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Bone tumors.

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General bone oncology.





- Diagnosis and treatment of the bone tumors and bone tumor-like affections is a problem in which resolution the orthopedists, radiodiagnostics, pathologists, oncologists and radiotherapists participate. However, the early diagnosis of these diseases, which is a basic assumption of treatment success, depends on the first doctor that patient visits.



Division and classification of bone tumors .



WHO classification 1972

- I. Bone-forming tumors
 - II. Cartilage-forming tumors
 - III. Giant cell tumor (osteoclastoma)
 - IV. Tumors arising from the bone marrow
 - V. Vascular tumors
 - VI. Other connective tissue tumors
 - VII. Other tumors
 - VIII. Unclassified tumors
 - IX. Tumor-like affections
- Tumors of fibrohistiocytic origin (1986)



Epidemiology.



- Primary bone tumors make up about 0.2% of all tumors
- Benign are more frequent than malignant
- Primary bone tumors are more common in young people, accounting for about 6-7% of the total

Metastatic tumor	28.4%
Osteogenic sarcoma	27.2%
Ewing's sarcoma	12.4%
NHL	10.6%
Chondrosarcoma	8.3%
Plasma cell myeloma	8.3%
Miscellaneous	4.8%

Cancer type	incidence	Median survival (mo.)
Myeloma	70 - 95%	6
Prostate	65 - 75 %	36
Breast cancer	65 - 75 %	24
Thyroid cancer	60 %	48
Lung cancer	30 - 40 %	7
Bladder cancer	40 %	6-9
Renal cancer	20 - 25 %	12



Epidemiology- malignant tumors.



- 1st decade: Ewing's sarcoma, osteosarcoma
- 2nd - 3rd decade: osteosarcoma, Ewing sarcoma
- 3rd - 4th decade: Giant cell tumor, parosteal osteosarcoma, secondary chondrosarcoma, secondary bone tumors
- 5th decade -: secondary bone tumors, multiple myeloma, primary chondrosarcoma, secondary osteosarcoma



Diagnosis.



- Diagnostics: 4 phases
- Phase 1 - significant tumor suspicion - standard X-rays, standard laboratory tests, thorough history and thorough physical examination
- Phase 2 - prebiptic examinations - USG, CT, (angio-CT), MRI to determine the exact location, size and type of tumor mass
- Phase 3 - biopsy
- Phase 4 - is performed with a high probability of malignancy, - searching for metastases CT, PET CT, Scintigraphy



Diagnosis- anamnesis.



- AGE: very important information, different distribution in age groups
- SEX: less important, only some tumors e.g. GCT more common in women
- RACE: Not very important, but Ewing sarcoma is very rare in the African population
- OTHER: any exposure to radiation or carcinogens



Diagnosis - clinical examination

- Pain
- Mass
- Malfunction
- Abnormal X-ray finding
- Pathological fracture





- PAIN: is the most common symptom, deep constant pain, insufficiently localisable, worsening at night, initially affected by analgesics, later only by narcotics
- TUMOR MASS: The intensity of growth is important
Fluctuation - cyst, ganglion, hemangioma
- NEUROLOGICAL SYMPTOMS: rarely present in patients, e.g. sacral tumors and tumors located near the nerve and causing nerve compression, especially in the sciatic nerve, inguinal canal and fossa poplitea
- UNCLEAR SWELLING: the finding in pelvic tumors that are painless and without palpable mass and compression of the iliac veins can cause swelling



Diagnosis - laboratory tests.



- ALP (bone isoenzyme): Under normal circumstances, this enzyme is present at high levels when there is increased activity in bone-forming cells (usually at the time of growth, or when fractures are repaired). High levels of alkaline phosphatase may also be an indicator of bone tumors (abnormal bone tissue)
- PTH test: Lower levels may be an indicator of bone tumor
- Serum phosphorus: Higher levels may be an indicator of bone tumor
- Ionized calcium and serum calcium: Higher levels may be an indicator of bone tumor
- Other tests: Hemoglobin, diff. KO, FW, CRP, PSA, markers, protein electrophoresis (Bence Jones protein)



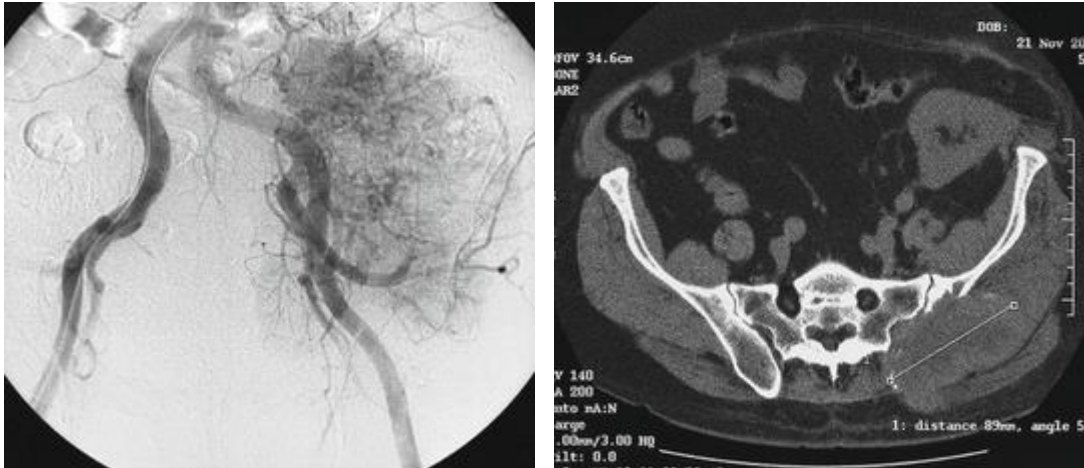
Diagnosis - auxiliary examinations.



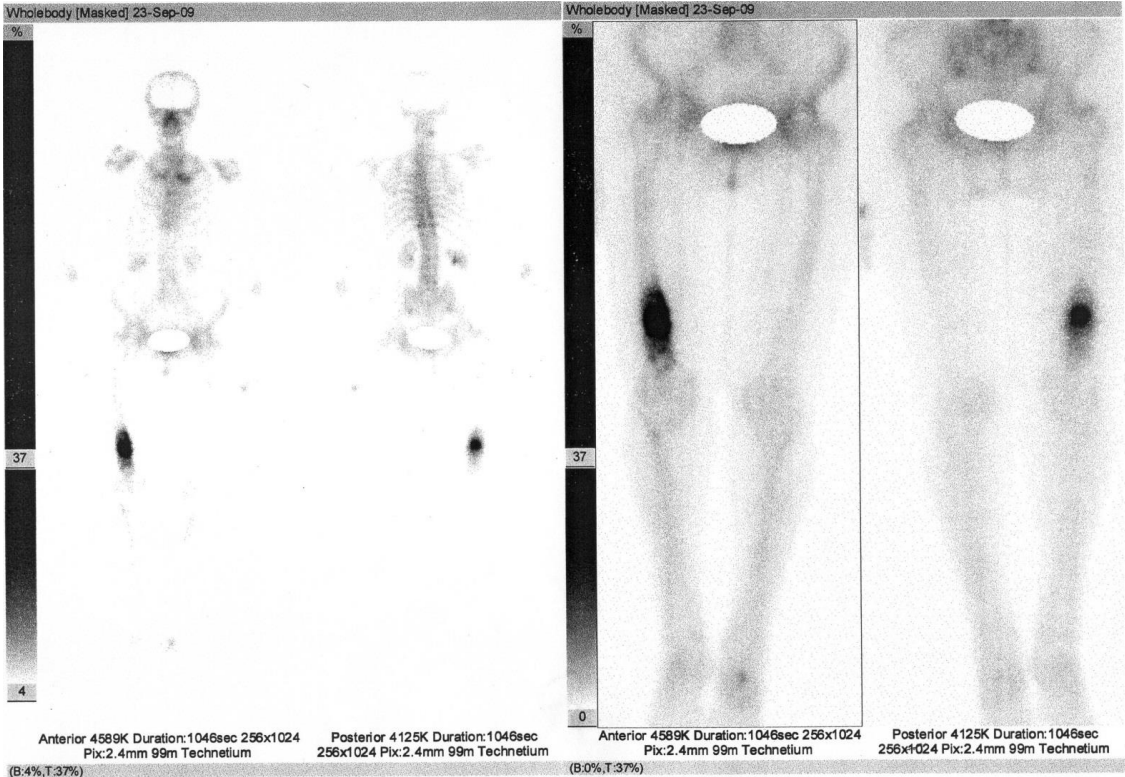
- X-ray
- CT
- MRI
- SCINTIGRAPHY
- PET CT: Positron Emission Tomography uses radioactive glucose to locate the tumor
- ANGIOGRAPHY: Pathological vascular supply is an important indicator of malignancy. It is also used for preoperative planning



CT finding and angiography



Scintigraphy.



Biopsy.



- Biopsy is a crucial method for determining of malignancy degree, type of bone cancer (primary or secondary) and staging. Depending on the size of the tumor and the type (malignant or benign), we decide on the purpose of the biopsy (remove the whole tumor or take a small tissue sample)
- There are 2 types of biopsies used in the diagnosis of bone cancer



- Needle biopsy: Collection of a small tissue sample with a bone needle. We know two types according to the thickness of the needle:

Fine needle aspiration: Aspiration of tissue with a thin needle



Core needle biopsy: Collection of a small cylindrical sample



- Incisional biopsy (scalpel): Sampling by opening the skin cover and surgical preparation (bone window)

Staging-benign tumors

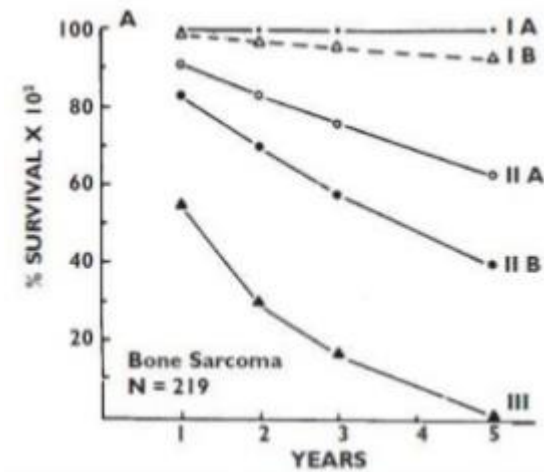
- Enneking classification
- Stage 1- LATENT - they do have the typical characteristics of growth, they can disappear spontaneously
- Stage 2- ACTIVE - lesions deform bones but do not overgrow them, require intralesional curettage
- Stage 3- AGGRESSIVE - the tumor overgrows the bone, requires complex treatment, broad-edge extirpation and local therapy



Staging- malignant tumors.

- Enneking classification

STAGE	GRADE	SITE
I A	Low – G1	Intracompartmental T1
I B	Low – G1	Extracompartmental T2
II A	High G2	Intracompartmental T1
II B	High G2	Extracompartmental T2
III A	Any grade with regional or distal Metastases	Intracompartmental T1
III B	Any grade with regional or distal Metastases	Extracompartmental T2



Radiological evaluation.

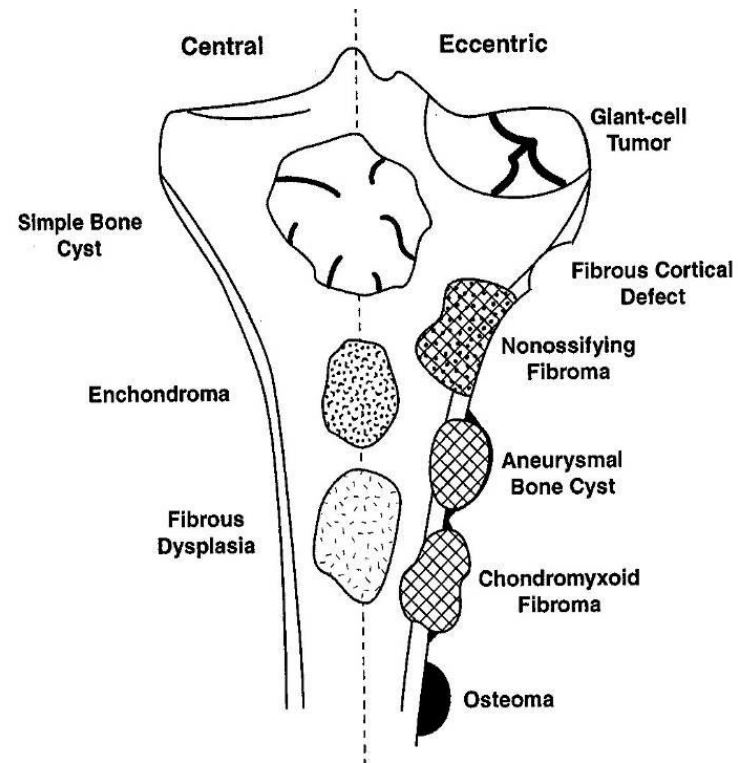


To achieve the most accurate diagnosis, several parameters need to be evaluated:

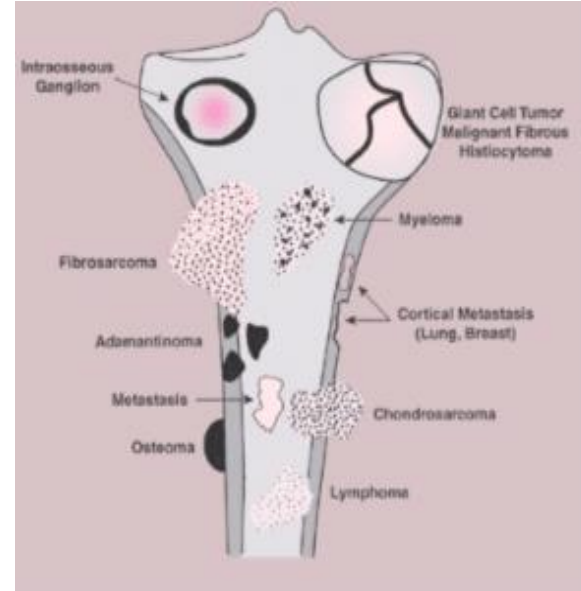
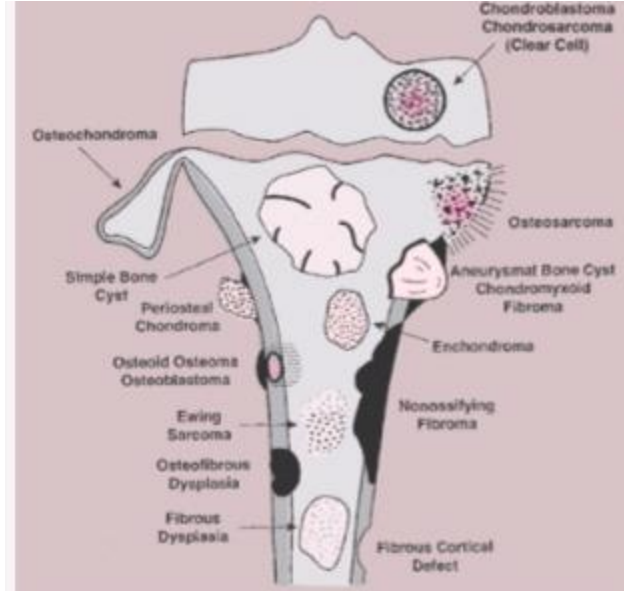
- Size and shape - X-ray, CT, MR
- Anatomical position
- Signs of destruction of the environment
- Periosteal reaction
- Cortical bone quality
- Matrix production
- Lesion density - lytic
- blastic



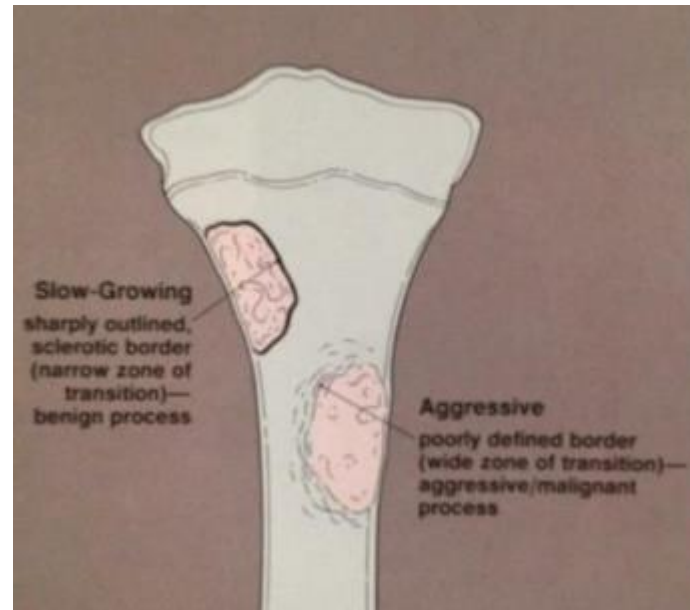
Radiological evaluation – localisation.



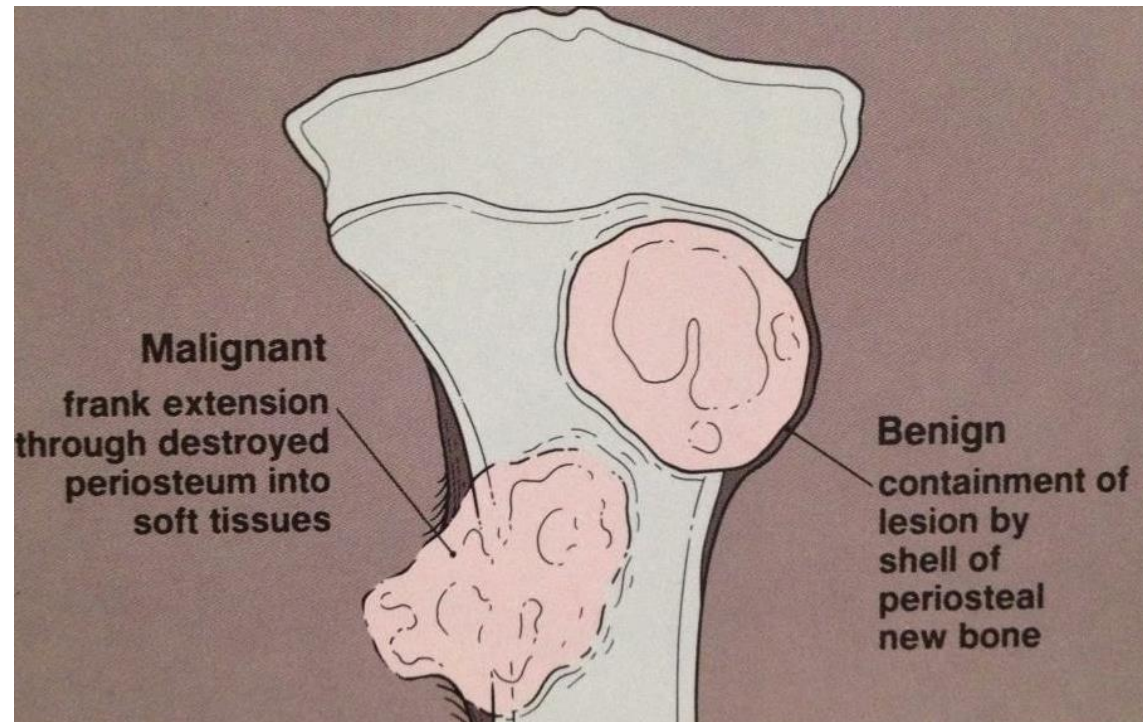
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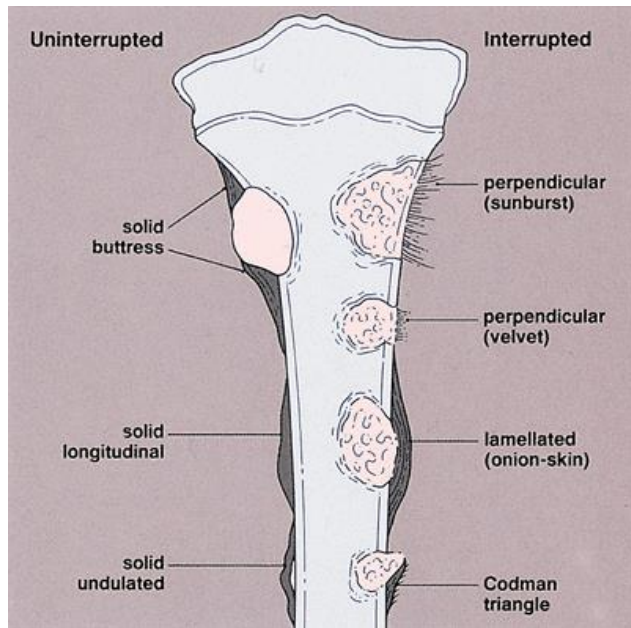
Radiological evaluation – tumor boundary.



Radiological evaluation – spreading.



Radiological evaluation - periosteal reaction.



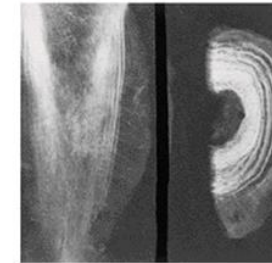
**sunburst
pattern -
osteosarcoma**



**lamellated or
onion-skin
type in ewing
sarcoma**



**Ewing sarcoma -
lamellated type**



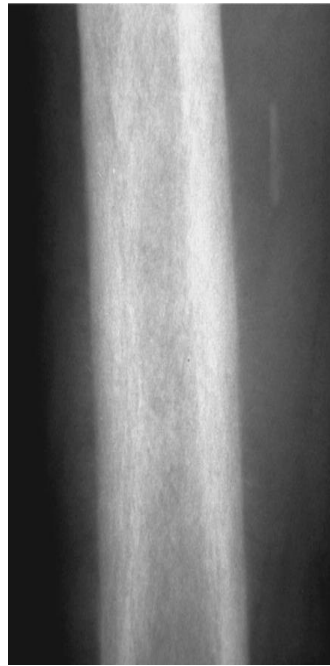
**Codman
triangle
(arrow)**



Radiological evaluation - periosteal reaction.



Solid



Sunburst



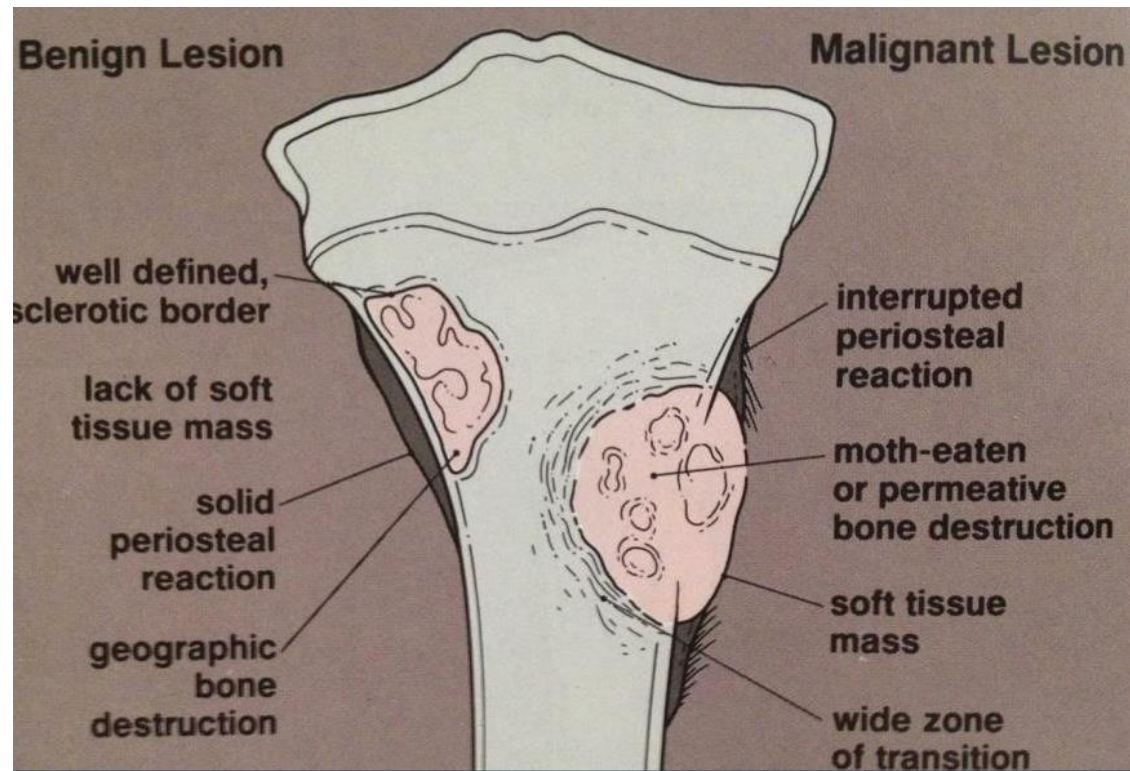
Onion peel



Codman triangle



Benign vs malignant tumors.



Differential diagnosis.

- Postraumatic changes
- Bone infarction
- Myositis isificans
- Gout
- Hamartomas of the sotf tissues
- Infection
- Bone defects



Therapy.



Therapy depending factors

- Primary focus-known/unknown
- Age
- Localisation
- Range of the bone destruction
- Pain
- General patient condition
- Patient prognosis
- Comorbidities
- Radiosensitivity
- Patological fractures



Therapy.

- Local therapy

Surgical

Radiotherapy

Others (embolisation, radiofrequency ablation, ..)

- Total therapy

Chemotherapy

Hormonal treatment

Bisphosphonates

Biological treatment, etc.



Surgical treatment.

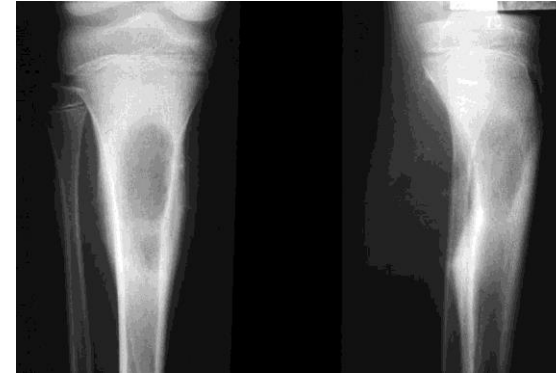


- Malignant tumors: Mostly radical extirpation, secondarily preservation of limb function
- Benign tumors: More attention is paid to functional outcome
- Secondary tumors (MTS): We choose a compromise between functional outcome, radical performance and patient prognosis



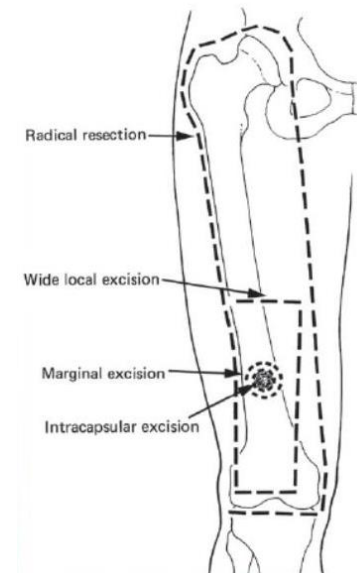
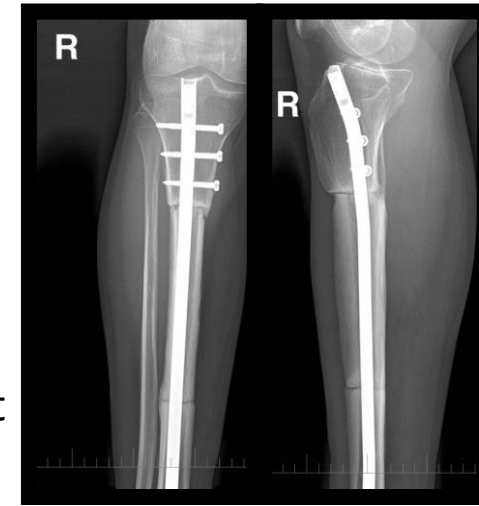
Surgical treatment - intralesional procedures.

- Needle decompression (cystic lesions, corticoid instillation)
- Excochleation (bone trepanation, benign tumors)
- Excolation and cement filling (cysts, MTS)
- Excochleation and spongionoplasty



Surgical treatment - resection procedures.

- Simple resection or ablation is indicated without replacement or osteosynthesis in nonweight bearing bones - fibula
- Use of a non-vascularized or vascularized homologous bone graft. When resected more than 10 cm vascularized graft
- Use of autologous graft - in combination with implantation of TEP, OS, or cement filling. Increased risk of late infection.
- Use of bone cement as a spacer - in the latter period we usually replace it with an endoprosthesis





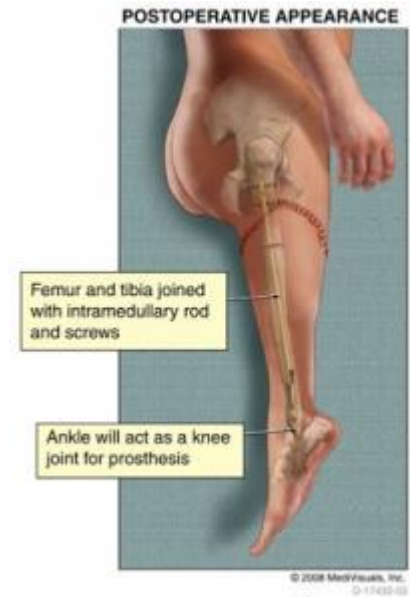
Surgical treatment - endoprosthetics

- Endoprosthetics - more than 60% of primary bone tumors form around the knee and the hip
- Tumor prostheses are a method of treatment for the knees, hips and shoulders
- The most used are non-cement (younger age)
- Advantages - faster loading and return to activities, faster and more intensive rehabilitation



Surgical treatment - ablative procedures.

- Amputation and exarticulation - is an absolute indication in case of tumor progression during preoperative chemotherapy. When the tumor grows into neurovascular bundles, infection, exulceration, etc.
- Rotary reconstructions - a special type of ablation, where the connection of the tibia to the proximal femur replaces the knee joint with ankle
- Individual anatomical prostheses of the pelvis, increased risk of infection





Special bone oncology.





Tissue of Origin	Benign	Malignant
Bone forming	Osteoma Osteoid Osteoma Osteoblastoma	Osteosarcoma
Cartilage forming	Chondroma Osteochondroma Chondroblastoma	Chondrosarcoma
Fibrous tissue	Fibroma	Fibrosarcoma
Giant-cell tumor	Benign Osteoclastoma	Malignant Osteoclastoma
Marrow tumors		Ewing's Sarcoma Myeloma
Vascular	Haemangioma	Haemangiosarcoma
Other connective tissue	Fibrous histiocytoma Lipoma	Malignant fibrous histiocytoma Liposarcoma
Other tumors	Neurofibroma	Adamantoma



Malignant bone tumors.





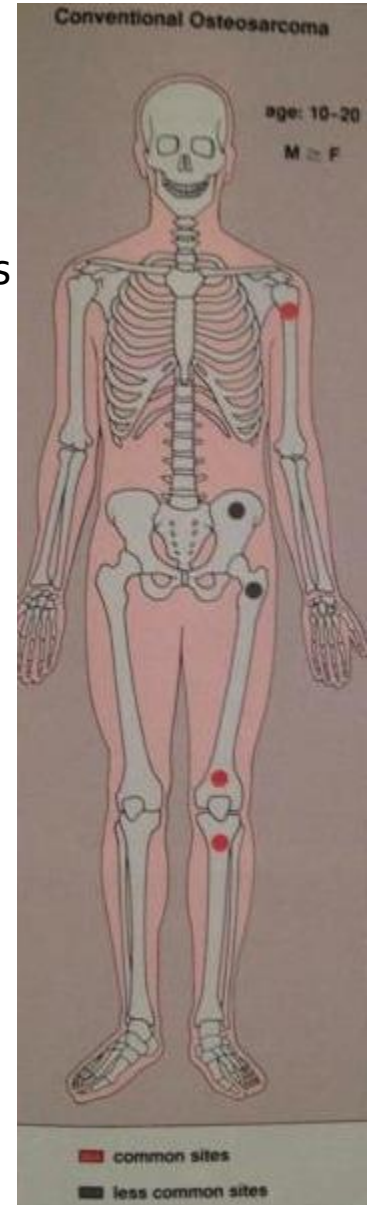
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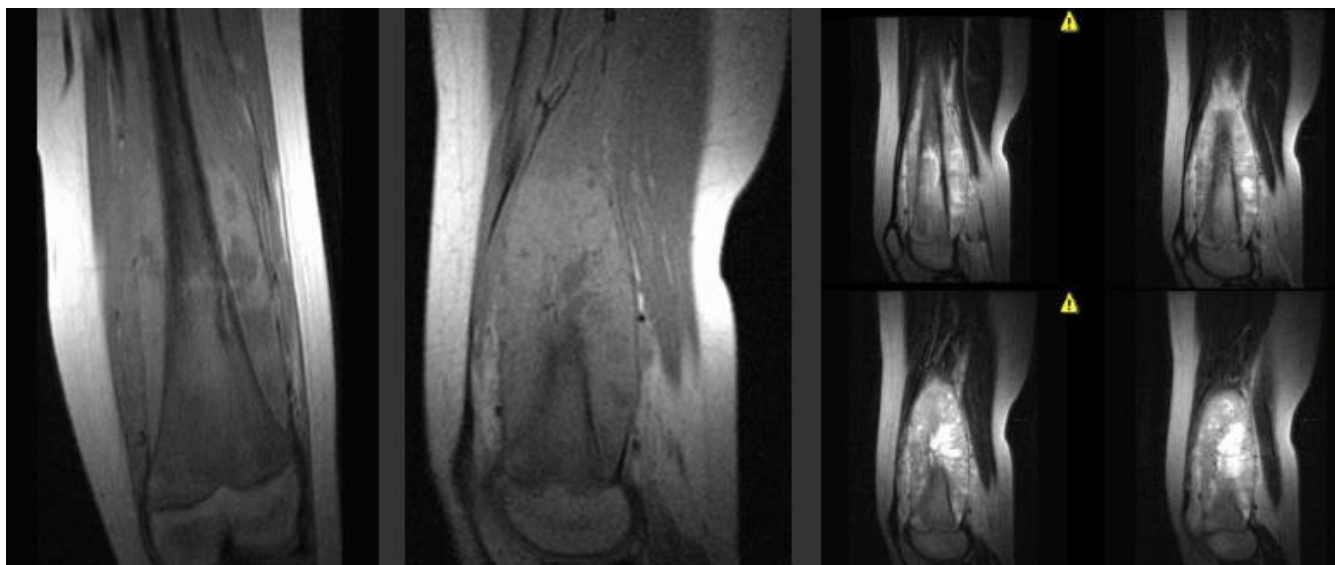
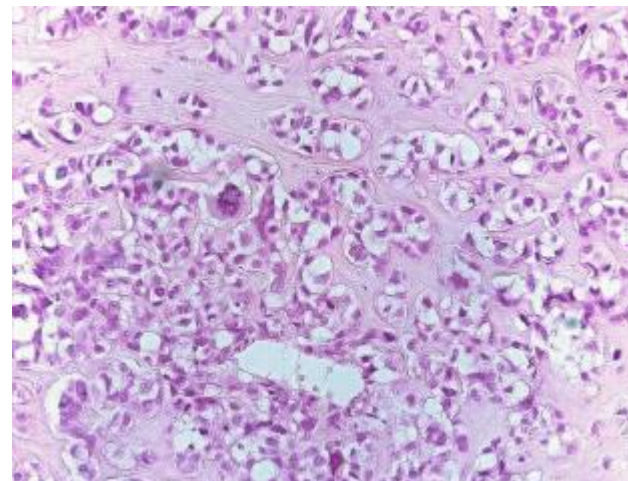
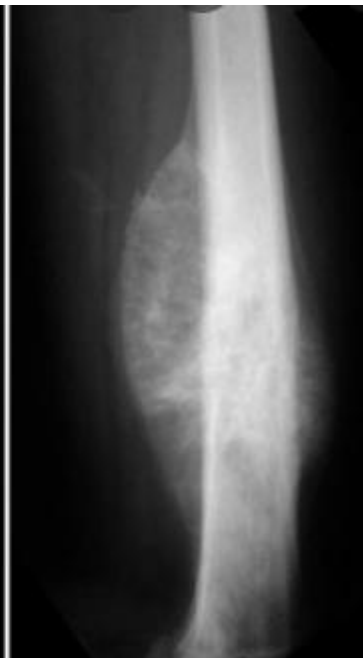


Osteosarcoma.

a malignant tumor characterized by direct bone formation or osteoid tissue directly by tumor cells

- about 1/3 of malignant bone tumors, 3-4 / 1,000,000 per year
- about 60% in II. decade of life
- most often metaphyseal - distal femur, proximal tibia, proximal humerus
- local pain for several weeks, more at night, deterioration in stress
- Osteosarcoma types: primary –the most frequent/ between 10-30y/
secondary-secondary malignisation/ M.Paget, fibrous dysplasia,
osteogenesis imperfecta, osteochondromatosis,
enchondromatosis/over 50y/





Osteosarcoma-periosteal reaction

- Codman triangle
- Sunburst reaction



Osteosarkom.

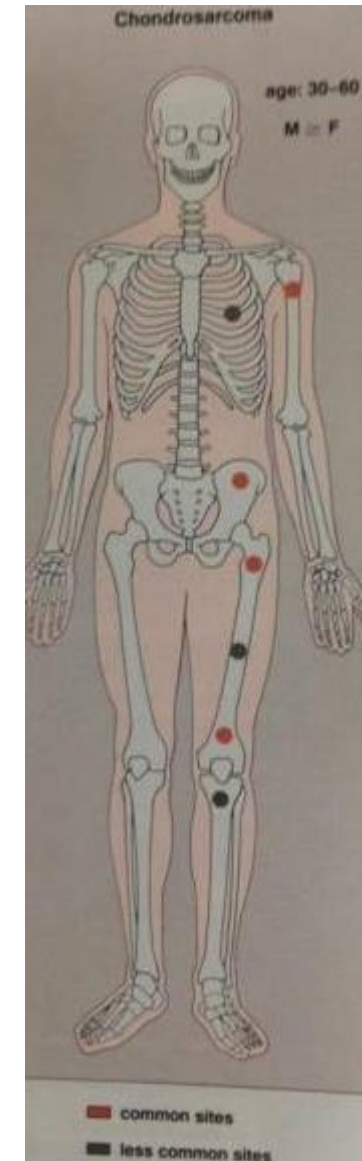
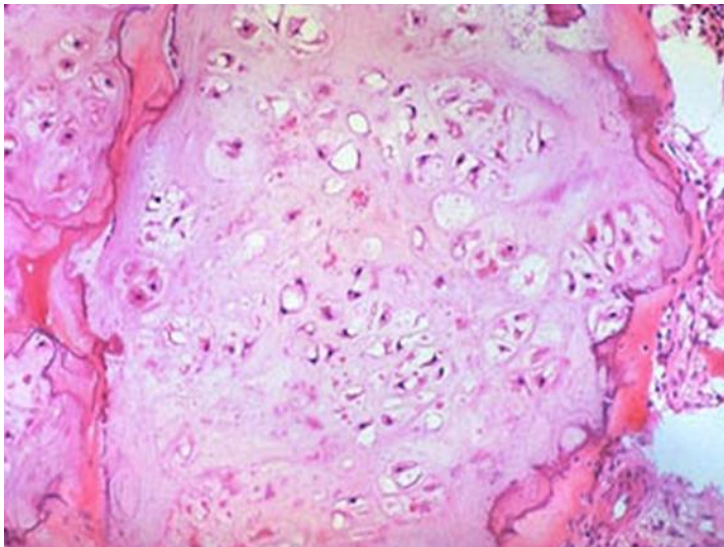


- Bad prognosis not due to the primary location of the tumor, which is solvable, but due to early metastasis (80-90% with radical removal of the primary tumor)
- up to 50% survivalship in case of early chemotherapy and surgery
- therapy- biopsy
 - chemotherapy for 2-3 months
 - tumor resection
 - adjuvant chemotherapy
- Prognosis: 77% survivalship till 5 years without MTS
26% survivalship till 5 years with MTS



Chondrosarcoma.

- Malignant tumor arising from cartilaginous tissue
- Dominant location in the metaphysis of the femur, tibia, humerus and pelvis
- It arises primarily, or by malignisation of the enchondrome or exostosis
- Typically between 40-70y of life



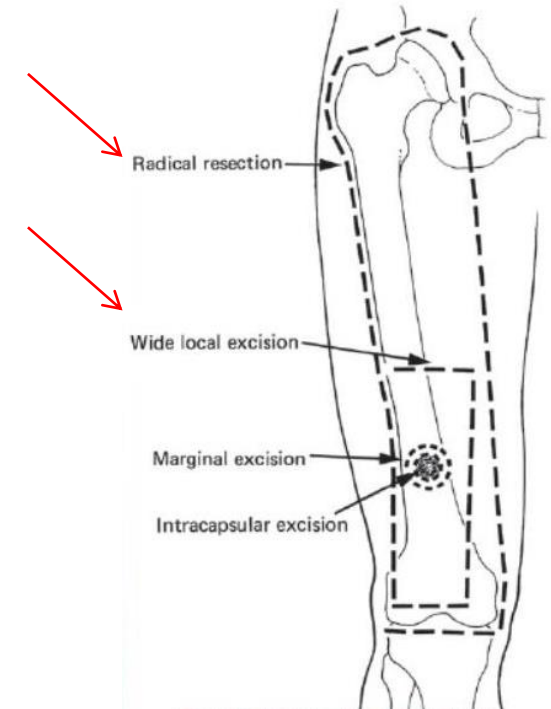


- Chondrosarcoma types: central /intracompartmental/
periferal /secondary from enchondroma,ostechondroma/



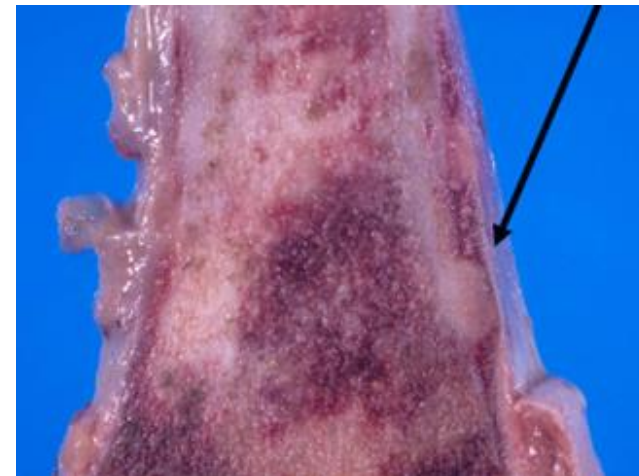
Chondrosarcoma-therapy.

- Tumor resistant to chemotherapy and radiotherapy
- Therapy: radical resection of the tumor
- Prognosis: 91% survivalship till 5 years without MTS
23% survivalship till 5 years with MTS



Ewingov sarkom.

- malignant round cell tumor arising from bone marrow
- age 10-30y, in 85% between 10 and 18y of life
- incidence 1-2/1 000 000 per year
- diaphyseal part of femur, tibia, humerus and pelvis
- often associated with fever and elevation of the inflammation parameters
- Therapy: chemotherapy
radiotherapy
tumor resection
- Prognosis: 70% survivalship till 5 years without MTS
15-30% survivalship till 5 years with MTS



Benign bone tumors.



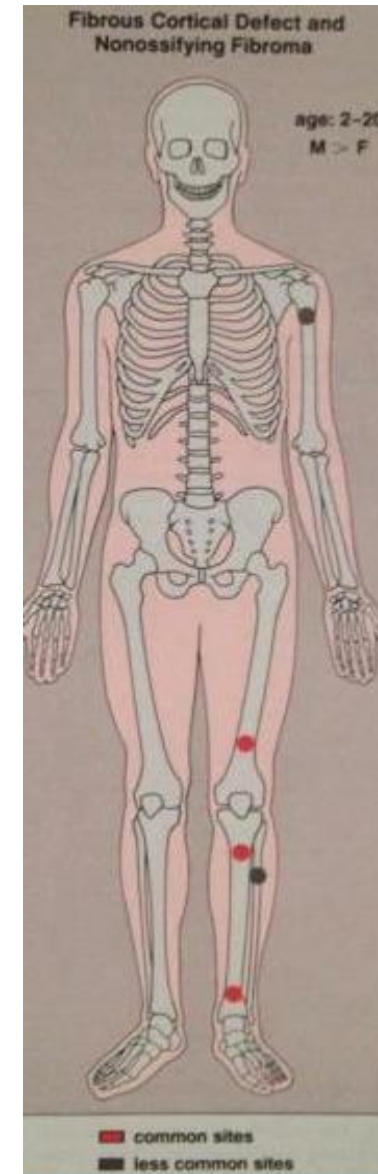


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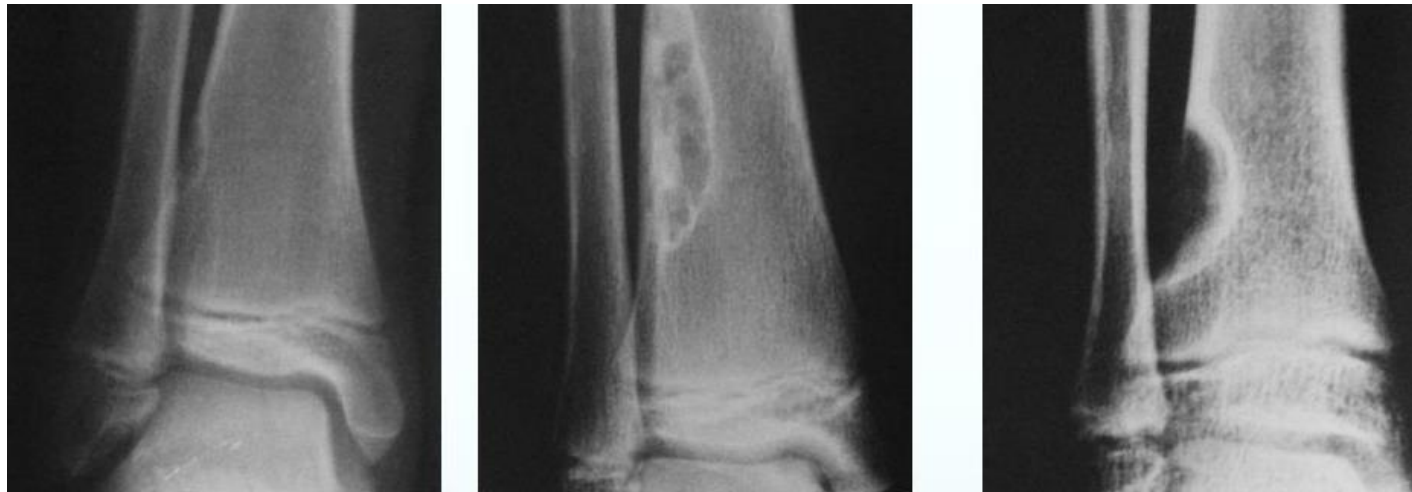
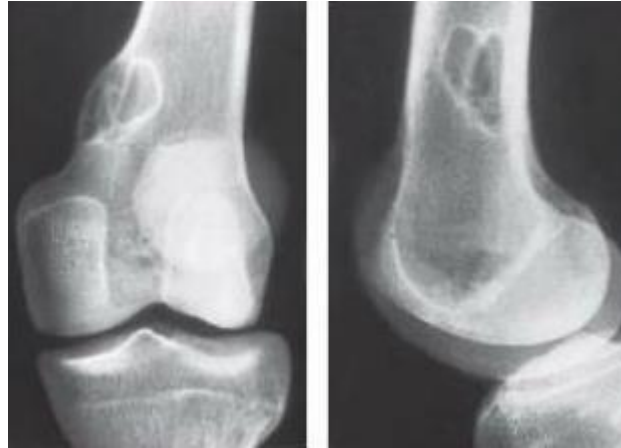


Fibrous cortical defect.

- One of the most frequent benign bone tumors
- Excentric localisation, sclerotic boundary
- Asymptomatic
- Metaphysis of the long bones
- Therapy: dispensarisation



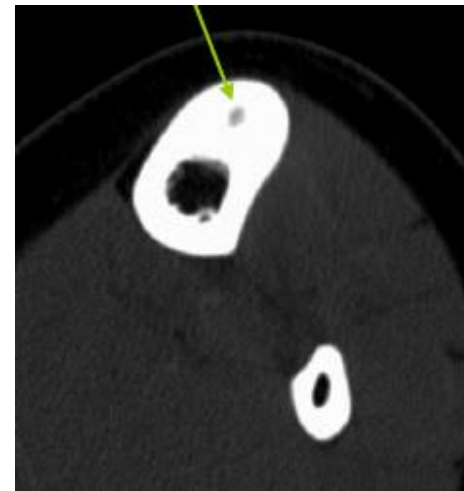
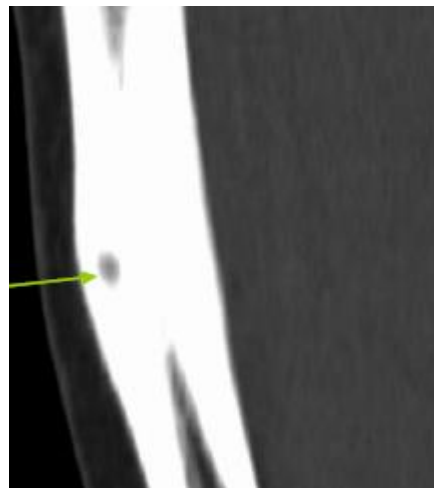
Fibrous cortical defect.



Osteoid osteoma.



- benign osteoplastic lesion characterized by its small size (usually to 1 cm), clearly marked edge and usually the presence of the surrounding zone formed by the reactive bone - nidus
- pain localized to the affected area, but also pain transmitted e.g. to the adjacent joint
- the pain is persistent, the worst at night, usually subsides after acylpyrine
- most often between 5 and 25 years
- Therapy: resection, RFA radioablation



Osteochondroma / Osteocartilaginous exostosis.



- cartilaginous cap covered bone growth on the outer surface of the bone
- one of the most common benign tumors
- most in the 1st and 2nd decade, more in men, forming by enchondral ossification from the bones
- metaphyses of the long bones (distal femur, proximal tibia, less often other parts of skeleton, rarely in spine and ribs)
- asymptomatic
- Therapy: growth monitoring, ablation in case of difficulties



Disease of multiple exostoses.



- 60% cases –positive familiar anamnesis
- Incidency 1/500 000 per year
- Metaphysis of the long bones, ribs, vertebrae
- Asymptomatic without pain
- Complications: deformities of the bones during the growth
- secondary malignisation to chondrosarcoma

Therapy: dispensarisation, ablation in case of difficulties

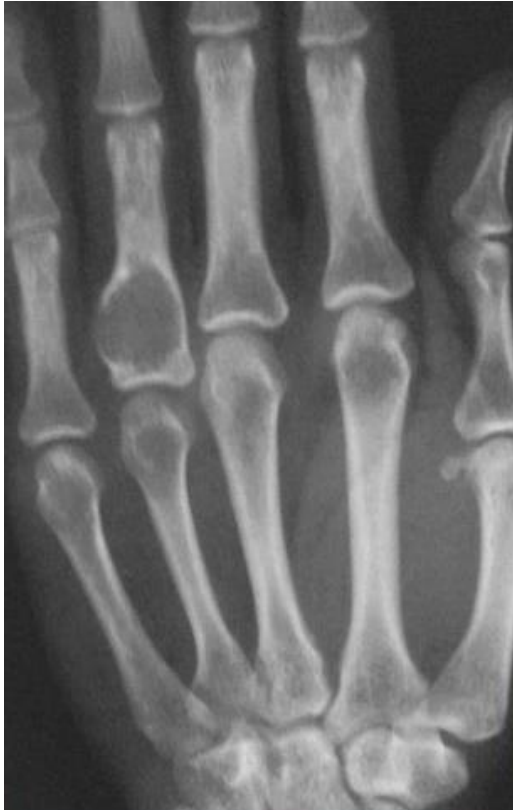


Enchondroma.

- intracompartmental benign bone tumor filled with cartilaginous mass
- incidence between 10-30y
- hand and foot phalanges, proximal humerus, femur
- mostly asymptomatic, rarely pain
- possibility of the extraosseal spread
- Therapy: dispensarisation, excochleation and spongionasty in case of difficulties



Enchondroma.



Enchondromatosis- Morbus Ollier.

- multiple enchondromas mostly in metaphysis of the long bones
- mostly adolescents
- can lead to growth retardation, deformation and bending of the bone
- 30% risk of the secondary malignisation
- Therapy: dispensarisation, excochleation and spongioplasty, osteotomies if deformities



Solitary bone cyst.



- a single-chamber cavity filled with a clear fluid lined with a membrane of variable width
- mostly in the 1st and 2nd decade, in the metaphyses of the long bones, 50-70% in the prox. metaphysis of the humerus, femur, proximal tibia and fibula
- mostly asymptomatic course
- growth into the diaphysis
- clearing with a fine sclerotic rim, signs of sept, does not penetrate the growth cartilage, in the case of a pathological fracture, the muscles sometimes heal
- in older age, the finding of hemosiderin is typical, the need for histological verification
- still benign, no malignisation, tendency to recurrence
- Therapy - decompression, curettage, grafting



Aneurysmal bone cyst.

- an expansively growing osteolytic lesion formed by ligament septums and cavities
- unlike a solitary bone cyst, it is filled with blood
- most often between 10-30 years.
- dominant in metaphysis of the long bones, pelvis, vertebrae
- Therapy - curettage, marginal resection, liquid nitrogen, phenol



Giant cell tumor.

- rare tumor
- young adults between 20-40y
- Epiphysis of the long bones, proximal humerus, distal radius, distal femur, proximal tibia
- Possibility of the aggressive growth with the bone and joint destruction
- 3 types- benign with slow growth
 - aggressive growth with bone destruction
 - aggressive with the metastasis
- Therapy: curettage, excision and spongiosis





**Thank you for
your attention!**

