

FOCUS ON VITAMIN D

by Dr Bevan Hokin

INTRODUCTION

Rickets was a common condition that all but disappeared once foods were fortified with vitamin D. Rickets is only the 'tip of the vitamin D-deficiency iceberg', with vitamin D deficiency remaining common in children and adults. In utero, vitamin D deficiency can cause growth retardation and skeletal deformity and increase the risk of hip fracture in later life. In adults, deficiency can precipitate or exacerbate osteopænia and osteoporosis, cause osteomalacia and muscle weakness. Of great interest is the role vitamin D can play in decreasing the risk of many chronic illnesses, including common cancers, autoimmune diseases and cardiovascular disease.

METABOLISM OF VITAMIN D

Vitamin D occurs in two forms, cholecalciferol, or vitamin D3, and the plant-derived ergocalciferol, or vitamin D2. These two forms are biologically equivalent in human beings. For most ambulatory people, the majority of the vitamin D in the body is derived from the action of ultraviolet B light on 7-dehydrocholesterol in the skin, converting it to previtamin D3, which, at body temperature, thermally isomerises into vitamin D3. A smaller proportion of vitamin D comes from dietary sources. Vitamin D made in the skin or ingested in the diet is biologically inert and must undergo conversion to 25-hydroxyvitamin D3 (25-OHD) in the liver and then in the kidney to 1,25-dihydroxyvitamin D3 (calcitriol).

NEED FOR VITAMIN D

The recommended daily intake (RDI) of vitamin D is 200 IU for children and adults up to age 50 years; 400 IU for adults 51-70 years; and 600 IU for adults 71 years and older. Without adequate sun exposure, the requirement increases to 800-1000 IU per day for all ages.

SOURCES OF VITAMIN D

Unlike the United States, few foods in Australia are fortified with vitamin D.

Humans get vitamin D from exposure to sunlight, some foods (oily fish, fresh whole milk, butter and margarine (Vitamin D is fat soluble)) and supplements. Table 1

PREVALENCE OF VITAMIN D DEFICIENCY IN AUSTRALIA

Several studies have assessed vitamin D status in Australia and New Zealand. The prevalence of deficiency varies, but is acknowledged to be much higher than previously thought. Deficiency is classified as either marginal (25-OHD levels <50 nmol/L) or frank (25-OHD levels, < 25 nmol/L). The highest rates of frank deficiency occur in dark-skinned, veiled, pregnant women (80%), with similarly high rates found in mothers of infants treated for rickets. Another high-risk group is the elderly, with marginal deficiency rates of 76% in nursing home residents, and 53% in hostel residents. Other studies assessing younger adults have reported marginal deficiency rates of 23% and 43%, with 8% of young women (20-39 years) found to have frank deficiency at the end of winter in Geelong (Victoria, latitude 38°S).

Table 1. Sources of Vitamin D

SOURCES OF VITAMIN D	VITAMIN D CONTENT
Salmon tinned (100 gm)	300-600 IU of vitamin D3
Cod liver oil (1 tsp)	400-1000 IU of vitamin D3
Egg yolk (one)	20 IU vitamin D2 or D3
Fresh whole milk (1 glass 250 mL)	100 IU
Butter (100gm)	50 IU
Margarine per 10 gm	Between 22 and 64 IU
Fortified skim or modified milk (200mL)	400 IU
Fortified Cheese (25 gm)	400 IU
Sun exposure (depending on time of day, season, latitude and skin type). 10 minutes exposure by direct sunlight to the exposed arms and legs	Up to 3000 IU

TREATMENT OF VITAMIN D DEFICIENCY

Children with vitamin D deficiency should be aggressively treated to prevent rickets. A cost-effective method of correcting vitamin D deficiency in children and adults, and maintaining adequate levels is to give patients either 1000 IU of vitamin D3 per day or 3000 IU of vitamin D2 per day. (Holick 2007)

SAMPLE TYPES

Suitable sample types are serum (plain tube) or Li-heparin (green top tube) or EDTA plasma (mauve top tube).

VITAMIN D REFERENCE RANGES

Ideal for general health: > 75 nmol/L
 Minimum for bone health: 50 - 80 nmol/L
 Marginally deficient: 25- 50 nmol/L
 Frank deficiency: <25 nmol/L

CONCLUSIONS

Undiagnosed vitamin D deficiency is common, and 25-hydroxyvitamin D is the barometer for vitamin D status. Serum 25-hydroxyvitamin D is not only a predictor of bone health but is also an independent predictor of risk for cancer and other chronic diseases. Much evidence suggests that the recommended adequate intakes are actually inadequate and need to be increased to at least 800 IU of vitamin D3 per day. It is very difficult to obtain that much vitamin D3 on a daily basis from dietary sources alone. Thus, sensible sun exposure (10 min/day on arms and legs) and the use of supplements are needed to meet the body's vitamin D requirement.

SAH Pathology offers vitamin D testing (25-hydroxyvitamin D). There is an item number for the test.



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References. This update is based primarily on the following papers:
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RADIOLOGY OF THE KNEE

by **Dr Andrew Stuart**

Knee pain is the commonest musculoskeletal GP complaint. The most common presentations relate to acute injury and the more insidious knee pain. Other presentations can relate to specific sites such as anterior or medial knee pain or relate to focal areas of swelling or limitation in range of movement.

Further discussion is on the basis of common clinical presentations.

Acute knee injuries are usually due to sporting injuries. Although x-rays are often unhelpful the presence of a lipohaemarthrosis (a fat/fluid level on a horizontal beam x-ray) may indicate an occult fracture. A bony avulsion from the lateral tibial plateau (Segond fracture), avulsion of the intercondylar tubercle or bony impaction of the lateral femoral condyle may indicate an associated ACL rupture. The presence of a comminuted intra-articular fracture requires CT for pre-op planning.

While CT can define fractures well, MR is better at defining microtrabecular fracture and hence mechanism of injury. The major benefit of MR is however the excellent delineation of soft tissue structures such as ligament, menisci, tendons and cartilage.

Acute traumatic meniscal tears are usually symptomatic and generally vertically orientated. In cases of locking, MR is useful to differentiate pseudolocking from muscle spasm and associated ligamentous injury from torn interposed meniscal fragments.

ACL rupture is associated with long term disability and secondary OA and hence an important clinical diagnosis made harder by muscle spasm. MR probably adds most benefit in diagnosing associated meniscal, ligamentous and osteochondral injuries. MCL tears are common and generally not specifically imaged but well defined on MR.

Transient patellar dislocation is a common acute traumatic injury with instantaneous dislocation and reduction making the clinical diagnosis difficult but easily diagnosed on MR due to a pathognomonic bone oedema pattern.

Rupture of the supporting soft tissue structures of the posterolateral corner of the knee can give rise to marked instability and is a relative orthopaedic emergency requiring prompt MR assessment.

Chronic knee dysfunction can present with pain and locking. The differential diagnosis includes unstable meniscal tears and degenerative osteoarthritis. Plain radiographs will usually define the osteodegenerative knee, while the obvious markedly degenerate knee benefits little from MR. Arthroscopy is also unlikely to add much if the patient is a likely candidate for knee replacement. More equivocal degenerate changes may benefit from MR.

With **chronic meniscal tears** the horizontal or oblique tear involving the posterior third of the medial meniscus is the commonest. Associated degenerative changes such as cartilage degeneration, subchondral oedema, osteophytosis and parameniscal cysts commonly coexist.

Chronically torn ligaments only regain partial strength and may be associated with accelerated degeneration associated with instability or the original cartilage injury.

Subchondral **bone oedema** is generally occult on x-ray and CT but well seen on MR. It provides a good clue to the symptomatic site where there is usually chondral degeneration. MR assessment of **cartilage**, although partially limited, is continually improving. The new **cartigram** technology (now available with new San MR upgrade) promises to add more functional information and is now of

more significance with a new range of surgical options for cartilage pathology.

Palpable masses around the knee joint may be imaged initially with ultrasound. The majority are usually cystic and normally reflect synovial cysts (joint communication), parameniscal cysts (associated with meniscal tears), bursa (friction preventing synovial pockets) and ganglia (representing mucoid degeneration of adjacent structures). Ultrasound allows further guidance for intervention.

Solid focal lesions around the knee are rare and if encountered should be further assessed with MR to exclude malignancies.

Anterior knee pain is more common in the younger patient and most commonly related to the patellofemoral joint. Common conditions include chondromalacia patella (early chondral degeneration in the young), patella tendinosis and Osgood Schlatters disease (largely a clinical diagnosis). Plain radiographs have a limited role but can detect more advanced osteoarthritis. Ultrasound is purely limited to the assessment of the patella tendon for tendinosis. MRI can assess for early cartilage degeneration, osteochondral defect, patellofemoral anatomy and subluxation, patellar tendinopathy and pathology in Hoffa's fat pad. Both dynamic CT and MR have a role to play where maltracking is suspected.

IN GENERAL TERMS

- X-rays are usually the first line of imaging
- Ultrasound is really only useful for extensor tendons and peri-articular swellings
- CT is primarily useful for preoperative planning for comminuted intra-articular fractures
- MR is the gold standard for imaging internal derangement.



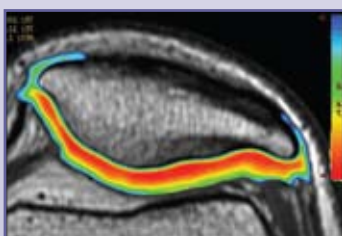
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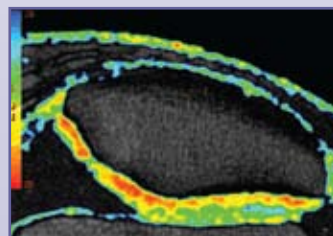
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CARTILAGE T2 MAPPING Images courtesy Hollis G. Potter, Hospital for Special Surgery, NYC. Slides courtesy of GE Healthcare



32 year old subject, no symptoms



52 year old subject, osteoarthritis