Hyperparathyroidism and its implications for podiatric surgery

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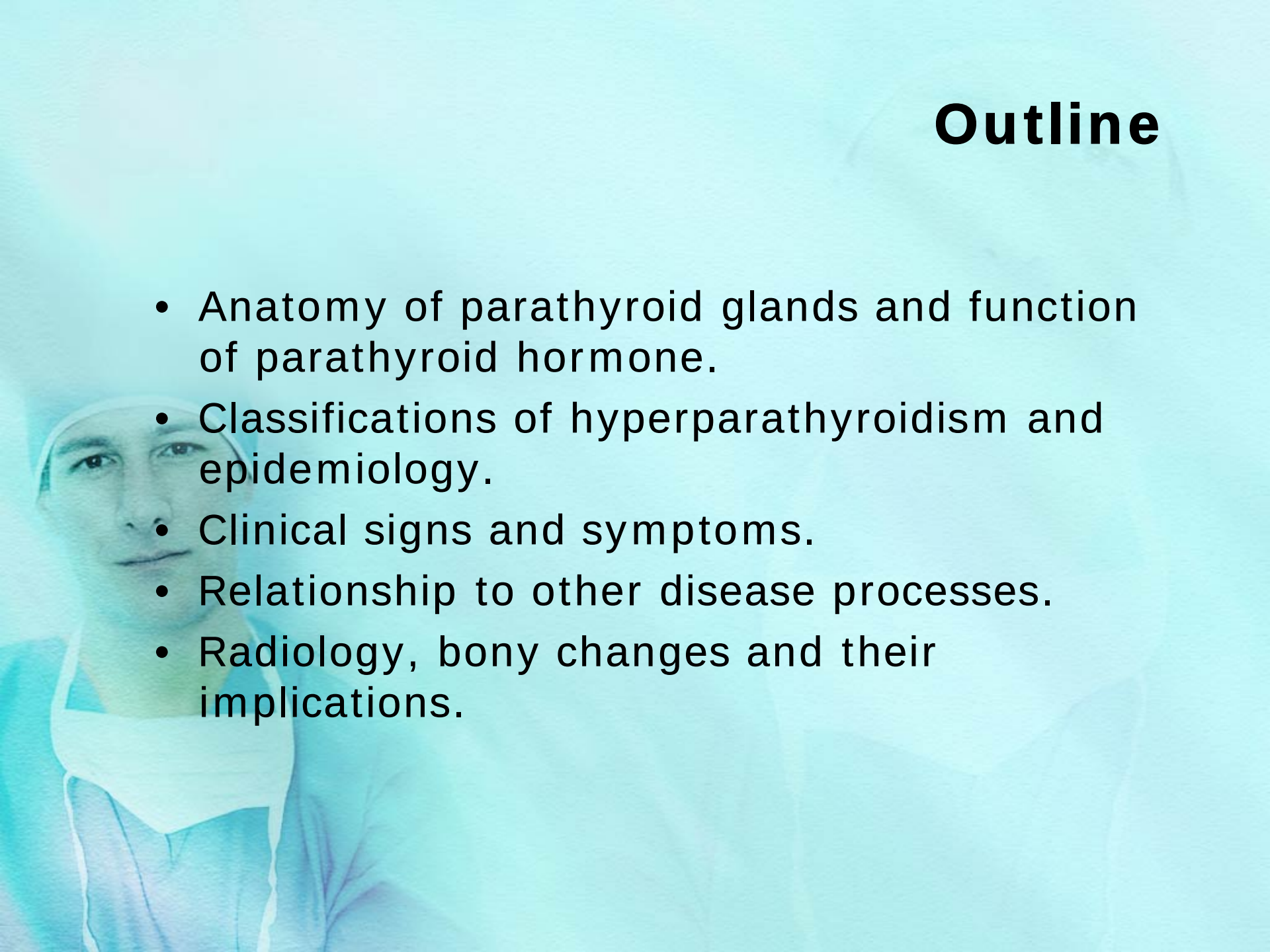
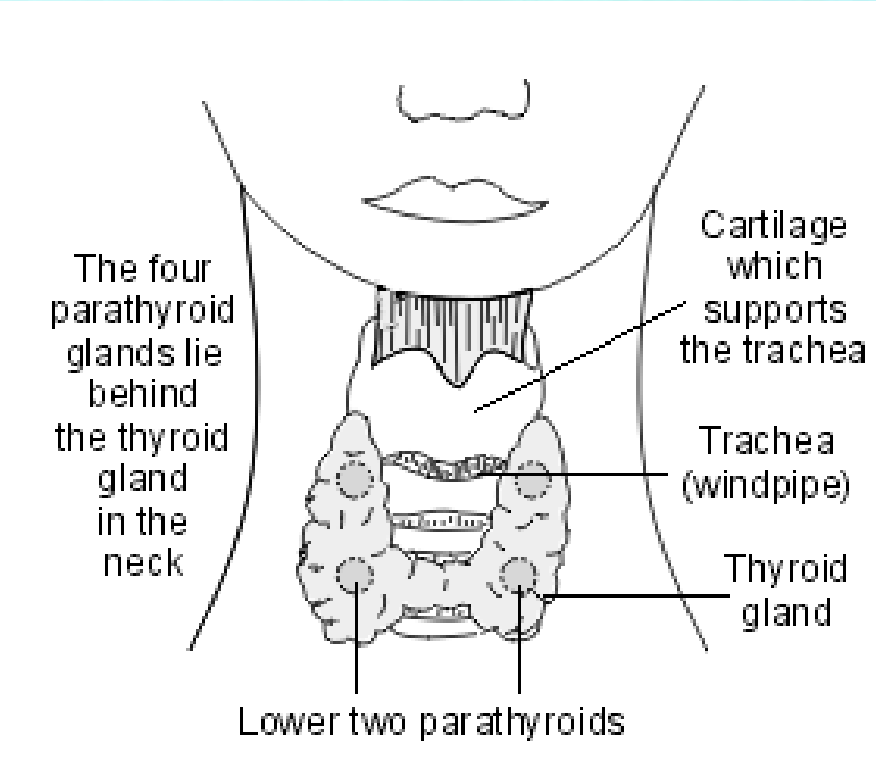
Outline



- Anatomy of parathyroid glands and function of parathyroid hormone.
- Classifications of hyperparathyroidism and epidemiology.
- Clinical signs and symptoms.
- Relationship to other disease processes.
- Radiology, bony changes and their implications.

The parathyroid glands

- 4 of them
- Situated behind the thyroid glands
- Produce parathyroid hormone (PTH)

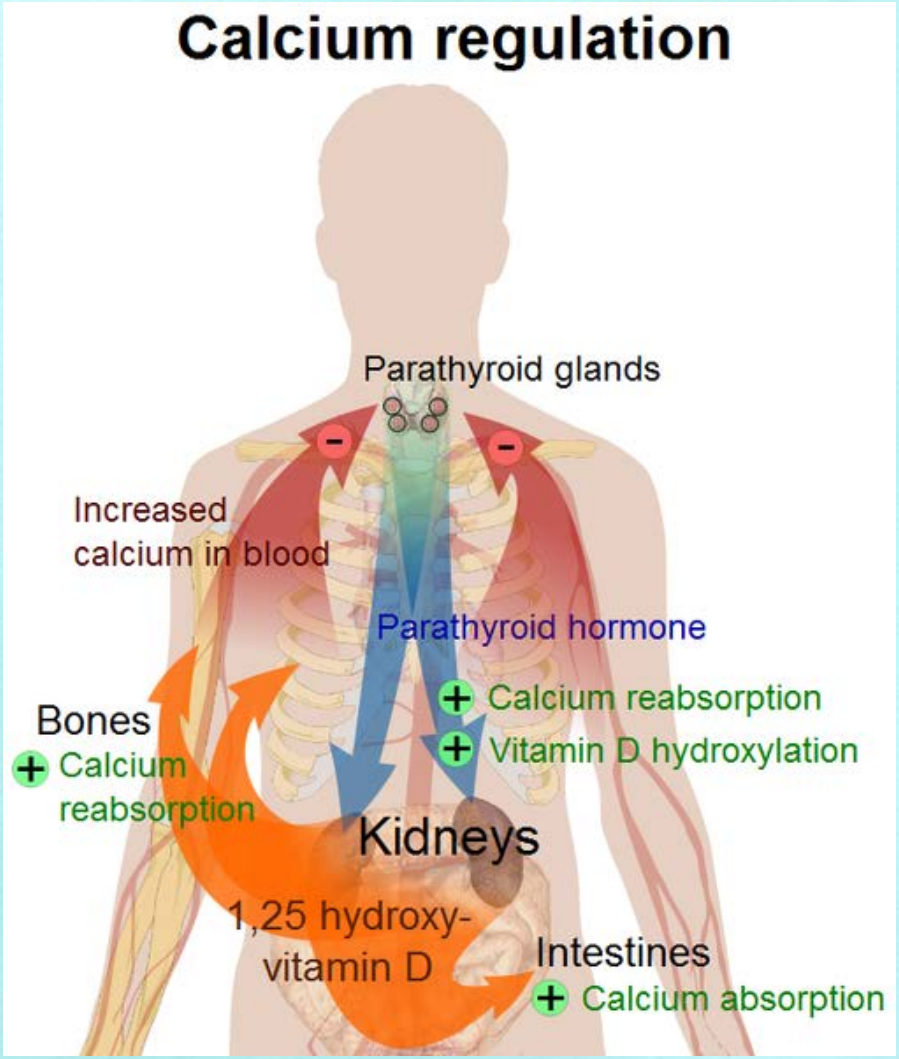


http://www.patient.co.uk/health/Hyperparathyroidism.htm

What does PTH do?

- Regulates:
  - Serum calcium levels
    - Bone
    - Kidney
    - Intestine
  - Serum phosphate
  - Vitamin D synthesis

Coetzee, M., Kruger, M. (2004)
Poole, K.E.S., Reeve, J. (2005)



Walter F., (2003)

Hyperparathyroidism definition

- An abnormal endocrine disorder characterised by hyperactivity of any of the 4 parathyroid glands, with excessive secretion of parathyroid hormone.

  Anderson, D. M. (2002)

- It may be:
  - Primary
  - Secondary
  - Tertiary

  Kumar, Cotran, Robbins (2003)

Epidemiology

- Yu et al. (2009), Tayside, Scotland.
- 2709 patients with PHPT (78% F)
  - Mean age:
    - Female – 68
    - Male – 64
- In 2006 incidence was 6.72 / 1000 overall, greater in postmenopausal women.
- “catch up” in 1970’s due to routine Ca^{2+} screening.
- Previously more severe cases now less so
- BUT incidence of SHPT increasing, due to general increase in kidney disease and specifically DM related nephropathy.

Primary HPT

- **Aetiology**
  - Single adenoma: 85%
  - Multiple adenoma: 5%
  - Hyperplasia: 10%
  - Carcinoma: <1%
- **Parathyroid gland(s) produce excess hormone due to the above.**
- 3rd most common endocrine disorder
- Most asymptomatic or mildly symptomatic

Sanders L. R. (2009)

Secondary HPT

- **Aetiology**
  - Renal insufficiency
    - Kidneys can’t filter phosphates so excess phosphates combine with circulating calcium. **Low calcium levels detected, so more PTH produced to increase levels.**
    - Also, failing kidneys don’t convert enough Vit D to its active form.
  - May also be caused by malabsorption

Fraser, (2009)

Chronic Kidney Disease-Mineral and Bone Disorder

- SHPT is part of a wider syndrome of CKD-M & BD.
- Results in abnormalities of:
  - Calcium, phosphate, vitamin D & PTH
  - Vascular and / or other soft tissue calcifications
  - Bone turnover, mineralisation & volume.
- Impairs quality of life and increases risk of mortality.
- Controlled by medication but progressive.

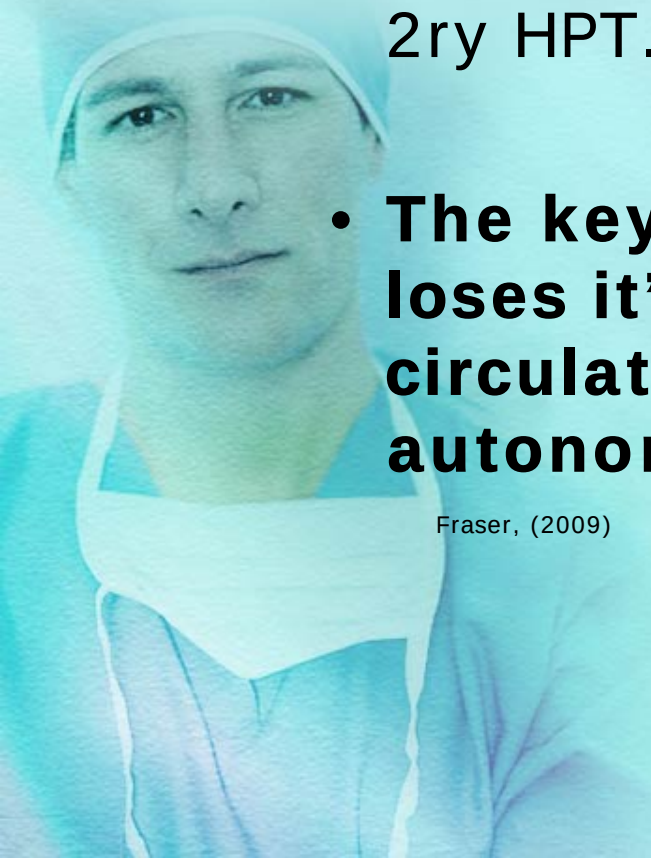
Smith and Smelt (2009)

Renal Osteodystrophy Disorder	Bone Turnover	Bone Mineralization	Bone Volume
Osteomalacia	Low	Abnormal	Low to medium
Adynamic bone disease	Low	Normal	Low to normal
Mild hyperparathyroid-related bone disease and osteitis fibrosa	Medium to high	Normal	Variable, depending on the duration of the disease
Mixed uremic osteodystrophy	High	Abnormal	Normal

Classification of Renal Osteodystrophy/Renal Bone Disease

Moe et al. (2005)

Tertiary HPT



- **Aetiology**
  - Follows persistent parathyroid over activity and hyperplasia, usually due to 2ry HPT.

  - **The key is that the parathyroid gland loses it's responsiveness to levels of circulating Ca^{2+} and begins relentless, autonomous production of PTH.**

Fraser, (2009)

Clinical signs and symptoms

Renal	Hypercalciuria, nephrolithiasis, nephrocalcinosis, polyuria/dipsia, failure.
Neuromuscular	Weakness, myalgia.
Neurologic and psychiatric	Memory loss, depression, psychoses, neuroses, confusion, lethargy, fatigue, paraesthesias.
Skeletal	Bone pain, osteitis fibrosa, osteopaenia/porosis, subperiosteal resorption.
GI	Abdominal pain, nausea, peptic ulcer, constipation, pancreatitis.
Vasculature	Hypertension, hypercalcaemia causes vasoconstriction. Arterial calcification.
Arthralgia, synovitis, arthritis	Deposition of crystals of: calcium phosphate, calcium pyrophosphate, urate.
Blood	Anaemia, ↑HPT, Hypercalcaemia (OR Hypo), Hypophosphataemia (OR Hypo). Alkaline phosphatase may be elevated.
Cornea	Band keratopathy, calcium phosphate precipitation.

Distinguishing the types

	PTH	Ca^{2+}	PO_4^-	Alkaline Phosphatase
1ry	↑	↑	↓	Normal
2ry	↑	↓	↑	May be elevated
3ry	↑ ↑	↑	↓	?

Diagnosis

- Clinical signs and symptoms
  - Could be anything
- Radiographs
  - Bony changes
  - Soft tissue calcification
- Female and over 40
- Presence of associated disease processes
  - Diabetes, kidney dysfunction, gout
- Request bloods

Normal blood values

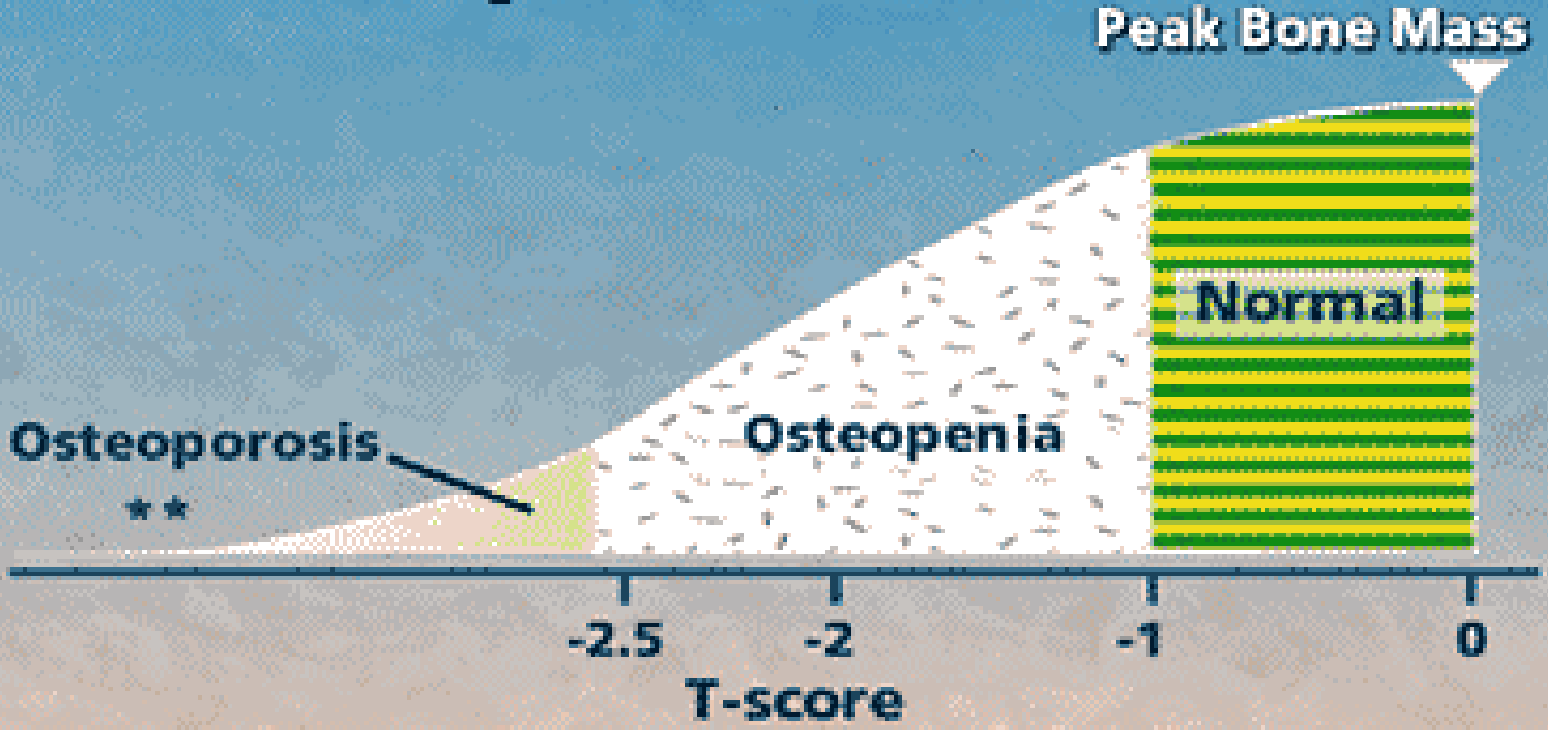
- PTH: 10 - 65ng/l
- Ca^{2+}: 2.25 - 2.75 mmol/l
- PO_4^{3-}: 0.97 - 1.45 mmol/l
- Alkaline Phosphatase: 0.5 - 2.0 microKat/l (Adult)
    - Child / adolescent figures higher.
- All units are SI units.
- Local variations may apply.

Pagana & Pagana (2006)

Osteopenia / porosis

- Many factors
  - Diseases, CRPS, drugs, diet, hormone imbalances, age, activity, smoking, sun, vitamin D deficiency, femaleness, low body weight, late menarche etc.
- Conventional radiographs have low sensitivity, 30 - 50% bone loss required.
- Peripheral bone-mass measurements performed using:
  - DXA, QCT or QUS
- Treatment
  - Removal of parathyroid gland(s) if HPT, reversal of above factors if possible, bisphosphonates

World Health Organization (WHO) Osteoporosis Guidelines



** Severe Osteoporosis = -2.5 + Fracture

World Health Organization. *Guidelines for Preclinical Evaluation and Clinical Trials in Osteoporosis*, 1998.

Radiology

- Generalised osteopaenia
- Cortical thinning
- Fractures
- Subperiosteal resorption (hands and feet; phalangeal tufts, erosions)
- Subligamentous and tendinous resorption (plantar fascia and TA)

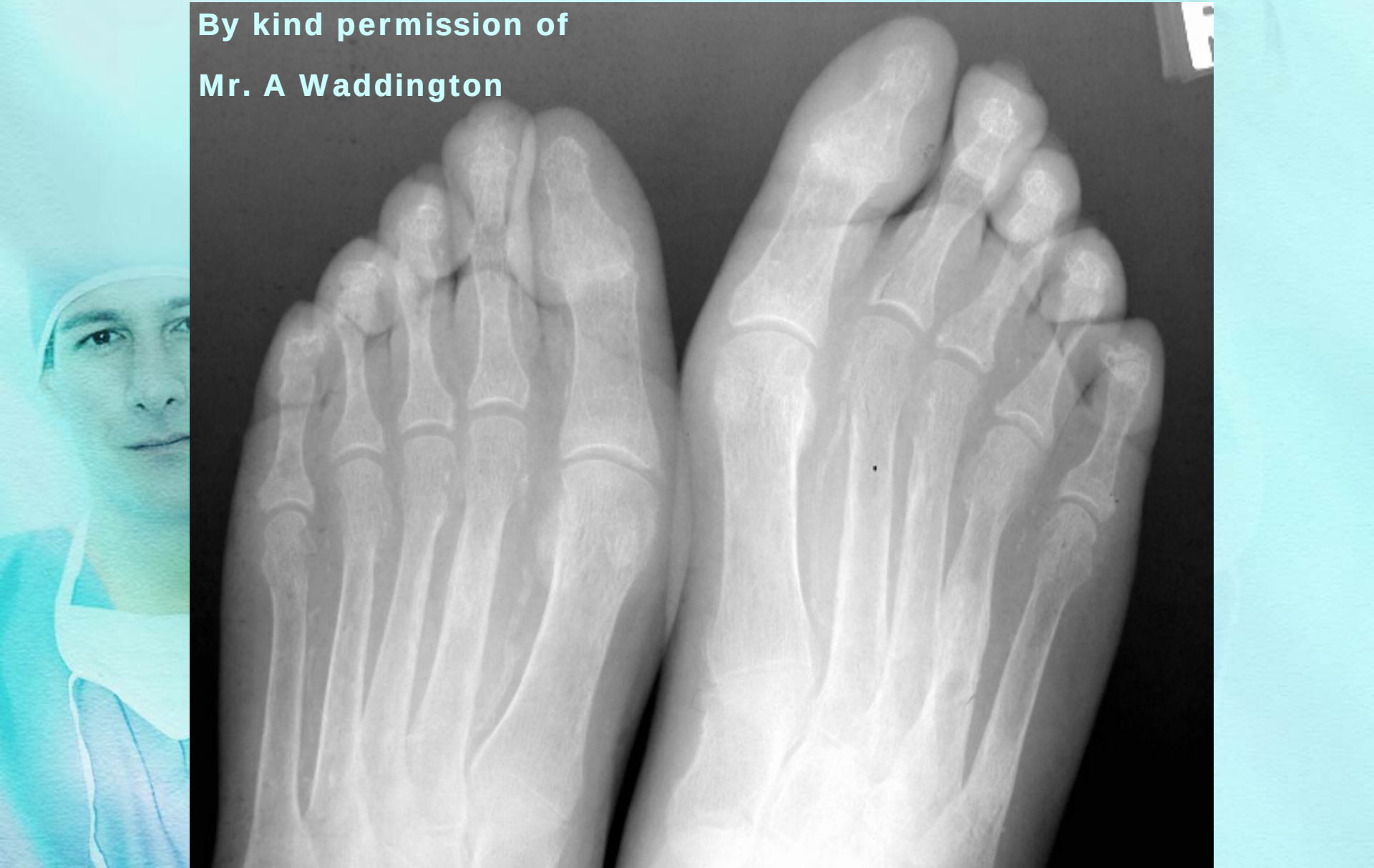
Lenchik & Sartoris (1998).

Radiology

- Sclerosis (spine, 2ry HPT)
- Brown tumours
- Chondrocalcinosis
- ST and vascular calcification (2ry HPT)

- It’s the bony changes due to the disease process that are seen radiologically that are the main direct challenge in podiatric surgery.

Radiology



Fractures / stress fractures

- Insufficiency / pathological fracture
  - Fracture due to normal loading of abnormal bone.
- The foot is a common place for stress fractures:
  - Calcaneus, metatarsals, navicular, other tarsals.
- Demineralisation of bone in HPT make such patients more susceptible to fractures / stress fractures in the foot, .

Fishco & Stiles (1999)

Healing calcaneal stress fracture subsequent to SHPT.

Fishco & Stiles (1999)

Fixation difficulties

- Osteoporosis per sé is not a barrier to fracture healing, although age might be.
- **BUT** Problems include:
  - Thin bone cortices reduce holding power of screws.
    - core diameter, pitch of thread.
  - Risk of further fracture.
  - Instability of fixation materials.
    - Thus, more screws & plates needed which may impair vascularity & healing.
  - May alter choice of procedure.

Strømsøe (2003)

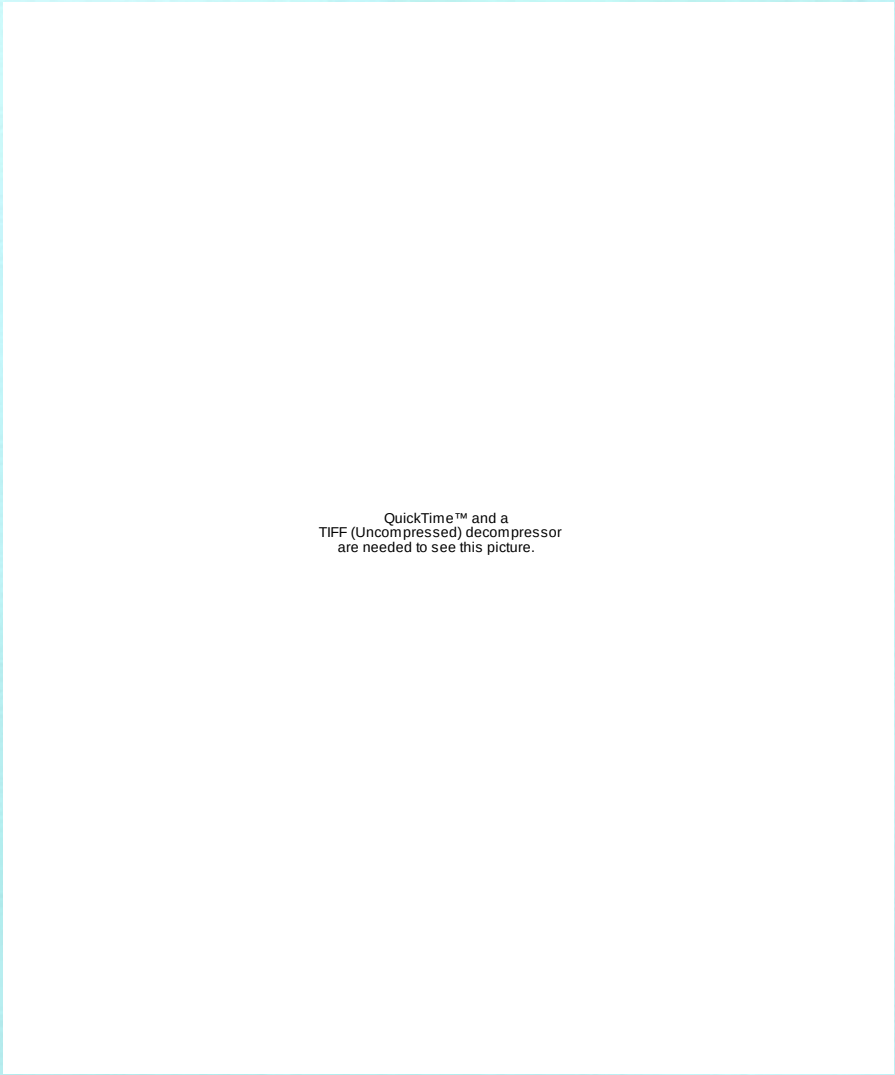
Fixation difficulties

- Reduced holding power of fixations in osteoporotic bone results in 10 – 25% failure rate.
- Fixation devices that share loading with host bone that minimise stress on the device and bone.
- Screws should be placed into cortical bone but parallel to trabeculae.
- Consider use of allografts or fillers like polymethylmethacrylate.

Cornell (2003)

Fixation difficulties

QuickTime™ and a
TIFF (LZW) decompressor
are needed to see this picture.



Weil et al., (2008)

Osteitis Fibrosis Cystica

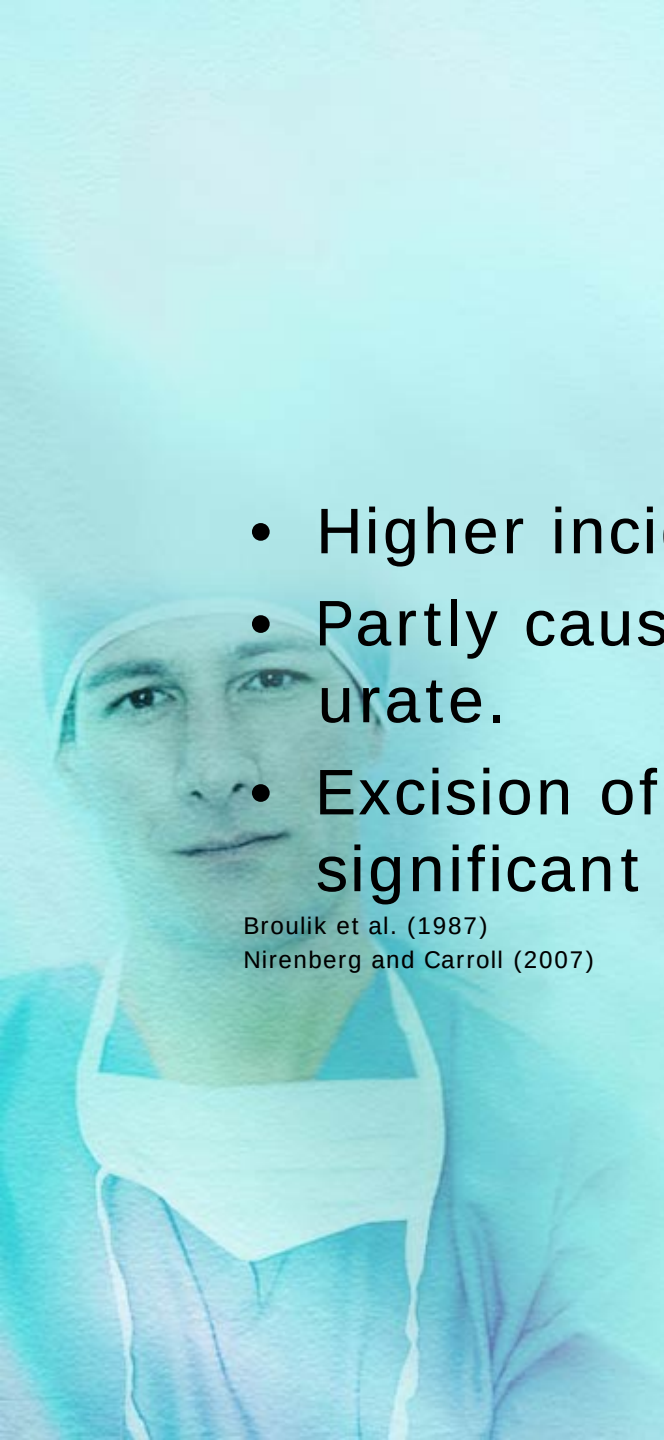
- AKA: Brown Tumours or Von Recklinghausens disease of bone.
- Benign, cystic bone lesions due to osteoclastic resorption, filled with vascularised fibrotic tissue.
- Occurs in: 3% of PHPT patients and 1.5% of SHPT cases.
- Tend to regress following parathyroidectomy.
- Occur in the appendicular skeleton, including the foot, reports of tumours in the calcaneus and metatarsals.

Yazgan (2008)

CT of Brown tumour in Right 3rd metatarsal.

Yazgan (2008)

Gout



- Higher incidence of gout in patients with PHPT.
- Partly caused by reduced renal clearance of urate.
- Excision of parathyroid gland may lead to significant falls in serum urate levels.

Broulik et al. (1987)
Nirenberg and Carroll (2007)

T2 weighted MRI, showing cystic changes of ankle and STJ due to gout subsequent to SHPT.

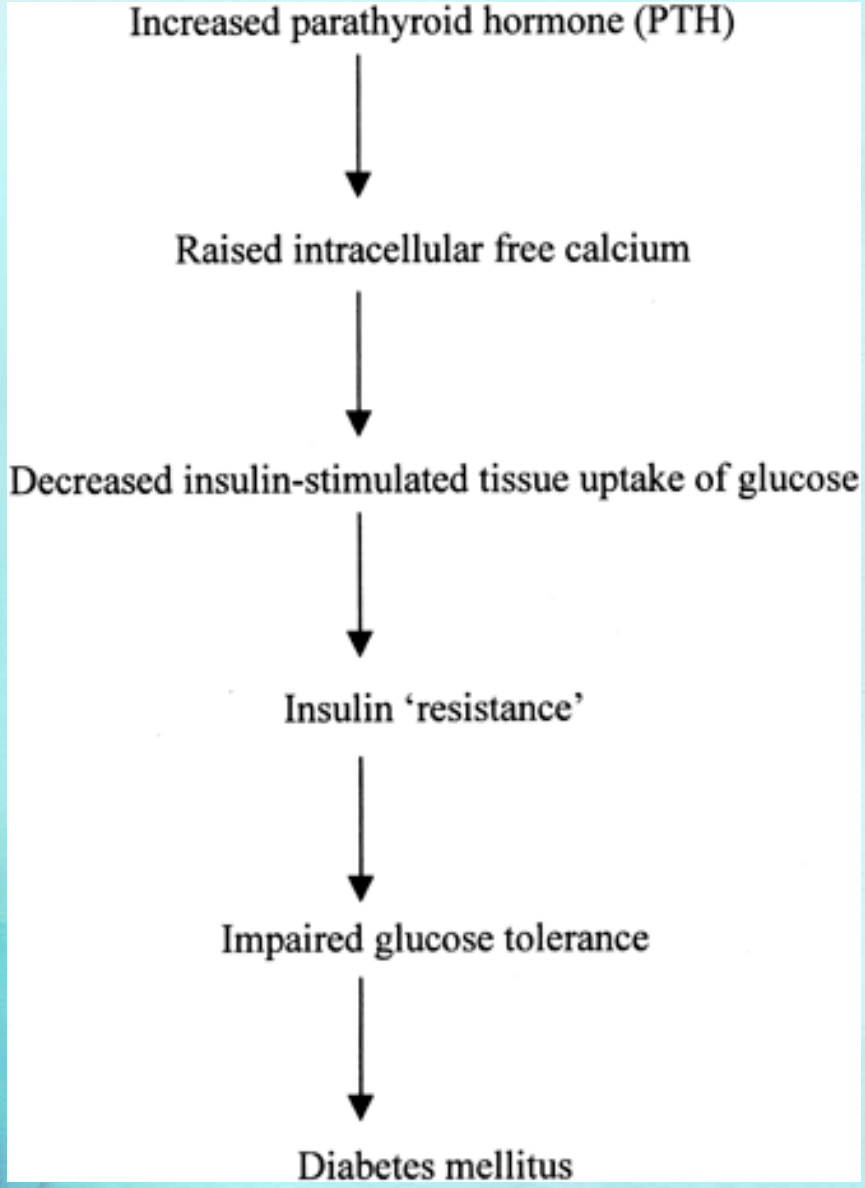
Nirenberg & Carroll (2007)

Diabetes mellitus

- Prevalence of DM in HPT is 8%
- Prevalence of HPT in DM is 1%
  - Both 3X higher than expected in general population.
- Patients with both tend to be:
  - Female and over 40 years old
- Some evidence that parathyroidectomy improves concurrent DM.
- HPT presents 1st = 20%
- DM presents 1st = 40%
- HPT & DM present together = 40%

Taylor and Khaleeli, (2001).

Quin and Gumpert, (1997).



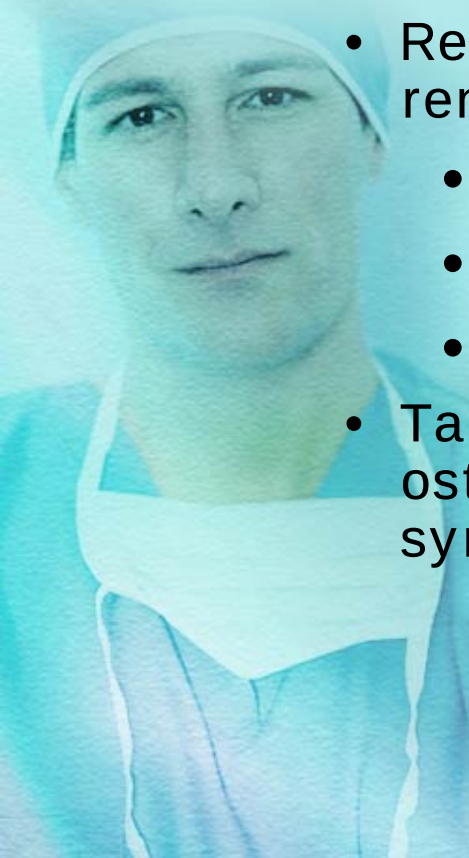
Hypothesis explaining how diabetes might arise in primary hyperparathyroidism

Taylor and Khaleeli (2001)

Other considerations

- Renal pathology of HPT precludes administration of NSAIDs postoperatively.
- Sequelae of HPT include constipation, thus administration of co-codamol precluded?
- Vascular calcification increases risk of intra and post operative bleeding.

Summary



- Not a condition encountered every day in podiatric surgery
- But in patients where it presents it may have direct and indirect implications.
  - Reduced bone density due to leaching of Ca^{2+} / renal osteodystrophy.
    - Fractures / stress fractures
    - Problems with fixation
    - Tendon rupture
  - Take bloods from patients with evidence of osteopaenia on X-ray and who fit profile of symptoms or links with other disease processes?

Summary

- Also, links to: diabetes, gout, brown tumours, all of which may manifest in the foot.
- Fall risk post operatively:
  - Damage to surgery site / fracture.
  - Hip fracture
- Plus, patients may have associated concurrent conditions which may reduce their ASA status and make them a greater surgical risk.
- Delay pod surgery until after parathyroidectomy or controlled with medication?


Have a seat Kermit. What I'm about to tell you might come as big shock...

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