INSTITUT JULES BORDET INSTITUUT

OECI Organisation of European Cancer Institutes European Economic Interest Grouping

Surgery of Bone Sarcoma

BSMO BESG

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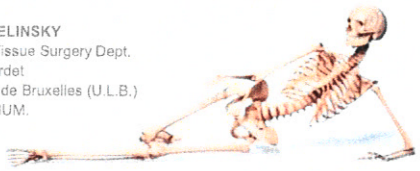

Bone Sarcoma

- Sarcoma < σάρκος
- 0,2% of all adult cancers
- 5% of all childhood cancers
- STS / BS = 5:1 ratio

Bone Sarcoma

Osteosarcoma (ICD-10: C40-C41): number of newly diagnosed cases, incidence and age-standardized incidence, by gender, Belgium, 2018

Belgian Cancer Registry

Gender	ICD-10	Tot	CR	ESR	WSR	CRI
Males + females	C40-C41	120	1.1	0.9	0.9	0.07
Males	C40-C41	71	1.3	1.1	1.0	0.07
Females	C40-C41	49	0.8	0.8	0.8	0.06

CR: crude rate (x100.000 person years)
ESR and WSR: for age-standardized incidence using the European (1976) and World standard population (x100.000 person years)
CRI: Cumulative Risk for 0-74 years (%)

- Belgian Cancer Registry, Brussels, 2020.
- C40-C41 = *ALL* bone sarcomas ! *(in spite of the « osteosarcoma » title)*
- 2,2 / 100.000

Histologic subtypes

Chondrogenic tumours	(1) Atypical cartilaginous tumour/ chondrosarcoma (grade I) (2) Chondrosarcoma (grades II/III) (3) Dedifferentiated chondrosarcoma (4) Mesenchymal chondrosarcoma (5) Clear cell chondrosarcoma
Osteogenic tumours	(1) Low-grade central osteosarcoma (2) Conventional (high-grade) osteosarcoma (chondroblastic fibroblastic osteoblastic) (3) Telangiectatic osteosarcoma (4) Small cell osteosarcoma (5) Secondary osteosarcoma (6) Parosteal osteosarcoma (7) Periosteal osteosarcoma (8) High-grade surface osteosarcoma
Notochordal tumours	Chordoma
Vascular tumours	(1) Epithelioid haemangioendothelioma (2) Angiosarcoma
Other malignant mesenchymal tumours	Fibrosarcoma, Leiomyosarcoma, Liposarcoma etc.
Miscellaneous tumours	(1) Ewing sarcoma (2) Adamantinoma (4) Undifferentiated high-grade pleomorphic sarcoma of bone

Fletcher et al. WHO classification of tumours of soft tissue and bone. 4th ed. Lyon: France IARC Press; 2013.

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Histologic subtypes

- Osteosarcoma
- Chondrosarcoma
- Ewing's Sarcoma / Primitive Neuroectodermal Tumor
- Angiosarcoma
- Fibrosarcoma / Malignant Fibrous Histiocytoma
- Chordoma
- Adamantinoma
- Other

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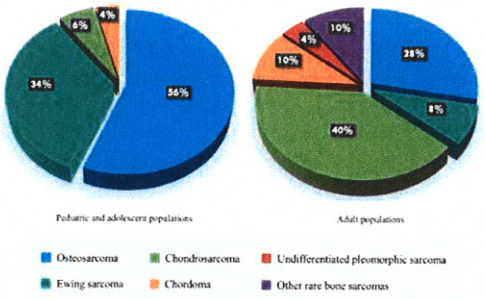
Histologic subtypes



Tharindratam et al. Advances in immune checkpoint inhibitors for bone sarcoma therapy. J Bone Oncol, 2019.

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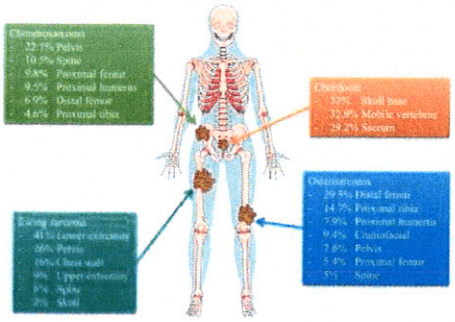
Anatomical distribution



Tharindra Sam et al. Advances in immune checkpoint inhibitors for bone sarcoma therapy. J Bone Oncol, 2019.

Prognostic factors

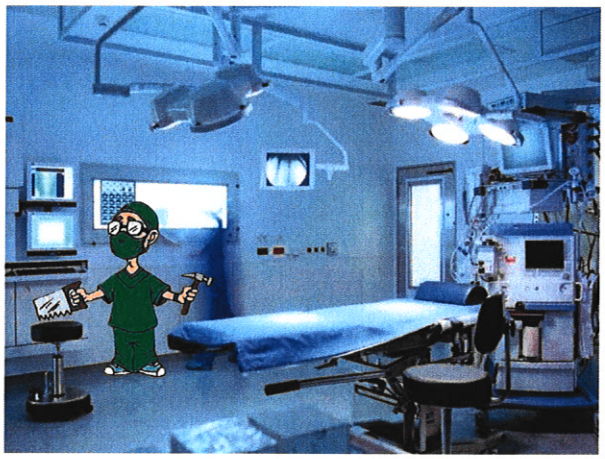
- Size
- Grade
- Location
- Metastases
- Histologic response to chemotherapy
- Pathologic fracture

AJCC Cancer Staging Manual (8th edition). Springer International Publishing: American Joint Commission on Cancer, 2017.

Decision making

- Patient factors
  - Age
  - Personal/family/cultural considerations
- Oncologic factors
  - Staging
  - Anatomical location
  - Histologic subtype and grade
- Treatment factors
  - Response to chemotherapy
  - Capabilities of the surgical team

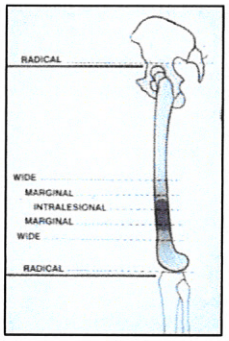
DeVita et al. Cancer. Principles and practices of oncology. 10th edition. Philadelphia: Wolters Kluwer Health, 2015.



Margins

- Wide or more !

✗ R2	Intralesional	Margins are entirely within the tumor (i.e., incisional biopsy)
✗ R1	Marginal	Margins are situated at the immediate extent of the tumor only (i.e., excisional biopsy)
✓ R0	Wide	Margins include the tumor and a cuff of normal tissue
✓ R0	Radical	Margins include the tumor and the entire compartment in which the tumor is contained

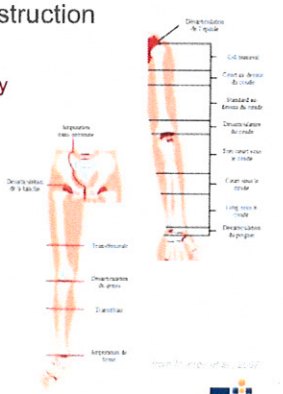


Surgical Options

- Resection without reconstruction
- Resection with reconstruction
- Adjuvants
- Growth issue in children

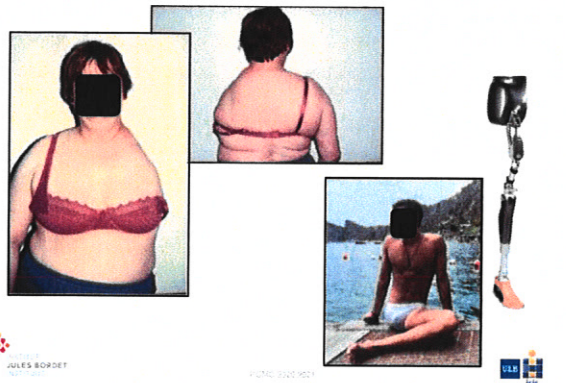
Resection without reconstruction

- 1970's : Limb Salvage Surgery
- Reconstruction not possible
- Amputation
- Disarticulation
- Hemipelvectomy



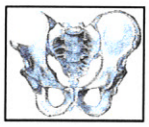
Amputation

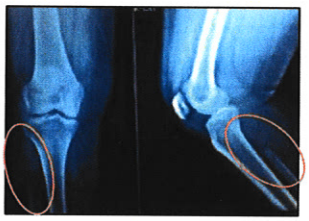
Disarticulation



Resection without reconstruction

- Reconstruction not needed
  - Fibula
  - Scapula
  - Patella
  - Iliac crest





Resection with reconstruction

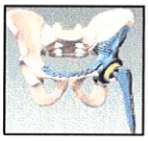
- Biological
  - Allograft
  - Autograft
- Composite *(auto/allo.graft + prosthetic)*
- Prosthetic

Resection with reconstruction

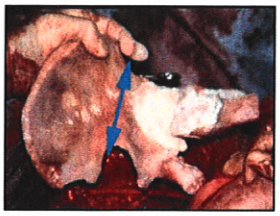
- Biological
  - Allograft → **No need for immunosuppressive drugs !**
  - Autograft
- Composite *(auto/allo.graft + prosthetic)*
- Prosthetic

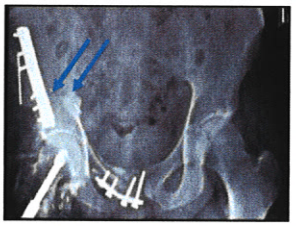
Resection with reconstruction

- Biological
  - Allograft
  - Autograft
- Composite *(auto/allo.graft + prosthetic)*
- Prosthetic
- New technologies (3D-printing)

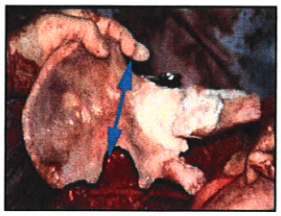


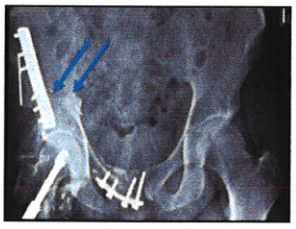
Allograft





Allograft



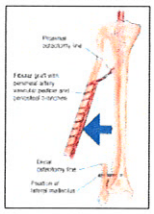


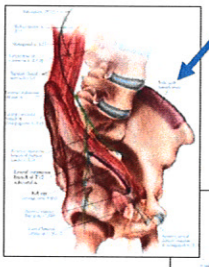
- **Infection rate : 5,4%**

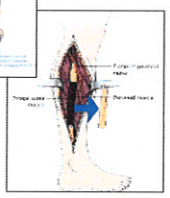
Delloye et al. Local complications of massive bone allografts: an appraisal of their prevalence in 126 patients. Acta Orthop Belg; 2014

Autograft

- < Ilium
- < Fibula
- Vascularized fibula







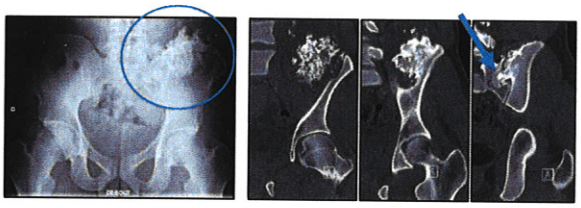
Autograft

- < Ilium
- < Fibula
- Vascularized fibula
- Composite grafts

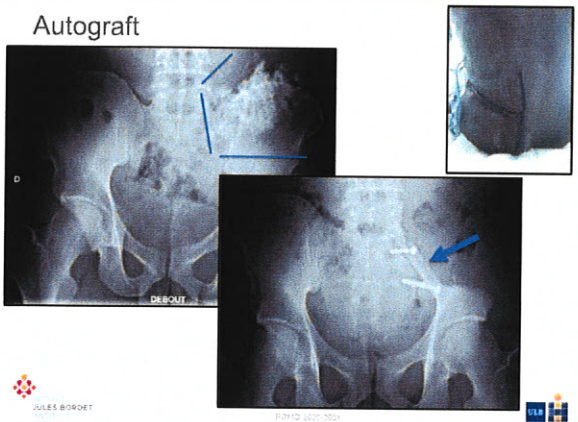
Autograft

- < Ilium
- < Fibula
- Vascularized fibula
- Composite grafts

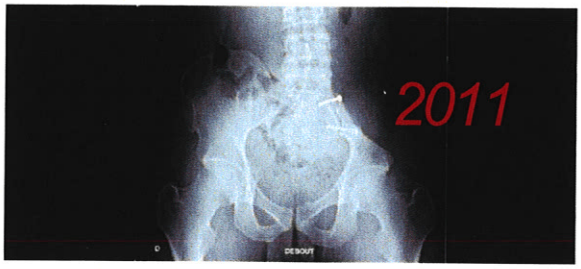
Autograft



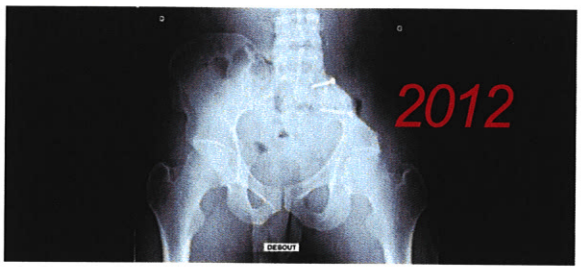
Autograft



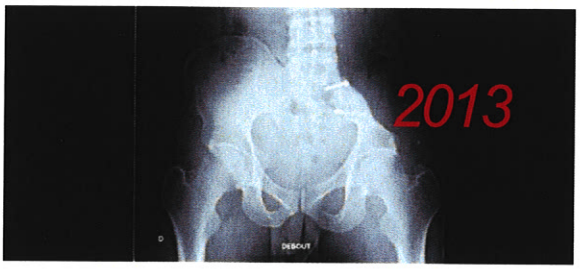
Autograft



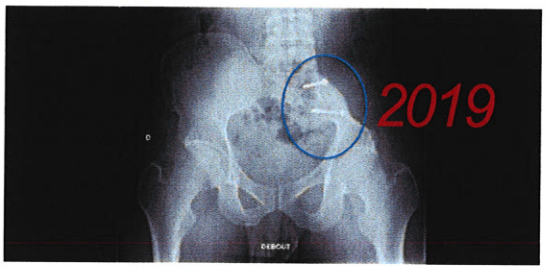
Autograft



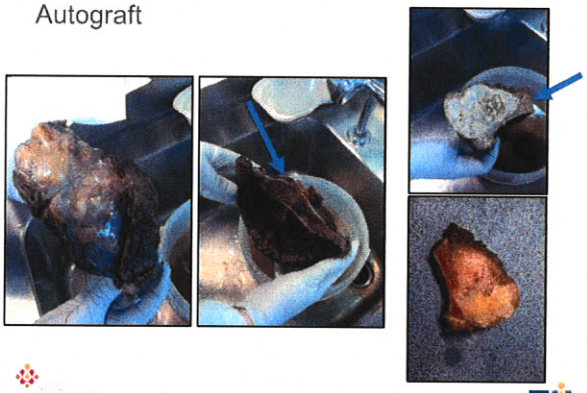
Autograft



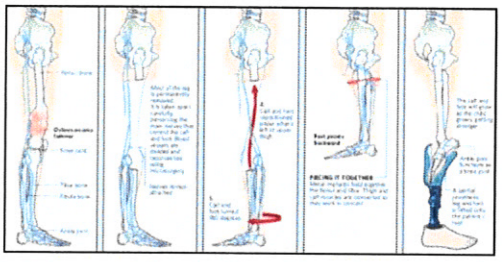
Autograft



Autograft

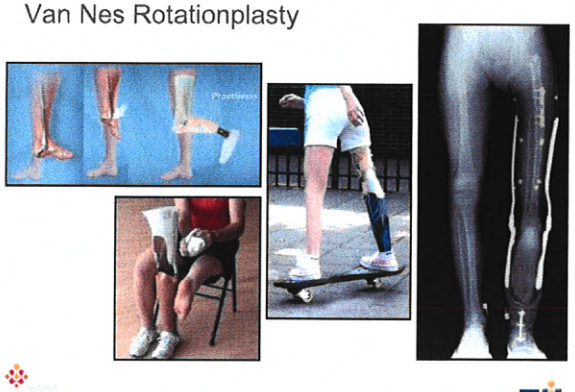


Van Nes Rotationplasty



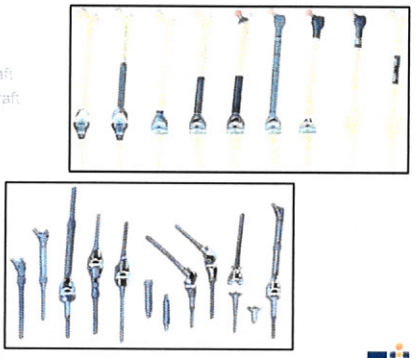
C.P. van Nes. Rotation-plasty for congenital defects of the femur. Journal of Bone and Joint Surgery, 1950.

Van Nes Rotationplasty

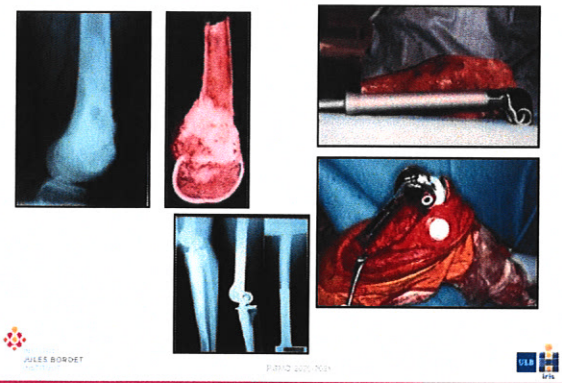


Endoprosthesis

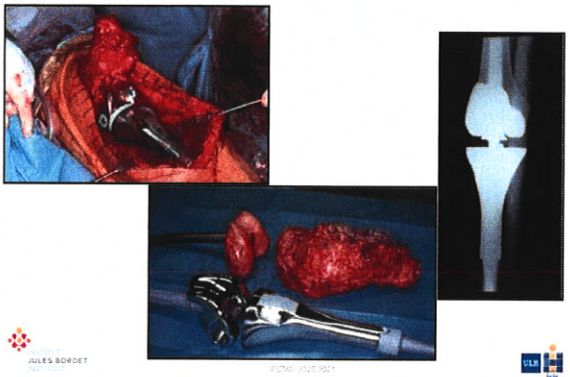
- Biological
  - Allograft
  - Autograft
- Composite
- Prosthetic



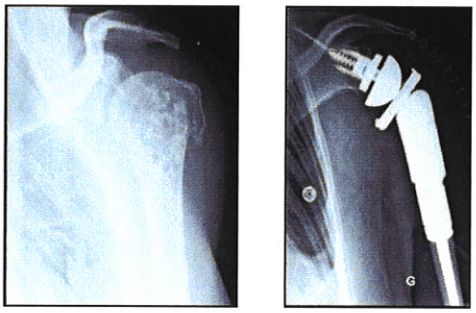
Endoprosthesis



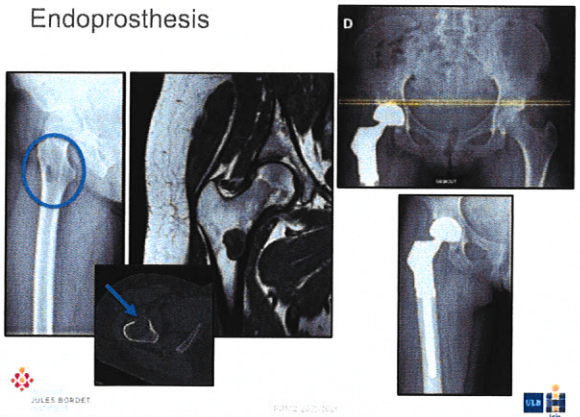
Endoprosthesis



Endoprosthesis

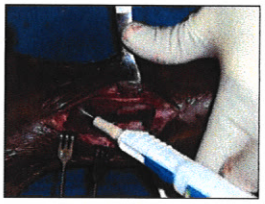


Endoprosthesis



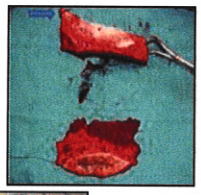
Adjuvants

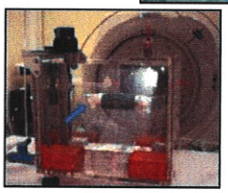
- Argon plasma coagulation
- Extracorporeal irradiation
- Pasteurisation



Adjuvants

- Argon plasma coagulation
- Extracorporeal irradiation (600Gy)
- Pasteurisation





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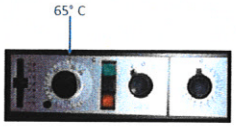
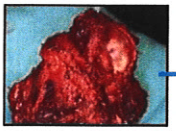
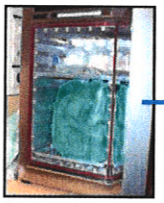
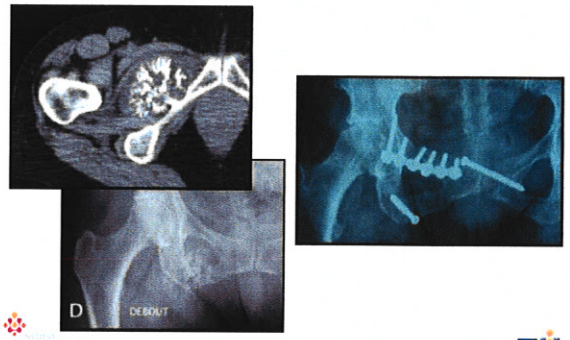






Adjuvants



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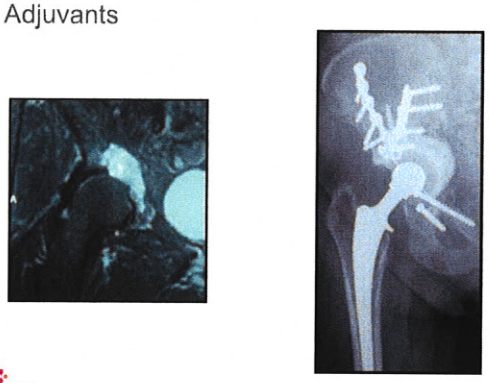

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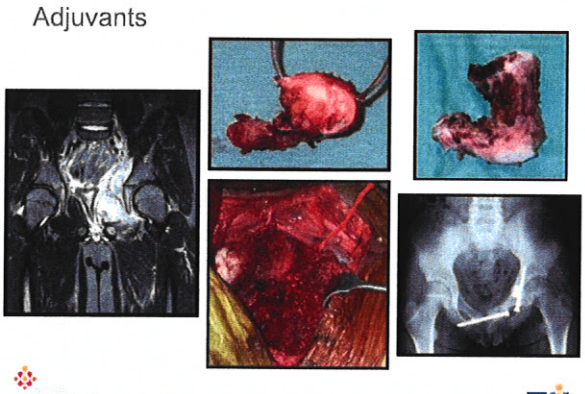
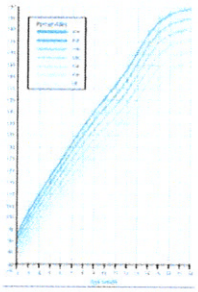


Growth issue in children

- Remaining growth
- Epiphysiodesis
- Expandable endoprosthesis



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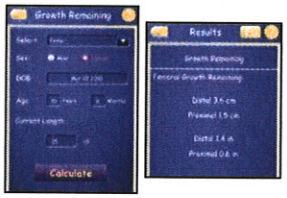

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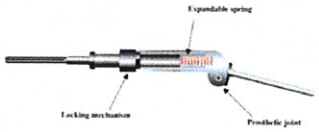
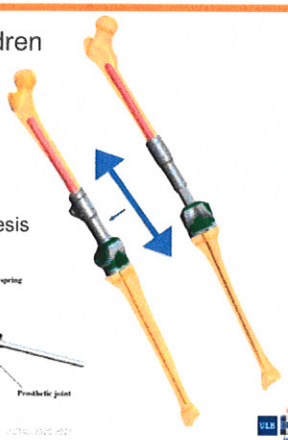
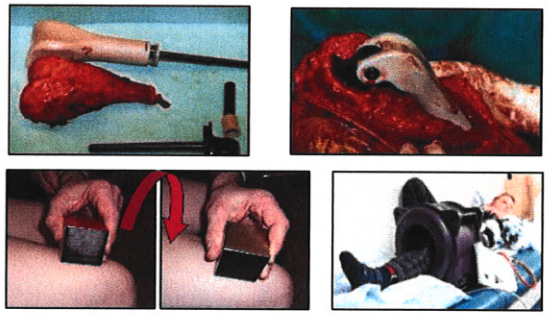




JULES BORDET

Expandable endoprosthesis

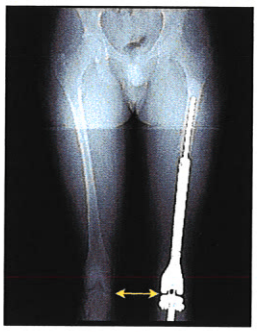


JULES BORDET

Expandable endoprosthesis

JULES BORDET

Expandable endoprosthesis



Complications after LSS

- Mechanical
  - Soft tissue failure
  - Aseptic loosening
  - Breakage / Fracture / Dislocation
- Non mechanical
  - Infection
  - Tumor progression
- Pediatric
  - Growth arrest
  - Joint dysplasia

Complications after LSS

- Mechanical
  - Soft tissue failure : 38%
  - Aseptic loosening
  - Breakage / Fracture / Dislocation
- Non mechanical
  - Infection : 11%
  - Tumor progression
- Pediatric
  - Growth arrest
  - Joint dysplasia

- Pelvis reconstructions
- Tibial reconstructions
- Radiotherapy

Complications after amputation

- Soft tissue failure
- Infection
- Phantom limb pain

Local recurrence

- Margins <2mm
- Poor chemotherapy responders (<90% necrosis)

Jeys et al. A Novel System for the Surgical Staging of Primary High-grade Osteosarcoma: The Birmingham Classification. Clin Orthop Relat Res. 2017.

Local recurrence

- Margins <2mm
- Poor chemotherapy responders (<90% necrosis)
- Incomplete chemotherapy protocol

→
- **Surgical margins**
- **Tumor biology**

Functional outcome after LSS

- Musculoskeletal Tumor Society Score (MSTS)
- Toronto Extremity Salvage Score (TESS)
- Reintegration to Normal Living Index (RNL)

Functional outcome after LSS

- MSTS score

Score	Pain	Function	Emotional	External support	Functional independence	Gait	Percentage (%)
5	None	No restrictions	Motivated	None	Independent	Normal	100
4	Intermediate	Intermediate	Intermediate	Intermediate	Intermediate	Intermediate	80
3	Not disabling	Recreational limitation	Satisfied	Orthosis	Limited	Minimal alteration	60
2	Intermediate	Intermediate	Intermediate	Intermediate	Intermediate	Intermediate	40
1	Incapacitating	Partial limitation	Accepts	Cane/crutch	Home	Very altered	20
0	Extremely incapacitating	Total restriction	No support	Two crutches	Dependant	Difficult	0

Enneking et al. A System for the Functional Evaluation of Reconstructive Procedures After Surgical Treatment of Tumors of the Musculoskeletal System. Clinical Orthopaedics and Related Research: 1993

Functional outcome after LSS

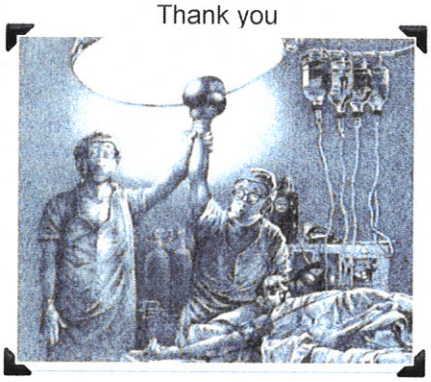
- Revised Musculoskeletal Tumor Society Rating Scale

Functional outcome after LSS

- Results
  - MSTS score ~ 63% for lower limb *(19/30)*
  - MSTS score ~ 60% for upper limb *(18/30)*

	MSTS score	Limb
McGoveran et al. (1999)	58,3 %	Lower
Ilyas et al. (2002)	63,3 %	Lower
Tunn et al. (2008)	67 %	Lower

Thank you



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