The Royal Orthopaedic Hospital NHS
NHS Trust

Management of bone and soft tissue tumours

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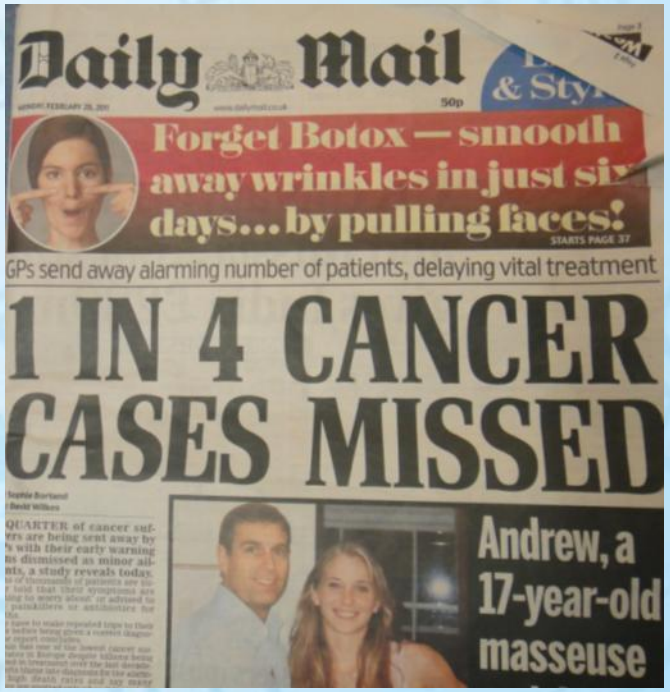
THE ROYAL ORTHOPAEDIC HOSPITAL BIRMINGHAM

Orthopaedic Oncology

- When to be worried
- What to do
- Principles of management
  - Soft tissue lumps and bumps
  - Malignant bone tumours
  - Metastatic bone disease
  - What's new
  - Sarcomas in court

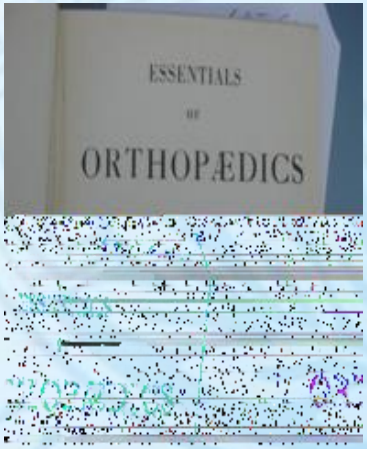


Has the disease changed?

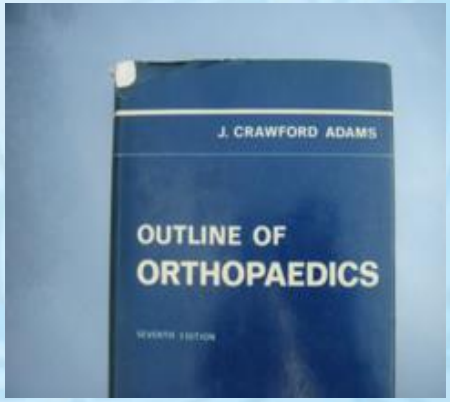
Osteosarcoma 1786– showing skip lesion and the eventual outcome !

Sarcoma Treatment 1976

- Unchanged for years
- Near fatal disease
- Immediate amputation
- 10-15% survival
- RT for palliation



1950



1973

Sarcoma treatment 2018

- Earlier diagnosis
- Centres of excellence
- NICE guidance
- Staging
- Adjuvant therapy (CT +/- RT)
- Limb salvage surgery
- 60%+ survival

THE S BLEM

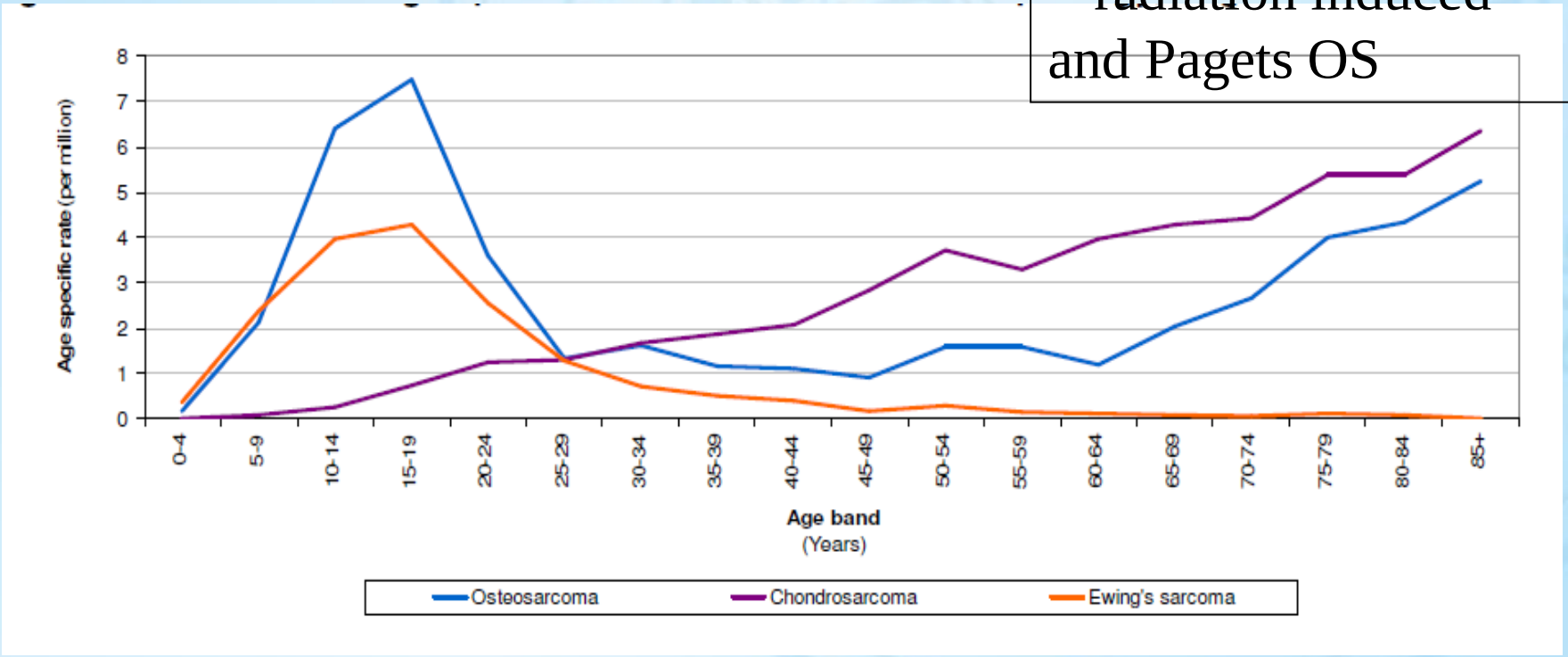
Sarcomas a er – 1% of all

	Size
• Osteosar	10 cm
• Ewing's S	9 cm
• Chondro	11 cm
• Spindle c	10 cm
• Chordom	10 cm
• STS	10 cm
• Metastas	

Bone sarcoma incidence

- Osteosarcoma and Ewings are (mostly) tumours of adolescence
- Chondrosarcoma of adults

2nd peak OS
= radiation induced and Pagets OS



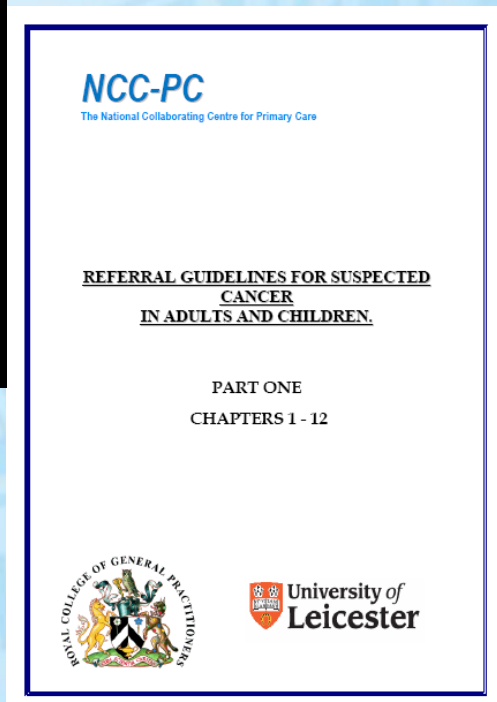
What Guidelines exist?

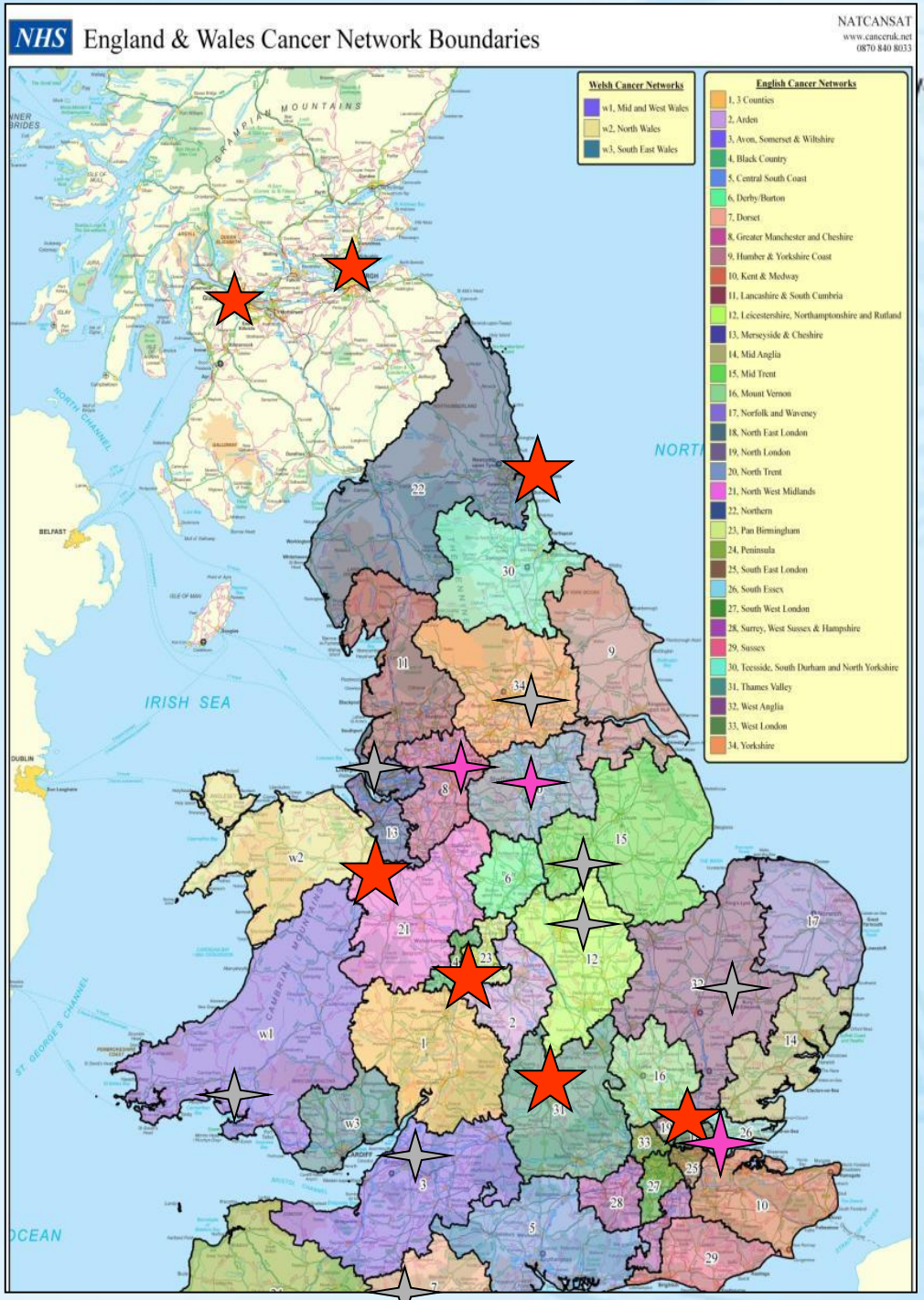
Earlier diagnosis - 2000

NICE early diagnosis – 2005 and 2015

NICE Improving outcomes – 2006

BSG Guidelines on management of bone and soft tissue sarcomas - 2010 and 2016



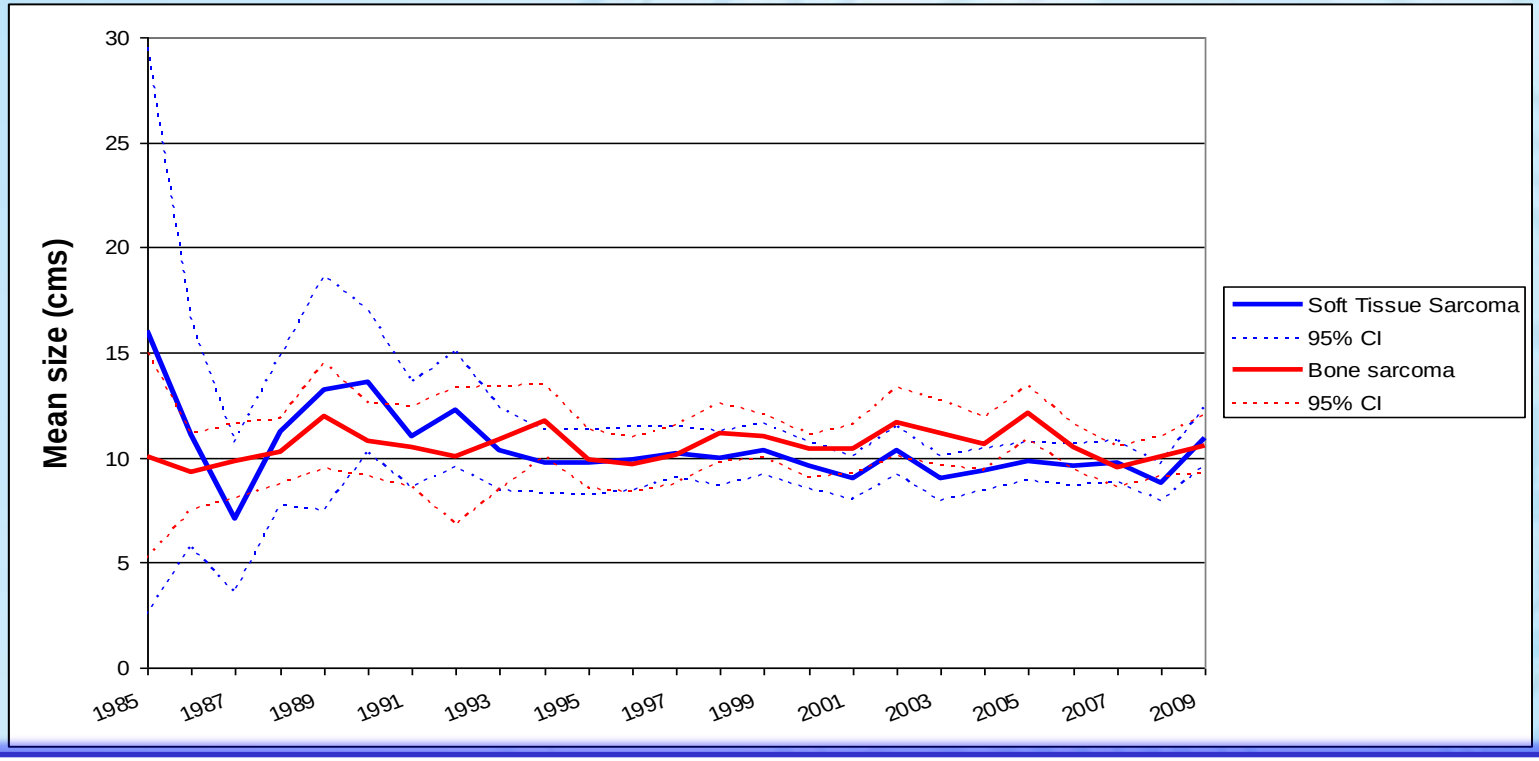


Bone + STS Centre

Large STS Centre

Small STS Centre

Mean size of Sarcomas over 25 yrs



Bone sarcomas - no change, with time
STS – slightly improved – from 10.3cm in 1990s to 9.6cm since 2000
Women present earlier – on average tumours are 0.6cm < in men (p=0.01)

RECOGNISING BONE TUMOURS

Symptoms:

Non Mechanical Pain

Night Pain

Boney swelling

Unexplained limp

Unexplained referred pain

Signs:

Swelling

Tenderness

Radiology:

Bone destruction

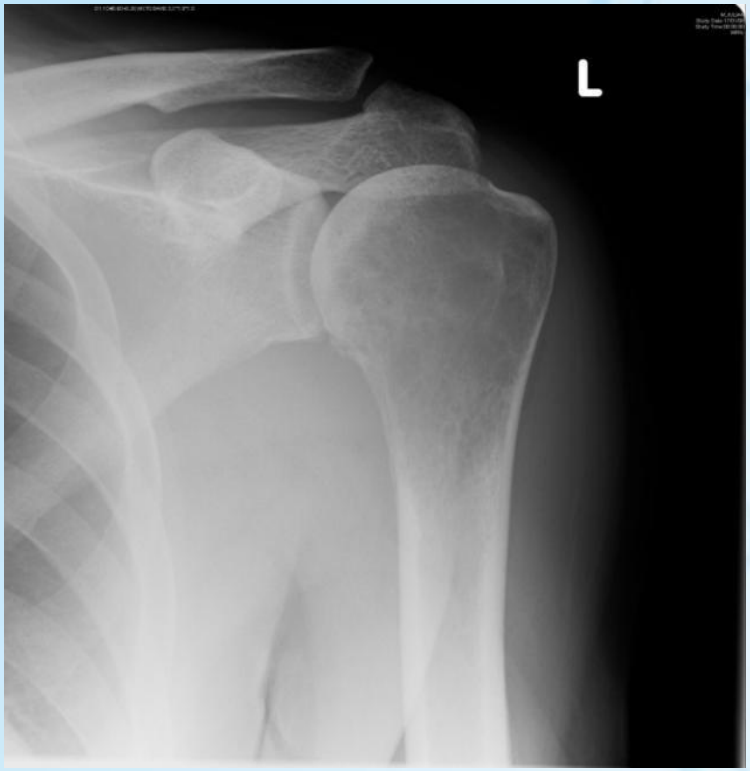
New bone formation

Periosteal elevation

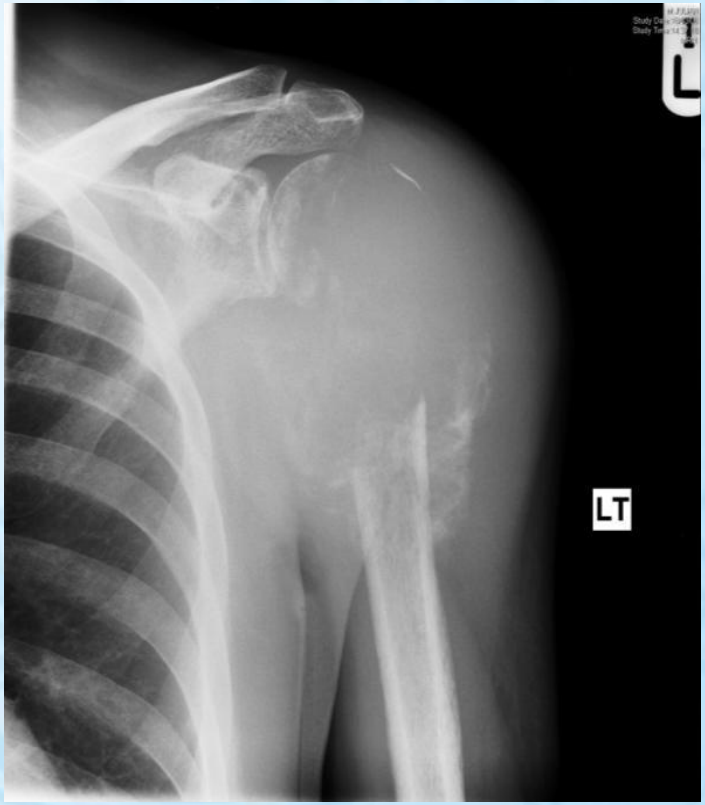
Soft tissue swelling

Any of these suggest possibility of a bone tumour and require further investigation

Painful shoulder 4 months



6 weeks later



Solitary Lesion
No previous malignancy
WHAT DO I DO?

- Is it a metastasis ?
- Is it a primary bone tumour ?
- Should I fix it now and find out what it is later ?

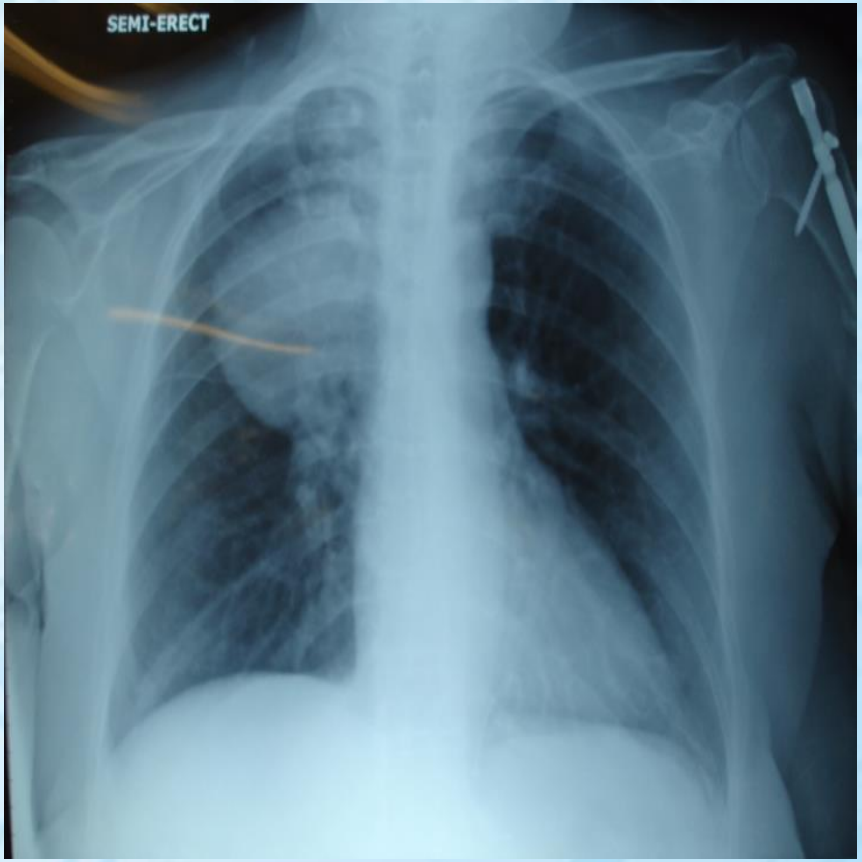
POSSIBLE DIAGNOSES

- Normal (or variant)
- Congenital
- Metabolic
- Inlammatory
- Infective
- Degenerative
- Vascular

- **Neoplastic**
  - Benign
  - Malignant
    - Primary
    - Secondary
      - **Lung**
      - Breast
      - **Kidney**
      - Thyroid
      - Prostate
    - Haematological
      - **Myeloma**
      - Plasmacytoma
      - Lyphoma

How to investigate….

- History
- Examination
- CXR
- Bloods - FBC, ESR, Profile, PSA, Myeloma
- Bone Scan
- CT Chest + Abdo
- MRI lesion
- Biopsy



THE JOURNAL OF BONE & JOINT SURGERY (BJ)

■ ASPECTS OF CURRENT MANAGEMENT

Earlier diagnosis of bone and soft-tissue tumours

R. J. Grimer,
T. W. R. Briggs

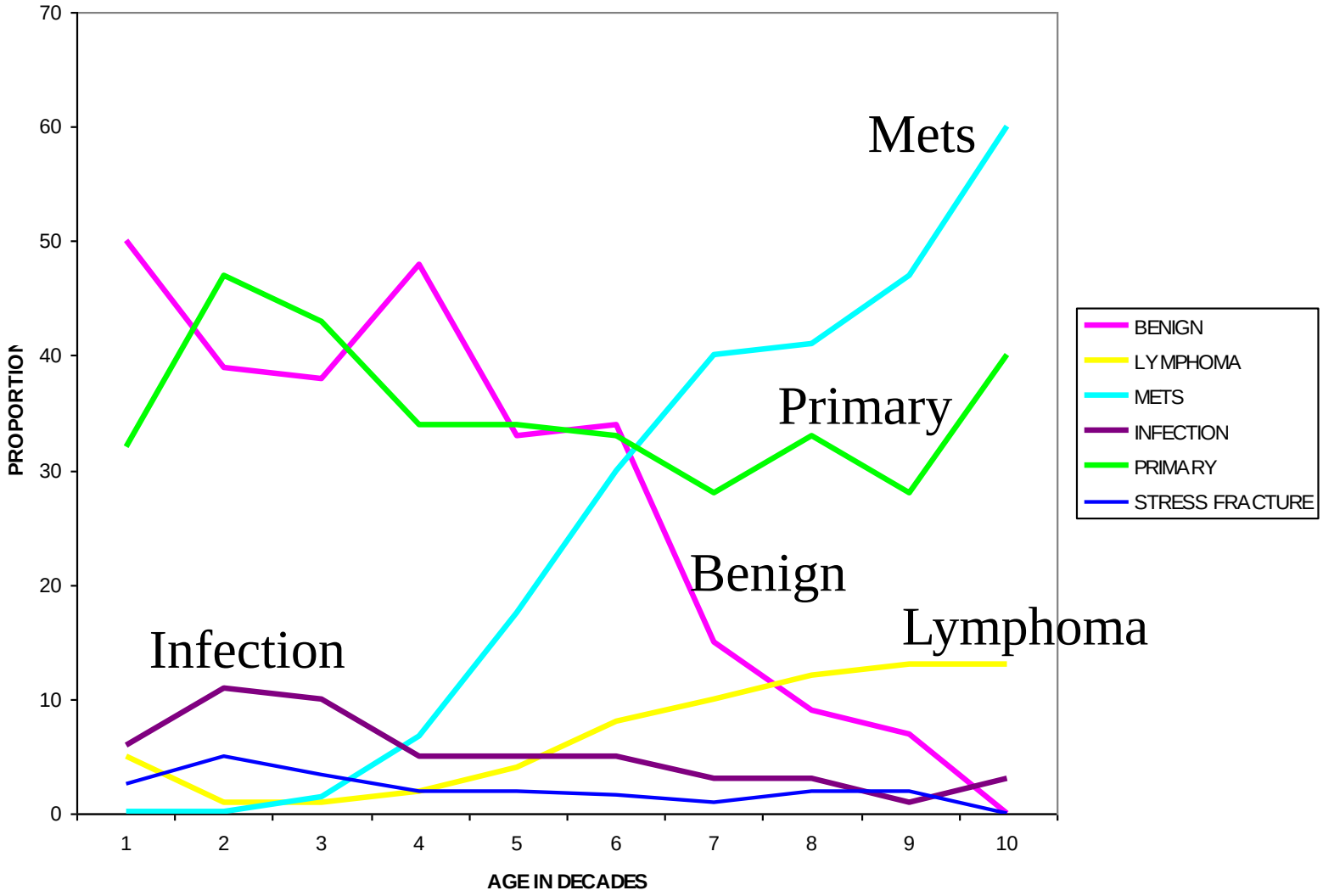
From the Royal Orthopaedic Hospital, Birmingham, and the Royal National Orthopaedic Hospital, London,

Fig. 2

Algorithm for investigating a suspicious bone lesion.

JBJS 2010; 92-B: 1489-92.

WHAT 'FUNNY' BONES TURNED OUT TO BE! (n=2000)



Have a high level of suspicion…

6 weeks of ache – “it broke while I was shutting the curtains…”

So don't go and mess it up….

3 months

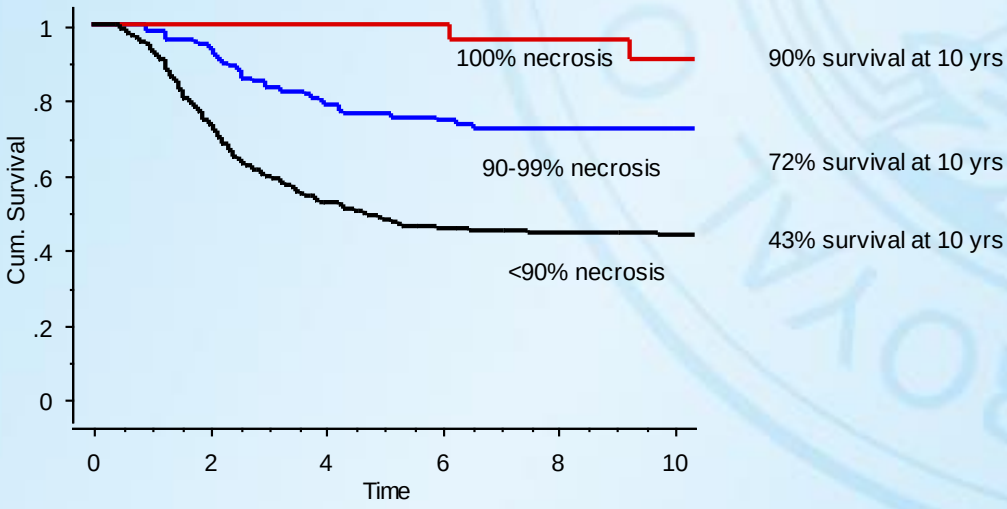
8 months = telangiectatic osteosarcoma

Osteosarcoma

- Most common primary bone tumour
- 150/ yr, mostly adolescents
- Increasing incidence of radiation induced OS following RT for other cancers
- Typically around knee (femur, tibia)
- Present with increasing pain, limp, occassionaly fracture
- XR= lytic / sclerotic / periosteal elevation
- Several different subtypes – parosteal, periosteal, low grade central, telangiectatic

Osteosarcoma Rx

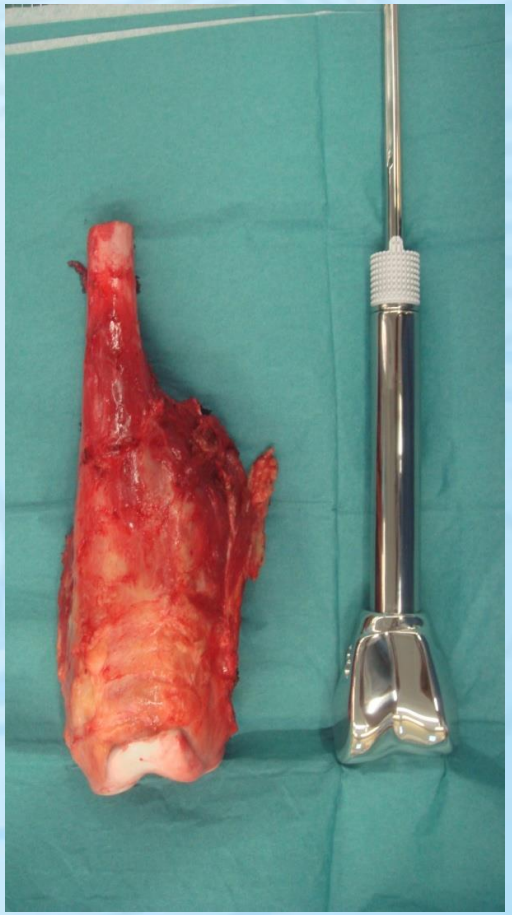
- Neoadjuvant chemotherapy
- (Adriamycin, MTX, Cisplatin, Ifosfamide)
- Resect tumour @ 10 wks
- Limb salvage in 85-90%
- Assess necrosis = very good prognostic indicator

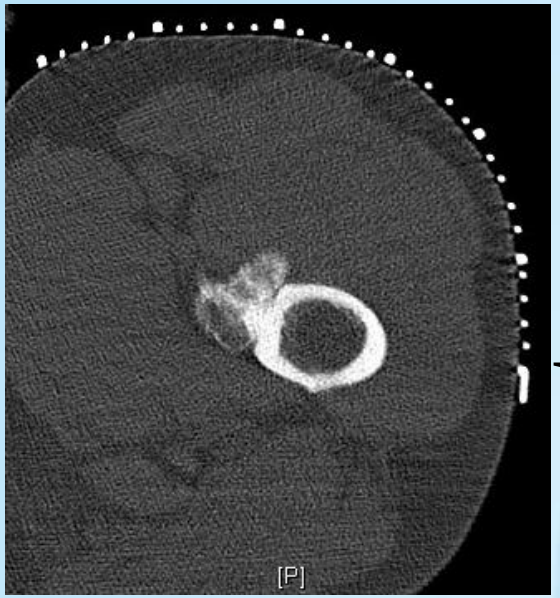


90% survival at 10 yrs

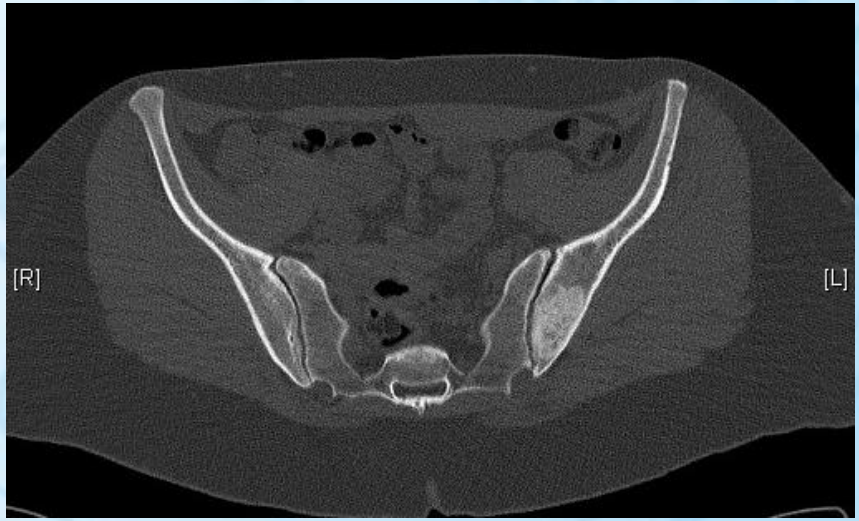
72% survival at 10 yrs

43% survival at 10 yrs

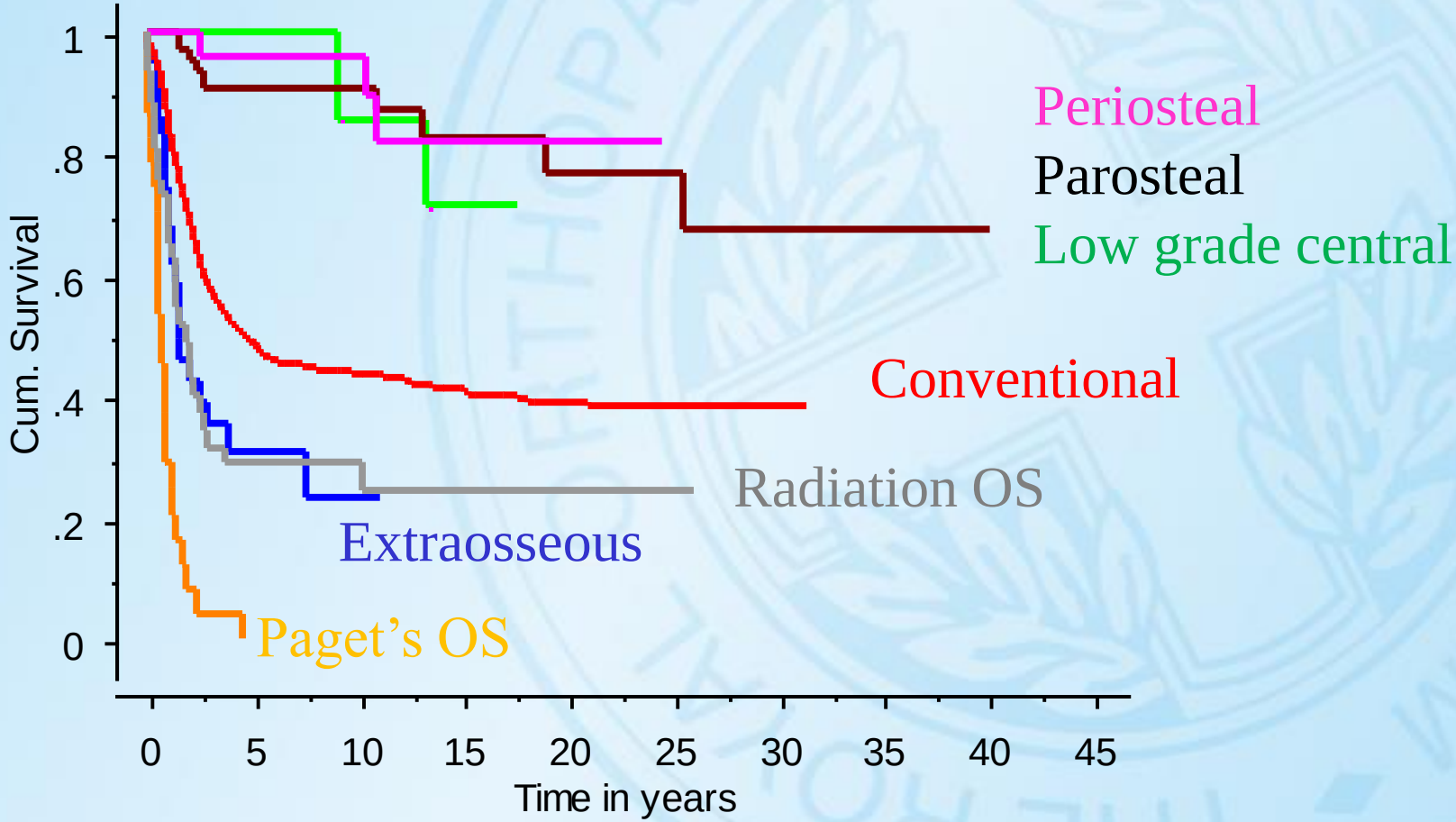




What do these all have in common ?

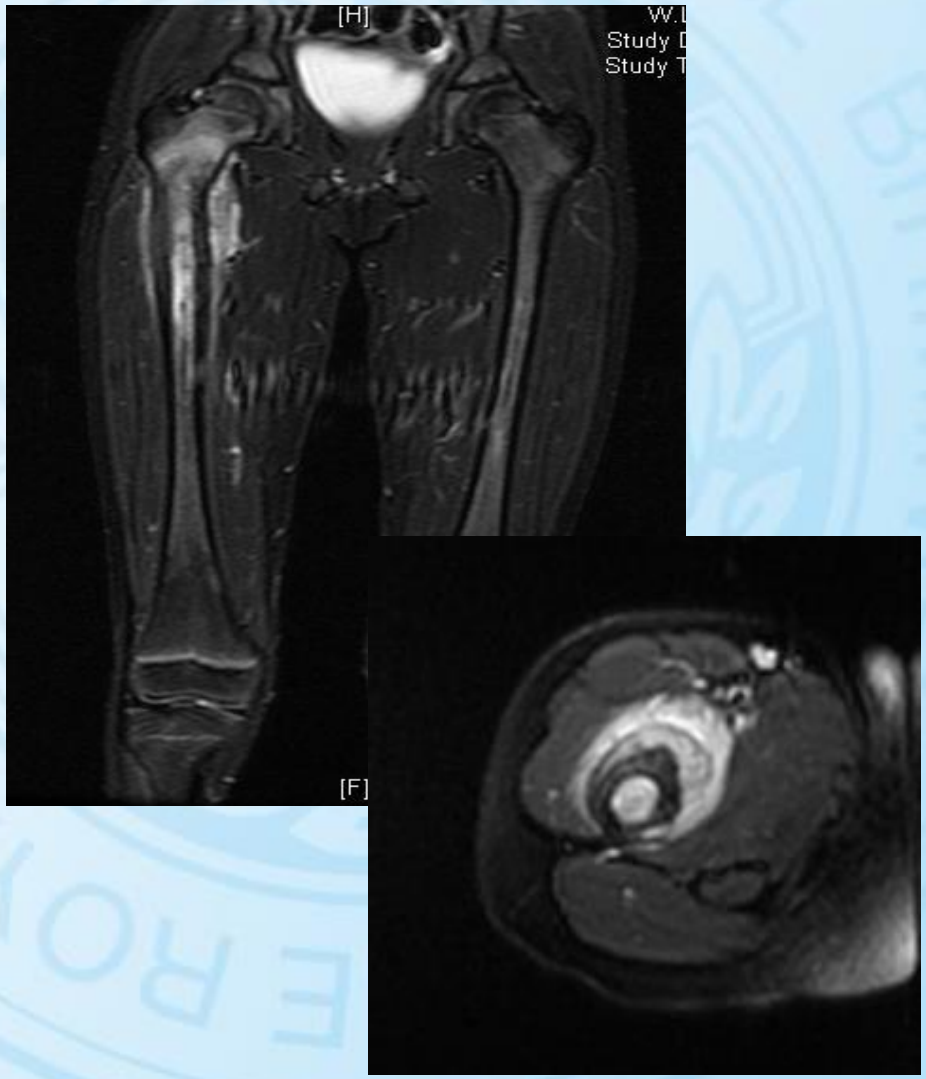


Survival – Osteosarcoma varieties



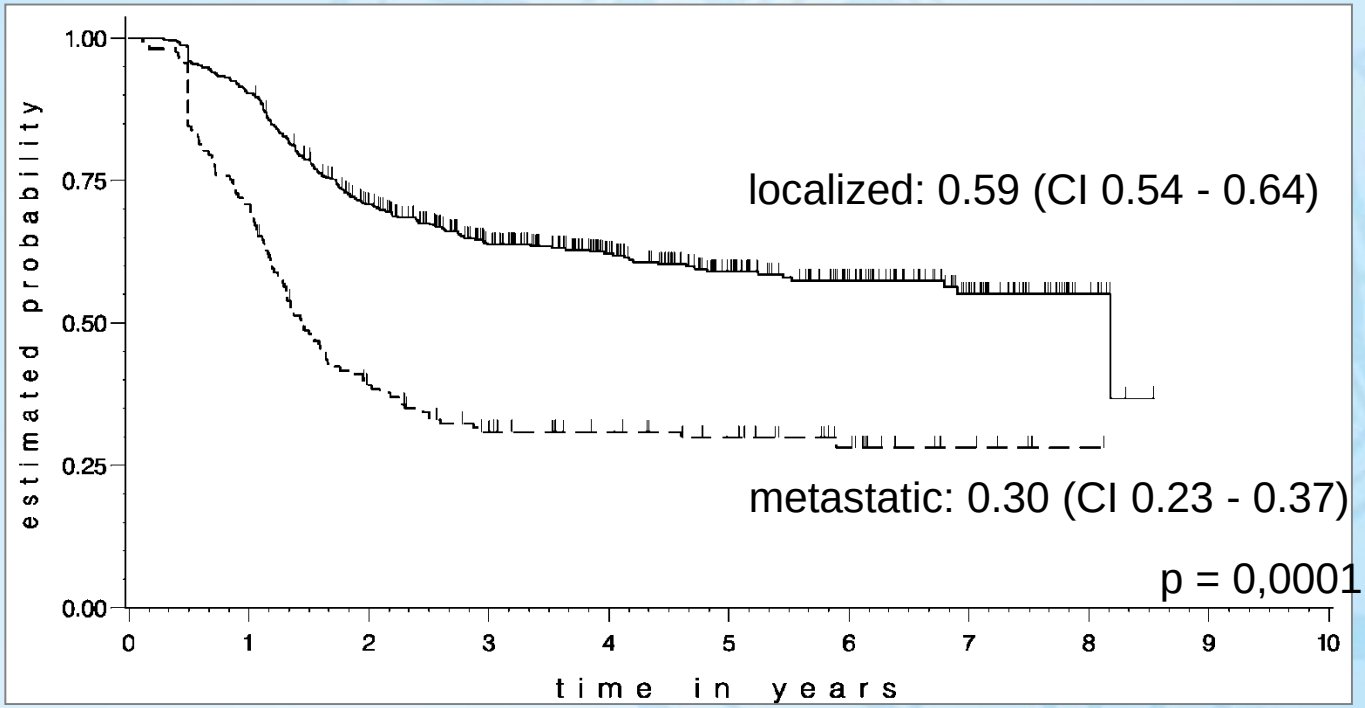
Ewing's Sarcoma

- Small blue round cell tumour
- Children and young adults
- t11/22 translocation
- Very responsive to Chemo + RT
- But high rate of recurrence
- Current Rx = CT + S + RT



EWS

- Prognosis related to size, response to chemo, LDH at diagnosis, mets at diagnosis



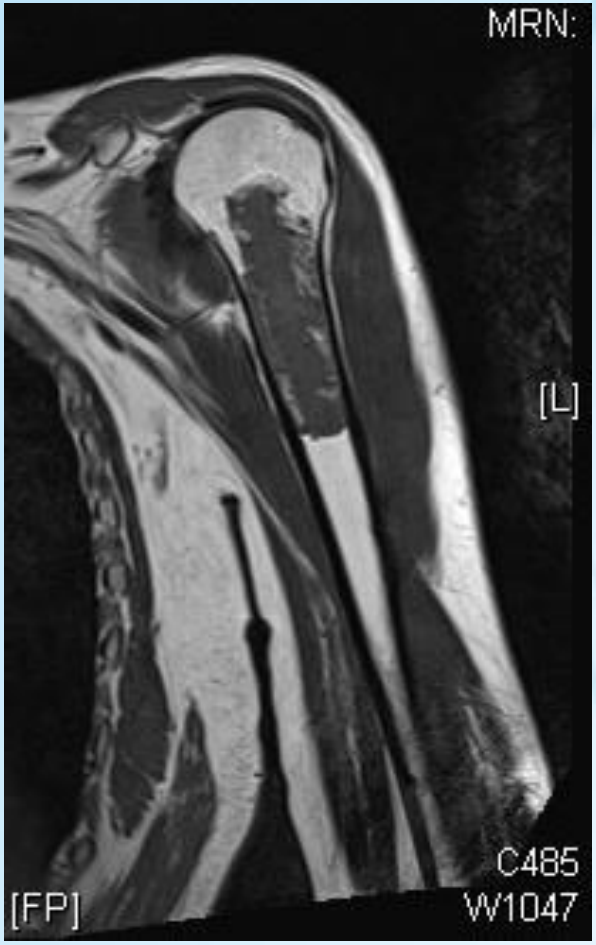
Chondrosarcoma

- Older patients
- Can be central (inside bone) or peripheral (outside bone)
- Typically present with pain or a lump
- Popcorn calcification typical inside bone
- Difficult to differentiate from benign enchondroma
- Surgery is only Rx
- Grade determines prognosis

Peripheral CS pelvis

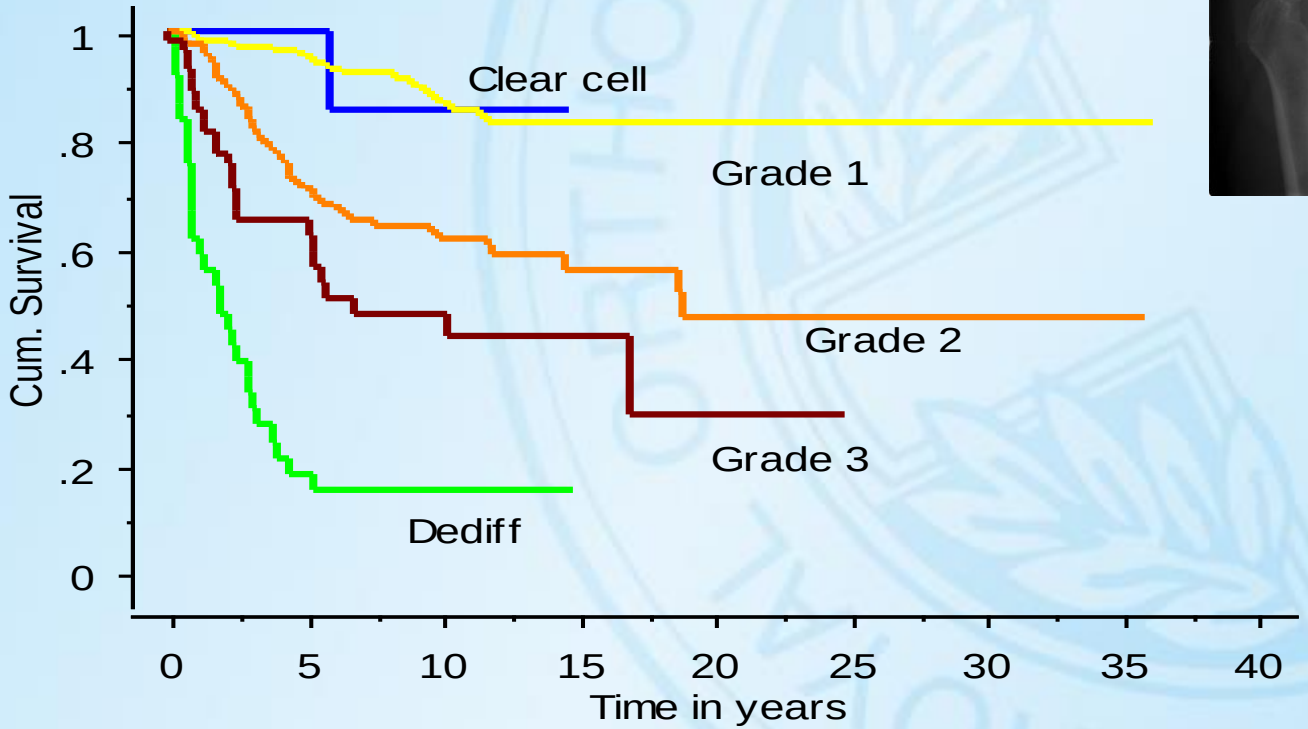
Central CS femur

When is a chondroid lesion a chondrosarcoma?



- Many chondroid lesions discovered incidentally
- Which are malignant?
- Is observation safe?
- Histology NOT helpful
- Pelvis – always malignant
- Worrying features:
  - Pain
  - > 5cm
  - Cortical erosion
  - Hot on BS
  - Dynamic MRI
    - Parlier-Cuau C, 2011

Chondrosarcoma survival by grade



Chordoma

- Sacral tumour
- Present with back pain, sacral pain and eventually incontinence
- ….if you don't put your finger in it….
- Rx – surgery but increasing evidence for high dose RT with Protons or Carbon Ions

Soft Tissue Lumps and Bumps

- Any lump presenting with the following should be considered malignant until proved otherwise:
  - **≥ 5cm**
  - **Increasing in size**
  - **Deep to the deep fascia**
  - **Pain**
  - **any recurrence of a previously excised lump**

The more of these present the more likely to be malignant

Delays in diagnosis common

- Patient delay
- Doctor delay
- Hospital delay

- Patients pathway anything but smooth

Clinical Study

Delays in Referral of Soft Tissue Sarcomas

G. D. Johnson,[1] G. Smith,[1] A. Dramis,[2] and R. J. Grimer[2]

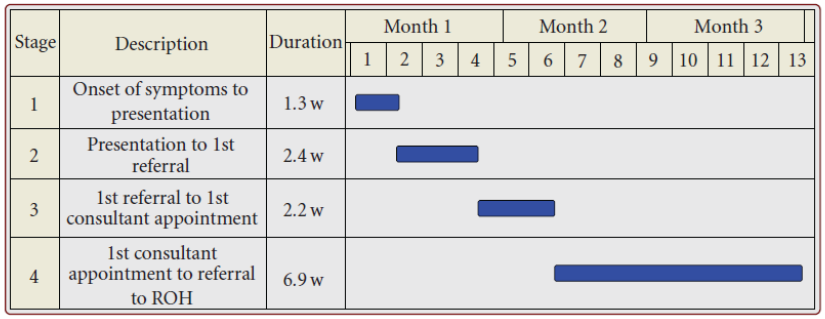


FIGURE 2: The median patient.

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NICE 2015 New Guidance!

Any soft tissue lump that is 'unexplained' or growing – to be referred for urgent ultrasound <48hr)– if worrying – refer on

Soft Tissue Sarcomas increase with age

Figure 1.2: Number of soft tissue sarcomas diagnosed in each age group and sex (England: 1985–2009)

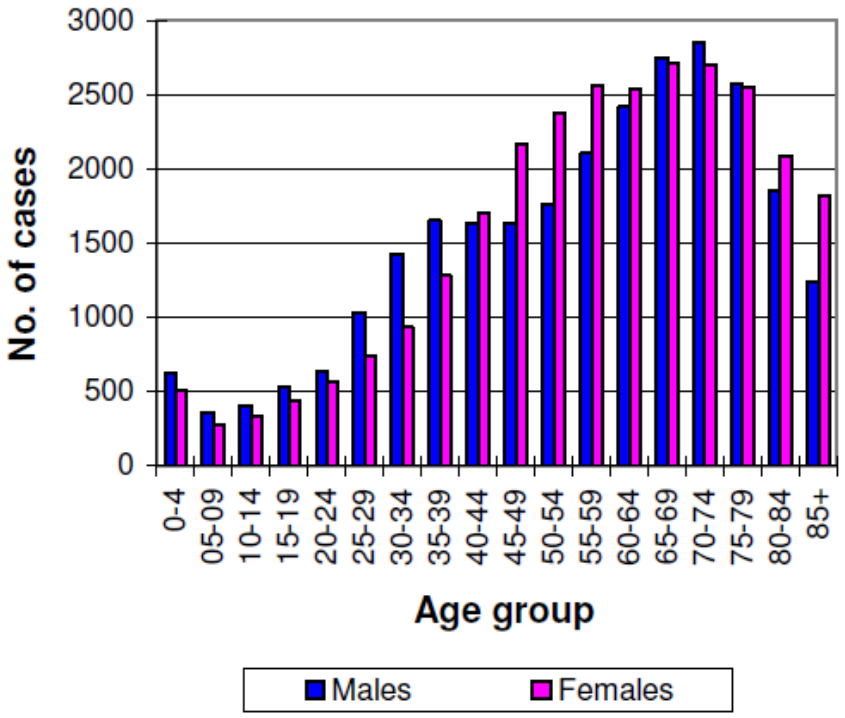
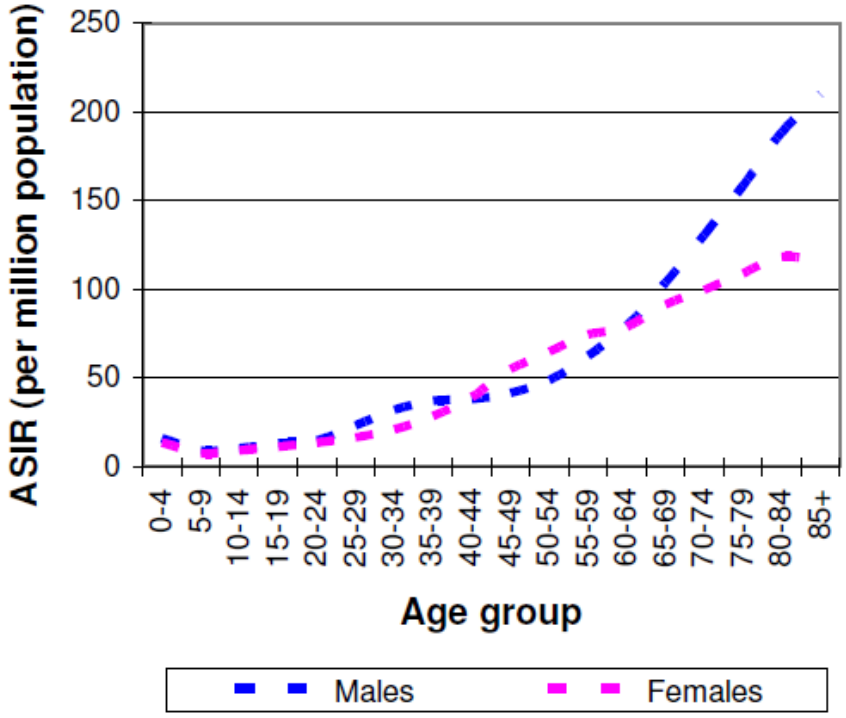


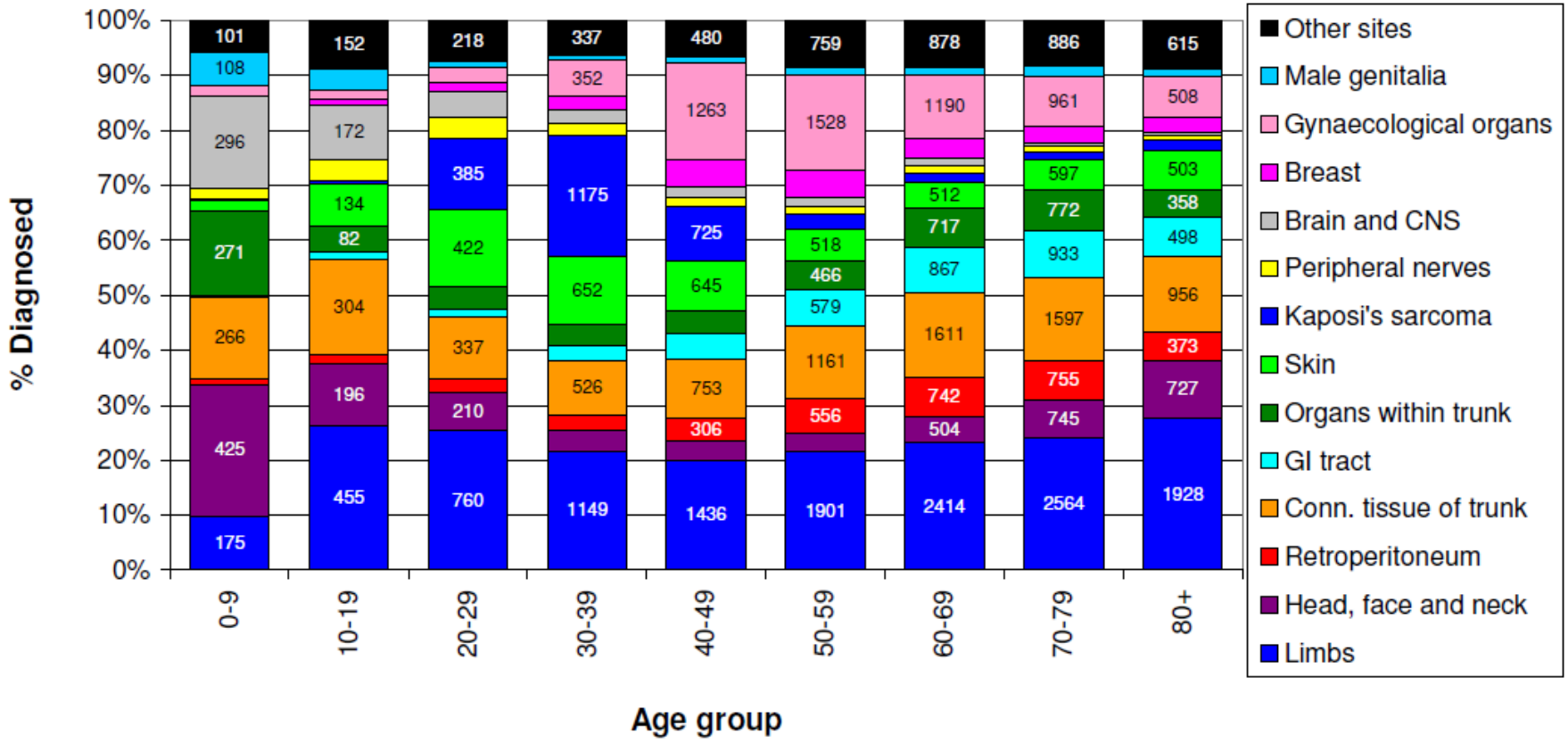
Figure 1.3: Soft tissue sarcoma age specific incidence rates (England: 1985–2009)



NCIN data

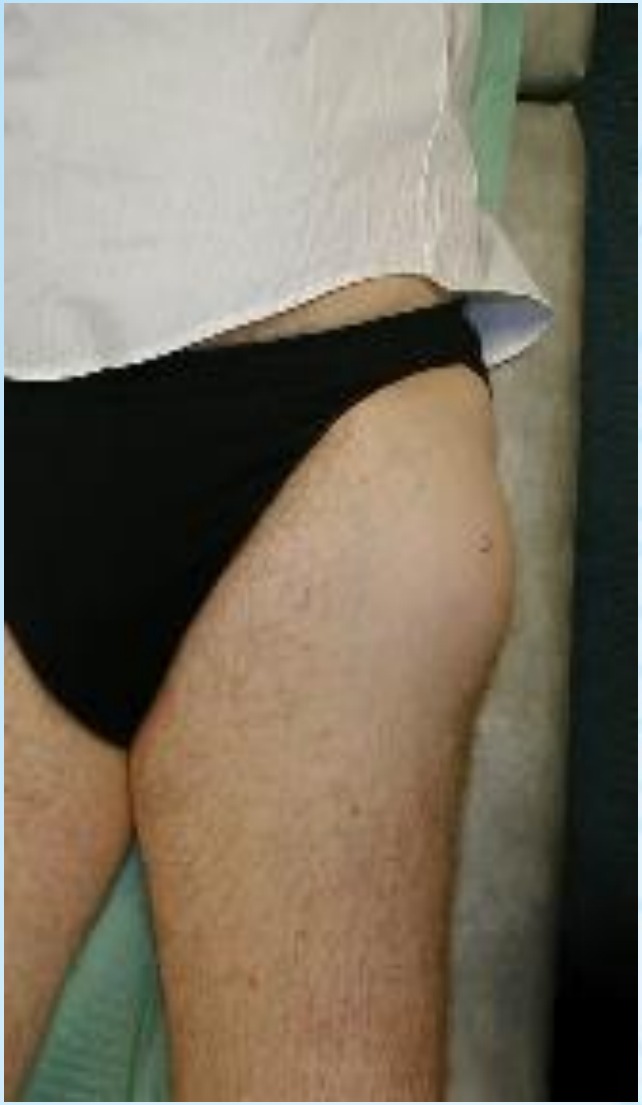
..and STS can arise anywhere!

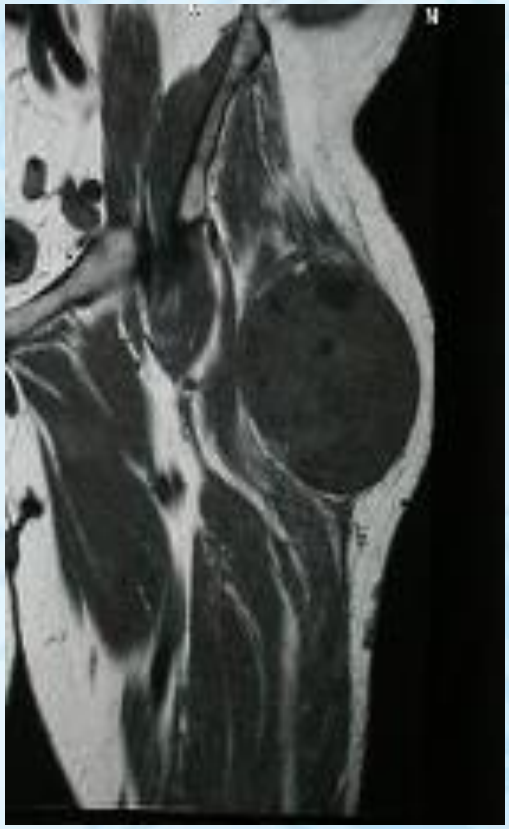
Figure 1.5: Proportion of soft tissue sarcomas diagnosed in each age group and anatomical site (England: 1985–2009)



NCIN data

A Typical Presentation…..



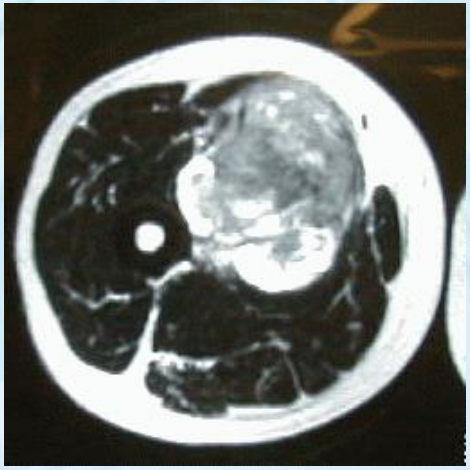


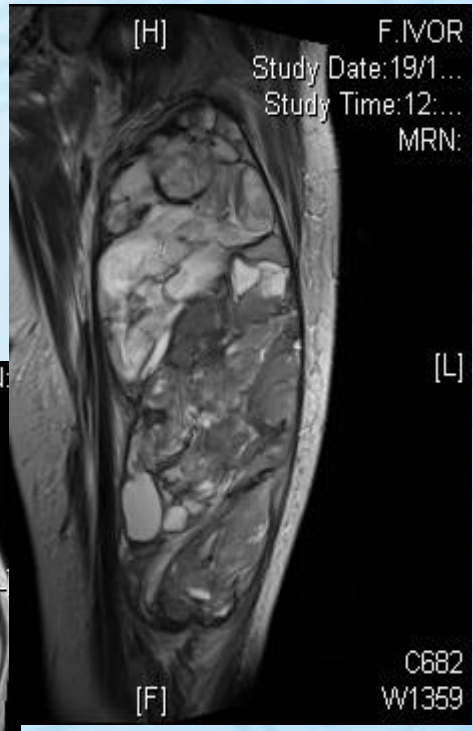
MRI is investigation of choice

MRI may tell you what it is

- If not obviously diagnosed on MRI
- **REFER** to sarcoma diagnostic clinic
- 2 week wait

- (local pathologists WRONG in 30% of sarcoma cases)





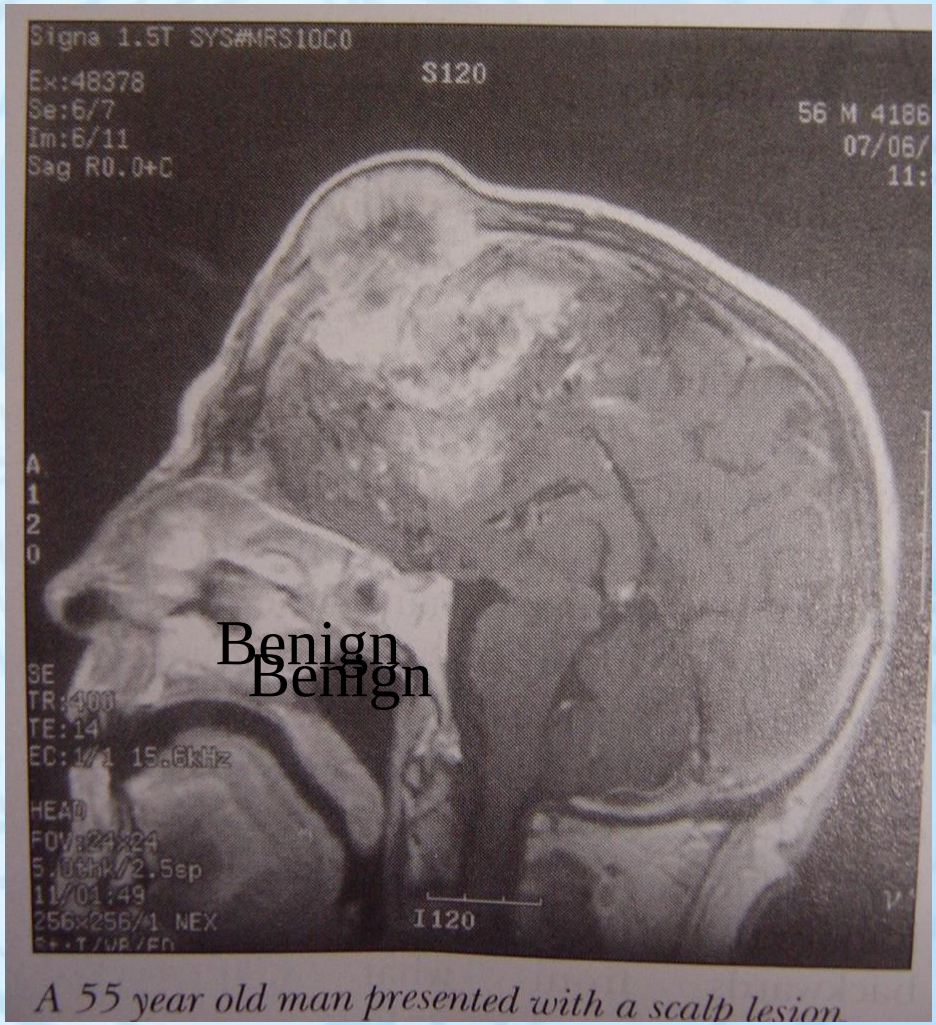
Diagnosing a soft tissue lump

- Review images – MRI best
- Biopsy – trucut best
  - Aim NOT to contaminate normal tissue
  - Aim to get a representative sample of tumour
  - Use imaging to hit the target
  - 96% diagnostic

What lumps can be safely excised without biopsy first?

- < 3cm
- Subcutaneous
- Well defined

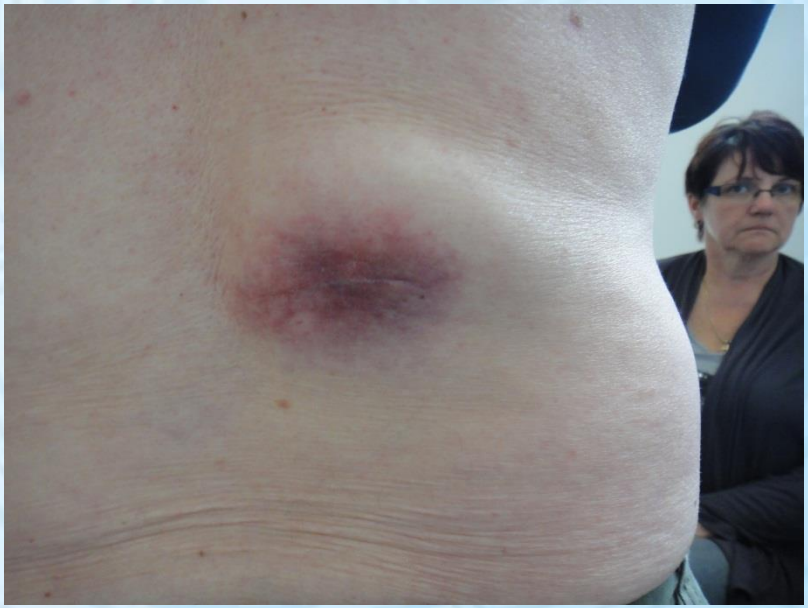
- All other lumps should be investigated



A 55 year old man presented with a scalp lesion

What is a 'Whoops'

- A 'Whoops' procedure is when someone has removed a lump without knowing it was a sarcoma – 50 -60% of cases will have residual tumour.
- The 'occulo-brachial reflex' – surgeon does not have to think!
- Re-excise + R/T

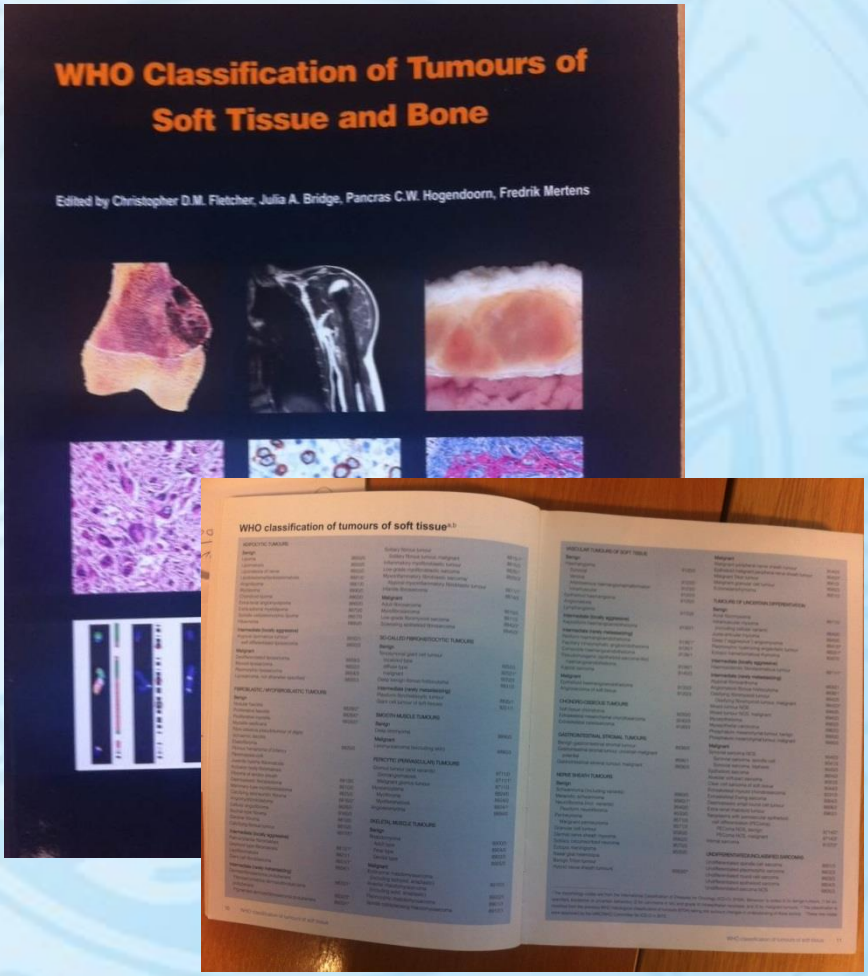


Soft Tissue Sarcomas

- 3200 /yr
- Increase with age
- Many different sarcomas

e.g.

  - Liposarcoma
  - UPS (was MFH)
  - Leiomyosarcoma
  - Fibrosarcoma
  - Rhabdomyosarcoma
  - MPNST
  - Synovial sarcoma etc.



The name is less important than the grade

Soft tissue sarcomas in a nutshell

- Excise with clear margins
- Pre or post op R/T for most
- Amputation if unresectable or for LR
- Chemotherapy NOT predictably effective (but may be used in children, SS, Myxoid Liposarcoma)
- Prognosis related to Stage……

TNM Staging

T = Tumour size

- STS - T1 ≤ 5cm, T2 > 5cm
- Bone sarcomas – T1 ≤ 8cm, T2 > 8cm

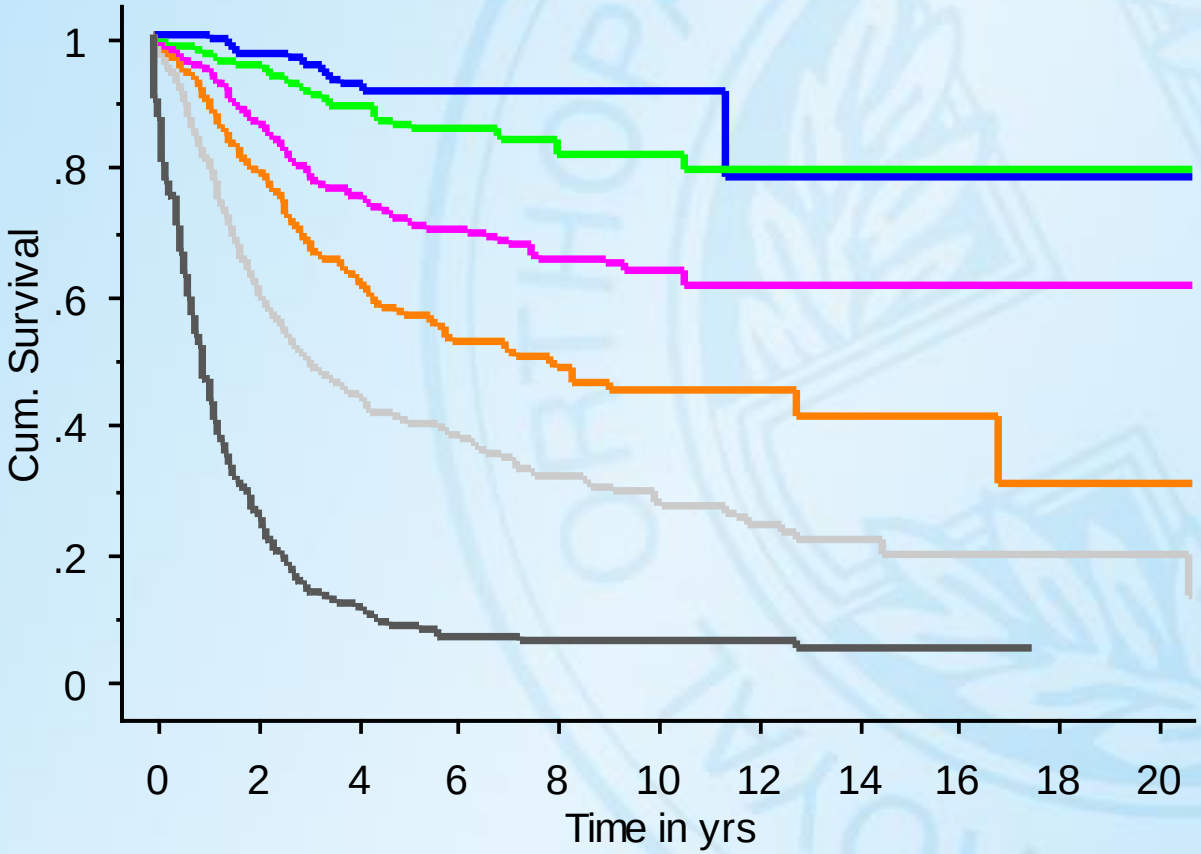
G = Grade (G1 = low, G2 = Intermed G3 = high)

N = nodes

M = mets

	Size	Grade
1A	Small	G1
1B	Big	G1
2A	Small	G2-3
2B	Big	G2
3	Big	G3
4	mets	

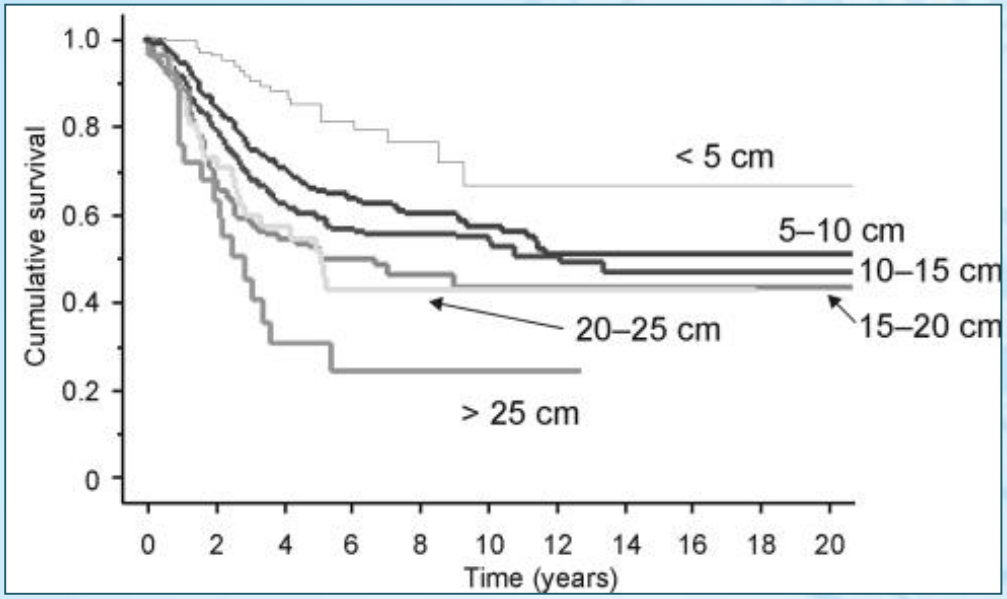
STS - outcome



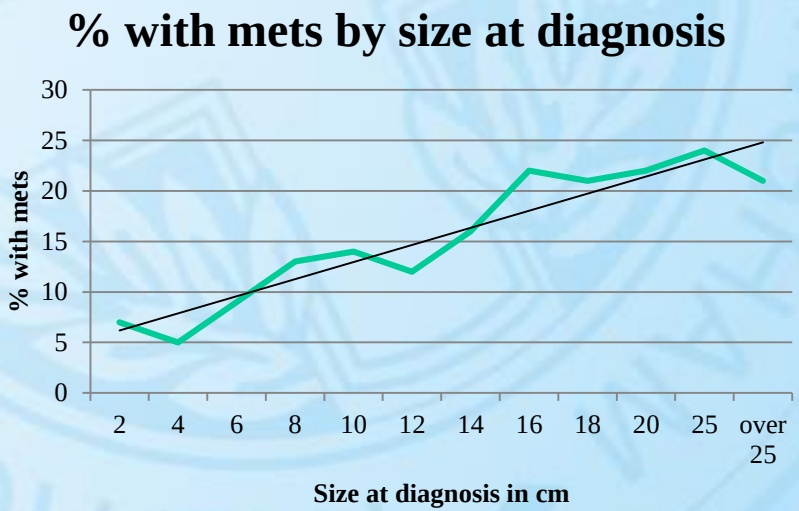
1A Small, low grade
1B Big, low grade
2A Small, int/high gd
2B Big, inter grade
3 Big, high grade
4 Mets at diagnosis

Size is important for survival

- Size is a prognostic factor for sarcomas
  - Metastatic disease
  - Overall survival

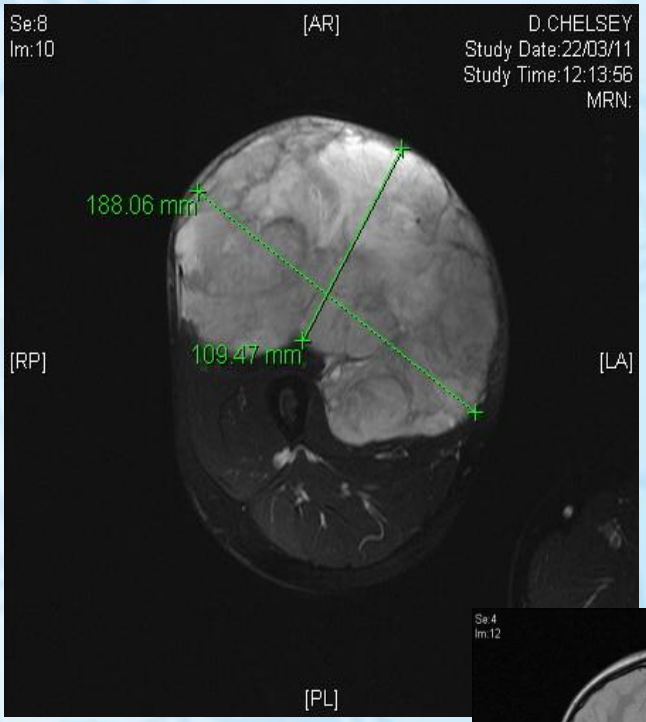


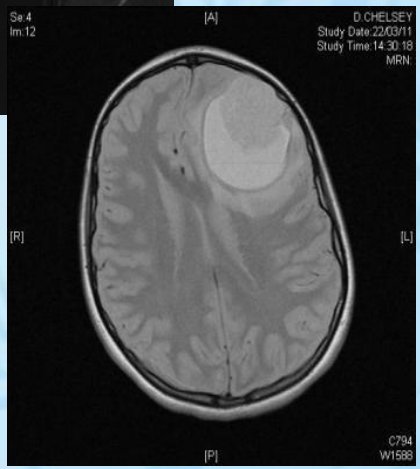
Survival decreases with increasing size



Metastatic disease increases with size

How can we educate patients?

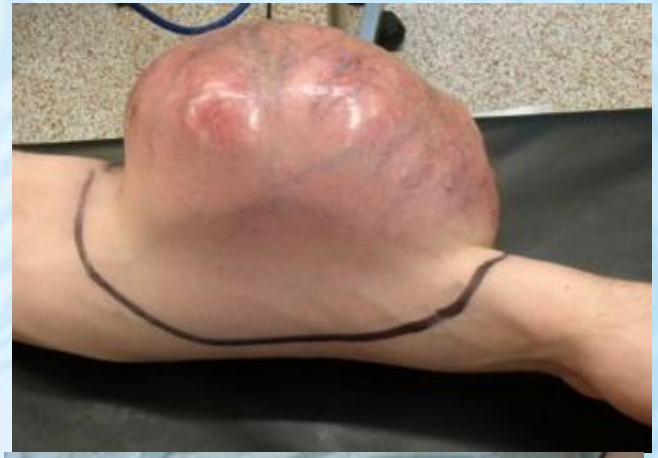




14 yr old plays semi- professional football, presents with headache and sleepiness……

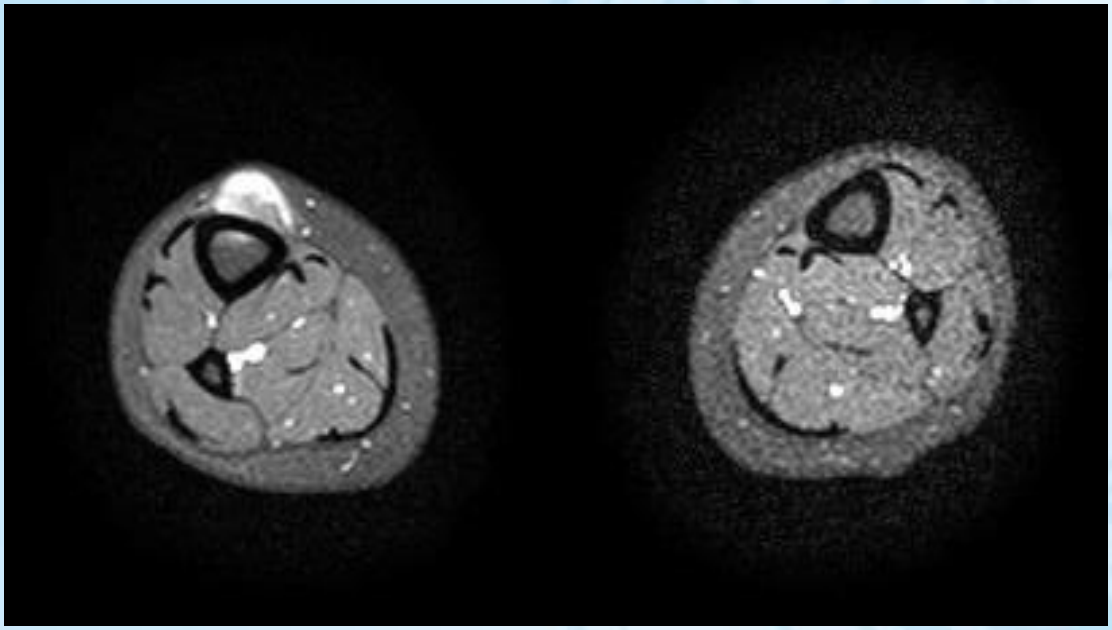
“I’ve got a patient with a football on their arm !”

- 19 yr old male
- Superficial STS
- Hid it from his parents !!



- Excision, flap, RT
- Alive and well 5 yrs

IF A SMALL LUMP DOESN'T LOOK RIGHT - BE SUSPICIOUS

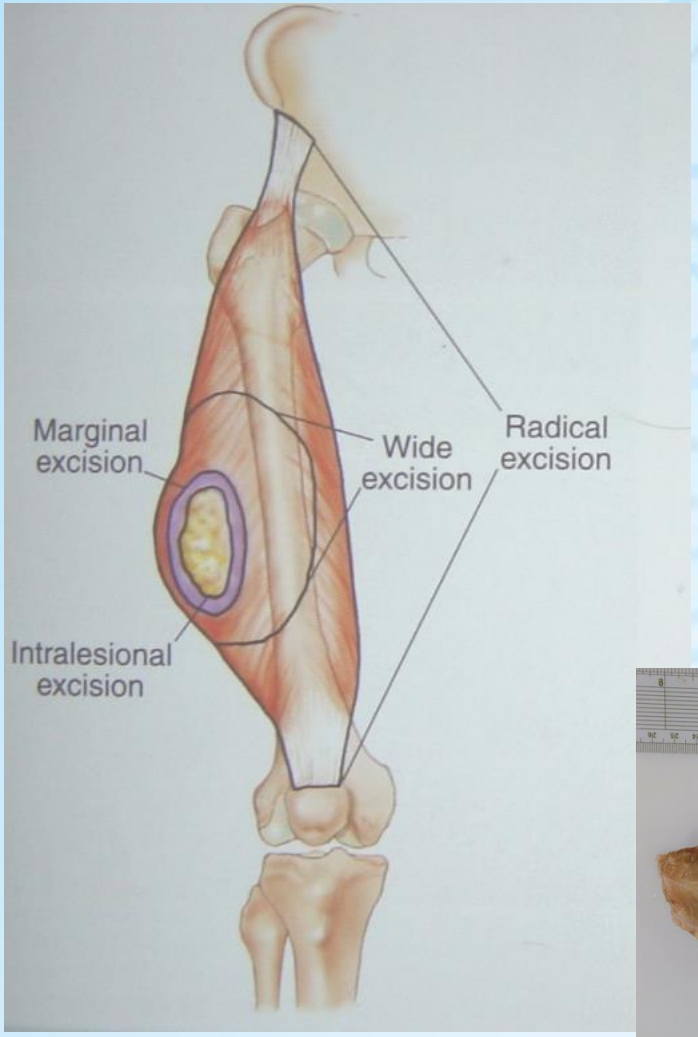


20 yr old with painless lump on shin – no trauma = Clear cell sarcoma - spreads along fascial planes

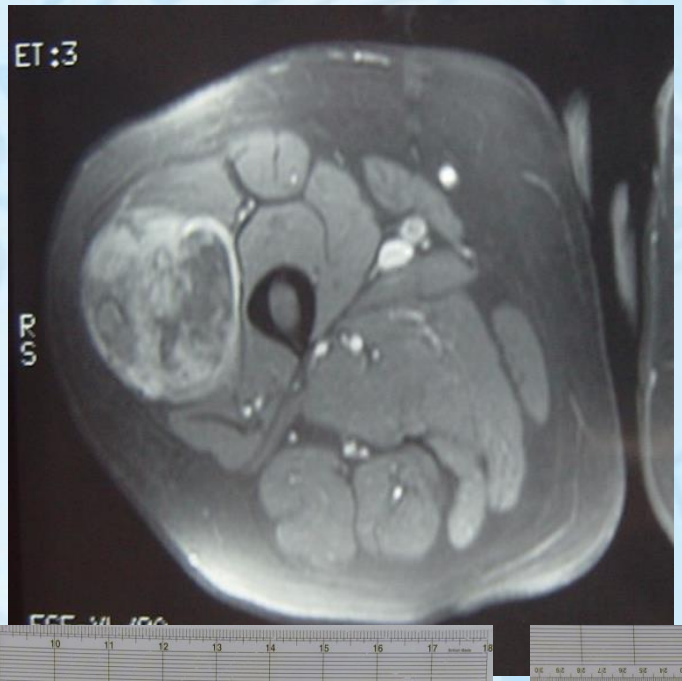
Required amputation for clearance

Message – size matters for sarcomas – any lump bigger than a golf ball should be considered a possible sarcoma till proved otherwise.

Margins - safe = low local recurrence



Enneking



WIDE

MARGINAL

Local Recurrence – split by margins and grade

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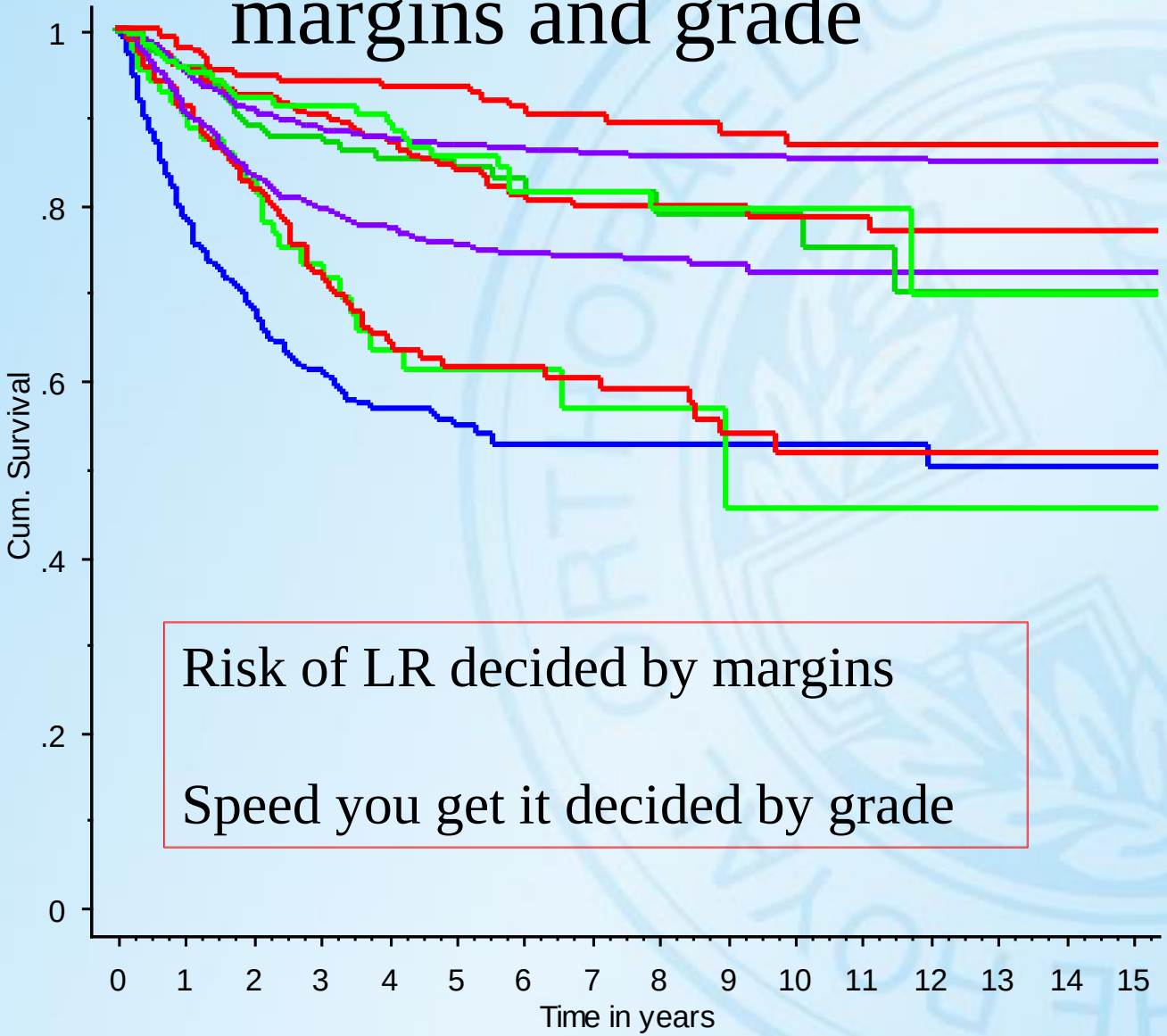


Wide

Marginal

Intralesional

LOW grade

Intermediate

HIGH grade

Risk of LR decided by margins

Speed you get it decided by grade

Rate of LR decreased by effective adjuvant eg RT or CT

Metastatic bone disease

Principles:

- >50% of **YOU** will get cancer
- Patients with cancer living longer
- More treatments available
- More will present with metastases- most common primaries – **breast, bronchus, prostate, kidney, thyroid**
- 70% of post mortems in patients with cancer will have bone metastases
- Management is based on diagnosis, multidisciplinary Rx, maintaining function

Will it fracture?

Mirel's scoring sytem

	1	2	3
Site	Upper Limb	Lower Limb	Troch
Pain	Mild	Moderate	W/B
Lesion	Blastic	Mixed	Lytic
Size(d)	<1/3	1/3 to 2/3	>2/3

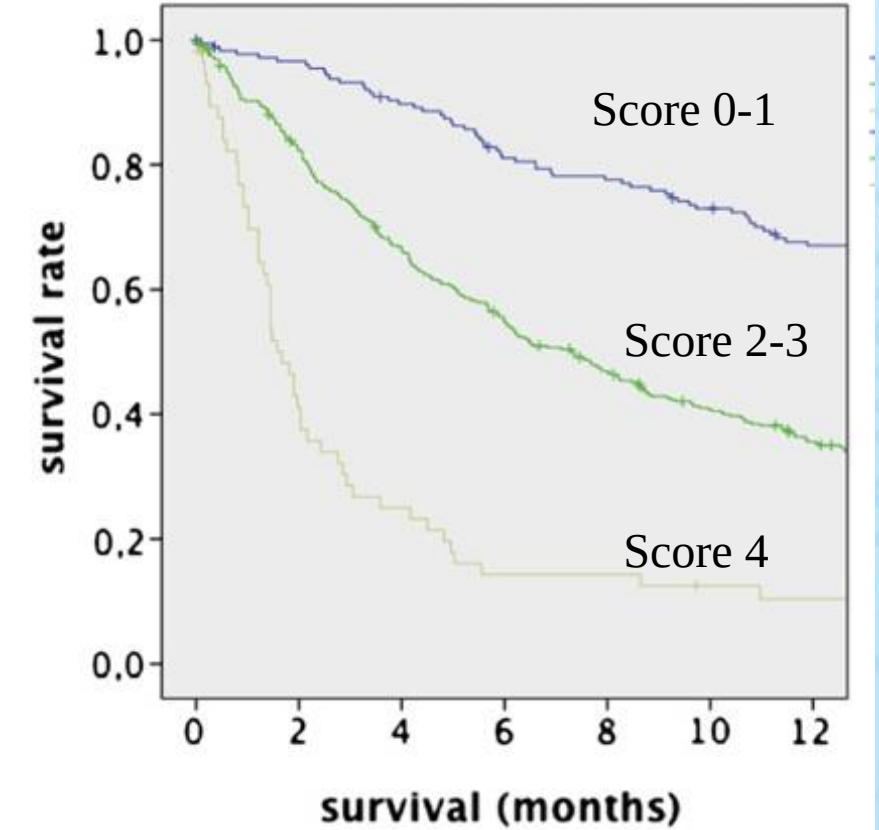
This site = Troch 3
Pain 3
Lytic 3
Size 3

Total 12 = HUGE risk of fracture – so fix it!

Right operation? – not for this one ?

Life expectancy after bone mets

Score	0	1
No of mets	Single	Multiple
Visceral mets	None	Yes
Br/renal/thy/myeloma	Yes	Other
Karnofsky score 70	Above (self care)	Below (needs help)



Contents lists available at SciVerse ScienceDirect
Surgical Oncology
journal homepage: www.elsevier.com/locate/suronc

Review

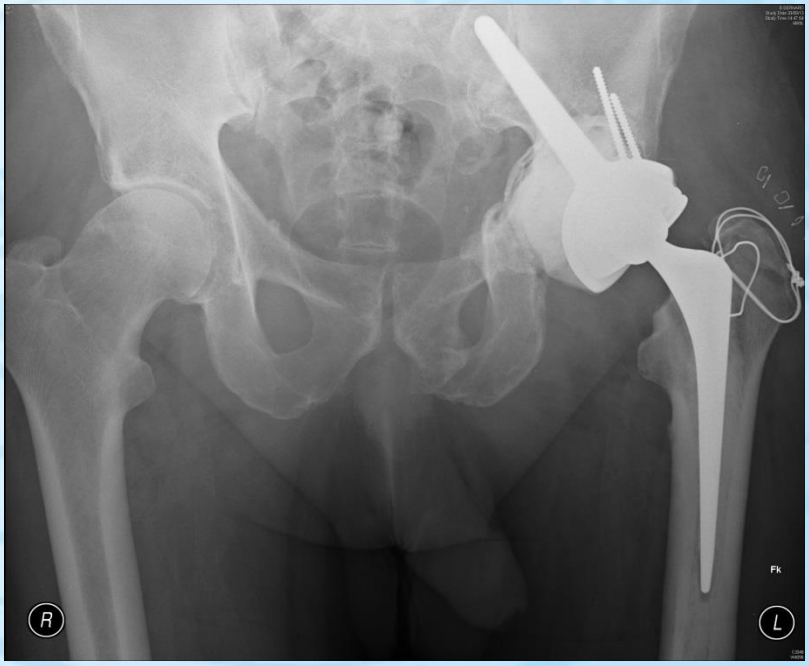
Insight opinion to surgically treated metastatic bone disease: Scandinavian Sarcoma Group Skeletal Metastasis Registry report of 1195 operated skeletal metastasis

Maire Ratasvuori[a,b], Rikard Wedin[c], Johnny Keller[d], Markus Nottrott[e], Olga Zaikova[f], Peter Bergh[g], Anders Kalen[h], Johan Nilsson[i], Halldor Jonsson[j], Minna Laitinen[b,*]

Helps determine how aggressively you should treat that patient.

New treatments for bone mets

- New drugs
  - Breast cancer is now a chronic disease
  - Renal Cancer – sunitinib
  - Denosumab replacing bisphosphonates (reduce risk of fracture)
- Clever radiotherapy
  - Targeted treatments
- Clever radiology
  - Embolisation
  - Vertebroplasty etc



Surgical management

- Assume fractures will not heal
- Reconstruction should out live patient
- Fill large gaps with cement not bone graft
- Most mets need RT + Denosumab/Zometa
- Consider EPR for large defects
- EPR for solitary renal mets (as poor response to RT and can have long survival)
- BOA Guidelines available:
- https://www.boa.ac.uk/wp-content/uploads/2014/01/Metastatic-Bone-Disease.pdf

WHAT IS THE BEST OPERATION?

Options include:

Amputation

Endoprosthesis

Allograft

Autograft - vascularised, reimplant

Bone distraction

Arthrodesis

Rotationplasty

AMPUTATION

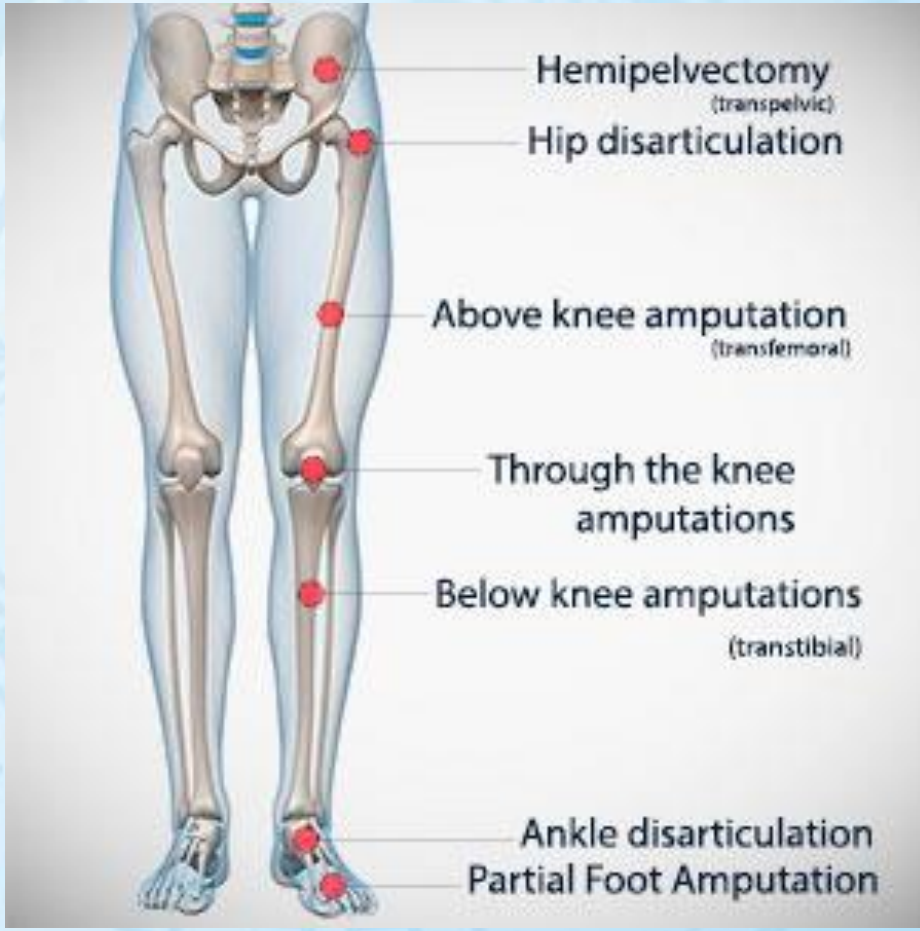
- Once and for all operation
- Outcome predictable
- Phantom pain
- Needs good limb fitting service
- Expensive
- 15% of patients with a bone sarcoma need one

Levels of amputation

- Level decided by need to get clearance of tumour
- Function deteriorates the higher the amputation
- Outcome unpredictable

but

- QoL NOT proven to be worse for amputees than those with limb salvage!



Amputations aren't always bad!

4 yr old with disarticulation hip for OS of femur and tibia. Converted to AKA by prosthesis – which can be extended as he grows!

Osseointegration – improving function following amputation = the future ?

Artificial limb ‘clicks on’ to implant a bit like a garden hose….

Patients report improved function++
But infection risk…

ENDOPROSTHETIC REPLACEMENT

Advantages:

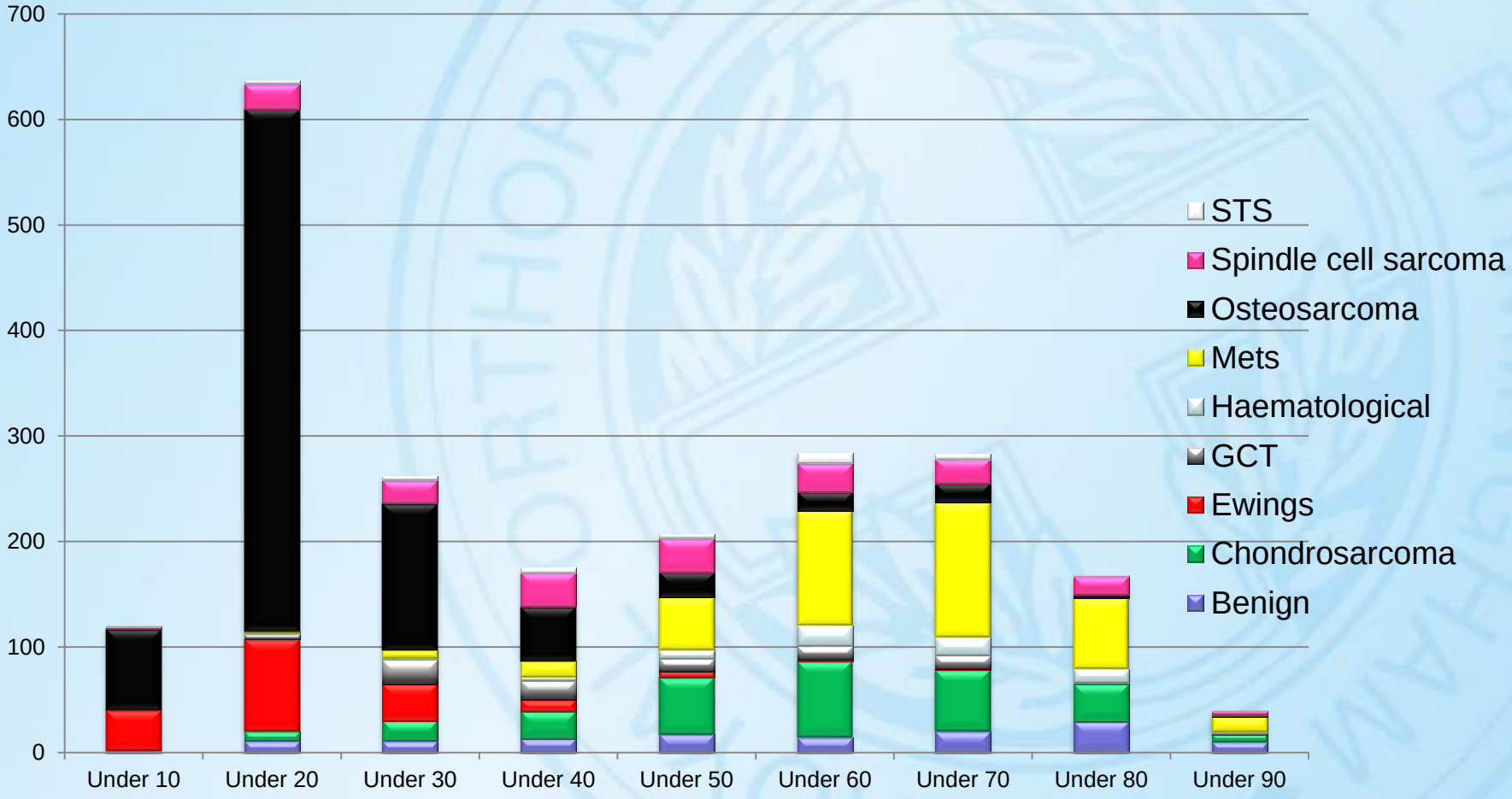
Immediate weight bearing

Predictable function (80%)

Low early complications

Readily available - modular

Indication for EPR split by age



Failure rates all causes and functional score

Site	Failure	Function
• Distal femur	- 2% / yr	83%
• Prox tibia	- 3% / yr	80%
• Prox femur	- 1% / yr	75%
• Prox humerus	- 0.5% / yr	86%
• Pelvis	- 3% / yr	66%
• Total femur	- 2% / yr	70%

Infection is still the major problem

Risk Factors

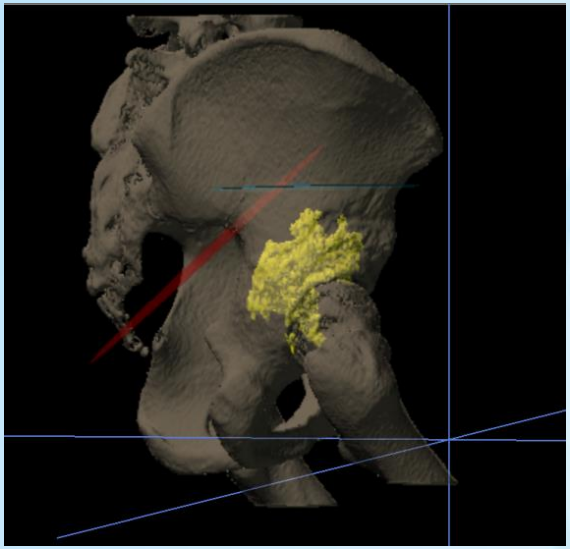
- Radiotherapy
- Myeloma
- Further surgery

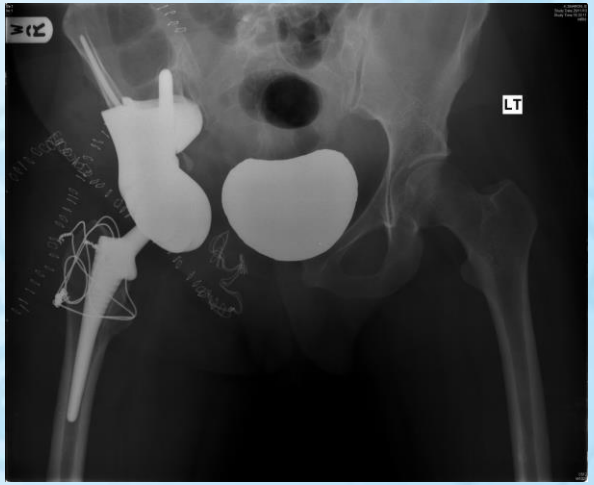
Site:

Tibia	23%
Pelvis	23%
Distal femur	10%
Prox femur	7%
Prox humerus	1%

(lifetime risk over 20 yrs)

Navigated surgery





Helps resect complex tumours with clear margins

EXTENDABLE EPRs FOR CHILDREN

The Royal Orthopaedic Hospital NHS
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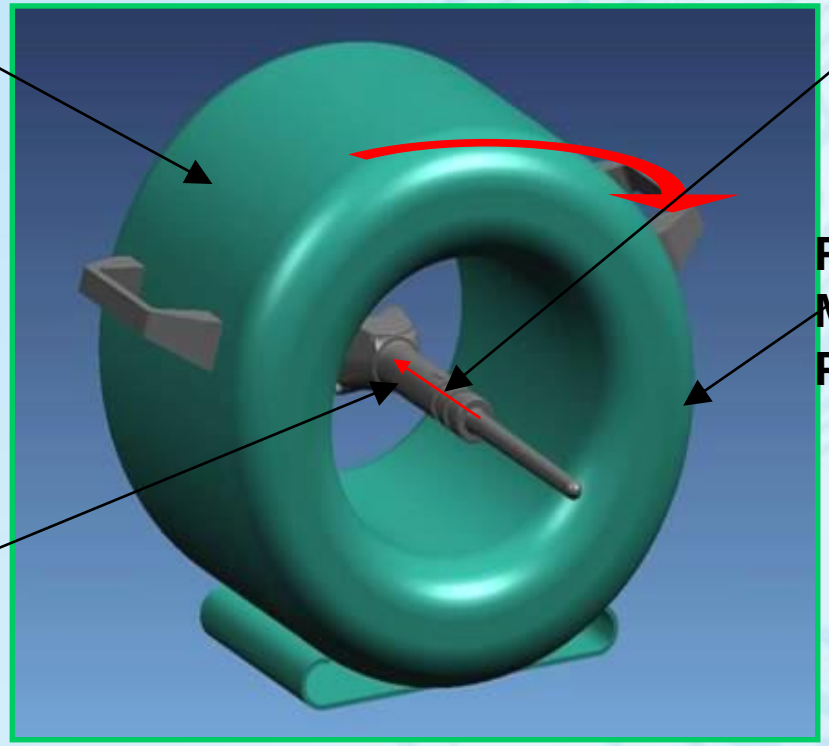
- If >3cm of growth expected
- Use an extendable EPR
- Minimally invasive
- X Ray control
- Stab incision
- 1 cm each lengthening

Non Invasive Extendable EPR

- Expensive - £15,000
- Lengthen 5 mm in 20 minutes
- Heavy metal magnet in motor
- Painless lengthening
- Patients (and parents) love it
- MRI not possible
- Needs minimum 12cm resection

IN ACTION

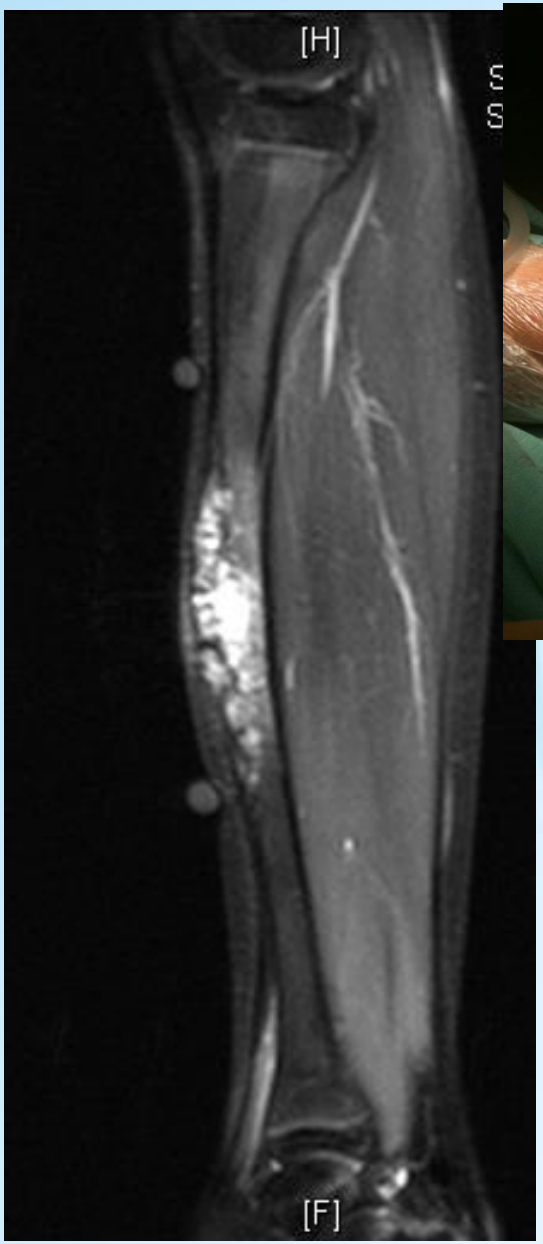
The Royal Orthopaedic Hospital NHS
NHS Trust

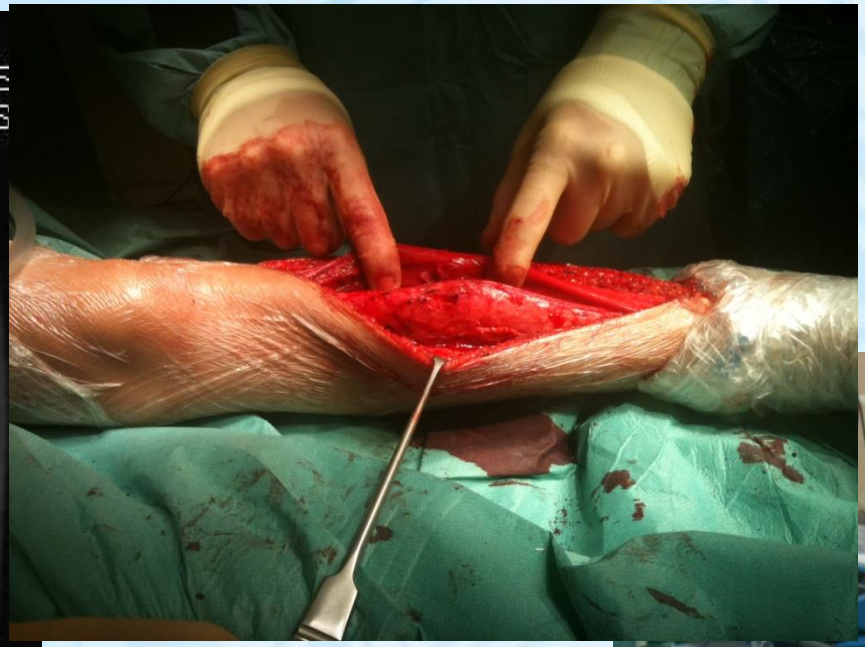


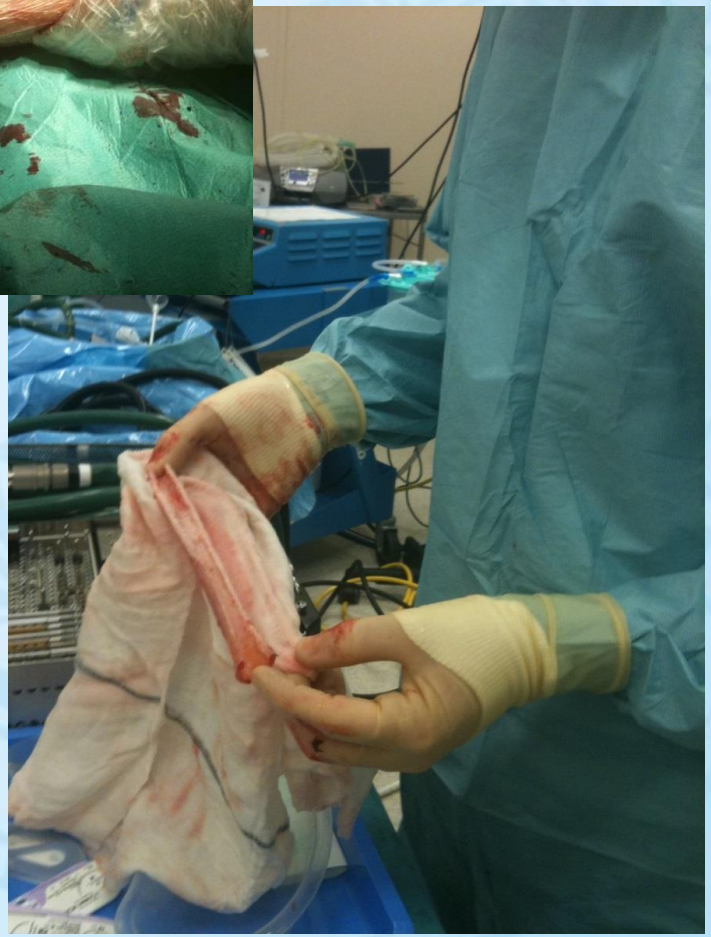
Non Vascularised Fibula Strut Grafts

Looks good but probably not necessary!

Bone grafts








LT
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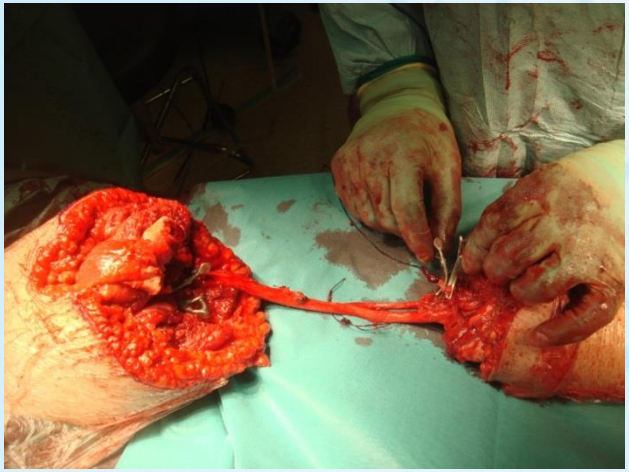
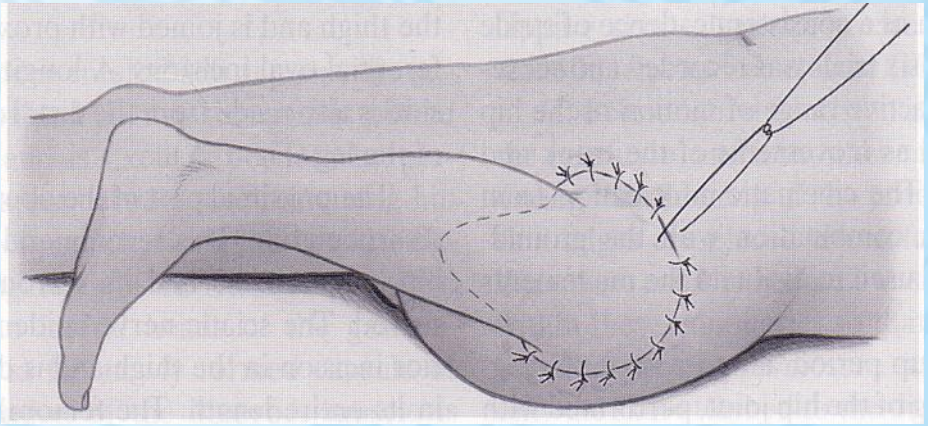
ROTATIONPLASTY

- Safe
- Aesthetically challenging
- Excellent function
- Needs good limb fitting





ROTATIONPLASTY

The Royal Orthopaedic Hospital NHS
NHS Trust

- Safe
- Aesthetically challenging
- Excellent function
- Needs good limb fitting
- No phantom pain

EWS left femur – aged 2

Good response to chemo

Rx ?

Amputate

RT

Replace

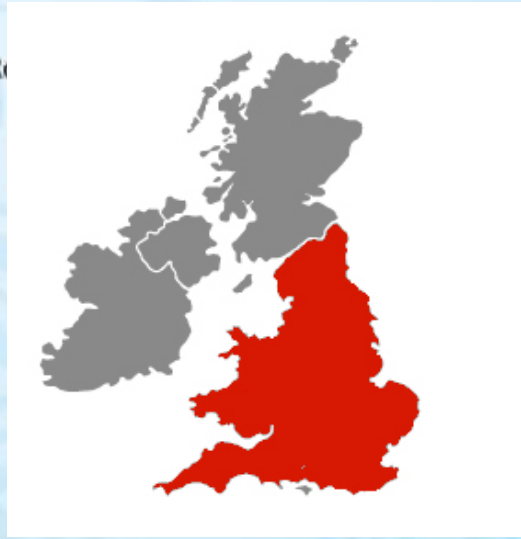
Rotationplasty

Now aged 25

36 operations
25 lengthen, 3 MUA, 2 revisions)
1 infection

Was it worth it ??

Negligence and sarcomas



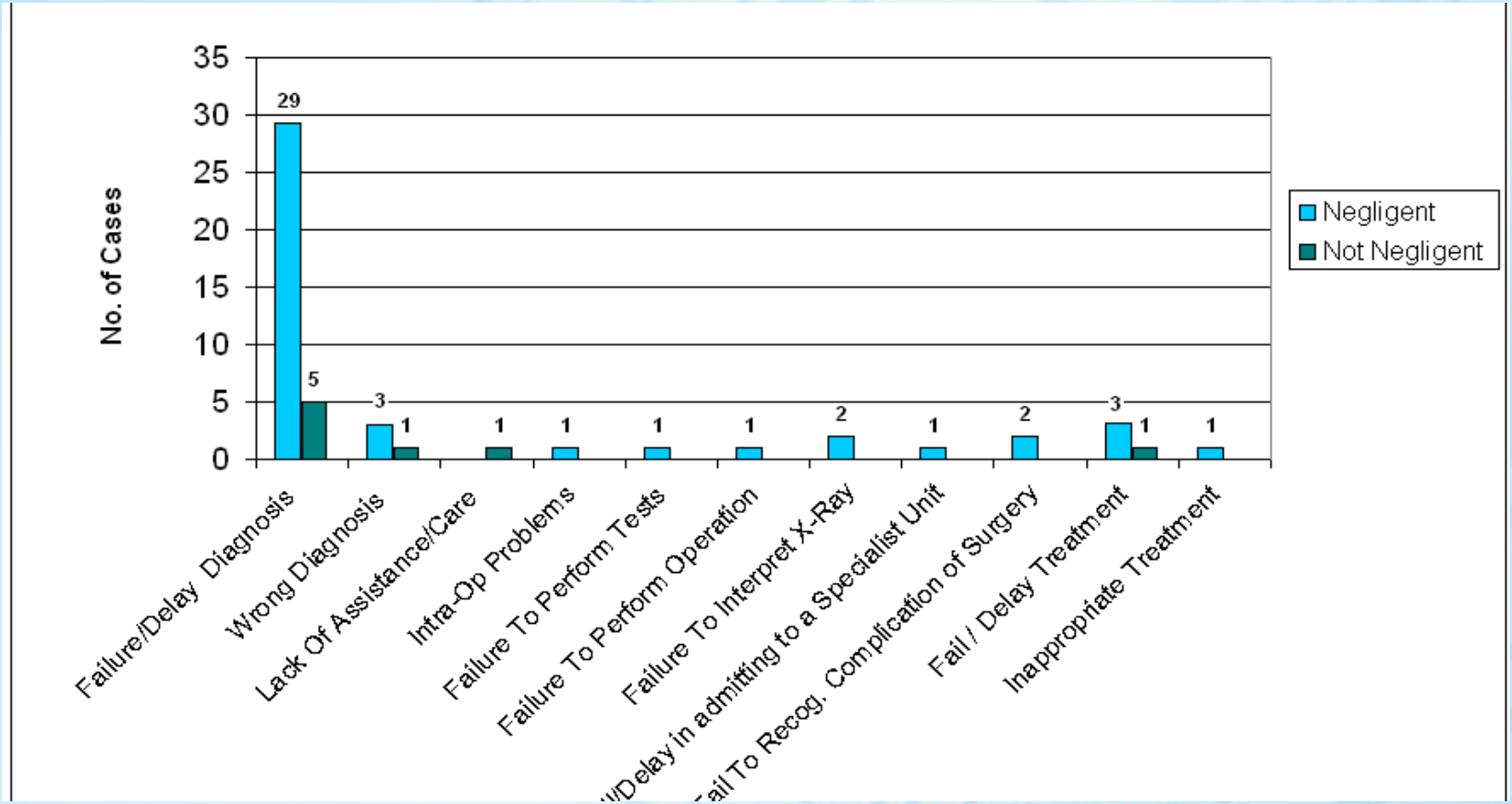
NHSLA Database - claims from 1995 to 2012
Search Words
"sarcoma" "tumour" "cancer"
Exclusions
Secondary tumours, unsettled cases

- 52 claims – 37 had negligence (71%)
- Mean cost £84,000 per case (Defence £22,000)
- Mean Compensation £92,000 (£650 - £978,000)
- Total cost £4.4 million

- 89% of claims were for delayed diagnosis

With thanks to Harrison, Sargazi and Chandrasekar (Liverpool)

Claims to NHSLA for sarcomas



USA Results

216 cases in a national database 1980-2012

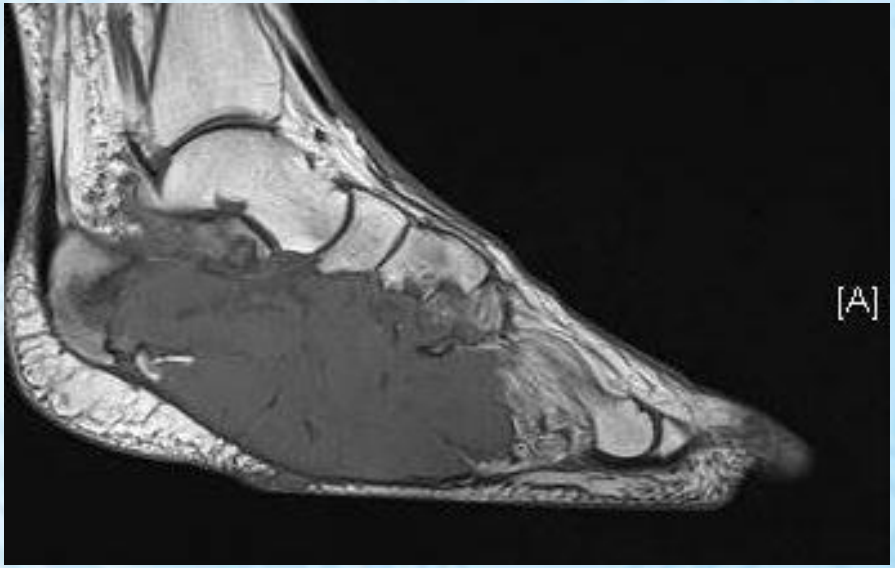
- 57% favoured plaintiff
- payment avge $2.3million ($65k-$12.7m)
- 81% delay in diagnosis
- 11% unnecessary amputation
- 7% misdiagnosis

Who was at fault?

- GPs - 34%
- Orthopaedic surgeons - 23%
- Radiologists - 12%

Mesko NW et al, J Surg Oncol 2014

Painless swelling in the foot
Known to have Rheumatoid Arthritis



Reassured for 2 years - Synovial sarcoma
Would have needed amputation anyway
But developed metastases ….
- would they have arisen with earlier diagnosis

12 yr old with fracture after a trivial fall – worried?

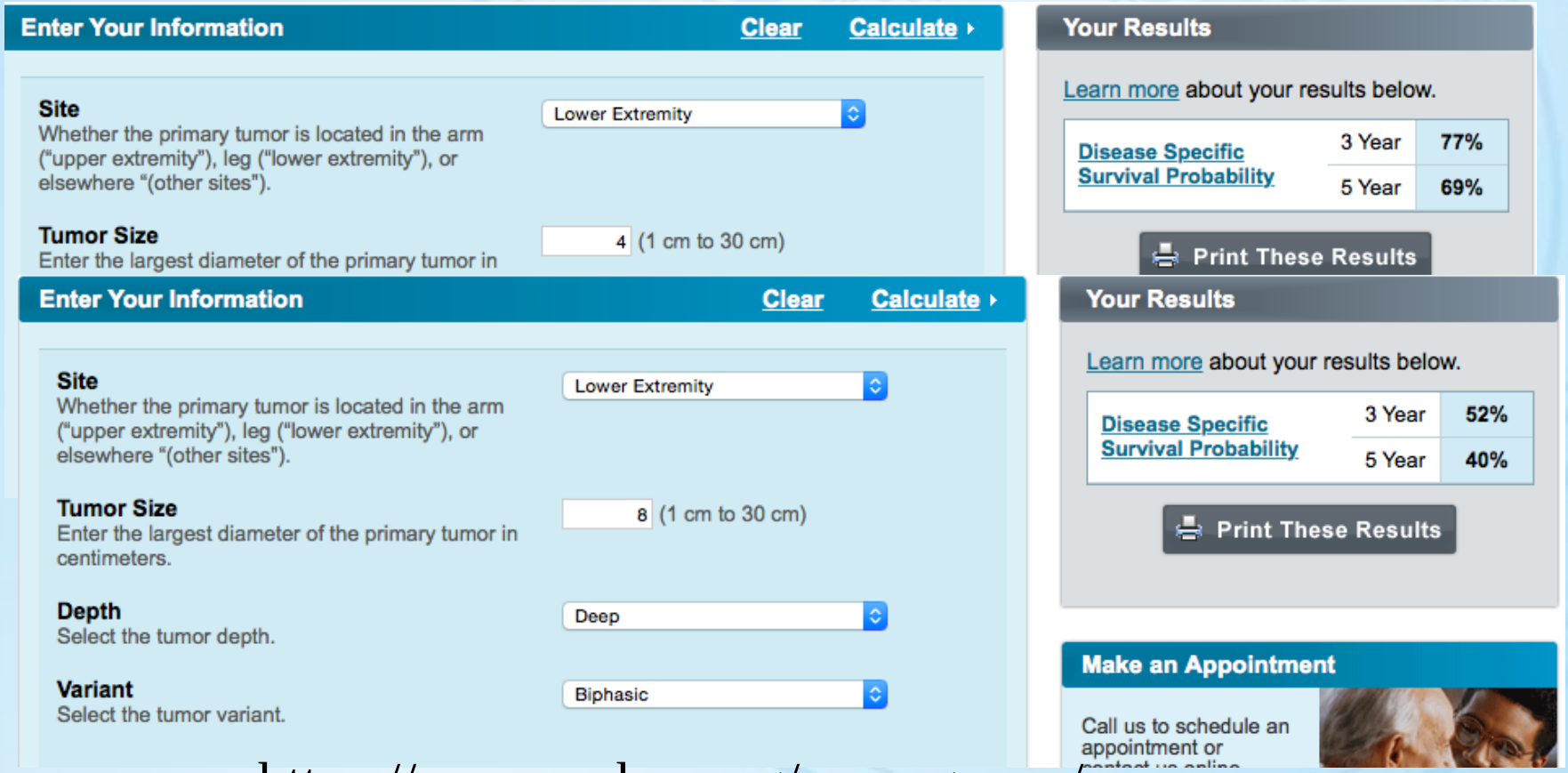
Internally fixed and watched for 5 months while bone disappeared = osteosarcoma

Hip pain …

- Reported as arthritis
- Actually diagnosed 3 months later as Chondrosarcoma
- Grown from 6 to 7cm
- Hindquarter amputation
- Would earlier diagnosis have made any difference?

Did delay in diagnosis = worse outcome? -MSKCC data very helpful

- e.g. 4 cm tumour missed and only diagnosed when 8cm – it will still be in same location and same grade



https://www.mskcc.org/nomograms/sarcoma

The single thing most likely to improve survival for patients with Sarcomas – is earlier diagnosis

Suggestion: Any lump bigger than this should have a diagnosis….

42mm

Sarcoma UK
The bone & soft tissue cancer charity

http://www.sarcoma.org.uk/