ORTHOPAEDIC ONCOLOGY / BONE SARCOMA

The Biopsy Is the Operation

Tract planning for bone sarcoma at seven anatomic sites

- Proximal humerus
- Pelvis
- Proximal femur
- Femur shaft
- Distal femur
- Proximal tibia
- Distal tibia

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WHY THIS TALK

You already know how to take a biopsy. The data say that is the problem.

- The biopsy looks like the simplest step in the pathway. It is the step that most often forecloses the limb.
- The errors are rarely about technique. They are about strategy: a tract placed where it cannot be excised with the tumour.
- A poorly placed tract is silent. It changes nothing on the day of the procedure and everything at the definitive resection.

2 to 12x

more errors, complications and adverse outcomes when the biopsy is done at the referring unit rather than at the treating sarcoma centre.

Musculoskeletal Tumour Society

THE EVIDENCE

The Musculoskeletal Tumour Society checked, twice

1982

329 sarcoma biopsies, 16 centres

18.2% major diagnostic error

17.3% complications

4.5% unnecessary amputation

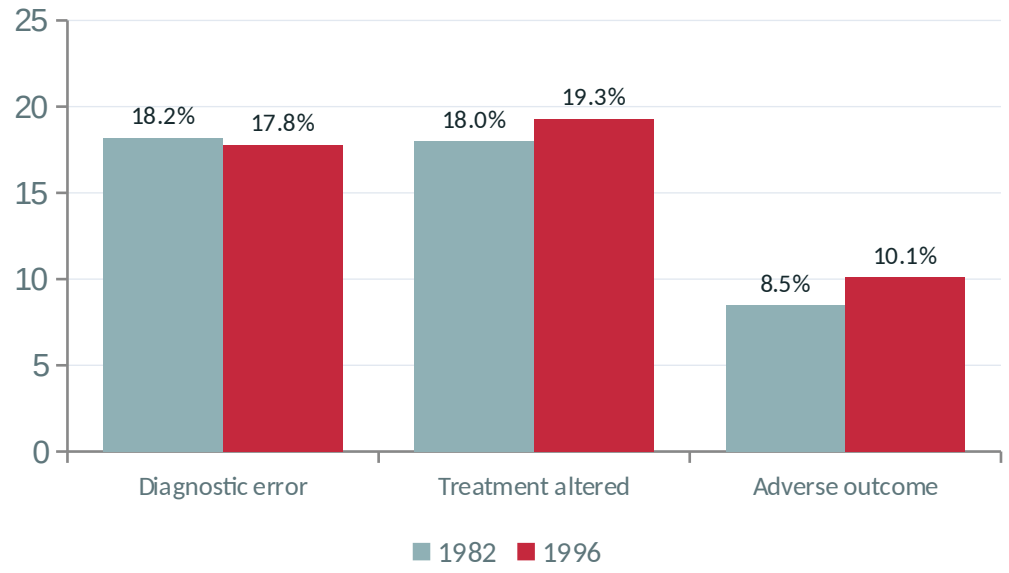
1996

597 patients, 21 institutions

17.8% diagnostic error

19% needed altered or wider surgery, or added chemo or radiotherapy

Fourteen years apart, the numbers barely moved (%)



The variable that changed outcomes was the institution, not the tumour. Errors, complications and deleterious results were two to twelve times higher at referring units.

THE ONE RULE

Plan the biopsy as carefully as the definitive resection. The tract, and the tissue around it, comes out en bloc with the tumour.

7% to 38%

Local recurrence after open biopsy rises more than fivefold when the biopsy scar is not excised at resection.

10 to 30%

Five-year survival after sarcoma recurrence is poor, commonly cited in this range. Isolated local recurrence markedly worsens prognosis and is rarely salvageable.

Joint. Compartment. Bundle.

Cross any of these and the resection must take it too, or the limb is lost.

BEFORE THE ANATOMY

The principles that govern every site

Longitudinal, in line

Incision along the line of the definitive approach. Never transverse.

One compartment

Shortest route through a single compartment. Cross nothing you do not have to.

No joint, no neighbour

Never violate a joint or enter an uninvolved compartment.

Off the bundles

Stay off neurovascular structures. Contamination costs the limb, not just the nerve.

Haemostasis is oncology

A haematoma carries tumour through every fascial plane it reaches.

Drain in line

If used, bring the drain out in line with and close to the incision, so it is excised with the tract.

Viable, and enough

Sample viable peripheral tumour, not the necrotic centre. Take multiple cores.

Confirm and culture

Image-guide where possible, confirm representative tissue, send for culture when infection is in the differential.

The meta-principle: biopsy at, or after consulting, the unit that will perform the definitive surgery.

CURRENT PRACTICE

Image-guided core needle is now first-line for most lesions

CORE NEEDLE, IMAGE-GUIDED

- Pooled diagnostic accuracy about 84% across 32 studies (n = 7209); modern bone series report 90 to 98%.
- Accuracy comparable to open biopsy, with fewer complications, lower cost, and a faster route to a tumour-board decision (about 8 versus 16 days).
- Tract seeding risk is low. Fine-needle aspiration tracts are lower still, but FNA is less accurate for primary bone tumours.

OPEN OR INCISIONAL

- Reserve for non-diagnostic cores, or when bulk tissue is required for grading and molecular work.
- Still the largest, most representative sample, at the cost of anaesthesia and higher complication rates.
- Same discipline applies: longitudinal, single compartment, excisable scar, meticulous closure.

The tract rule does not relax for a needle. Plan the needle path exactly as if it will be resected, because it will be. Switching from a blade to a 14-gauge core does not make a bad trajectory safe.

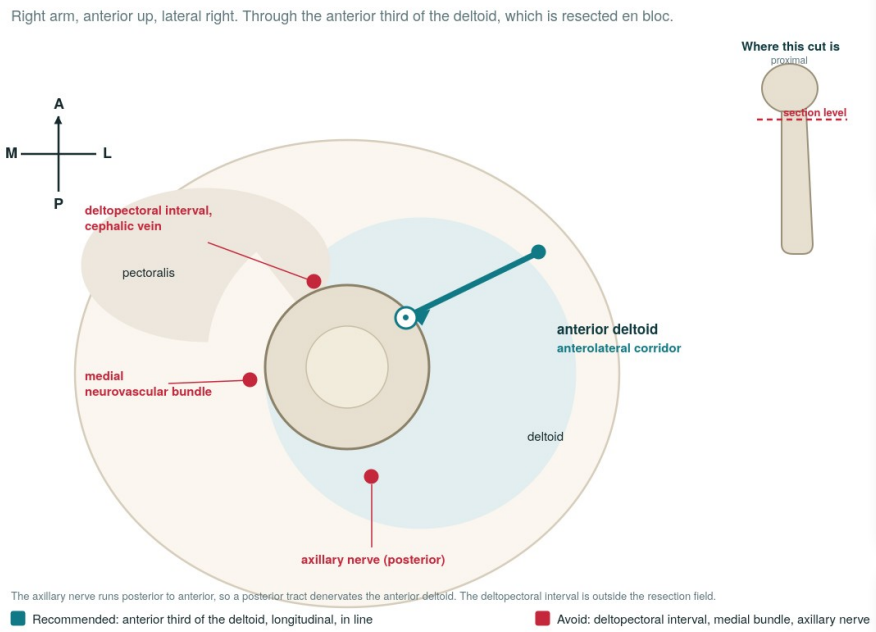
Seven sites. One framework.

The same rule, read off different anatomy. For each site: the safe corridor, the structures that cost the limb, and the reconstruction at stake.

1	**Proximal humerus**	*The deltoid and the interval*
2	**Pelvis**	*The highest stakes, the most anatomy*
3	**Proximal femur**	*The hip joint and the intraosseous neck*
4	**Femur shaft**	*Lateral, through vastus lateralis*
5	**Distal femur**	*The commonest site, anteromedial*
6	**Proximal tibia**	*The extensor mechanism*
7	**Distal tibia**	*The soft-tissue envelope*

1 Proximal humerus

The deltoid is resected with the tumour. Keep the tract inside it, and keep the interval clean.



RECOMMENDED TRACT

Anterior third of the deltoid, longitudinal, in line with the surgical approach. Arm externally rotated.

Stay just lateral to the cephalic vein. The deltoid will be taken en bloc, so a transdeltoid tract is recoverable.

AVOID, AND WHY

The deltopectoral interval and groove, the pectoralis (needed for reconstruction), the long head of biceps, the medial bundle.

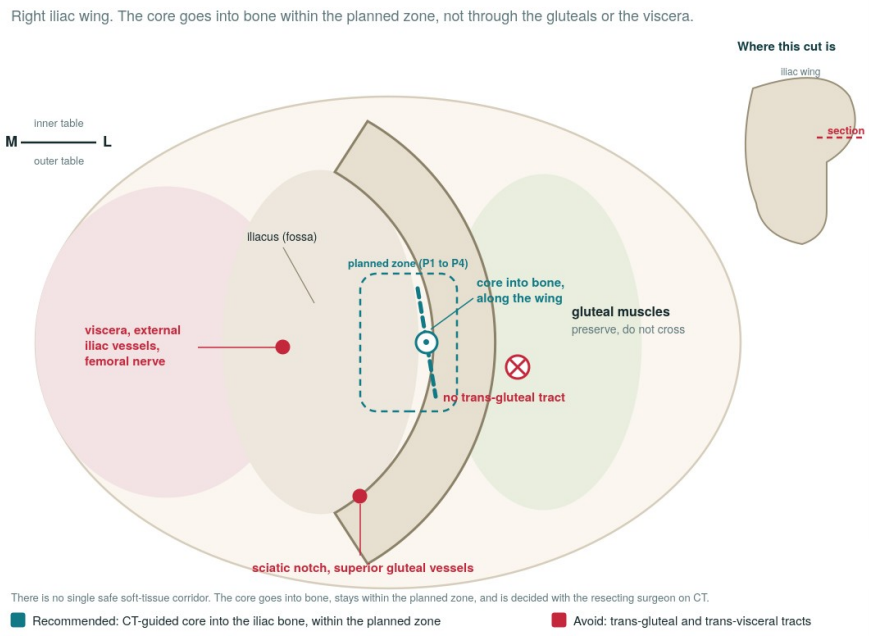
Axillary nerve runs posterior to anterior, so a posterior tract denervates the anterior deltoid.

IF YOU GET IT WRONG

A deltopectoral or posterior tract disseminates along normal planes and raises local recurrence. It can turn a limb-sparing resection into a forequarter amputation.

2 Pelvis

Lowest tolerance for error. Plan the trajectory with the resecting surgeon, on CT, every time.



RECOMMENDED TRACT

CT-guided core directly into the iliac bone, along the long axis of the wing, anterior or posterior, within the planned resection field (Enneking zones P1 to P4).

Mandatory consult with the resecting surgeon before the needle goes in.

AVOID, AND WHY

Gluteal muscles and rectus femoris, both needed for limb-sparing. Anteriorly: femoral nerve, external iliac vessels, viscera.

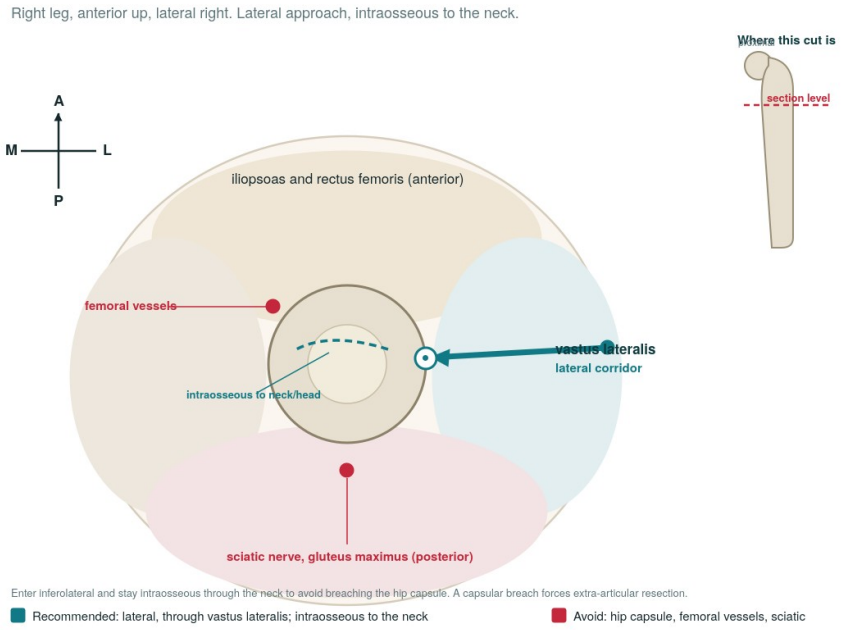
Posteriorly: internal iliac vessels, gluteal branches, sacral plexus, the greater sciatic notch.

IF YOU GET IT WRONG

A trans-gluteal or trans-visceral tract contaminates compartments that cannot be taken en bloc, and converts an internal hemipelvectomy into a hindquarter amputation.

3 Proximal femur

Lateral approach. For neck and head lesions, take an intraosseous path through the neck to spare the hip capsule.



RECOMMENDED TRACT

Lateral, longitudinal, in line with the lateral approach, through a small part of vastus lateralis.

Neck and head lesions: enter inferolateral in the subtrochanteric region and angle up through the neck on an intraosseous course, to avoid the hip capsule.

AVOID, AND WHY

Rectus femoris and vastus intermedius, whose loss ends ambulation. The femoral bundle anteriorly. The hip joint capsule.

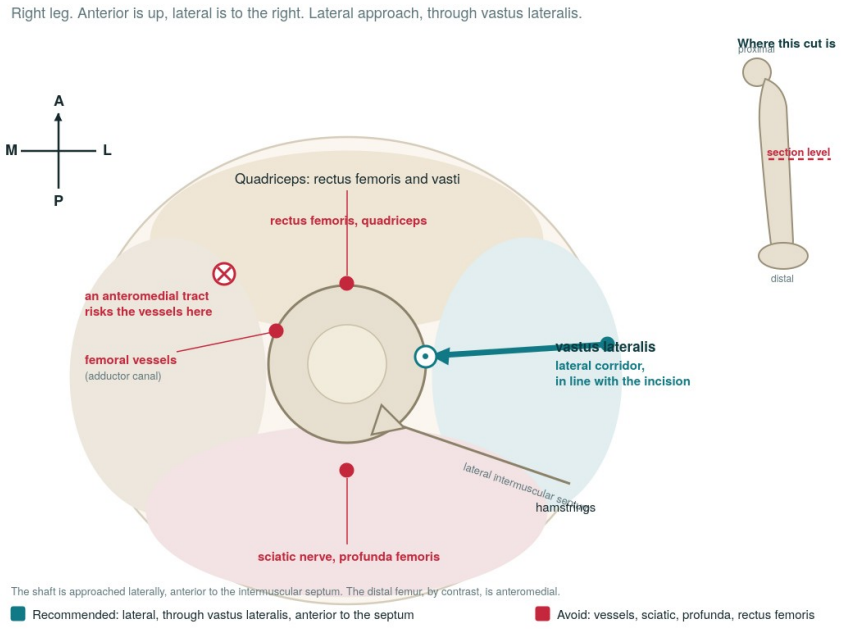
The sciatic nerve and profunda femoris lie just behind the septum, posteriorly.

IF YOU GET IT WRONG

A capsular breach mandates extra-articular resection or joint sacrifice. An anterior quadriceps tract through rectus femoris costs knee extension and can end ambulation.

4 Femur shaft

Lateral, through vastus lateralis, anterior to the intermuscular septum. A different corridor from the distal femur.



RECOMMENDED TRACT

Lateral, longitudinal, in line with the lateral thigh incision, through a small part of vastus lateralis, which is reflected anteriorly and taken with the specimen.

Stay anterior to the lateral intermuscular septum. The same lateral corridor applies along the whole diaphysis.

AVOID, AND WHY

An anteromedial tract: it risks the femoral vessels in the adductor canal and falls outside the lateral resection field.

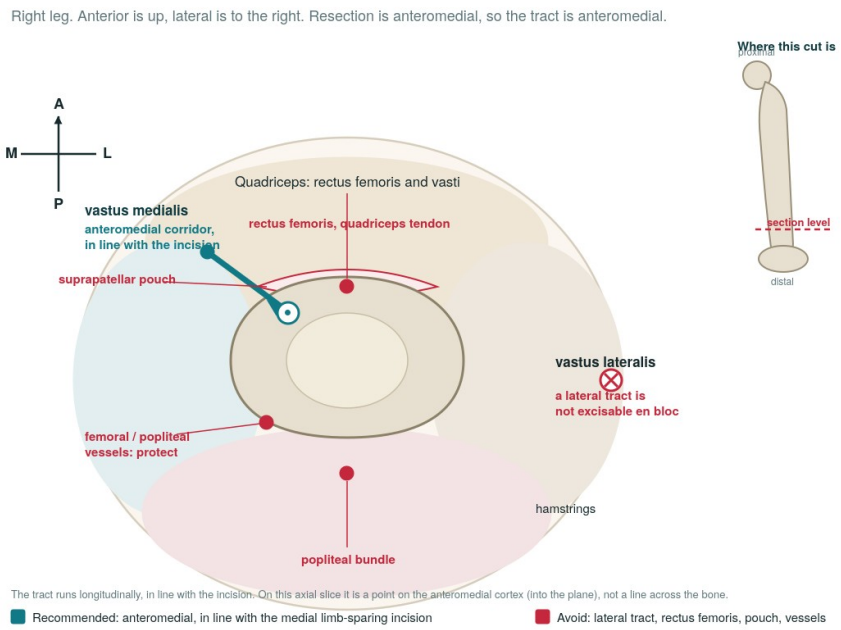
Posteriorly, behind the septum: the sciatic nerve and profunda femoris. Anteriorly, the rectus femoris.

IF YOU GET IT WRONG

A tract placed medially or anteromedially endangers the femoral vessels and cannot be taken en bloc with the lateral resection. Keep the corridor lateral and in line with the incision.

5 Distal femur

The commonest osteosarcoma site. Anteromedial, in line with the resection, off the rectus femoris, out of the knee.



RECOMMENDED TRACT

Anteromedial, longitudinal, in line with the standard anteromedial limb-sparing incision, through vastus medialis. This is the incision that exposes and protects the femoral and popliteal vessels, so the tract must lie inside it.

The vessels are identified and protected through the same medial exposure. Keep clear of them; do not go lateral to reach the bone.

AVOID, AND WHY

A lateral tract. It sits outside the anteromedial resection field and cannot be taken en bloc. The rectus femoris and extensor mechanism anteriorly.

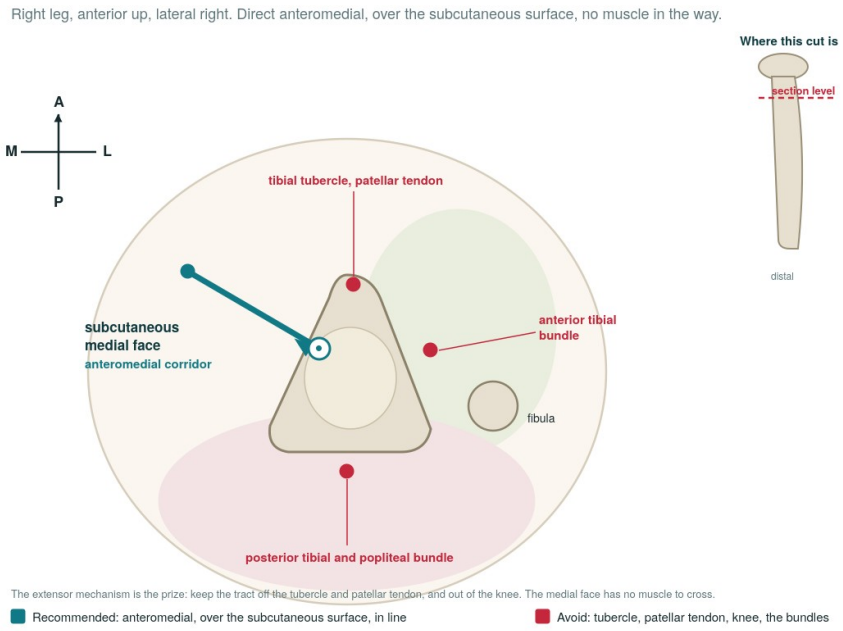
The knee joint and the suprapatellar pouch, which can extend well up the distal femur. The femoral and popliteal vessels, protected through the same medial exposure.

IF YOU GET IT WRONG

A lateral tract cannot be excised with the anteromedial resection, forcing a wider excision or a compromised margin. An anterior rectus femoris tract costs knee extension. The reported Ewing case, biopsied anteriorly at an outside unit, lost extension and recurred at 9 months despite clean margins.

6 Proximal tibia

The extensor mechanism is the prize. Keep the tract off the tubercle and out of the knee.



RECOMMENDED TRACT

Anteromedial, longitudinal, directly over the anteromedial tibial cortex.

Through subcutaneous fat into bone, with no intervening muscle compartment. The subcutaneous medial border is the corridor.

AVOID, AND WHY

The tibial tubercle and patellar tendon insertion: the extensor mechanism can be retained only if it and the knee are spared.

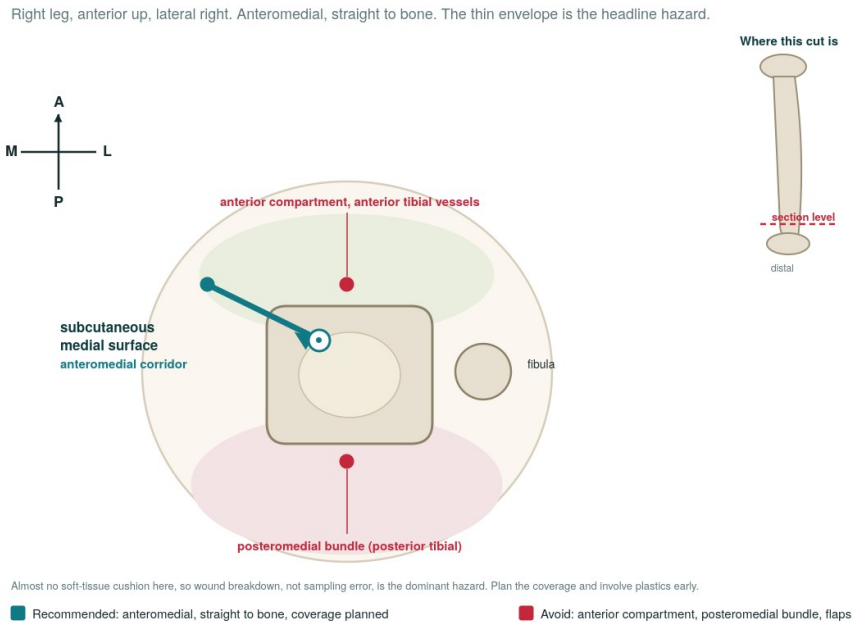
The knee joint; the anterior and posterior tibial bundles; the popliteal bundle posteriorly.

IF YOU GET IT WRONG

A tract through the tubercle or the joint forfeits the extensor mechanism or the knee, the hardest structures to reconstruct after proximal tibial resection. Iatrogenic seeding from patella to proximal tibia is on record.

7 Distal tibia

Anatomy is forgiving on where the bone sits, unforgiving on what covers it.



RECOMMENDED TRACT

Anteromedial, longitudinal, directly over the subcutaneous medial tibial surface, straight to bone with no intervening compartment.

In line with the definitive incision. Plan the soft-tissue coverage before you cut.

AVOID, AND WHY

Crossing the anterior compartment or the posteromedial neurovascular structures. Raising flaps, undermining, or closing under tension over a thin envelope.

The peroneal and tibial bundles.

IF YOU GET IT WRONG

The distal tibia has almost no soft-tissue cushion, so wound breakdown and exposed bone, not sampling error, are the dominant hazard. Involve plastics early: a poorly placed scar can dictate a free flap or a below-knee amputation.

FAILURE MODES

The recurring avoidable errors

The transverse incision

Crosses compartments and cannot be excised in line. The most common avoidable error.

The uncontrolled haematoma

Tumour follows blood through every fascial plane the bleed reaches.

The ‘obviously benign’ excision

An unbiopsied mass removed on assumption. On the humerus and thigh, this is how limbs are lost.

The wrong compartment

A tract that takes the path of least resistance instead of the planned plane.

The drain at the far corner

A separate stab wound becomes a second tract to resect, or one that is missed.

FNA alone on a heterogeneous lesion

Fast and low-seeding, but often non-representative for a primary bone tumour.

On record: *a distal femoral Ewing biopsied anteriorly through rectus femoris at an outside unit. Limb-sparing was still done, but it forced an extra resection, cost knee extension, and recurred at 9 months despite clean margins and chemoradiotherapy.*

ADEQUACY

The biopsy no longer just gives you a diagnosis

- Tissue now has to carry grade, immunohistochemistry, and molecular and cytogenetic testing. Many sarcomas are translocation-defined.
- Take multiple cores from viable, peripheral tumour. Keep tissue fresh for cytogenetics, and send for culture whenever infection is in the differential.
- Inadequate tissue is a failed biopsy even when the tract is perfect. It forces a repeat procedure and delays treatment.
- Every suspected primary bone sarcoma belongs in front of a multidisciplinary tumour board before definitive surgery.

A perfect tract that yields non-representative tissue is still a failed biopsy.

Get the trajectory right and the tissue right. Both, every time.

WHAT TO CARRY INTO THE NEXT CASE

1. If a solitary bone lesion could be a sarcoma, the biopsy is the first step of the resection, not a separate event.
2. One rule: the tract must be excisable en bloc. Longitudinal, single compartment, off joints and bundles.
3. Memorise the safe corridor for each site. The anatomy is fixed; the error is optional.
4. When in doubt, do not biopsy. Refer, or call the unit that will operate.
5. **A perfect needle in the wrong plane still costs the limb.**

SOURCES

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