoid injury.

A. Walking Lunges (1 minute) Elapsed Time: 1.5 – 2.5 min
Purpose: Strengthen the thigh (quadriceps) muscle.
Instruction. Lunge forward leading with your right leg. Push off with your right leg and lunge forward with your left leg. Drop the back knee straight down. Make sure that your keep your front knee over your ankle. Control the motion and try to avoid you front knee from caving inward. If you can't see your toes on your leading leg, you are doing the exercise incorrectly.

B. Russian Hamstring (1 minute) Elapsed Time: 2.5 –3.5 min
Purpose: Strengthen hamstrings muscles
Instruction: Kneel on the ground with hands at your side. Have a partner hold firmly at your ankles. With a straight back, lead forward leading with your hips. Your knee, hip and shoulder should be in a straight line as you lean toward the ground. Do not bend at the waist. You should feel the hamstrings in the back of your thigh working. Repeat the exercise for 30 seconds and switch with your partner.

C. Single Toe Raises (1 minute) Elapsed Time: 3.5 – 4.5 min
Purpose: This exercise strengthens the calf muscle and increases balance.
Instruction: Stand up with your arms at your side. Bend the left knee up and maintain your balance. Slowly rise up on your right toes with good balance. You may hold your arms out ahead of you in order to help. Slowly repeat 30 times and switch to the other side. As you get stronger, you may need to add additional repetitions to this exercise to continue the strengthening effect of the exercise.

Section III: Plyometrics

These exercises are explosive and help to build, power, strength and speed. The most important element when considering performance technique is the landing. It must be soft! When you land from a jump, you want to softly accept your weight on the balls of your feet slowly rolling back to the heel with a bent knee and a bent hip. These exercises are basic, however, it is critical to perform them correctly. Please begin these exercise using a flat cone (2 inches) or with a visual line on the field.

A. Lateral Hops over Cone (30 seconds) Elapsed Time: 4.5 – 5min
Purpose: Increase power/strength emphasizing neuromuscular control
Instruction: Stand with a 2" cone to your left. Hop to the left over the cone softly landing on the balls of your feet land bending at the knee. Repeat this exercise hopping to the right. Progress to Single leg hops

B. Forward/Backward Hops over cone (30 sec) Elapsed Time: 5 – 5.5 min
Purpose: Increase power/strength emphasizing neuromuscular control
Instruction: Hop over the cone softly landing on the balls of your feet and bending at the knee. Now, hop backwards over the ball using the same landing technique. Be careful not to snap your knee back to straighten it. You want to maintain a slight bend to the knee.

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C. Single Leg hops over cone (30 seconds) Elapsed Time: 5.5 – 6 min
Purpose: Increase power/strength emphasizing neuromuscular control.
Instruction: Hop over the cone landing on the ball of your foot bending at the knee. Now, hop backwards over the ball using the same landing technique. Be careful not to snap your knee back to straighten it. You want to maintain a slight bend to the knee. Now, stand on the left leg and repeat the exercise. Increase the number of repetitions as needed.

D. Vertical Jumps with headers (30 seconds) Elapsed Time: 6 – 6.5 min
Purpose: Increase height of vertical jump.
Instruction: Stand forward with hands at your side. Slightly bend the knees and push off jumping straight up. Remember the proper landing technique; accept the weight on the ball of your foot with a slight bend to the knee.

E. Scissors Jump (30 seconds) Elapsed Time: 6.5 – 7 min
Purpose: Increase power and strength of vertical jump.
Instruction: Lunge forward leading with your right leg. Keep your knee over your ankle. Now, push off with your right foot and propel your left leg forward into a lunge position. Be sure your knee does not cave in or out. It should be stable and directly over the ankle. Remember the proper landing technique; accept the weight on the ball of your foot with a slight bend to the knee. Repeat 20 times.

Section IV: Agilities

A. Forward run with 3 step deceleration Elapsed Time: 7 – 8 min
Purpose: Increase dynamic stability of the ankle/knee/hip complex
Instruction: Starting at the first cone, sprint forward to the second cone. As you approach the cone, use a 3 step quick stop to decelerate. Continue on to cone 2 using the same strategy to deceleration. Do not let your knee extend over your toe. Do not let you knee cave inward. This exercise is used to teach the athlete how to properly accelerate and decelerate while moving forward and the hip, buttock and hamstring musculature.

B. Lateral Diagonal runs (3 passes) Elapsed Time: 8 – 9 min
Purpose: To encourage proper technique/stabilization of the hip and knee. This exercise will also deter a “knock knee” position from occurring – which is a dangerous position for the ACL.
Instruction: Face forward and laterally run to the first cone on the right. Pivot off the right foot and shuttle run to the second cone. Now pivot off the left leg and continue onto the third cone. Make sure that the outside leg does not cave in. Keep a slight bend to the knee and hip and make sure the knee stays over the ankle joint.

C. Bounding run (44 yds) Elapsed Time: 9 – 10 min
Purpose: To increase hip flexion strength/increase power/speed
Instruction: Starting on the near sideline, run to the far side with knees up toward chest. Bring your knees up high. Land on the ball of your foot with a slight bend at the knee and a straight hip. Increase the distance as this exercise gets easier.

Begin your training session with your coach. After the completion of training, resume the PEP program at section V.

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Section V: Stretching

It is important to incorporate a short warm-up prior to stretching. Never stretch a "cold muscle".By performing these stretches, you can improve and maintain your range of motion, reduce stiffness in your joints, reduce post-exercise soreness, reduce the risk of injury and improve your overall mobility and performance. Note: this portion of the program may be moved to the end of your training session. Do a warm-up such as brisk walking for five to 10 minutes before stretching. Gently stretch to a point of tension and hold. Hold the stretch for 30 seconds. Concentrate on lengthening the muscles you are stretching. Breathe normally.

A. Calf stretch (30 seconds x 2 reps) Elapsed Time: 10 to 11 minutes
Purpose: stretch the calf muscle of the lower leg
Instruction: Stand leading with your right leg. Bend forward at the waist and place your hands on the ground (V formation). Keep your right knee slightly bent and your left leg straight. Make sure your left foot is flat on the ground. Do not bounce during the stretch. Hold for 30 seconds. Switch sides and repeat.

B. Quadricep stretch (30 seconds x 2 reps) Elapsed Time: 11 to 12 minutes
Purpose: stretch the quadricep muscle of the front of the thigh
Instruction: Place your left hand on your partner's left shoulder. Reach back with your right hand and grab the front of your right ankle. Bring your heel to buttock. Make sure your knee is pointed down toward the ground. Keep your right leg close to your left. Don't allow knee to wing out to the side and do not bend at the waist. Hold for 30 seconds and switch sides

C. Figure Four Hamstring stretch (30 sec x 2 reps) Elapsed Time: 12 – 13 min
Purpose: To stretch the hamstring muscles of the back of the thigh.
Instruction: Sit on the ground with your right leg extended out in front of you. Bend your left knee and rest the bottom of your foot on your right inner thigh. With a straight back, try to bring your chest toward your knee. Do not round your back. If you can, reach down toward your toes and pull them up toward your head. Do not bounce. Hold for 30 seconds and repeat with the other leg.

D. Inner Thigh Stretch (20 sec x 3 reps) Elapsed Time: 13 – 14 min
Purpose: Elongate the muscles of the inner thigh (adductor group)
Instruction: Remain seated on the ground. Spread you legs evenly apart. Slowly lower yourself to the center with a straight back. You want to feel a stretch in the inner thigh. Now reach toward the right with the right arm. Bring your left arm overhead the stretch over to the right. Hold the stretch and repeat on the opposite side.

E. Hip Flexor Stretch – (30 sec x 2 reps) Elapsed Time: 14 - 15 min
Purpose: Elongate the hip flexors of the front of the thigh.
Instruction: Lunge forward leading with your right leg. Drop your left knee down to the ground. Placing your hands on top of your right thigh, lean forward with your hips. The hips should be square with your shoulders. If possible, maintain your balance and lift back for the left ankle and pull your heel to your buttocks. Hold for 30 seconds and repeat on the other side.

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Patient matched total knee replacement

The early results of this exciting new technology are very promising. Patient matched surgery allows accurate cuts and implant placement which should improve the end result of the operation.

Total knee replacement is probably the only operation that has been shown to be cost effective for the community. It restores function to patients, reducing their reliance on other people and therefore reduces the burden on society. Six months after joint replacement significant improvements are seen in global health and in functional status[1]. Currently it has better than a 95% success rate with most implants lasting up to 15 years.

Traditional surgery Knee replacement has been around since the 1970's. Over the years techniques evolved to make the cutting guides more accurate and easier to use. Unfortunately this involved placing metal rods in the patients medullary canal. This was used to judge alignment and rotation and often resulted in fat embolism and blood loss. Even with this technique it was possible to malrotate the components because rotation was determined by visual inspection or manual palpation of anatomic landmarks.

Computer assisted surgery In the last five years or so new technologies have been used to improve the alignment of the prosthesis during the surgery. Tools to measure how accurately we are able to implant the prosthesis have improved tremendously and this should result in better outcomes for patients.

We know that if an implant is inserted more than three degrees away from it's optimal position then it tends to wear out faster. Alignment of the prosthesis can be difficult to judge when using a small incision around the knee.

Computer assisted surgery was a major breakthrough because it allowed the surgeon to measure the alignment of the implant during the operation for the first time. Bony landmarks were registered by the surgeon into a computer and tracking markers were drilled into the femur and tibia. The computer was able to give feedback to the surgeon as to the alignment of the cutting blocks and the bone resections.

Unfortunately the computers did not help control the rotation of the implant and only partly reduced the likelihood of creating a fat embolism. The disadvantage of using computer assisted systems is that they require extra instrumentation, lengthen the surgical time and create extra potential complications for the patient (such as a fracture where the guide pins are inserted). The hospitals also have to buy expensive computer systems and an extra person is required at each operation to run the computer.

Patient matched surgery The next generation of computer assisted surgery attempts to address these short comings. Computer analysis is now used in the planning stage of the surgery rather than during the operation itself. This is called "patient matched instrumentation" and no longer requires the previous expensive computer systems in the operating theatres or staff to run them. Slightly more effort is required from the surgeon before the operation but this is more than compensated for by having a quicker and easier operation.

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Which companies? Currently the main companies using this technology are: Smith & Nephew's Visionaire Patient Matched System; OtisMed Custom-Fit Knee Replacement System; Depuy Tru-Match Personalized Solutions for Knee Replacement; Biomet Vanguard and ConforMIS Patient Specific Knee Implants but most companies are following suit.

What is patient matched instrumentation? The patient matched system is based on achieving a neutral mechanical axis so that the tibial and femoral components are aligned perpendicular to the mechanical axis of the tibia and femur. The preoperative planning helps the surgeon achieve appropriate axial rotation, sagittal alignment, flexion and extension gaps and sizing of the components.

The patient has an MRI and long leg Xray of the knee performed. The data from these images is processed by an engineer (with input from the surgeon) and a physical model of the patient's bone is created. Specific anatomic points such as the center of the femoral head, the center of the distal femur, the center of the proximal tibia, and the center of the ankle are identified and used to establish mechanical axes of the femur and the tibia in the coronal and sagittal planes. Axial rotation of the knee is established using landmarks such as the geometric centers of the medial and lateral tibial plateau and the femoral epicondyles.

Measurements of the bone model are taken and the exact size of prosthesis to be implanted can be calculated before the surgery. Based on these models (and the surgeons clinical examination of the patient); a cutting block is generated for the patient. The cutting block guides the surgeon to cut off the exact amount of bone that will be replaced by the implant.

After the jigs are used to guide bone resection the operation proceeds as usual and the customary components are implanted. The surgeon is not constrained to the preoperative plan and can make adjustments during surgery if necessary.

The following items can be adjusted by the surgeon:

Thickness of resection

- Distal femur
- Posterior femoral condyles
- Proximal tibia

Alignment of components

- Varus/valgus of femoral component
- Varus/valgus of tibial component
- Rotation of femoral component
- Rotation of tibial component
- Flexion/extension of femoral component
- Slope of tibial component

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Translation of components/bone resection

- Medial/lateral femoral component
- Medial/lateral tibial component
- Anteroposterior femoral component
- Anteroposterior tibial component

Referencing options for components/bone resection

- Anteroposterior axis of femur (Whiteside line)
- Transepicondylar axis
- Posterior condylar axis
- "Anterior referencing" for femur
- "Posterior referencing" for femur

Cost Savings Significantly less equipment needs to be sent to the hospital because the exact size of the prosthesis to be implanted is known before the surgery. Less instrumentation is required during the surgery and so sterilization and courier costs are reduced. The blocks are shipped sterile for use during the operation.

Advantages during the surgery During the surgery a standard (or slightly smaller) approach is undertaken to the knee. The block 'locks into place' on the femur in the exact position planned prior to the surgery. Since the block can only fit correctly in one position less exposure of the bone is required than was required for traditional surgery. This ensures that the alignment and rotation are correct with far less tissue trauma.

Traditionally 6 blocks were used to check alignment and rotation but using the femoral cutting block eliminates the need to perform these steps. The surgery is quicker and reduces the chance of a fat embolism by eliminating instrumentation of the femoral canal. This reduces blood loss and surgical time which should lead to faster recovery and less pain. The surgeon is assured of good alignment and rotation and the patient has a shorter anaesthetic which also improves outcomes.

Benefits to the patient include:

- less time in surgery (shorter anaesthetic)
- reduced chance of a fat embolism
- reduced blood loss
- perfect alignment and rotation
- potentially a faster healing time

CONCLUSION

The early results of Patient Matched Total Knee Replacement Surgery are extremely promising. Those of us who have used the technique are convinced that it is a huge improvement over the previous surgical methods.

1. Arthritis Rheum. 1986 Aug;29(8):937-43 - **Cost-effectiveness of total joint arthroplasty in osteoarthritis;** Liang MH, Cullen KE, Larson MG, Thompson MS, Schwartz JA, Fossel AH, Roberts WN, Sledge CB

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Foot & Ankle	Dr. Todd Gothelf	Concord | Hurstville | Penrith | Randwick
	Dr. John Negrine (Adult only)	Concord | Hurstville | Randwick
General Orthopaedics	Dr. Rodney Pattinson	Concord | Hurstville | Randwick
Hand	Dr. David Dilley	Concord
Hip	Dr. Andreas Loefler	Hurstville | Randwick
	Dr. Allen Turnbull	Hurstville
Knee	Dr. Andreas Loefler	Hurstville | Randwick
	Dr. Ivan Popoff	Hurstville | Randwick
	Dr. Doron Sher	Concord | Randwick
	Dr. Allen Turnbull	Hurstville
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Shoulder	Dr. Jerome Goldberg	Hurstville | Randwick
	Dr. Todd Gothelf	Concord | Hurstville | Penrith | Randwick
	Dr. Ivan Popoff	Hurstville | Randwick
	Dr. Doron Sher	Concord | Randwick
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