

San Doctor

Ortho Edition 2026



Adventist
HealthCare

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**Message from Brett Goods,
Chief Executive Officer**

Orthopaedic care continues to evolve rapidly, with advances in technology and surgical techniques creating new opportunities to improve the patient experience and outcomes. In this edition of San Doctor, I'm pleased to share some of the latest developments in orthopaedic care at the San.

Among these are several important milestones, including the addition of another Mako robotic system and the first robotic-arm assisted shoulder replacement surgery in NSW. These investments reflect our ongoing commitment to supporting our specialists with leading technology and providing patients with access to high-quality, contemporary care.

Importantly, this edition also looks beyond surgery to provide a broader view of the patient journey. From pre-operative optimisation and diagnostic imaging through to surgery, rehabilitation and the management of complications, the articles showcase the multidisciplinary expertise involved in supporting patients at every stage of their care.

We value the important role GPs play throughout our patients' journeys from early assessment and referral through to ongoing care and recovery. We hope the clinical insights and updates in this edition are useful in your practice and help us continue to deliver connected, high-quality care for our shared patients.

Thank you for your ongoing support and the trust you place in the San and our specialists.

Brett Goods, CEO
Chief Executive Officer
Adventist HealthCare Limited

References for articles are available on request.



Foreword

By Dr Ali Gursel

It is with pleasure I write the prelude to this edition of San Doctor. It is a privilege to be the Head of Department of such a comprehensive and skilled group of surgeons who provide world-class outcomes for our patients.

The following articles highlight some of their interests and specialities but also proves how it really is a team effort to ensure every patient's journey is optimised with care and compassion at the San.

Most of our orthopaedic cases are elective surgery, and we thank our GP referrers who entrust the care of their patients to us. At the same time, we understand that the admissions through emergency represent the trust the community places in us in managing acute care.

As surgeons, we may receive the accolade for a great result, but we are only as good as the team we work with day in and day out.

The patient journey at the San starts with the trust of the GPs and referrers, and positive experiences of past patients sharing good word of mouth.

After appropriate assessments using the San's exceptional radiology services, a booking is usually forwarded to the hospital.

Patients may need further pre-operative reviews by the physicians involved in their care prior to proceeding with surgery. Our physicians expedite their appointments and investigations to minimise the fuss and hassle.

The journey may then take them to the preadmission clinic, where further tests are completed and an introduction is made to the physiotherapists and anaesthetists that will be involved in their surgery and recovery. This service aims to ensure a smooth transition of the postoperative period and flag any patients that

may need rehabilitation services following surgery.

Our patients then usually present on the day of surgery through our surgical centre. The staff here start very early and stay until late to expedite the transition upstairs to theatre and rarely get thanked for the job they do.

Once in theatre, our skilled anaesthetists and their assistants do a great job alleviating our patients' anxiety and delivering the appropriate anaesthetic to facilitate the surgery. Our anaesthetists are onboarded with the latest techniques to ensure the enhanced recovery goals after surgery can be met.

The actual dynamics of the surgery is dependent on our experienced scrub and scout staff. The San has an excellent pathway for the teaching of our new nursing graduates and training perioperative nurses.

A special mention should also be given to the Central Surgical Sterilising Department (CSSD), who ensure the sterility and timely processing of the instruments and the multitude of trays needed for the surgery. I must also acknowledge our surgical assistants and registrars who are vital to the flow of our theatres.

After surgery, our recovery staff expertly stabilise our patients prior to transfer to the ward for most of our cases. We have a very accommodating intensive care team who always provide a backup for our more fragile patients.

Once on our ward, the care is provided by our wonderful team led by our experienced Nursing Unit Manager, Sandy Hunt, who you will read about later in this edition.

All my patients are also cared for by Dr Auriel Jameson, an expert Perioperative Physician. There are many expert

physicians utilised by surgeons at the San to medically optimise their orthopaedic journey.

The transition out of hospital is facilitated by our physiotherapists who have usually met our patients at the preadmission clinic. We have a comprehensive rehabilitation unit for patients who need extra time before they can get home safely.

We have a very responsive hospital administration and surgical management team. Communication is open and they have a 'can do' attitude to all reasonable requests in the interests of patient care. This has been demonstrated by the purchase of state-of-the-art equipment including the many robotic platforms we use, which you will learn about in this newsletter.

I sincerely hope you enjoy this edition and thank you for your partnership.

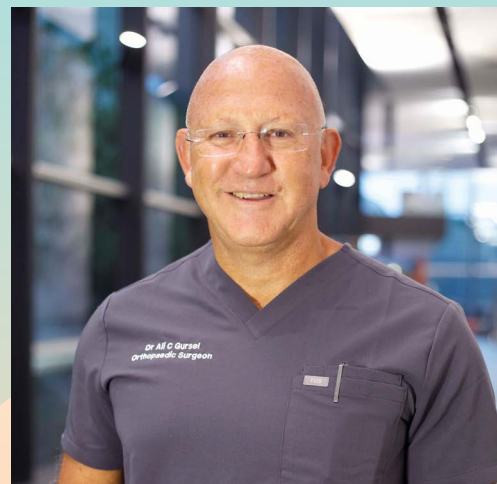
Celebrating 500 VELYS Procedures



In July 2026, Head of Orthopaedic Surgery Dr Ali Gursel performed the hospital's 500th VELYS robotic-assisted knee replacement.

The achievement reflects the continued growth of the San's orthopaedic robotics program since the introduction of the VELYS system, helping patients benefit from greater precision and personalised knee replacement surgery.

Dr Gursel has performed a significant number of the hospital's VELYS procedures, playing a leading role in establishing and growing the program. The milestone has also been made possible through the commitment and expertise of the wider orthopaedic team, including Dr Nagamori, Dr Lin and Dr Gooden, who have embraced the technology and contributed to its ongoing success.



Dr Ali Gursel

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Dr Gursel is the Head of Orthopaedic Surgery at the San, and sits on the hospital's Medical Advisory Committee. His subspecialty interests include surgery of the Hip and Knee; Arthroscopic, Joint Replacement and Revision surgery.

He currently serves at the NSW Chair of the Australian Society of Orthopaedic Surgeons and is a member of the Arthroplasty Society of Australia.

Dr Gursel has also served as the NSW Chair of the Australian Orthopaedic Association (AOA) and is a former member of the Hip Advisory Committee, Medical Services Committee and Standards Australia. He was the recipient of the AOA Leadership Award in 2018.

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Pre-Optimisation Before Elective Orthopaedic Surgery: What the Evidence Tells Us

An article by Dr Jobe Shatrov

Over 60,000 hip and knee replacements are performed in Australia each year, yet recovery varies enormously between patients having the same operation with the same implant and surgeon. Some walk unaided on day one; others remain in hospital beyond day five. **Enhanced Recovery After Surgery (ERAS) programs** increasingly target this recovery gap rather than the operation itself, and much of that gap is determined before the patient ever reaches theatre. GPs are often best placed to address it, well ahead of the surgical consult.

Anaemia

Preoperative anaemia (haemoglobin <120 g/L in women, <130 g/L in men) is associated with significantly higher rates of major complications (4.1% vs 2.8%), extended length of stay, and increased 30-day mortality. Simple pre-referral screening and correction, iron studies, and treatment where indicated, can meaningfully shift a patient's risk profile before surgery is even booked. Correcting preoperative anaemia remains one of the most powerful modifiable risk factors for improving a patient's outcome after elective orthopaedic surgery.

Smoking and vaping

Tobacco use significantly increases wound complications (OR 1.78) and infection risk (OR 2.02). Cessation of at least 4 weeks pre-operatively reduces surgical site complications, with 8 weeks preferable where feasible. Vaping should be treated with the same caution. The evidence base is smaller, but current data suggest it is at least as harmful as smoking, and "switching to vaping" is not a safe peri-operative strategy. Continued abstinence for at least 4 weeks post-op also supports wound healing.

Diabetes

Glycaemic control matters more than a diagnosis label. An HbA1c threshold around 7.7% has been shown to distinguish risk of prosthetic joint infection, with rates climbing from under 1% to over 5% above this level. Optimising control in the months before referral, rather than in the fortnight before surgery, gives the best chance of meeting this target.

Weight

A BMI over 40 is associated with a six-fold increase in complications following TKA, but BMI should not be used as a rigid cut-off in isolation; a whole-patient assessment is more useful than a hard threshold. Where weight loss is appropriate, medically supervised weight loss appears to carry a better safety profile than surgical weight loss in this context. A common misconception is that a patient feels they cannot lose weight due to inability to exercise as a result of their orthopaedic condition (often arthritis). However, evidence shows people tend to gain weight after a total knee replacement. The cornerstone of effective and sustainable weight-loss is caloric reduction and control, not increased exercise.

Nutrition

Preoperative serum albumin below 31 g/L is linked to higher rates of infection and broader medical and surgical complications, with low albumin carrying an adjusted odds ratio of nearly 4.7 for prosthetic joint infection. Nutritional status is still under-recognised in routine pre-operative work-up, and simple screening may identify patients who would benefit from dietetic input before surgery.

A few specific supplements are worth a mention, as patients often ask:

- **Vitamin D:** deficiency is common and is associated with longer hospital stays and poorer functional scores after TKA and THA. Checking levels and correcting deficiency preoperatively is a low-cost, low-risk intervention with a reasonable evidence base, though large RCTs confirming a causal benefit are still pending.
- **Protein/essential amino acids:** this has the strongest evidence of the group. Meta-analyses show EAA or protein supplementation (roughly 1.2–1.6 g/kg/day, higher than the general RDA) meaningfully reduces quadriceps and hamstring muscle atrophy after TKA, with more modest and inconsistent effects on strength. A practical, low-risk recommendation, particularly for patients with poor baseline intake.
- **Creatine:** despite its popularity in sports medicine, multiple RCTs in both TKA and ACL reconstruction have found no benefit for strength, muscle mass, or functional recovery. Not currently supported by the evidence in this setting.
- **Branched-chain amino acids specifically:** the benefit seen with amino acid supplementation is driven by essential amino acids as a group (including leucine) rather than BCAAs in isolation; there's no orthopaedic-specific evidence to support BCAA-only products over a broader EAA or high-quality protein source.

Prehabilitation

Blanket structured pre-surgical exercise for every patient isn't well supported by the evidence, but targeted programs for the right patients are. GLAD (Good Life with Osteoarthritis Denmark), a physiotherapist-led education and neuromuscular exercise program, RACGP-endorsed as first-line OA management, has strong Australian outcomes data: roughly three-quarters of participants report clinically meaningful improvement in pain or quality of life, and three in four patients who initially wanted surgery no longer wanted it at 12 months. It's a reasonable referral for sedentary, deconditioned, or surgery-reluctant patients, whether the outcome is a better-prepared surgical candidate or, for some, avoiding surgery altogether.

The bottom line for referral

Important gains in recovery are made before the surgical episode begins. Correcting anaemia, achieving reasonable glycaemic control, stopping nicotine in any form for at least a month, taking a nuanced approach to weight, and flagging nutritional or activity concerns early all give patients a genuinely better shot at the fast, uncomplicated recovery that ERAS pathways are designed to support.

Hear more from
Dr Jobe Shatrov
from our recent
Orthopaedic
Webinar here:



Dr Jobe Shatrov

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Dr Jobe Shatrov is an orthopaedic surgeon with a subspecialty interest in knee surgery. At the forefront of research, innovation and teaching, he has completed prestigious fellowships, including at the FIFA Medical Centre of Excellence in France focusing on robotic knee surgery; and the Centre Orthopedic SANTY, a leading treatment centre for professional footballers from across Europe and the Fortius Clinic in London, UK, centre responsible for managing acute sports injuries for premier league football players and international level sports players.

He is currently undertaking a PhD focused on the patellofemoral joint in total knee arthroplasty.

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Mako 4.0: The Next Generation Arthroplasty Robot

An article by Dr John Limbers

Mako robotic joint replacement technology has recently marked 20 years. It was launched in Australia in 2015 for partial knee replacement surgery, then total hip replacement surgery and total knee replacement surgery. This year the Mako total shoulder replacement application was released, with the first case in NSW being performed at the San. The new Mako 4.0 robot has now been launched. The San has purchased the Mako 4.0 robot, with two Mako robots now in regular use.

Features of the Mako 4.0 Robot

The Mako 4.0 robot (Fig.1) integrates the fourth generation Q Guidance System. It includes an upgraded hardware and operating system. The camera has enhanced visibility. The mechanics are more precise, and software and data integration are improved. The camera and computer console are now combined into a single unit, increasing functional theatre space. These features allow increased operative workflow efficiency, increased surgical accuracy and more complex procedures.

Total Hip 5.0 Software

Mako assisted total hip replacement features functional planning, because the position of the pelvis and hip is influenced by stiffness of the spine when sitting and standing. A pre-operative CT scan is performed. This is loaded onto the Mako system software, to provide a 3-D CT model of the total hip replacement. Standing and sitting lateral X-rays are also performed, allowing the sacral slope values to be measured and entered into the software. This allows the virtual hip replacement to be taken through a range of motion in the standing and sitting positions. Any impingement (as a result of spinal stiffness) of the acetabular and femoral components on each other in the variable standing and sitting positions are a potential cause of hip dislocation. This impingement can be seen in the virtual plan. The surgeon can then alter the plan, prior to surgery, to relieve the impingement.



Fig.1 The Mako 4.0 Robot

The surgeon then performs the approach to the hip joint. Navigation pins are inserted into the pelvic bone. This is followed by mapping the anatomy of the hip joint utilising a specialised probe. This information is detected by the camera and passed to the Mako robotic unit. This allows the patient's hip joint to be matched to the individualised plan. The surgeon then reams the acetabulum and inserts the acetabular component under robotic control. The femur is then broached and the hip reduced with a trial femoral stem and head in place. Further measurements are then taken with the specialised probe to check the leg length and offset. If these are correct, then the definitive femoral stem and head are inserted.

Recently, Total Hip 5.0 software has been released with the Mako 4.0 robot. This has Mako robotic revision hip replacement surgery capability, which is a major advancement, as revision surgery is often significantly more complex and difficult. The introduction of greater precision and accuracy has great potential benefits.

In Mako assisted revision total hip replacement, the existing hip replacement undergoes CT scanning, with standing and sitting X-rays. A virtual revision total hip replacement with functional planning is then performed. This allows the planning of revision acetabular component size and position with acetabular augments (Fig.2). It also allows precise planning of revision acetabular component screw placement, including technically difficult but biomechanically important ischial and pubic ramus screws (Fig. 3). This ability is valuable, as accurate positioning of these components and restoration of the hip centre of rotation can be a significant challenge in revision hip replacement. The revision femoral stem is also planned (Fig.4). Acetabular and femoral bone loss or defects can be detected and planned for.

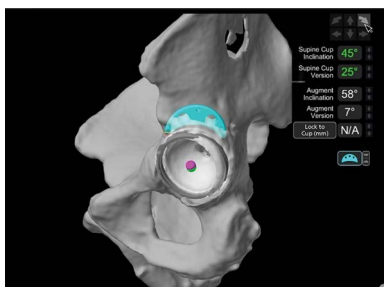


Fig.2 Acetabular Component and Augment Planning

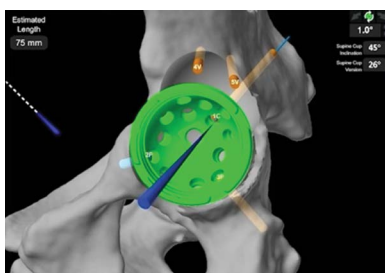


Fig.3 Screw Trajectory Planning

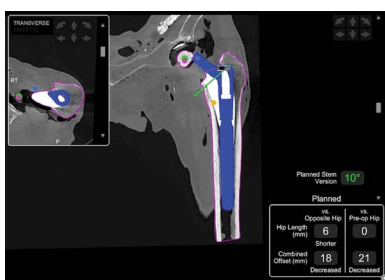


Fig.4 Revision Femoral Component Planning

During the surgery, the hip and existing components are mapped in the same way as a primary procedure. The existing acetabular and femoral components are then removed. The revision acetabular components, augments and screws are inserted utilising the robotic haptic technology. After femoral preparation, the planned trial revision femoral components are inserted. The definitive femoral components are inserted after probe checking of leg length and offset.

In Summary

Installing the latest generation Mako 4 robotic system with shoulder and revision hip replacement capabilities represents a great advance in robotic assisted joint replacement at the San. The revision hip replacement application represents a real advance in precision in highly technically demanding surgery.



Dr John Limbers

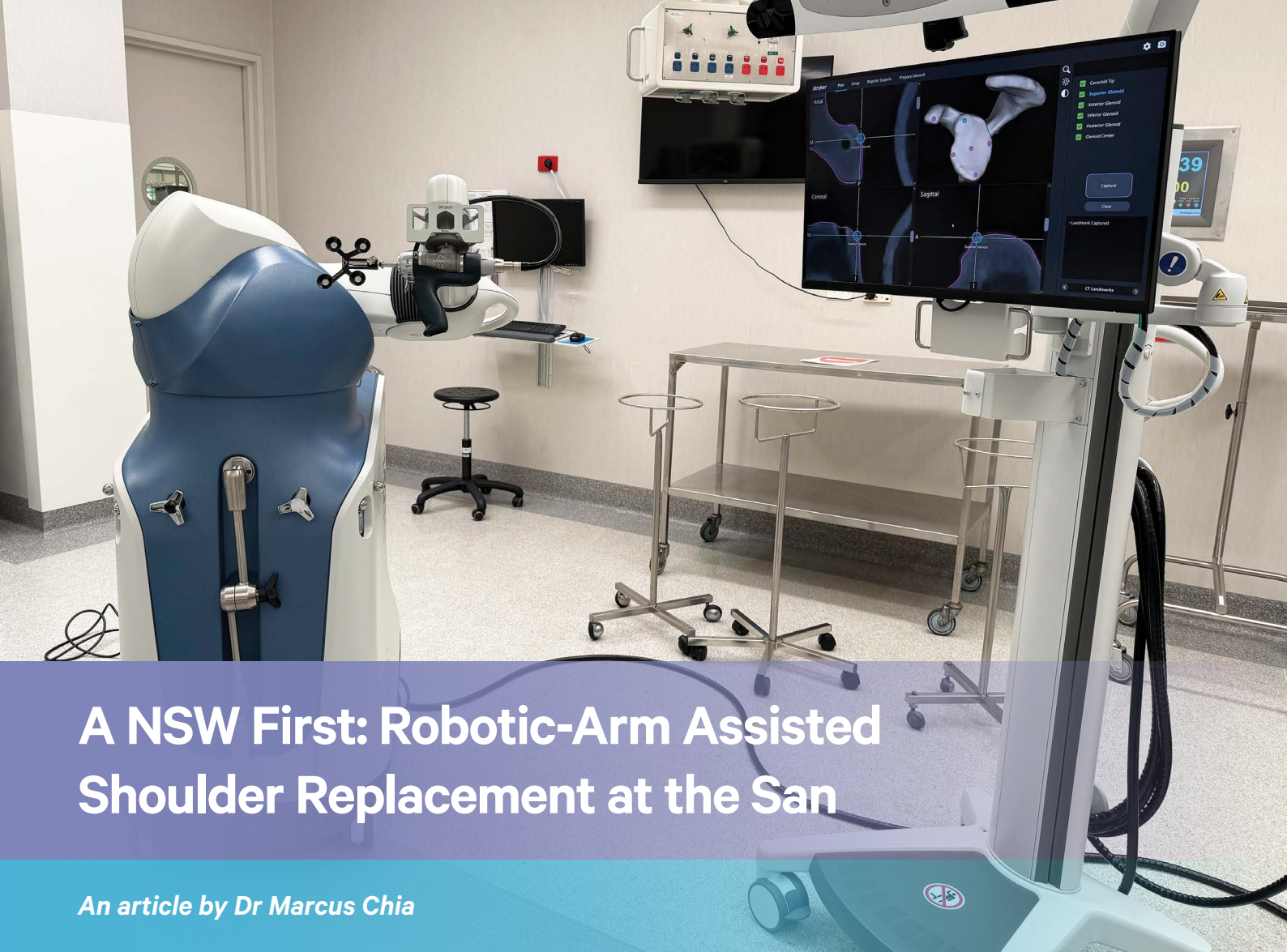
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Dr John Limbers is an orthopaedic surgeon with subspeciality expertise in Mako robotic anterior hip replacement surgery and Mako robotic knee replacement surgery. He also performs arthroscopic knee surgery. Dr Limbers has completed over 5,000 hip and knee replacement procedures during his 25+ year orthopaedic surgery career and has now performed over 3000 robotically assisted joint replacements, including anterior hip (minimally invasive approach). He was the first surgeon in NSW to perform a MAKO robotic total knee replacement.

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A NSW First: Robotic-Arm Assisted Shoulder Replacement at the San

An article by Dr Marcus Chia



In March this year, I performed the first Mako robotic-arm-assisted shoulder replacement in New South Wales. It was a milestone I was proud to share with the San, a hospital with a long record of investing early in surgical technology, and it brings to the shoulder a platform already validated across millions of hip and knee arthroplasties worldwide.

Why precision matters in the shoulder

Colleagues who refer patients for shoulder arthroplasty will know that the glenoid has always been the technically demanding part of the operation. Glenoid component malposition remains the leading cause of failure and revision: version errors alter joint mechanics and accelerate wear, and incorrect component height disrupts the length-tension relationship of the deltoid and rotator cuff, leading to pain or instability. Small positioning errors carry disproportionately large consequences, which is precisely the problem robotic assistance is designed to address.

How the technology works

The Mako SmartRobotics™ system (Stryker) combines CT-based three-dimensional pre-operative planning with real-time intraoperative guidance. Implant size, version, inclination and depth are planned on a virtual model of the patient's anatomy before we

enter the theatre. Intraoperatively, the system continuously tracks the patient's anatomy and applies haptic boundaries, physical resistance that prevents any cutting or reaming outside the planned safe zone, protecting native bone and soft tissue. The robot does not perform the surgery; I control the arm throughout. What it adds is a consistency of execution that is difficult to match freehand, particularly on the glenoid side.

What this means for your patients

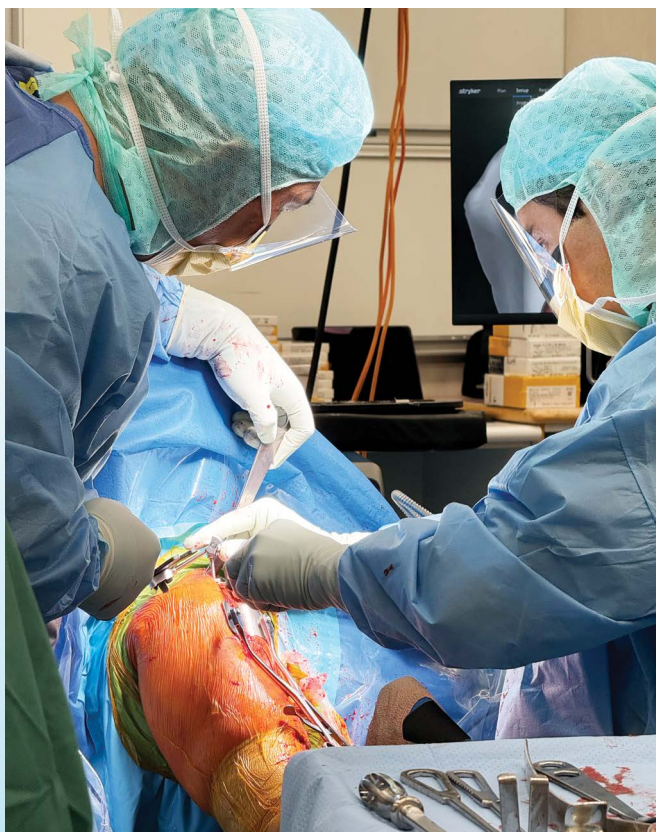
The system is currently used for reverse shoulder replacement, and the indications are unchanged from conventional arthroplasty: glenohumeral osteoarthritis, cuff tear arthropathy, complex proximal humerus fracture, inflammatory and post-traumatic arthritis, avascular necrosis, and selected revision cases, where the 3D planning is particularly valuable in characterising residual bone stock. The robot assists the execution of surgery, not the decision to operate.

From the patient's perspective, little changes: the same deltopectoral approach, anaesthetic technique, one-to-two-night stay and staged rehabilitation protocol. The robotic technology does not attract a separate out-of-pocket charge. The evidence from hip and knee suggests that accurate component positioning and reduced unplanned tissue disruption support less postoperative pain, an earlier, more confident return to daily activities, and potentially improved implant longevity; shoulder-specific long-term data is accumulating.

Referrals

As always, arthroplasty remains a last resort after appropriate conservative management. For patients with end-stage shoulder pathology, or those in whom you are weighing surgical referral, I am happy to assess suitability for robotic-assisted or conventional techniques. Not every patient is a candidate, and the choice depends on bone quality, prior surgery and individual anatomy.

That this technology is now available in Sydney reflects the San's continued commitment to bringing world-class orthopaedic care close to home and I look forward to sharing our early outcomes with you in future editions.



Dr Marcus Chia

**MBBS (Hons) FRACS (Orth)
BAppSc (Physio)**

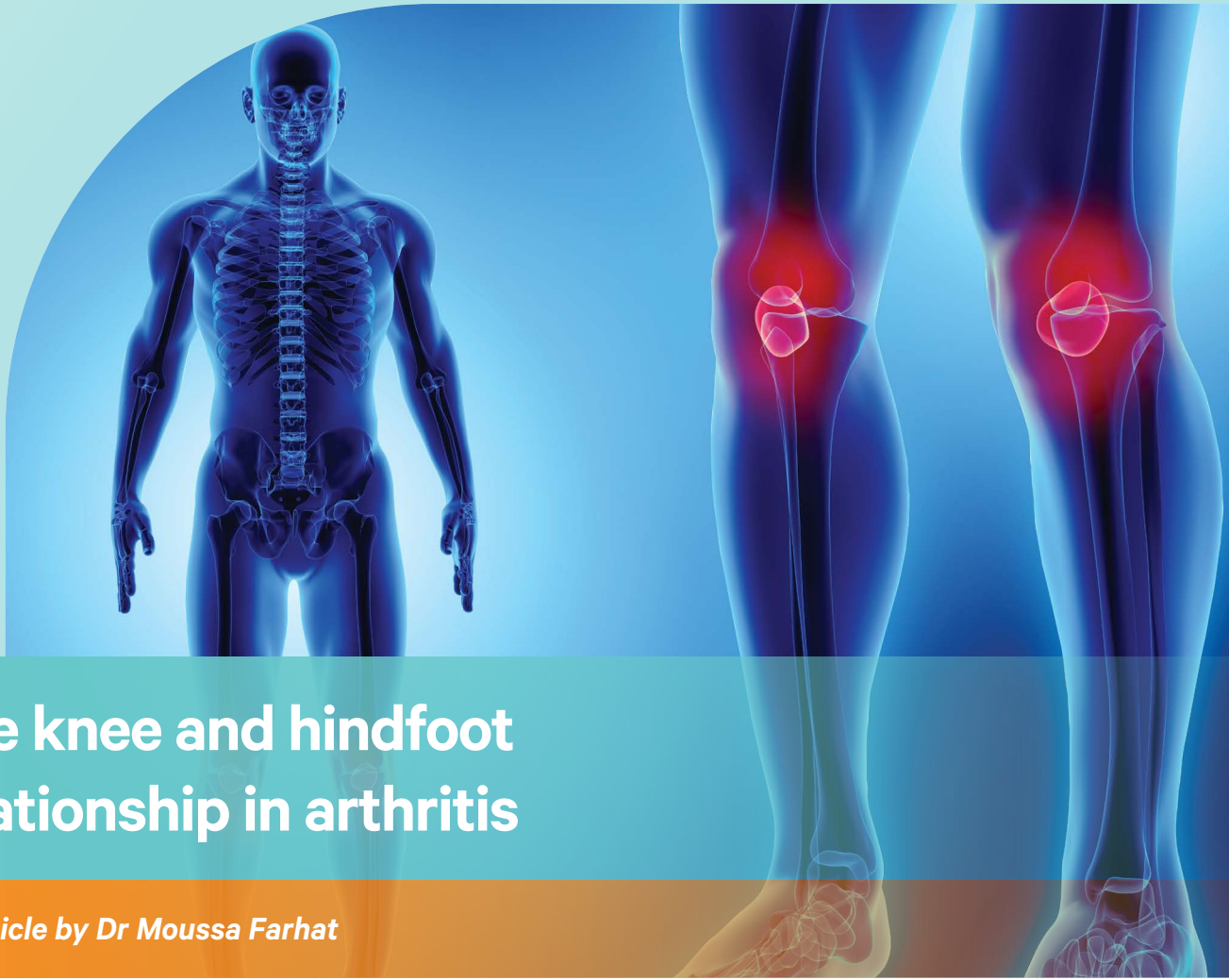
Dr Marcus Chia is an Orthopaedic Surgeon specialising in Shoulder and Elbow Surgery. Utilising his surgical expertise coupled with his prior Physiotherapy training, his practice specialises in restoring function via surgical and non-surgical management of patients. Dr Chia completed his Fellowship of the Royal Australasian College of Surgeons (FRACS) in 2011. To gain further experience in his chosen subspecialty of Shoulder and Elbow Surgery, Dr Chia undertook intensive, specialised training at the Alps Surgery Institute, Clinique Generale, Annecy, France, where he trained under Dr Laurent Lafosse, a pioneer in shoulder arthroscopy.

Dr Chia's expertise extends to: Minimally invasive and advanced techniques for the treatment of arthritis; Shoulder instability; Rotator cuff tear; Fracture management; Paediatric Orthopaedics; and Obscure and unusual shoulder and elbow disorders.

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The knee and hindfoot relationship in arthritis

An article by Dr Moussa Farhat

Total hip and knee arthroplasty are amongst the most successful surgical procedures in the history of medicine and are employed routinely to manage end-stage arthritis. In a similar vein, total ankle replacement surgery is becoming increasingly reliable as an option for the ankle joint.

Robotic-assisted and personalised implants with custom-cutting guides are increasing the accuracy with which we can position components and balance the soft tissues in lower limb arthroplasty procedures. Regarding the management of end-stage subtalar joint arthritis however, the gold standard remains to be a fusion procedure.

As a lower limb reconstruction specialist managing the spectrum of arthritis and deformity from the hip to the foot-and-ankle, I frequently encounter patients with multiple arthritic joints and/or deformities in the lower limb, across a spectrum of severity. Knee arthritis is commonly associated with hindfoot (ankle and subtalar) complaints. The knee and hindfoot are mechanically linked in the coronal (frontal) and sagittal planes, i.e. when one joint moves, it forces adjacent muscles, ligaments and joints to react. These reactions are usually compensatory and protective. These compensatory mechanisms can however be deficient, or deteriorate with time, resulting in secondary pathological deformities and eventually, concomitant arthritis.

For the patient with concomitant knee and hindfoot arthritis, we are faced with the traditional choice as to which joint to 'focus' on, when in fact all joints need to be considered simultaneously. A well-executed arthroplasty procedure can produce excellent results but inadvertently exacerbate a down-stream or up-stream problem when a "single-joint approach" is taken. Moreover, a failure to recognise an adjacent joint mal alignment can jeopardize the longevity of an arthroplasty.

Mechanical Considerations

- **Lower limb alignment** is best conceptualised as a line drawn from the centre of the femoral head to the centre of the calcaneal tuberosity i.e. where weight is transferred through.
- **Coronal plane deformity** can occur at any joint.
- **Coronal plane compensation** happens mainly at the subtalar joint; the knee and ankle contribute little.

- **Classic pattern:** a varus knee drives compensatory hindfoot valgus, and vice versa (Figure 1A).
- **Compensation frequently fails.** About 30% of varus knees show an uncompensated varus hindfoot instead (Figure 1B). Some advanced-osteoarthritis cohorts find no reliable knee–hindfoot correlation at all. Check the hindfoot, don't assume it has compensated.
- **Flexible vs rigid matters.** Flexible hindfoot deformity often corrects once the knee is realigned; rigid deformity (e.g. neuromuscular disease and established hindfoot arthritis) does not.
- **An unaddressed hindfoot can threaten a knee replacement,** via a shifted weight-bearing axis and instability.

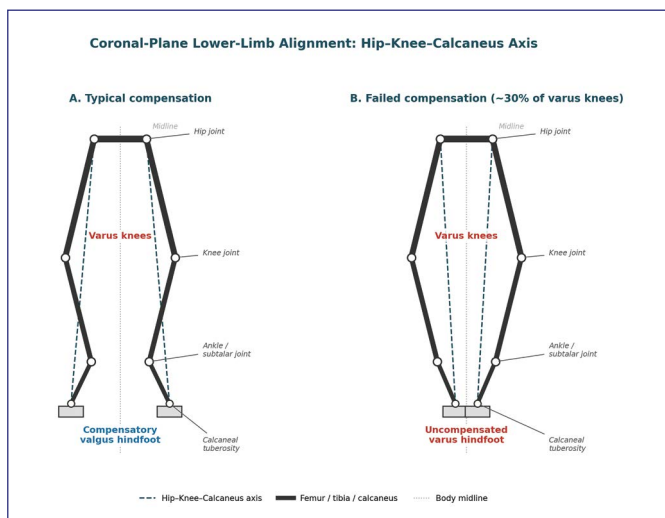


Fig.1 Hip–Knee–Calcaneus axis: typical (A) vs failed (B) hindfoot compensation for a varus knee.

Patient Work-Up

Patients presenting with knee osteoarthritis should be assessed for hindfoot involvement as a routine part of the workup, and vice versa.

History: Patients with severe knee or ankle arthritis will often focus on their respective painful joint. Targeted questions regarding adjacent joint disease should form part of every assessment, as patients will often fail to volunteer such complaints. The location of the pain in the knee might help differentiate a uni-compartmental problem to a more diffuse process. In the hindfoot, location of pain does not always correlate with arthritis but might point to impingement, tendon dysfunction and ligamentous attrition as a result of failing/failed compensatory mechanisms. The absence of pain in the presence of a significant deformity might raise alarms for a neurological cause at play.

Examination: This should include observation of the alignment of all the lower limb joints in the static standing position. Coronal, sagittal, axial and rotational plane deformities all need to be accounted for whilst both standing, and walking.

Knee range of motion in the sagittal plane and laxity in the coronal plane should be identified whilst observing the patient's gait, and with the patient seated/supine. Flexibility of the hindfoot can be ascertained by asking a patient to stand on their toes and observing for inversion of the heel, as well as performing a Coleman-block test.



Dr Moussa Farhat

MBBS FRACP

Dr Farhat has a special interest in Joint Replacement Surgery of the Ankle, Knee and Hip, as well as Lower Limb Deformity correction and conditions affecting the Foot and Ankle. He is passionate about caring for patients with acute Orthopaedic injuries of both the upper and lower limbs.

Dr Farhat completed his Orthopaedic Specialty training across NSW and the ACT through the Australian Orthopaedic Association before further completing Fellowships in Complex Foot and Ankle Reconstruction and Lower Limb Reconstruction in Sydney, a fellowship in Foot and Ankle Surgery through the Nuffield Orthopaedic Centre in Oxford, UK and attending other international observerships and courses in Capetown (South Africa), Basel (Switzerland) and Baltimore (USA) focussed on Lower Limb Reconstructive Procedures.

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If the patient is using insoles/orthoses, it is important to ascertain whether they help to correct a deformity or accommodate for one. The key is to identify the deformities and determine whether they are flexible / correctible or not. Muscle power testing is undertaken of all the major muscle groups, along with a neurovascular examination.



Image: Varus knee arthritis and hindfoot Valgus alignment which corrects with heel raising i.e. a flexible deformity

Investigations:

- Weight bearing knee-only radiographs are an excellent start, however fail to identify adjacent sources of deformity/compensation.
- I routinely request long-leg (hip-to-calcaneus) imaging (e.g. EOS scan) and, where needed, weight bearing CT scans of the lower limb.
- If hindfoot symptoms are present, add dedicated weight-bearing foot/ankle views ± a hindfoot alignment x-ray.
- Joint-space narrowing at the ankle/subtalar joint indicates true arthritis, not just compensation, and changes the referral pathway.

When and what to address?

Conservative care should always be considered first where reasonable, irrespective of the joint involved. This may include activity modification, analgesia, weight loss, articular injections (Hyaluronic acid, PRP, Corticosteroids), low impact exercise and orthotics.

The choice of surgical intervention is influenced by many factors including: patient age, flexibility of deformity, relative pain severity and number of joints involved.

Joint preservation procedures such as realignment osteotomies are preferred in younger patients as a means of obtaining as much 'mileage' as possible from the native joint before succumbing to

a fusion or arthroplasty. Around the knee, osteotomies of the femur and tibia can be undertaken to shift the weight bearing axis of the lower limb from the more affected part of the knee to the least affected side.

Joint sacrificing procedures such as fusions and arthroplasty procedures are reserved for cases where conservative measures have failed and if preservation procedures have either failed or are not appropriate. Fusions and arthroplasty procedures both impact alignment of the joint, so care needs to be taken to ensure that the joint being operated on is placed in a mechanically well-balanced position, without negatively influencing adjacent joints.

Where both joints are significantly deformed: thorough pre-operative planning is paramount. Generally, addressing the most painful or debilitating joint with surgery is ideal. There is no one clear winner and the approach should be personalised to the patient. A "knee-first" approach avoids fusing a hindfoot that could still compensate, while a "hindfoot-first" approach has been shown to result in lower hindfoot-reconstruction reoperation and revision rates.



Key Points

- The foot and ankle should be assessed in every knee osteoarthritis patient, and vice versa.
- Obtain weight-bearing imaging capturing both joints where possible.
- Flexible vs rigid deformity predicts whether knee treatment alone will address the hindfoot.
- Approximately 1 in 3 varus knees are not compensated for as expected — check, don't assume.
- If both joints are deformed, refer together – a holistic approach to the lower limb mechanical chain is ideal.

San Orthopaedic Rehabilitation



Here for Your Recovery, Every Step of the Way

At the San, rehabilitation is an integral part of the orthopaedic journey. From the moment surgery is planned, the recovery pathway is coordinated and personalised to achieve the best possible outcome.

Having both surgery and rehabilitation in one hospital offers significant advantages. Patients transition seamlessly from the surgical ward to our dedicated rehabilitation unit, ensuring continuity of care and consistent clinical oversight. We are committed to helping patients achieve the strongest possible recovery.

Why Choose In-House Rehabilitation?

- Seamless transition from surgery to rehab
- Direct access to your orthopaedic surgeon
- Specialised orthopaedic rehabilitation programs
- Multidisciplinary team approach
- Comprehensive hospital support including 24-hour Emergency and ICU
- Full diagnostic facilities on site



Our Rehabilitation Facilities

Our purpose-designed rehabilitation unit includes:

- Private rooms with ensuites and natural light
- Physiotherapy gymnasium
- Hydrotherapy pool (aquatic physiotherapy)
- ADL (Activities of Daily Living) assessment areas
- Consulting rooms for individual therapy sessions
- Open spaces for group therapy
- Multi-disciplinary team

Flexible Rehabilitation Options

We understand that every patient's needs are different. The San offers:

Inpatient Rehabilitation



Structured daily programs designed to optimise recovery following orthopaedic surgery.

Day Rehabilitation



This includes Post-operative physiotherapy, Hydrotherapy programs, Transport assistance.

Rehabilitation in the Home



Where appropriate, programs can be supported in your home environment.



Alternate Locations

If an alternative location better suits the patient's needs, the San has agreements with the following facilities.

- Mt Wilga Private Hospital
- Berkeley Vale Private Hospital
- Warners Bay Private Hospital
- Hunters Hill Private Hospital
- Lakeview Private Hospital
- Lady Davidson Private Hospital



Person-centred rehabilitation following total hip or knee replacements

An article by Dr Pearl Chung

Advances in surgical and perioperative management of total hip replacements (THRs) and total knee replacements (TKRs) have improved how patients recover. Patients are encouraged to ambulate earlier and can tolerate it better, in keeping with the Enhanced Recovery After Surgery (ERAS) principles. It has reduced many – but not all – rehabilitation needs of the patients undergoing the surgeries at the San and continues to create novel opportunities for rehabilitation services to be increasingly person-centred and flexible in how rehabilitation is delivered.

Rehabilitation is needed when there are pre-existing or newly acquired physical, cognitive or psychological vulnerability or disability, or a complex social or home environment with significant risks related to a direct discharge to home. Following THRs/TKRs, patients with pre-existing balance and mobility problems due to other health conditions may find it more difficult to achieve safe and independent ambulation with the crutches. For patients with cognitive difficulties, it may be difficult to learn adaptive techniques and information for equipment – especially for completing self-care – and medication management. Such patients need extra practice and support to reach safety, either with increased time on the acute ward or inpatient rehabilitation units.

When patients undergo a rehabilitation program, it is preferable to repair or undo the impairment by taking a remedial approach. Where there is an outstanding problem that is not easily fixed, a temporary or permanent solution is provided in a compensatory approach (e.g. equipment for hip precautions). A multidisciplinary team approach addresses the complex interplay between multiple problems requiring input from multiple health disciplines.

With increased access to elective THRs/TKRs – especially in the private sector – patients can plan and prepare better through various ‘prehabilitation’ programs. Improving self-efficacy, normalising experience and reducing fear through education, advice and peer support can improve patient experience in their recovery journey. For patients seeking to ‘get rid of the pain’ through the THRs/TKRs, managing pain – especially when it was not anticipated – during the first weeks of recovery can be very challenging.

For patients who are ready to leave acute hospital care, there is a range of therapy options for elective THRs/TKRs. Private or

home-based physiotherapy is often recommended in rural or regional areas. Each provider needs to ensure that they have the capacity to assist with pain management, joint stiffness/weakness, wound issues, venous thromboembolism, peripheral oedema or other medical complications. Providers need to consider how they can manage the risks and ensure appropriate care for patients under their program.

At the San, the hospital-based day-admitted rehabilitation - known as the San Day Only Rehab (DOR) - has been uniquely adapted to provide multidisciplinary rehabilitation following THR/TKRs. The program is closely managed by rehabilitation medicine physicians and the allied health team. It is ideal for any patients who can safely return home with walking aids and equipment. The return to the home environment is often helpful and contributes to normalising the recovery experience.

We emphasise patient education to avoid overuse and over-exertion and recommend a paced home exercise program to improve their strength, mobility, balance and wean gait aids, and this continues until their 6-week post-operative review. We now offer wound management in the program. A key component of this model is peer support over the morning tea during the program at San DOR, as the program is exclusively offered to our THR/TKRs only.

Inpatient multidisciplinary rehabilitation admission continues to be provided at the San Rehab for patients who do not reach safety to return home after their surgery. The goal is to reach safety for discharge to home. Once patients are discharged, they are offered weekly attendance at the San DOR until their 6-week post-operative review.



Dr Pearl Chung

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Dr Chung is Clinical Director in the San Rehabilitation Service and oversees the San Day Only Rehabilitation Program. She completed her medical degree at the University of Melbourne in 2005 and a Master of Public Health at Monash University in 2013. She became a specialist in rehabilitation medicine in 2016 and was awarded her PhD in traumatic brain injury rehabilitation through the University of Melbourne in 2017.

Dr Chung is the Academic Representative on the Royal Australasian College of Physicians (RACP) and Australasian Faculty of Rehabilitation Medicine (AFRM) Council and chairs the AFRM Research Committee and is a member of the College Education Committee of the RACP.

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Prosthetic Joint Infection: What GPs need to know

An article by Dr Ali Bokhari

Background

Arthroplasty surgery has transformed the lives of millions of Australians and is largely a very successful and satisfying procedure with over 140,000 hip and knee replacements performed in 2024. Unfortunately, approximately 1-2% of hip and knee replacements will develop a prosthetic joint infection (PJI) with most occurring in the first two years. The Australian Orthopaedic Association National Joint Replacement Registry demonstrates infection as the most common cause for revision of hip and knee arthroplasty. General practitioners have a very significant role in the prevention of PJI and its early diagnosis which can be difficult as it will often present with subtle signs.

Prevention

Prevention begins with pre-operative optimisation of the patient and continues after surgery for the life of the patient. Modifiable factors that have been shown to increase infection that should be optimised pre- and post-operatively include:

1. Diabetes (HbA1c ideally <7.5)
2. Smoking
3. Obesity
4. Skin ulcers and wound management
5. Remote infection (e.g. UTI)
6. Malnutrition
7. Anaemia
8. Alcohol
9. Rationalising immunosuppressive medications to achieve disease control with least amount required

Diagnosis

Prosthetic joint infection can be challenging to diagnose. It very often does not present with the classical warm, swollen and potentially discharging wound that we are taught in training and medical school. In the acute post-operative period, wound drainage beyond five days post operatively is very concerning for infection. Outside of this time frame it can be very subtle with the symptoms and signs ranging from increased swelling or pain and/or reduced function or range of motion. Often there is no significant change in the temperature or colour of the knee.

A high degree of suspicion needs to be maintained, and any newly painful knee replacement is infection until proven otherwise. The first steps are to perform blood tests with inflammatory markers including WCC, CRP and ESR. A new x-ray should be performed to check for signs of loosening, and the patient should be immediately referred back to the surgeon. Other imaging modalities such as bone scan and CT should be performed at the treating surgeon's discretion as they are not always required. The surgeon will organise or perform an aspirate of the joint if the index of suspicion is high enough.

It is critical to not start antibiotics as this will heavily compromise the results of an aspiration in growing an organism. This normally occurs when there is some new erythema around the knee and it is treated as cellulitis with oral antibiotics. It should always be presumed there is a possible deep infection. Being unable to isolate an organism due to antibiotic use greatly harms the patient as

we are unable to target antibiotic therapy to a specific organism. If the patient is unwell and needs to commence antibiotics they should be immediately sent to the emergency department.

Time is critical in establishing diagnosis as established infection (generally >3 weeks) will not respond to relatively less complex irrigation, debridement and exchange of modular components. Established infection requires full revision either in one or two stages.

Management

Prosthetic joint infections can be classified according to:

1. **Acute post-operative infection:** Usually occurs soon after surgery
2. **Acute hematogenous seeding to prosthetic joint:** Can occur anytime during the lifetime of the implant and usually presents acutely after a long period of a well-functioning implant
3. **Chronic prosthetic joint:** Can occur anytime during the lifetime of the implant and usually presents as chronic pain, issues, swelling or lack of function with the joint replacement

The difference between an acute or chronic infection principally is the development of a biofilm. Organisms form a biofilm on the metal implant, and it allows them to exist in a steady state and shield itself from antibiotics and the immune system. The biofilm starts developing within days of infection, but it is generally accepted it does not mature for three or four weeks. An acute infection is considered symptom/infection onset within three weeks while chronic is more than three weeks. This is a critical distinction, as with an acute infection prior to the biofilm maturing, a relatively smaller intervention in the form of a debridement, irrigation and exchange of modular components has a higher chance of success and achieving cure. Once the infection is chronic and the biofilm is mature, there is very little to no chance of a debridement achieving cure. This scenario requires full revision arthroplasty in either one or two stages, and this major surgery carries significant risk and morbidity for the patient.

For patients who are not suitable to undergo major surgery, an alternative option is to suppress the infection with lifelong antibiotics. This requires an MDT approach to make a shared decision and generally involves the patient, surgeon, infectious disease physician and medical physician.

Any major surgery should be performed at a facility equipped with the above specialities including an intensive care unit.

Conclusion

Prevention and optimisation of the patient is the best cure for prosthetic joint infection. Diagnosis can be challenging but there should always be a high degree of suspicion as the signs can often be subtle. Immediate referral should be made to the surgeon with new blood tests and x-ray, and antibiotics should not be started unless the patient is unwell, in which case they should be sent immediately to the emergency department.



Dr Ali Bokhari

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Dr Bokhari is an Australian trained orthopaedic surgeon with a sub-specialty focus on hip, knee and trauma surgery. He completed his medical degree at the University of New South Wales and completed a Master of Surgery at the University of Sydney. He then completed his orthopaedic surgery training in NSW to become a fellow of the Royal Australasian College of Surgeons and Australian Orthopaedic Association.

Dr Bokhari has subsequently completed several sub-specialty fellowships in Europe including a Complex Primary and Revision Hip and Knee Replacement Fellowship at the ENDO-KLINIK in Hamburg, Germany; a Sports Knee Fellowship at Gelenkpunkt FIFA Medical Centre of Excellence in Innsbruck, Austria; and a Pelvic/Acetabular Trauma and Joint Replacement Fellowship at Paris St Joseph Hospital in Paris, France.

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Nurse Spotlight



Arnold de Sagun



Sandy Hunt

Behind our exceptional orthopaedic surgeons are a team of highly skilled nurses providing expert care, coordination and support at every stage of the patient journey.

In this edition, we're shining a light on the dedicated nursing professionals from our operating theatres to the orthopaedic ward, whose clinical expertise and patient-centred approach play a vital role in achieving the best possible outcomes for patients and clinicians.

We spoke with Nursing Unit Manager Sandy Hunt and Clinical Nurse Consultant Arnold De Sagun about their roles and how their team works alongside our specialists to deliver seamless, high-quality care.

Can you briefly describe your role and what a typical day looks like?

Sandy: I am the Nursing Unit Manager of the orthopaedic ward here at the San. A typical day is reading all the patient notes to determine the discharges and incoming patients from Emergency Care and theatre cases and determining how many staff is needed for the next 24 hours. I also do rounds with doctors and patients to get feedback and address any concerns.

Arnold: I am the orthopaedic Clinical Nurse Consultant in the Operating Theatres. On a typical day my role involves managing the clinical and logistical needs in my area. From a clinical perspective, I help determine the appropriate nursing skill mix for the various operating lists, provide appropriate clinical assistance to scrub and circulating nurses whenever necessary and provide appropriate support to ensure the efficient flow of procedures. On the logistical side, I ensure that all consignment and loan sets are available for all the procedures. In addition, I coordinate with surgeons and appropriate suppliers to ensure the availability of relevant instruments and consumables for emergency cases.

How long have you been working in orthopaedics, and what drew you to this area of nursing?

Sandy: I completed my training at the San at the end of 1987 and went straight to the orthopaedic ward and have been here ever since (39 years this year!). I just love orthopaedics and bones! I enjoy looking after the elderly with broken hips and love seeing them comfortable after their fractures have been fixed.

Arnold: I've been working in orthopaedics since I started my perioperative career in 2008 at Mona Vale Hospital. While I was not always allocated to do orthopaedic lists because it was a public hospital, I have always enjoyed doing orthopaedic cases. It was only when I worked at the Mater Hospital in North Sydney from May 2015 until August 2023 that I was exclusively doing orthopaedic lists.

The orthopaedic specialty is very dynamic. In joint replacements, for instance, the development of technology from the time I stepped foot in the operating theatre to now is incredible. Performing knee, hip and shoulder joint replacements has evolved from using instrumentations to robotic-assisted approaches or patient-specific instrumentations.

What do you think sets the San's Orthopaedics service apart?

Sandy: We have friendly, warm staff and nurses that genuinely care and go above and beyond to ensure patients are well looked after, and we all have good rapport with our surgeons. Our new ERAS (Enhanced Recovery After Surgery) program is something that makes us stand out. As part of this program, physios mobilise patients within four hours of getting back to the ward and most patients are able to return home within three days. We also have two robots in theatre for robotic joint replacements.

Arnold: The nurses and the collaboration among various management levels are the factors that make the orthopaedic specialty exceptional at the San. In a specialised nursing practice in the operating theatre, we are fortunate to have highly skilled scrub and circulating nurses that can meet the demands of the lists. On the management side, there is a good collaboration among various stakeholders from different levels of management. This collaboration is committed to delivering holistic care with the goal of achieving positive outcomes for patients.

How do the nursing team, surgeons and allied health teams work together to deliver coordinated care?

Sandy: We have a multidisciplinary team meeting every morning which includes physios and OTs to determine patient requirements which ensures everyone is on the same page. We also have a good relationship with social workers who can help find support for patients who have been discharged from hospital but are unable to return home.

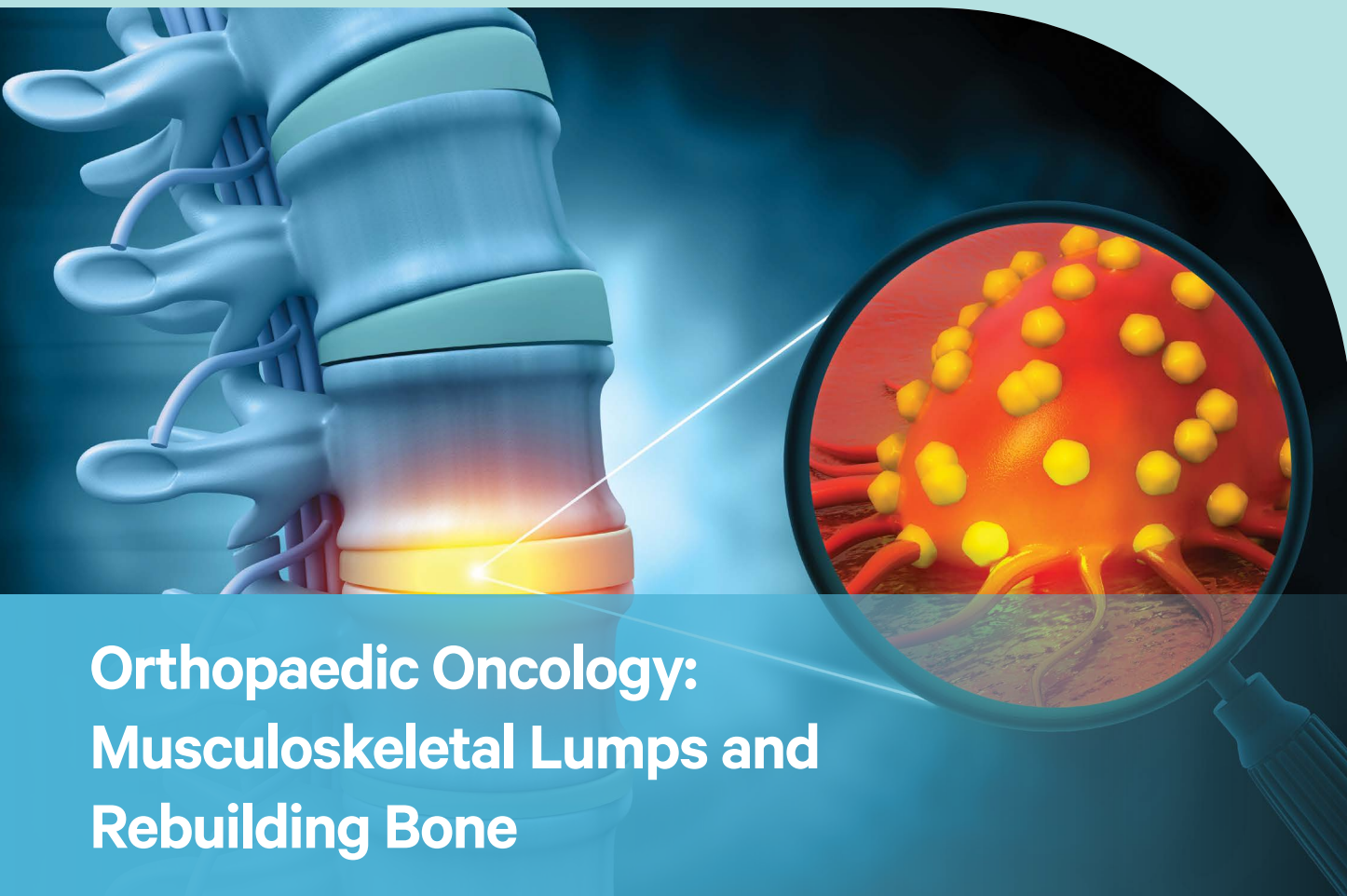
Arnold: Communication is vital in delivering successful coordinated care. This starts with clarifying with the surgeons the requirements for cases. This enables me to coordinate with relevant suppliers and plan additional resources that may be needed for procedures. I then pass relevant information to the nursing staff so they can manage cases more effectively.

What is the most rewarding part of your role?

Sandy: The most rewarding part of my job is seeing a patient walk out of our doors better than they walked in.

Arnold: Although the patients' time in the operating theatre is brief, what makes my role rewarding is knowing that the support that I have provided to the nurses, surgeons, allied health services and ancillary support teams will result in the best possible outcome for patients.





Orthopaedic Oncology: Musculoskeletal Lumps and Rebuilding Bone

An article by Dr Daniel Franks

The vast majority of musculoskeletal lumps are benign.

Lipomas, ganglia, haematomas, cysts and bursae are common presentations in general practice. Sarcomas are primary malignancy of connective tissues and present very similarly to benign musculoskeletal diagnoses. They account for only around 1% of adult cancers. The challenge is identifying the rare malignant lesion amongst the many benign masses encountered in general practice every year.

When should we worry?

Several clinical features should raise suspicion for a soft tissue sarcoma:

- Increasing size
- Larger than 5 cm
- Deep to fascia
- Painful
- Fixed to surrounding structures

A useful rule of thumb is that any lump that is **growing, deep or larger than a golf ball** deserves further investigation.

MRI remains the investigation of choice for suspicious soft tissue masses. Standard for Systemic staging requires PET scan and CT chest. Ultrasound can be useful but should support, rather than replace, clinical judgement. One of the more common pitfalls is the presumed haematoma without a convincing history of trauma, particularly if it continues to enlarge.

For bone lesions, plain radiographs remain invaluable. Aggressive features such as cortical destruction, periosteal reaction or an associated soft tissue mass should prompt specialist review.

Why the first procedure matters

In musculoskeletal oncology, emphasis is placed on the importance of the first biopsy and the first operation. An inadvertent excision of a sarcoma,

sometimes referred to as a “whoops lesion”, can complicate subsequent surgery and compromise limb salvage options. Similarly, biopsy incisions need to be planned carefully so that they can be incorporated into definitive surgery if required. Such careful planning can prove to be the difference between limb salvage and amputation. For this reason, suspicious lesions are best referred before biopsy or excision. The majority of referrals to an orthopaedic tumour service ultimately prove benign, which is entirely appropriate if it allows earlier diagnosis of the malignant minority.

Recognising suspicious lump and early referral to an appropriate service is the main way in which primary care physicians can improve outcomes for these rare tumours.

Rebuilding Bone

Following tumour resection, we are often faced with major defects involving bone, joints and soft tissue.

Modern megaprotheses can replace large sections of bone around the hip, knee and shoulder, allowing limb salvage in situations that previously required amputation. These technologies are increasingly being used not only for tumours, but also for severe trauma, failed arthroplasty and complex revision surgery.

For some defects, however, standard implants are simply not enough.

Patient-specific 3D printed reconstruction

The pelvis represents one of the greatest reconstructive challenges in orthopaedic surgery. Every tumour and every defect is unique.

Using high-resolution CT imaging, a virtual reconstruction of the patient's anatomy is created and the planned resection performed digitally before surgery. Custom implants can then be designed to recreate the defect, restore hip biomechanics and optimise fixation to the remaining bone.

Patient-specific cutting guides, porous ingrowth surfaces and pre-planned screw trajectories allow reconstructions that were previously simply not possible.

These operations remain complex and carry substantial risks, but advances in implant design, imaging and manufacturing continue to expand what can be achieved with limb salvage surgery.

Take Home Message

The best opportunity to improve sarcoma outcomes is often early recognition and appropriate referral.

An enlarging, deep or unusual lump should be investigated before excision.

For patients requiring major tumour surgery, modern reconstruction increasingly allows us not simply to remove disease, but to restore function and preserve mobility.

**Hear more from
Dr Dan Franks
from our recent
Orthopaedic
Webinar here:**



Dr Daniel Franks

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Dr Franks has seven years of experience as a consultant Orthopaedic surgeon, during which time he has developed a strong focus on hip and knee arthroplasty, including complex reconstruction, and revision surgery. He is also experienced in the management of bone and soft tissue tumours, as an integral member of the NSW multidisciplinary care pathway.

Dr Franks is particularly interested in the design and development of 3D-printed prostheses, aiming to create patient-specific, cost-effective, and durable solutions. In parallel, he is engaged in robotic joint surgery, investigating how robotic assistance can improve surgical precision, alignment, and reproducibility, ultimately leading to better clinical outcomes for patients.

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Acute Hand and Wrist Trauma: Recognising Injuries That Require Urgent Referral

An article by Dr Michael Strong

Hand injuries are among the most common musculoskeletal presentations encountered in general practice, urgent care and emergency departments. While many can be managed conservatively, certain injuries require early recognition and specialist referral to optimise functional outcomes. Delayed diagnosis can result in infection, tendon retraction, nerve scarring, fracture malunion or permanent nail deformity, making later reconstruction considerably more difficult.



The key for primary care clinicians is recognising the injuries where timely referral can significantly alter long-term hand function.

One of the most commonly underestimated injuries is the nail bed laceration. These frequently occur following crush injuries and are often associated with distal phalanx fractures. A disrupted nail plate or nail bed laceration associated with a distal phalanx fracture should be considered an open fracture requiring specialist assessment. Early repair of the nail bed can minimise the risk of permanent nail deformity and improve both functional and cosmetic outcomes.

Similarly, animal and human bites to the hand should never be considered trivial. Even a seemingly minor puncture wound, particularly from a cat bite, may penetrate a tendon sheath, joint or deep fascial space, allowing infection to progress rapidly. While clenched-fist injuries are encountered less frequently in private practice, human bites over the metacarpophalangeal joints still deserve particular caution, as extensor tendon injury and joint penetration are easily overlooked. Early irrigation, appropriate antibiotics and prompt referral are essential; delayed treatment often results in operative debridement, tendon reconstruction or prolonged intravenous antibiotic therapy.

Lacerations involving the hand and wrist require careful assessment for tendon and nerve injury. Inability to actively flex or extend a finger following a laceration should always raise suspicion of tendon injury. Equally important is documenting sensation in the digital nerve distribution, as patients often focus on the wound itself and numbness may go unnoticed unless specifically examined. Digital nerve injuries are not usually middle-of-the-night emergencies, but timely referral allows primary repair before scar formation complicates reconstruction, offering the best chance of sensory recovery and reducing the risk of a painful neuroma.

Fractures of the hand and wrist also warrant careful evaluation. While many stable fractures can be managed non-operatively, certain patterns require early specialist review. Rotational deformity is a particularly important clinical finding, as even minor malrotation can produce substantial functional impairment. The deformity often becomes more apparent with finger flexion, making assessment through a full range of motion more informative than inspection in extension alone. Open fractures, unstable intra-articular fractures, fracture-dislocations and significantly displaced fractures should also prompt early referral. In the wrist, persistent pain following trauma despite normal initial radiographs should raise suspicion for an occult scaphoid or perilunate injury, both of which are frequently missed and can have significant long-term consequences if diagnosis is delayed.

Thumb ulnar collateral ligament injuries ("skier's thumb") should also be considered following a fall onto an abducted thumb. A Stener lesion prevents ligament healing and requires surgical repair. Significant metacarpophalangeal joint laxity or persistent instability should prompt early specialist referral rather than prolonged immobilisation.

Perhaps the most important lesson in hand trauma is that the size of the wound rarely reflects the severity of the underlying injury. A seemingly innocuous laceration may conceal tendon, nerve or vascular damage, or even an open fracture, while a small puncture wound from an animal bite can progress to a deep space infection requiring multiple operations. Careful examination of tendon function, digital sensation and finger alignment will identify the majority of significant hand injuries.

At Sydney Adventist Hospital, patients with acute hand and wrist injuries benefit from an integrated service incorporating the Emergency Department, advanced imaging and specialist hand surgery. With rapid access to operating theatres, operative microscopy and microsurgical expertise, the hospital is well equipped to manage complex tendon, nerve, vascular and fracture injuries requiring timely intervention. Hand surgeons at the San are always happy to discuss borderline presentations or provide advice regarding specific patients when required.

For many hand injuries, the ultimate outcome is determined less by the size of the wound than by the timing of diagnosis and referral. Early recognition remains the most important step in preserving hand function and helping patients return to work, sport and everyday activities as quickly as possible.



Dr Michael Strong

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Dr Michael Strong is an Orthopaedic Surgeon subspecialising in Hand, Wrist and Peripheral Nerve Surgery. He graduated from the University of Newcastle and completed orthopaedic surgical training across multiple large training hospitals in NSW and ACT. After becoming a Fellow of the Royal Australasian College of Surgeons (RACS) and the Australian Orthopaedic Association (AOA) Dr Strong completed two years of vigorous hand and wrist surgical fellowships as part of the Post-Fellowship Education and Training (PFET) program through the Australian Hand Surgery Society.

Dr Strong has developed an interest in managing hand and wrist trauma, in particular fractures and injuries around the wrist.

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Practical considerations for sports injury imaging

An article by Dr Toos Sach

Introduction

Sport provides important physical, social and developmental benefits for children and adolescents. It also accounts for a significant proportion of acute and chronic musculoskeletal presentations in general practice.

Most sports-related injuries improve with activity modification, rehabilitation and clinical follow-up. Imaging is particularly valuable where an occult fracture, physeal injury, internal joint derangement or osteochondral lesion is suspected.

Selecting the appropriate initial and follow-up imaging can clarify and assess the cause of symptoms and support directing management, specialist referral and return-to-sport planning.

Imaging considerations in the growing skeleton

Injury patterns in children and adolescents may differ from those seen in skeletally mature patients. Forces that might produce a ligament or tendon injury in an adult may instead affect the physis, apophysis or incompletely ossified bone.

Growth plates and apophyses are particularly susceptible during periods of rapid growth. Avulsion injuries may occur at tendon attachments, particularly around the pelvis, knee and elbow, while some fractures and osteochondral injuries may be subtle or occult on initial radiographs. Persistent focal pain, swelling or reduced function following normal or inconclusive radiographs may therefore benefit from clinical reassessment and further imaging.

Selecting the imaging modality

Modality	Common Applications in Sports Injury
X-RAY	Suspected fracture, dislocation, avulsion injury, physeal injury or alignment abnormality
ULTRASOUND	Selected superficial tendon or muscle injuries, fluid collections and dynamic assessment
MRI	Occult fracture, microtrabecular fracture (bone bruising), physeal injury, osteochondral injury and meniscal, ligamentous or other internal joint derangement

Radiographs remain the usual initial examination where there is focal bony tenderness, deformity, significant swelling, inability to weight bear or concern for fracture, dislocation or avulsion injury.

A normal radiograph does not exclude an occult fracture, bone contusion, cartilage injury or soft-tissue internal derangement. MRI provides detailed assessment of bone marrow, physes, cartilage, menisci, ligaments, tendons and muscles without ionising radiation.

MRI may assist where there is:

- Ongoing clinical concern despite normal or inconclusive radiographs
- Suspected occult fracture or bone contusion
- Significant joint effusion following trauma

- Locking, catching or instability
- Suspected meniscal, ligamentous or osteochondral injury
- Persistent pain or functional limitation
- A clinical decision regarding rehabilitation, specialist referral or return to sport

Clinical information that supports tailored imaging

Mechanism and date of injury; precise site of pain or tenderness; timing of swelling or effusion; weight-bearing or functional limitation; mechanical symptoms or instability; restriction of movement; previous injury or surgery; and the principal clinical concern.

Example: Acute twisting injury while playing soccer, with immediate knee swelling, lateral joint-line tenderness and reduced extension. Query internal derangement.

This information allows the examination to be tailored and the report to address the clinical question more directly.

Acute knee injury in the young athlete

MRI is frequently used in the assessment of acute and persistent knee symptoms in young athletes.

A large or rapidly developing effusion following a twisting injury raises the possibility of significant internal injury. Relevant considerations include anterior cruciate ligament injury, meniscal tear, osteochondral injury, patellar dislocation and occult fracture.

Radiographs are generally appropriate where there is focal bony tenderness, substantial effusion, inability to weight bear or concern for fracture. When radiographs are normal or inconclusive and internal derangement remains suspected, MRI provides comprehensive assessment of the intra-articular structures and subchondral bone.

Clinical features that commonly suggest MRI assessment

- Immediate or substantial swelling following a twisting injury
- Loss of full extension
- Mechanical locking or catching
- Recurrent giving way or instability
- Persistent joint-line tenderness
- Suspected cruciate ligament injury
- Ongoing pain and functional limitation despite initial management.

Following a first-time patellar dislocation, MRI may demonstrate an osteochondral injury or intra-articular fragment not evident on radiographs. Outpatient MRI can generally be arranged without delaying immediate management.

A locked knee, marked instability, neurovascular abnormality or clinically significant fracture requires urgent orthopaedic or emergency assessment rather than routine outpatient imaging.



Dr Toos Sach

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Dr Sach joined the team at San Radiology & Nuclear Medicine in April 2020 and was appointed to the role of Clinical Director in April 2021, which he held until March 2023. Dr Sach's subspecialisation extends to musculoskeletal imaging, neuroradiology and interventional radiology.

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Persistent wrist pain following a fall

Falls onto an outstretched hand are common across many sports. Scaphoid fracture is an important consideration in older children and adolescents with anatomical snuffbox tenderness, scaphoid tubercle tenderness or pain on axial loading of the thumb.

Dedicated scaphoid radiographs are the appropriate initial examination. Negative radiographs do not completely exclude a scaphoid fracture where clinical suspicion remains.

In this setting, immobilisation, clinical review and further imaging may be appropriate. MRI provides sensitive assessment for an occult scaphoid fracture and may also identify an alternative cause of persistent wrist pain.

A negative MRI may support earlier discontinuation of immobilisation, while confirmation of a fracture facilitates appropriate treatment and follow-up. The under-16 Medicare wrist MRI item requires prior radiographic examination and suspected scaphoid fracture.

GP-requested Medicare-eligible MRI for patients under 16

GPs can request several Medicare-eligible MRI examinations for patients under 16 years of age. Eligibility depends on the clinical indication meeting the relevant Medicare Benefits Schedule criteria and the examination being performed on eligible MRI equipment.

Region & MBS Item	Eligible Indication
KNEE 63513	Internal joint derangement in a patient under 16. Prior radiography is not required by the item descriptor.
ELBOW 63519	Following radiography, where a significant fracture or avulsion injury that would change management is suspected.
WRIST 63522	Following radiography, where a scaphoid fracture is suspected.
SPINE 63510	Following radiography for significant trauma, unexplained neck or back pain with neurological signs, or unexplained back pain where significant pathology is suspected.
HIP 63516	Following radiography, where septic arthritis, slipped capital femoral epiphysis or Perthes disease is suspected.

Key Points

- Injury patterns in the growing skeleton may involve the physis, apophysis or incompletely ossified bone.
- Radiography remains the usual initial examination where fracture, dislocation or avulsion injury is suspected.
- Normal radiographs do not exclude occult fracture, osteochondral injury or internal joint derangement.
- MRI is particularly useful for traumatic effusion, mechanical symptoms, instability and persistent focal symptoms.
- GPs can request Medicare-eligible MRI for selected indications in patients under 16 years of age.
- Clinical information regarding the mechanism, examination findings and principal concern supports tailored imaging and a focused radiology report.