Pars Stress Fractures
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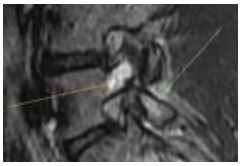

MRI of the Hip Region
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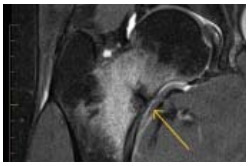

Victoria House Medical Imaging

MIA Victoria

MSK imaging update

February 2010

Leaders in Sports Medicine and Orthopaedic Imaging

Celebrating 20 Years of Sports Imaging Excellence

FAI OVERVIEW FEMOROACETABULAR IMPINGEMENT

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Clinical

Osteoarthritis (OA) of the hip is an increasing problem in Australia. In 2008, 32,724 hip replacements were performed in Australia, up 21% since 2003. One of the causes of early onset OA of the hip is now thought to be due to Femoroacetabular Impingement.

The hip is a ball and socket joint with a spherical femoral head and a deep socket, the acetabulum, which is further extended with a fibrocartilaginous labrum, similar to the shoulder. This makes a stable supportive joint, while still maintaining a large range of motion.

Problems arise if the femoral head is not quite spherical, if the femoral head is not in its normal orientation with respect to the femoral neck, or if the neck of the femur is too large. All these anatomical variations may allow the femur to impinge on the margin of the acetabulum and labrum, causing labral and cartilage damage, and also bone injuries.

Direct impaction of the femur and acetabulum together may occur compressing the labrum and cartilage. Alternatively there may be a hinge effect anteriorly with subsequent translation and shearing stress occurring on the posterior side of the joint.

Two main types of FAI are described: cam-type and pincer-type.

A cam is an eccentric bump, and in the hip is seen as a bony protuberance of the femoral neck. The normal concavity of the femoral head neck junction is lost, which limits the range of motion of the hip, leading to impingement on adjacent normal structures, causing local injury and degenerative change.

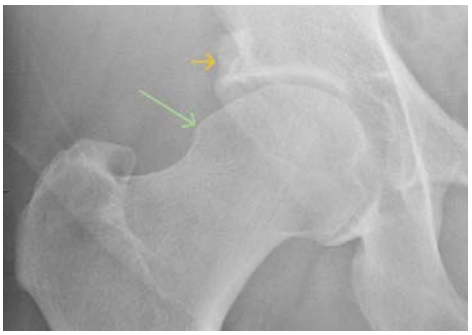

Fig 1a. Plain X-ray of a right hip with cam deformity (long arrow) of the femoral head neck junction and sclerosis of the acetabular margin (short arrow).

Fig 1b. Plain X-ray of a normal left hip.

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Autologous Blood Injections
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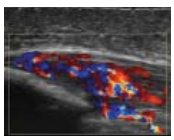

WELCOME

MIA Victoria, including Victoria House Medical Imaging, is the largest provider of diagnostic imaging services in Victoria and offers a comprehensive range of imaging services including specialised musculoskeletal (MSK) examinations, crucial for the rapid and accurate diagnosis required for sporting injuries.

At MIA we manage the diagnostic imaging demands of most Melbourne based AFL teams, Melbourne Storm, Melbourne Victory, Australian Tennis Open and Australian cricket team, placing us at the cutting edge of sports medicine performance requirements and management.

Our state-of-the-art equipment and technologies combine with radiological skills and expertise, in providing your patients with the best possible solution for effective diagnosis and management. In 2010, our centres of excellence include 3T MRI, CT, Ultrasound and Nuclear Medicine services.

We are committed to providing quality patient care and the highest level of service and support to referring medical practitioners.

Our specialised sports medicine and orthopaedic imaging clinics include:

Mercy Private Radiology
Level 1, 141 Grey St, East Melbourne
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316 Malvern Rd, Prahran
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I hope you enjoy the first edition of our "MSK Imaging" newsletter with articles written by a team of radiologists dedicated to musculoskeletal radiology.

Dr Andrew Rotstein
Victoria House Clinic Director and editor of this publication.

The pincer type results from overgrowth of the acetabulum. This may result from osteophyte formation, or result from the acetabulum lying in an abnormal orientation. Normally, the joint angles forward about 20 degrees. If it is angled posteriorly then the anterior part of the joint may impinge on the anterior aspect of the femoral neck, causing anterior impingement injury, or if a hinge effect occurs, posterior shearing forces produce labral and chondral injury.

Most cases of FAI result from a combination of the two types.

FAI affects sporting elite, but also many non-sporting people. The consequences are: limited activity, pain, stiffness, premature OA and potential hip replacement at an early age.

Plain X-ray is used to assess the morphology of the femoral head and neck, the acetabulum and any joint space narrowing. Joint space narrowing indicates that there is already chondromalacia.

MRI is used to detect labral tears and chondral pathology. With the latest generation of MRI scanners, particularly with 3T, more accurate assessment of the labrum and cartilage is possible. (Note that MRI may still miss small but significant chondral delamination, and arthroscopy may still be required in the symptomatic individual with a “normal” MRI.)

CT is used to assess the hip joint in 3 dimensions particularly looking for femoral cam deformities, acetabular orientation and acetabular rim lesions. It is used for preoperative planning. As most of these patients are young, a low dose technique is preferred.

Medical imaging also allows intervention in the form of cortisone injections. Decreasing the amount of inflammation may allow the patient to return to normal activities, or to provide relief while more definitive treatment is being planned. Injections can be performed with fluoroscopic or ultrasound guidance.

Fig 2. Oblique X-ray demonstrating an os acetabulare that is contributing to pincer type impingement.

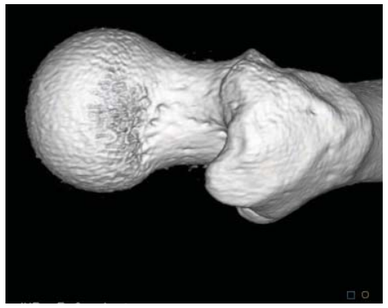

Fig 5. 3D surface rendered CT image of a normal left femoral head and neck for preoperative surgical planning. Note the shape of the femoral head and neck junction both anteriorly and posteriorly.

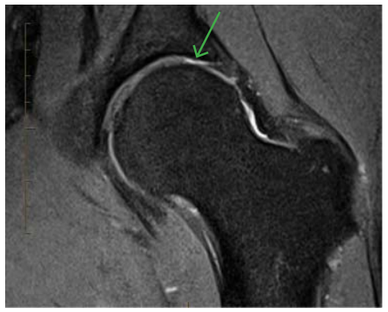

Fig 3. MRI Coronal PD fat saturated of the left hip. Focal acetabular rim chondral wear.

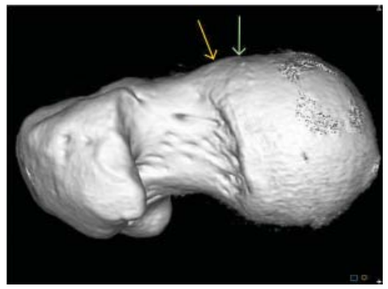

Fig 6. 3D surface rendered CT image of the right femoral neck demonstrating a cam deformity at the anterior femoral head neck junction (arrows). The femoral head is also more posterior than normal with respect to the neck, so called posterior offset.

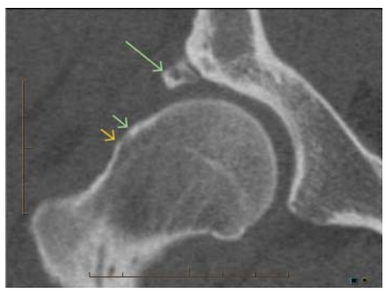

Fig 4. Coronal MPR CT showing a cam deformity (short arrows) and an os acetabulare (long arrow).

REVIEW OF THE CLINICAL PRESENTATION AND ULTRASOUND APPEARANCES OF THE HAMSTRING ORIGIN

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The hamstrings (H/S) arise from the ischial tuberosity which is situated a couple of cms lateral to the natal cleft. The origin is covered by the gluteus maximus muscle. The biceps femoris (BF) and semitendinosus (ST) arise together as a conjoint tendon and the semimembranosus (SM) arises as a separate tendon.

In the thigh, the BF lies laterally and the ST and SM lie medially with the ST superficial to the SM.

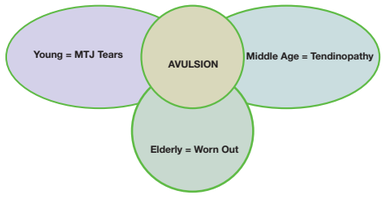


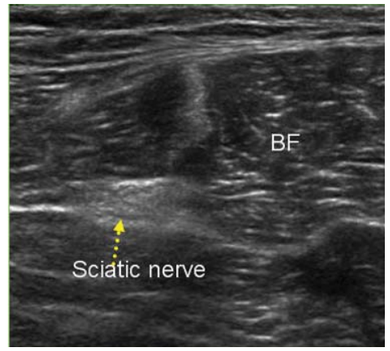
Fig 1. The 3 ages of Hamstring Injury.

The Young

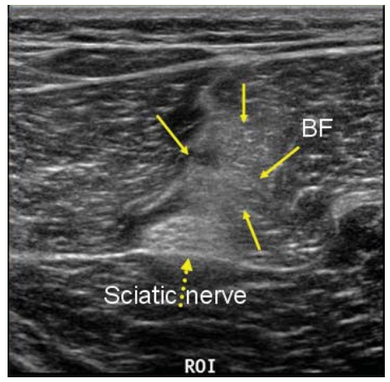
In the 20+ year old footballer we see strains and tears of the musculotendinous junction (MTJ). They present with a sudden pain in the back of the thigh when kicking or sprinting.

Strain is when there is microscopic myofibrillar damage, tear is when there is macroscopic damage. The challenge for ultrasound (US) is to appreciate the presence of a small injury which can be very subtle. For a strain injury, we are looking for a small patch of increased echogenicity deep to where the patient pin points their pain. (Fig 2)

Fig 2. Strain Injury to musculotendinous junction.



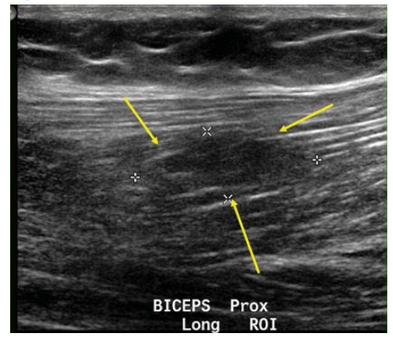
Normal appearance to the muscle.

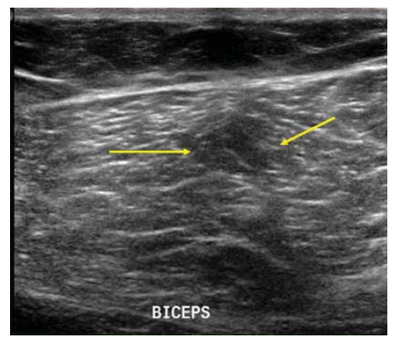


An area of increased echogenicity representing oedema.

Ultrasonically apparent oedema, can take 2 days to develop and the injury initially may be occult to US. MRI is very sensitive in detecting oedema and is now considered the modality of choice when imaging elite athletes. Small tears are also tricky on US as both muscle and, at least initially, tears are hypoechoic, so for fresh tears we are basically looking for “black in black”. (Fig 3) With the development of haemorrhage and oedema the injuries become more obvious as they become echogenic or “white in black”, but can still be subtle and comparison to the other side is useful. US is more sensitive as the injury becomes more severe and inter or intramuscular haematoma develops.[1]

Fig 3. Biceps femoris.





This area of hypoechogenicity represents a small tear of the musculotendinous junction.

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The Middle Aged

Hamstring origin tendinopathy, "Runner's bum", most frequently occurs in middle aged runners and hockey players. They present with start up and cooling down pain. They can't sprint as fast and fatigue more easily. Overtraining stirs up the problem.

The Point Test and "Wellie" Test (Fig 4) are clinical findings evident in hamstring tendinopathy. The Point Test focuses point tenderness over the ischial tuberosity with downward force on the tibia when the knee and hip are flexed. In a positive "Wellie" test, the patient experiences hamstring pain when planting the heel of the affected side and anchoring it with the toes of the good foot and then pulling up on the affected leg, as if removing a gumboot or "wellie".

Fig 4. Signs of Tendinopathy.

The Point Test.

Wellie Test.

The tendons as they arise from the ischial tuberosity appear swollen and may just show the hypoechogenicity of tendinopathy but often have a stripey look due to multiple insubstance tiny splits. (Fig 5 & 6) These changes may be in the conjoint tendon (combined origin of BF and ST), in SM or all 3. The changes usually extend distally for 1-4cm.

Fig 5. Runner's Bum.

The SM tendon is no longer flat but rounded and hypoechoic. Compare with normal image below.

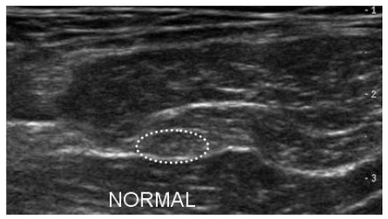
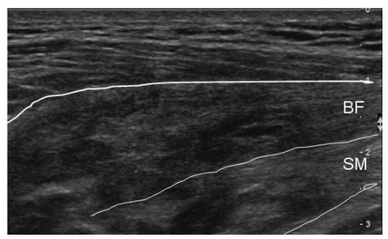


Fig 6. Runner's Bum.



This 66 year old man thought he had one more marathon left in him but his hamstring said "NO".

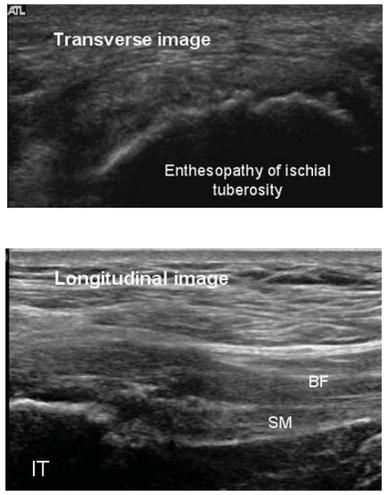
Longitudinal scan of hamstring tendons arising from ischial tuberosity.

Note the thickened tendon origins and stripey appearance due to multiple tiny insubstance splits.

The Elderly

They complain of pain on sitting and pain on walking. The Wellie test is positive. The tendons are thin and worn out+/- tendinopathy. There is irregular bone pitting and spurring (enthesopathy) as a result of stress at the tendon/bone interface, and fatty atrophy of the gluteal muscles. (Fig 7)

Fig 7. Elderly hamstrings.



Longitudinal and transverse images of an elderly gent who found sitting for long car rides painful.

Scans show thin tendons with the stripey look of chronic tendinopathy and insubstance splits.

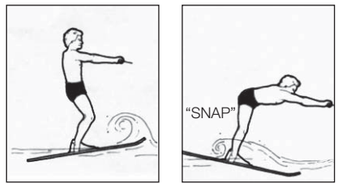
Note overlying tissues are also thin, giving no padding.

Avulsion

Avulsion occurs when there is forceful flexion of the hip with the ipsilateral knee in extension or to put it another way, the trunk is pulled forward whilst the feet are firmly planted with the knees extended causing a parting of ways at the ischial tuberosity.

The patients know that they have done a serious injury. They describe a "pop" or "snap" with instantaneous buttock pain. (Fig 8) They have a palpable defect, a big bruise, can't bend their knee in the prone position and have an unstable leg.

Fig 8. Classical mechanism for hamstring avulsions.

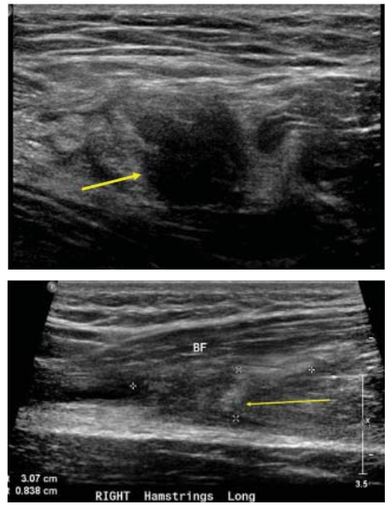


The water skier is forcibly pulled out of the water with the tips of the skis under the surface anchoring his feet.

In spite of this dramatic history the majority of cases of proximal avulsions are overlooked and hence present as chronic injuries!

In the acute phase, haemorrhage can make identification of landmarks difficult and pain, not allowing probe pressure, creates diagnostic uncertainty. But careful attention to anatomy allows US to identify whether one or all of the tendons have been avulsed. (Fig 9) If there is still doubt MRI will be able to provide a definitive answer.

Fig 9. Avulsion.

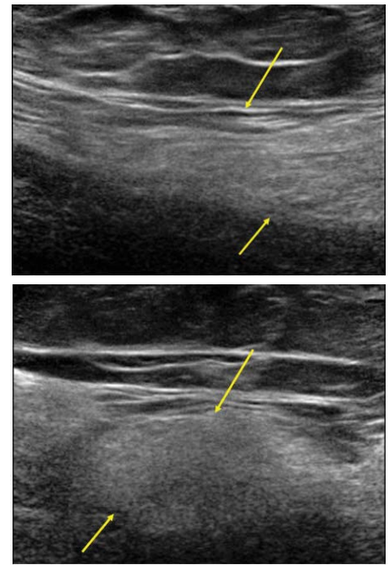


Large fluid gap (black) where the hamstring tendons should be.

Longitudinal view shows bull nosed retraction of muscle.

But most importantly, if you think the hamstring tendons are avulsed they probably are, so reach for the phone and call a surgeon. Early repair allows a good functional outcome. A report from Finland showed that of 41 patients with avulsion injuries only those repaired within 2 months reported a good outcome, whereas the 12 who had delayed surgery for an average of 11 months, all did poorly.[2] (Fig 10)

Fig 10. Chronic atrophy.



This lady slipped on a wet floor in the supermarket. Two years later echogenic (white) muscles due to irreversible fatty atrophy are evident.

Conclusion

Young athletes strain/tear their MTJs, middle aged runners/hockey players develop "runner's bum" and the elderly have enthesopathy and thin tendons. Avulsions need urgent surgical referral.

Ultrasound can help you sort all these diagnoses and MRI is used for the trickier cases where the US findings are not in accord with the clinical impression.

Acknowledgements

Thanks to David Young FRACS, for his clinical input which was most useful in preparing this article and for allowing me to use one of his slide images.

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MRI OF SPORTS RELATED INJURIES OF THE HIP REGION

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MRI is an excellent tool in the work-up of acute sports related injuries of the hip region. Athletes, whether they be recreational "weekend warriors" or high level sportsmen, are prone to not only acute insults, but also chronic repetitive injuries.[1] MRI, with its excellent soft tissue contrast, plays an invaluable role in both the assessment of soft tissues about the hip and also provides excellent visualisation of bone marrow oedema and stress fractures. Whilst other modalities have their place in the work-up, MRI generally provides the most precise definition and best overview of underlying injuries. MRI, in addition, has the benefit of the absence of ionising radiation, a factor important in the younger population.

Osseous Injuries

Stress Fracture

Endurance athletes are prone to stress fractures. These occur due to prolonged abnormal stress to normal underlying bone which ultimately fatigues. X-ray and CT changes are evident comparatively late with early changes better depicted with MRI. MRI is extremely sensitive in detecting early bone marrow oedema which develops as the bone reacts to stress. Early diagnosis and appropriate management may prevent the need for surgical intervention. CT can be complimentary in further defining the fracture. Stress fractures may occur in the femoral neck (Fig 1) with other common sites being the pubic rami and the sacral ala. (Fig 2)

Fig 1. MRI Coronal PD fat suppressed. Stress fracture of the medial femoral neck with vivid surrounding marrow oedema.

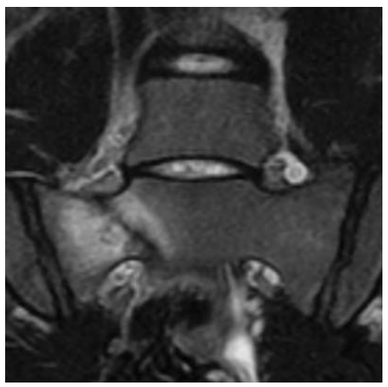

Fig 2. MRI Coronal T2 fat suppressed. Right sacral stress fracture with surrounding marrow oedema.

Fibrocartilagenous Injuries

Labral Tears

Acute labral pathology (Fig 3) is elegantly displayed with MRI which provides the gold standard non-invasive means of visualisation. A number of mechanisms may result in acetabular labral injury such as hyperextension, hyperflexion and over-rotation.[2] Patients often present with mechanical symptoms such as clicking or locking. MRI has, in our experience, been very reliable in depicting labral tears in the absence of arthrography. In addition, MRI also provides information in regards to conditions predisposing to labral tears such as femoroacetabular impingement where hip or acetabular dyplasia is associated with labral impingement and accelerated chondral degeneration.

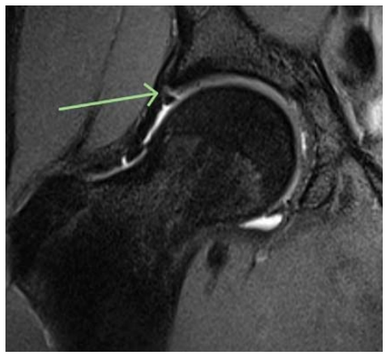

Fig 3. MRI Coronal PD fat suppressed. Acute superolateral labral tear with a full thickness fluid cleft undermining the labrum.

Chondral Injuries

Patients who have chronic, persistent pain following hip injury, with otherwise negative or equivocal radiographic findings, may benefit from evaluation with MRI for the assessment of an underlying chondral injury. CT is unable to assess the chondral surfaces in the absence of intra-articular contrast.

Osteitis Pubis

Osteitis pubis is extremely common amongst running athletes, especially in those involved in sports requiring jumping and twisting motions as well as sudden changes in direction. These patients typically present with groin type symptoms but may also have pain that is poorly localised. Typically, pain is brought on by kicking type motion and in the forward swing phase of gait. The disorder was originally described by Beer in 1924 and later by Spinelli in 1932. It is thought that the condition is caused by an imbalance in forces acting on the symphysis pubis, ie, by the rectus abdominus and adductor muscle group.[3]

Whilst changes can be demonstrated on bone scan and CT, MRI is the modality of choice. MRI can show not only the chronic changes that CT may show such as bone spurring and cystic change, but also reactive marrow oedema, central disc degeneration as well as secondary tears in the adductor muscle group. (Fig 4)

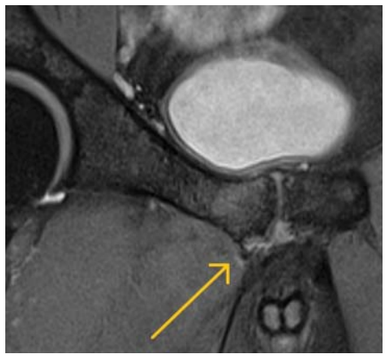

Fig 4. MRI Coronal PD fat suppressed. Osteitis Pubis with secondary cleft (tear) undermining adductor longus tendon.

Soft tissue Injuries

Musculotendinous Injuries

In suspected high grade myotendinous unit injuries, MRI can both accurately detect and grade the severity of injury. This can help in terms of prognostic information (eg. duration of rest period) as well as determining the need for surgical intervention. Long term sequelae such as myositis ossificans can also be evaluated with MRI and/or CT.

Fat suppressed proton density and T2 sequences are fluid sensitive sequences that are extremely helpful in the diagnosis of a muscle tear or strain. (Fig 5 & 6)

Appropriate tailoring of the scan to the site of pain will best show the underlying injury which potentially could lie out of the field of view on routine imaging. For example, hamstring injuries often occur distal to the ischial tuberosity which may not be included on routine hip MRI.

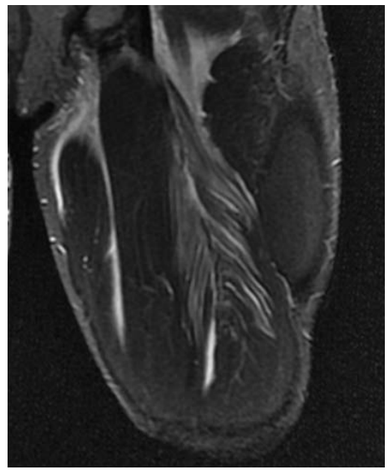

Fig 5. MRI Coronal STIR. Myotendinous junction strain of the long head of biceps femoris. Typical feathery pattern of oedema at the myotendinous interface characteristic of a strain. Partial myofibril disruption in this case is present, consistent with a Grade 2 injury.

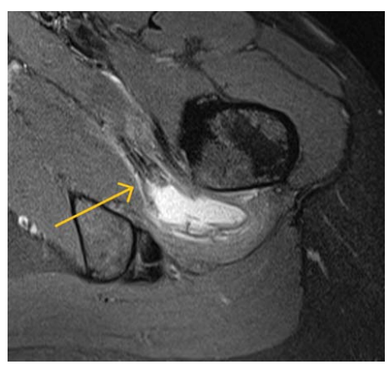

Fig 6. MRI axial fat suppressed PD scan. Acute intramuscular haematoma related to a myotendinous junction injury of quadratus femoris.

Avulsion injuries

These are also commonly seen in athletes. The avulsion fragment can sometimes be difficult to see on MRI. In difficult to interpret cases, CT may help confirm the avulsed bone fragment. Common avulsion fractures include the musculotendinous insertions of the rectus femoris (anterior inferior iliac spine), sartorius (anterior superior iliac spine), iliopsoas (lesser trochanter), and at the symphysis, the adductor group. Hamstring tendon origin avulsion (ischial tuberosity) is also relatively common.

Conclusion

MRI is playing an increasingly important role in the work-up of patients with hip region pain. It provides excellent detail of the soft tissue structures about the hip. MRI is also sensitive in detecting labral, cartilage and bone pathology that may be occult on CT and plain X-ray.

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SCLEROTHERAPY – TREATMENT OPTION FOR TENDINOPATHY AND NEOVESSELS

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Tendinopathy – clinically detected tendon swelling, pain and loss of function – is common and can be severely debilitating. The cause for this condition is regarded as overuse resulting in micro tears in the tendon substance, which the body is unable to repair satisfactorily. Histological studies show mucoid degeneration, with disorganised tendon fibres and abnormal blood vessels. There is no evidence of inflammation and so the term tendinosis rather than tendinitis is regarded as appropriate for the pathological and imaging appearances. On ultrasound (US) imaging there is swelling of the tendon with hypoechoic areas and the presence of small blood vessels (neovessels), usually in the acute phase. (Fig 1) These imaging findings are the hallmarks of tendinosis, as typically seen in the achilles, patellar and common extensor tendon origin (CEO) at the elbow.

The cause of pain in tendinosis is not known.[1] One postulated mechanism is nerve fibre mediated pain. In support of this, there is evidence for increased concentration of glutamate – a known neurotransmitter.[2] On biopsy specimens the presence of pain sensitive nerve fibres in intimate association with small blood vessels have been detected. These changes are not present in normal tendons.[3] The fine nerve fibres cannot be visualised, but their location is indicated by the accompanying neovessels which are readily seen.

Aim of Treatment

We routinely perform various ultrasound guided treatment options for tendinosis which include the injection of either autologous blood or corticosteroid. Sclerotherapy is a new treatment reserved only for patients with ultrasound detected tendinosis and neovessels.

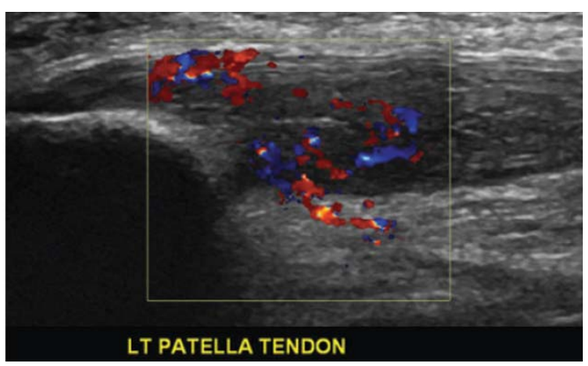

Fig 1. Longitudinal US scan. Tendinosis of proximal patellar tendon. The tendon is swollen, hypoechoic and neovessels enter from the deep surface of the tendon.

The aim of sclerotherapy is to stop the pain and to allow the patient to resume normal activity in conjunction with an eccentric exercise program.[4]

Technique

Using an aseptic technique and US guidance, the neovessels are injected, just outside the tendon margin, with 2-4 ml of a sclerosant, polidocanol. (Fig 2 & 3) This substance is a non ionised aliphatic surface anaesthetic, widely used by dermatologists and vascular surgeons to obliterate small blood vessels.[5] Polidocanol causes the vascular endothelium to become adherent, and is also mildly neurotoxic itself, further helping to inactivate the small pain sensitive nerve fibres. There are no significant side effects from the use of polidocanol, but skin atrophy may occur if the injection is made too close to the skin surface. Following injection, the patient is advised to not exercise for 2 weeks, and then to resume exercise in increasing stages over the following 4 weeks. The patient is then reassessed and, if necessary, the procedure is repeated. Typically, a course of 2 injections is sufficient. Once pain free, the patient is encouraged to exercise while allowing the tendon to heal.

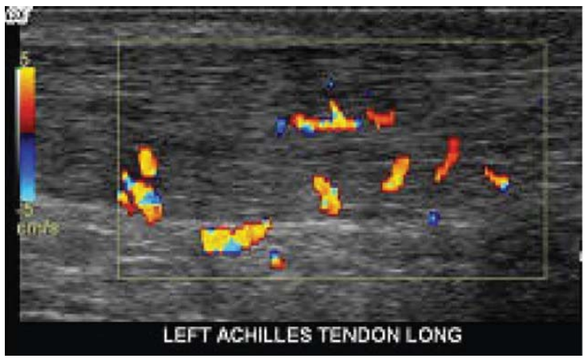

Fig 2a. Longitudinal US scan mid achilles tendon shows neovessels in the mid achilles tendon.

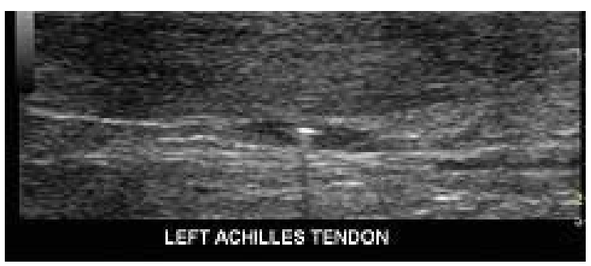

Fig 2b. Same patient as above. Shows the position of a needle tip just outside the deep surface of the tendon following injection of sclerosant.

Outcome

Scandinavian researchers have reported several studies using polidocanol for sclerosing neovessels in the achilles tendon, the patellar tendon and also the CEO, including controlled randomised trials.[6] They have injected more than 1500 tendons with a good outcome in 80-90% of cases. Typically, the pain is significantly diminished, and over 2 years the tendon returns to a normal appearance with no neovessels and no pain. (Fig 4a & 4b) In over 500 tendon studies reported there were two major complications – in both, tendon rupture occurred. In one case the patient exercised vigorously within one week of injection against advice and in the other the rupture occurred away from the injection site and was probably related to the general tendon pathology rather than being caused by the injection (personal communication). There have been no long term complications.

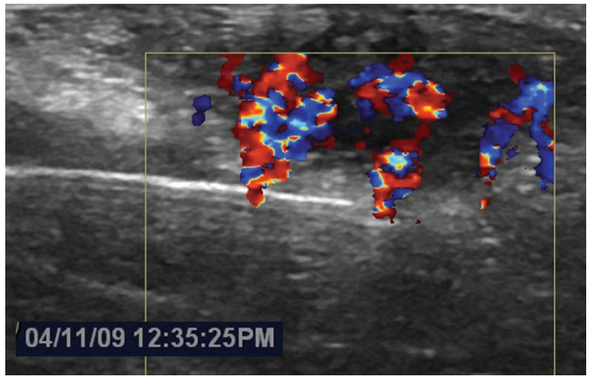

Fig 3a. Transverse US scan proximal patellar tendon. The position of a needle tip just outside the deep surface of the patellar tendon within the neovessels prior to injection of sclerosant.

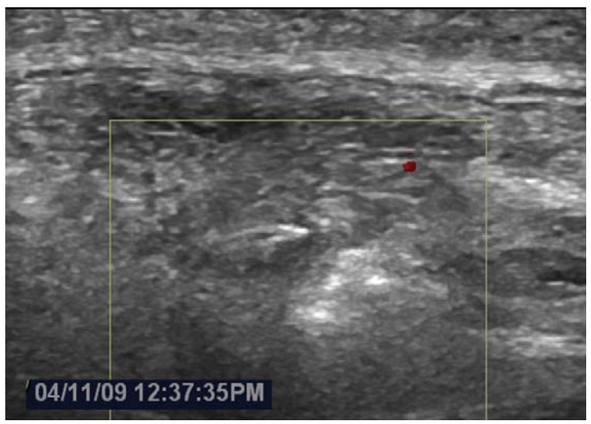

Fig 3b. Same patient as above. Transverse US scan proximal patellar tendon. Following injection, the neovessels adjacent to the needle tip have shut down.

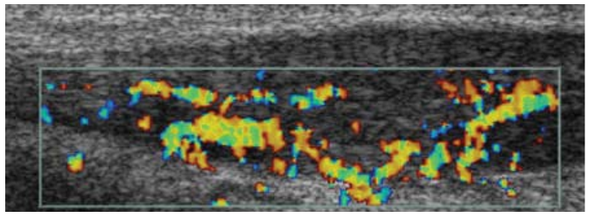

Fig 4a. Longitudinal US scan mid achilles tendon prior to treatment shows swelling and neovessels.

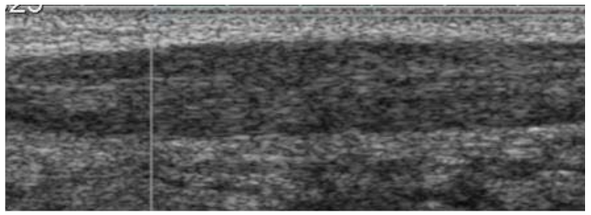

Fig 4b. Same patient as above. Two years following sclerotherapy, the tendon is much less swollen and there are no neovessels and no pain.

Conclusion

Sclerotherapy is an alternative treatment option for tendinosis with neovascularity. The aim of treatment is to stop tendon pain, allowing normal activity and eventual healing. Good outcomes are reported in 80-90% of cases in conjunction with an eccentric exercise program.

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PARS STRESS FRACTURE IMAGING

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Introduction

The pars is a narrow portion of bone that provides a bridge between the vertebral body and pedicle to the posterior vertebral elements. The pars is susceptible to rotational stress and this can result in the development of a pars stress fracture. Pars stress fractures (spondylolysis) occur during adolescence in physically active individuals. Cricket bowlers, footballers, basketballers and tennis players are particularly at risk for developing Pars stress fractures.

Pars stress lesion is a broader term that includes both pars stress fracture and the pre fracture stage of a pars stress reaction.

Clinically important acute pars lesions are pars stress reaction and incomplete stress fracture.

Patients with an acute pars lesion will benefit from a period of rest to either reverse the stress reaction or enable an early incomplete fracture to heal and unite. Incomplete fractures are likely to unite if detected, where as complete fractures have a higher incidence of non union and complications.

The complications of complete fractures are the development of spondylolisthesis, subsequent disc degeneration and foraminal nerve impingement.

Unilateral fractures are more likely to heal than bilateral fractures.

Imaging is used to detect pars stress lesions and additionally differentiate acute pars lesions that will heal with conservative rest from chronic complete pars fractures.

Imaging Modalities

A number of imaging modalities are available to assess pars stress lesions. Each investigation has its advantages and disadvantages.

X-Ray

X-ray can demonstrate chronic complete fractures with non union but has poor sensitivity for the clinically important acute pars lesions.

Nuclear Medicine Bone Scan and SPECT

Bone scan with SPECT is very sensitive in detecting acute pars lesions. (Fig 1) Bone scan provides a functional assessment of osteoblastic activity which is greatly increased in an acute pars lesion.

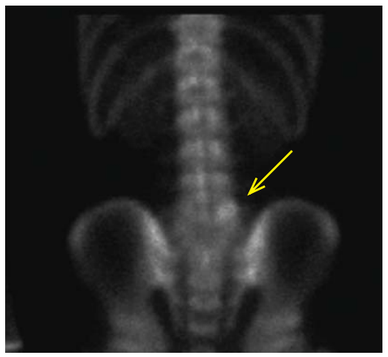

Fig 1. Bone scan. Right L5 pars stress lesion with increased tracer activity.

Bone Scan's sensitivity to more chronic lesions is reduced. As Bone scan has no morphologic information, it cannot distinguish between a stress response and stress fracture. Bone scan is best reserved for patients with a high clinical pre test probability for an acute pars lesion.

Bone scan has a small percentage of false positive outcomes and therefore confirmatory CT is always required.

A patient with a normal bone scan may still require an MRI or CT to assess for other possible causes of the back pain.

MRI

MRI is able to detect pars stress response and an acute incomplete fracture as an area of bone marrow oedema on fluid weighted sequences. (Fig 2) Dunn et al demonstrated the presence of bone marrow oedema within 93% of incomplete pars fractures. [1]

MRI has strong sensitivity to incomplete and complete fractures. (Fig 3)

Fig 2. MRI Sagittal STIR. L5 pars stress reaction with bone marrow oedema.

Currently we are involved in a research project assessing the use of thin slice MRI sequences to improve detection of incomplete pars fractures.

In the future, monitoring of pars stress fracture healing may be able to be performed by MRI rather than repeat targeted CT.

MRI has multiple advantages over both Bone scan and CT. MRI avoids the use of ionising radiation in this young patient group. MRI's excellent soft tissue contrast resolution provides a superior overview of the spine. MRI will demonstrate other pathologies that are part of the differential diagnosis. These include disc fissures, protrusions and extrusions, nerve impingement and central canal stenosis, vertebral endplate abnormalities, fractures and tumours such as osteoid osteoma.

Fig 3. MRI Sagittal T1. Incomplete L5 pars stress fracture.

CT

CT is the best method for detecting fractures due to its high spatial resolution for cortical and trabecular bone. The modern helical 16 slice CT scanners at Victoria House and Mercy Private enable a large volume of data to be acquired. The data is then reformatted into multiple planes to best assess the pars. There is no need for the clinician to request "reverse gantry scanning" which was required for old single slice CT machines.

CT is the best modality for grading fractures into incomplete or complete. CT can also assess fracture healing and differentiate acute complete from chronic complete fractures. However, in the clinically important pre fracture state of a pars stress reaction, CT will be normal. MRI and Bone scan are highly sensitive to the stress reaction stage.

Because CT exposes the patient to ionising radiation, the CT is targeted to the particular active pars level previously detected by MRI, Bone scan or prior CT.

CT can accurately grade the pars lesion into 1) Normal, 2) Normal but stress reaction on MRI or Bone scan, 3) Incomplete fracture, 4) Complete fracture 5) Complete fracture non union and 6) Healed fracture.

Incomplete fractures commence at the inferior pedicle / pars cortical junction and have an intact superior cortex. (Fig 4)

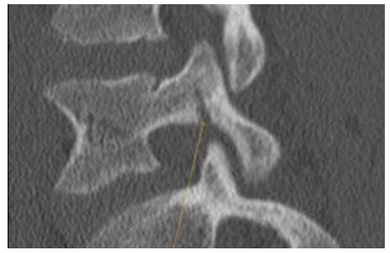

Fig 4. CT sagittal reformat. Incomplete L5 pars stress fracture.

Acute complete fractures pass through the entire pars and are sharply defined. Complete fractures with non union demonstrate sclerotic fracture margins with rounded smooth edges and a widened fracture defect.

Pars fracture healing can be demonstrated on serial CT and occurs from superior to inferior with resolution of the lysis. A healed pars fracture will demonstrate persistent sclerosis and irregularity of the inferior cortical margin.

A longitudinal comparison of 2 CT studies will distinguish whether an incomplete fracture is in a healing phase or evolving towards a complete fracture. (Fig 5)

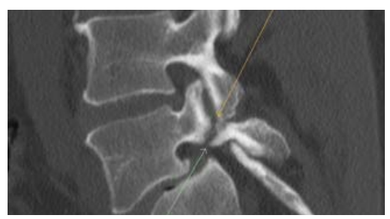

Fig 5. CT sagittal reformat. Complete L5 pars stress fracture with non union.

Imaging Pathways

There are two possible imaging pathways in the investigation of back pain in a young patient with a possible pars lesion.

Imaging Pathway One MRI +/- Targeted CT

In a young patient with a differential diagnosis that includes a Pars stress lesion, MRI is recommended as the initial imaging modality. There are 4 possible MRI outcomes:

1. MRI detects an acute pars stress lesion. Targeted CT of this pars level is recommended to further grade the lesion.
2. MRI detects a chronic complete pars fracture that correlates clinically. No further imaging is required.
3. MRI detects other pathology such as a disc protrusion and nerve impingement. This must be correlated clinically and managed appropriately.
4. MRI is normal. Assessment of the pre test probability of a pars lesion is required.

If the pre test probability for a pars lesion is high and the MRI is normal, then consideration must be made to performing a bone scan +/- limited CT at the appropriate clinical level to exclude a pars lesion.

If the pre test probability for pars lesion is low and the MRI is normal then no further imaging is required.

Imaging Pathway Two Bone Scan +/- CT

Another alternative imaging pathway is to perform Bone scan first and then targeted CT to the particular level of increased tracer activity. This does, however, expose the young patient to two studies with ionising radiation.

A normal Bone scan may also require the patient to have either MRI (preferable) or CT to assess for another cause of their back pain.

The clinician investigating for a pars lesion can write on the patient's request form for MRI or Bone scan to be performed +/- CT at the targeted level. The radiologist at these clinics will review the MRI or bone scan and decide if CT is required and at what targeted level, while the patient is in the radiology department.

Summary

State of the art MRI is recommended as the initial investigation for a pars stress lesion in a young patient. High quality MRI has strong sensitivity to acute pars lesions.[2]

Multislice helical CT is the best modality to grade the Pars stress lesion and for follow up of fracture healing.

Pars stress reaction and an incomplete pars fracture will heal with conservative management and avoid the development of a complete fracture and its subsequent complications.

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ULTRASOUND GUIDED AUTOLOGOUS BLOOD INJECTION FOR TENDINOPATHY

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Tendinopathy or tendinosis is a degenerative condition (usually from overuse) affecting a tendon.

In cases where there is tendinopathy without significant tearing, an autologous (your own) blood injection is appropriate treatment. Autologous blood injection is a safe and natural alternative in the management of tendinopathy.

Histopathologic assessment of tendinopathy reveals underlying angiofibroblastic degeneration due to a failed healing response. Inflammation may play a minor role in the initiation but not the evolution of tendinopathy.[1] The condition should be termed tendinosis rather than tendonitis. The rationale of the autologous blood injection is that the targeted injection of white blood cells, platelets and growth factors will stimulate tendon healing and regeneration. [2] It is postulated that autologous blood contains the necessary cellular and humoral mediators to activate the healing cascade. [3]

The commonest tendons which cause significant discomfort to people involve the Achilles, elbow common extensor origin, gluteal tendons, patellar tendon and ham-string origin.

In 1999, after an extensive and successful trial at Victoria House of injecting autologous blood into Achilles tendons, Dr Bass and Dr Burke commenced injecting various tendons.

The procedure involves an examination of the tendon with ultrasound to confirm tendinopathy. Local anaesthetic is injected and dry needling of the tendon performed. A small amount of autologous blood is withdrawn from a vein and then, under ultrasound guidance, injected into the focus of tendinopathy in the affected tendon.

An information sheet on post injection procedure is provided and a second autologous blood injection four to six weeks later is recommended for most patients. Occasionally, three injections are needed.

The results from these injections have been excellent. If you require any information on this treatment, feel free to contact any of the Radiologists at Victoria House or the Mercy Private.

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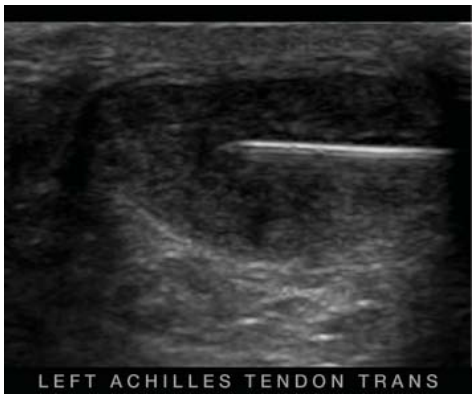

Fig 1. Ultrasound guided autologous blood injection of Achilles tendinopathy.

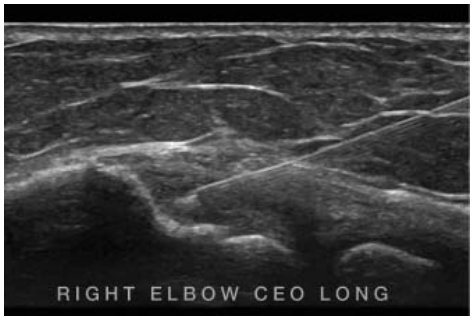

Fig 2. Ultrasound guided autologous blood injection of elbow common extensor tendinopathy.

AUSTRALIAN TENNIS OPEN

As one of the leading providers of Musculoskeletal Imaging in Australia, diagnosing sports injuries and orthopaedic problems, Victoria House Medical Imaging provides all imaging services for the Australian Tennis Open.

Dr Cheryl Bass and Dr Frank Burke are contracted by Tennis Australia to provide an on-site ultrasound imaging service at Rod Laver Arena.

The No1 ranked woman tennis player in the world, Serena Williams, was referred to the No1 MSK imaging practice, Victoria House Medical Imaging, MIA Victoria.

Serena thanks Dr Burke