Long Term Outcomes of Knee Reconstruction in Tumor Patients

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Disclosures

- None

Distal Femur History

- Walldius 1951
- First Known Distal Femur 1973
- Kinematic Rotating Hinge 1978
- Modern modular systems followed

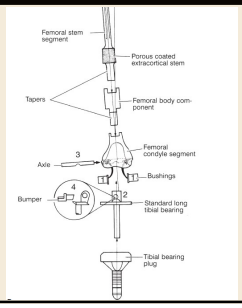
Walldius Mark IV prosthesis. (From Jones, Blundell)

Sarcoma.org

Early Designs

- Custom made- lead time to surgery
- No intraoperative flexibility
- Fixed Hinges
- Small diameter stems
- Abrupt transition from stem to body
- Stem Fractures, Loosening

Modern Design



Indications

- Radical resection of bone tumor
- Revision with substantial bone loss
- Pathologic fracture in metastatic patients
- Distal femoral fractures in elderly

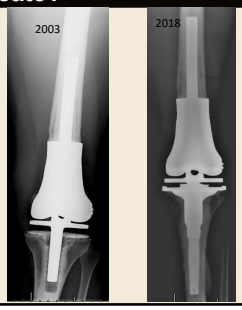
Advantages	Disadvantages
• Immediate full weight bearing (cemented) • No balancing! • Non-tumor- Not technically demanding • Short Term Results	• Infection • Infection • Infection • Aseptic Loosening • Long-Term Results

Results
Apples vs Apples?

- Difficult to compare
- Different Patients
  - Chemo vs No chemo
  - Elderly vs Young
- Different resection lengths
- Different stem lengths
- Different fixation
  - Cement vs Uncemented

Long Term Results
How do we replicate?

- Original 1984 (34 years)
- Distal Femur Osteosarcoma
- Subsequent Breast Carcinoma
- Tibia revised due to poly wear 2008 (24 yrs)
- Avid cyclist, 5 bushing exchanges
- Why no loosening?
- How Replicate Results?



J Bone Joint Surg Br. 2007 Apr;89(4):521-6.

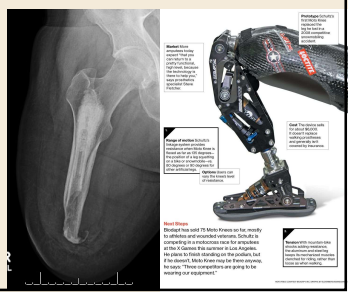
Endoprosthetic replacement of the distal femur for bone tumours: long-term results.

Myers GJ[1], Abudu AT, Carter SR, Tillman RM, Grimer RJ.

- 192 patients avg f/u 12 years (5-30)
- Any further surgery endpoint- 61% estimated risk of failure at 10 years
- Revision any reason 17% 5 yrs, 33% 10 yrs, 58% 20 yrs
- Overall revision risk fell by 52% when rotating implant was used

Myers et al

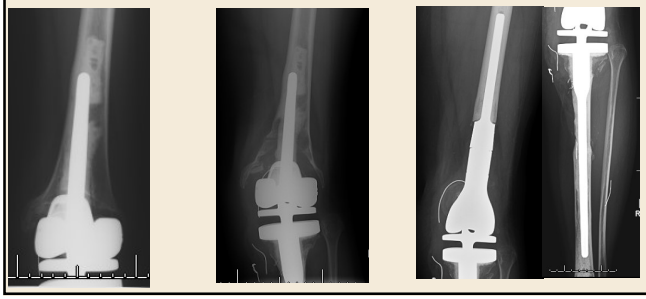
- 10.7% amputation
- Risk of amp-9% at five years 17% at 20 years.
- Most common reasons local recurrence 6% and infection 4.5%
- "rotating-hinge prosthesis with a hydroxyapatite collar offers the best chance of long-term survival of the prosthesis"



Myers et al

- Aseptic loosening main reason for failure of fixed hinge.
- Infection and stem fracture most common for rotating hinge.
- "We believe that a cemented, rotating-hinge prosthesis with a hydroxyapatite collar offers the best chance of long-term survival of the prosthesis"

Speaking of Cement…
Original 1984, Revised 2010 (26 yrs)



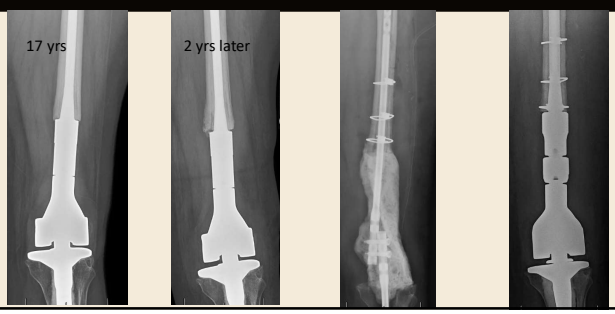
Clin Orthop Relat Res. 2010 Aug;468(8):2198-210. doi: 10.1007/s11999-009-1197-8. Epub 2009 Dec 22.

Cemented distal femoral endoprostheses for musculoskeletal tumor: improved survival of modular versus custom implants.

Schwartz AJ[1], Kabo JM, Eilber FC, Eilber FR, Eckardt JJ.

- Single Surgeon- 101 custom, 85 modular
- Overall survival rates at 10, 20, and 25 years were 77.2%, 57.9%, and 50.2%
- custom vs modular: 15 yr survivorship 51.7 vs 93.7
- Concluded that long-term survivors should expect revision

Expected Bushing Exchange



Periprosthetic Fracture

Clin Orthop Relat Res. 2017 Mar;475(3):708-718. doi: 10.1007/s11999-015-4644-8.

What Are the Long-term Results of MUTARS® Modular Endoprostheses for Reconstruction of Tumor Resection of the Distal Femur and Proximal Tibia?

Bus MP[1], van de Sande MA[2], Fiocco M[3,4], Schaap GR[5], Bramer JA[5], Dijkstra PD[2].

- 110 implants 89 distal femur, 21 prox tibia majority uncemented
- 5, 10, 15 yr mechanical failure 16.9%, 20.7%, 37.9%
- 89% had an implant at final F/U, Median 8.9 yrs
- Infection rate 13%

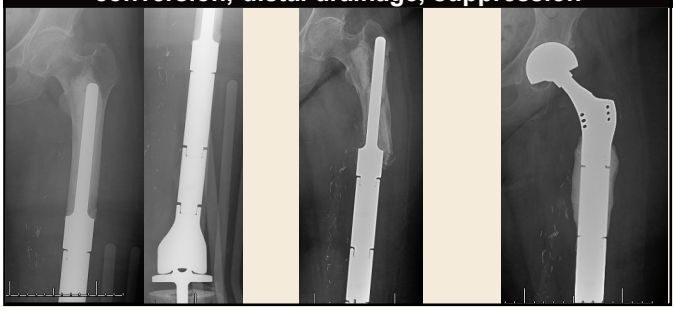
Clin Orthop Relat Res. 2015 Mar;473(3):891-9. doi: 10.1007/s11999-014-3699-2.

Survival of modern knee tumor megaprostheses: failures, functional results, and a comparative statistical analysis.

Pala E[1], Trovarelli G, Calabrò T, Angelini A, Abati CN, Ruggieri P.

- 247 GMRS knee prosthesis 187 femurs 60 proximal tibias
- Majority Uncemented
- Overall failure 29.1%
- Survivorship of 70% at 4 yrs and 58% at 8 yrs
- 9.3% infection

2012 resection, infection, 2018 fracture, conversion, distal drainage, suppression



J Bone Joint Surg Am. 2005 Apr;87(4):842-9.

Periprosthetic infection in patients treated for an orthopaedic oncological condition.

Jeys LM[1], Grimer RJ, Carter SR, Tillman RM.

- 1240 patients, mean f/u 5.8 years
- Various implants
- Infection: 136 patients (11.0%)
- Two-stage revision successful in 72%
- Local surgical debridement with or without antibiotic implants was successful in 6%
- Amputation 37%

Surg Infect (Larchmt). 2015 Jun;16(3):267-75. doi: 10.1089/sur.2014.085. Epub 2015 Mar 26.

Infected Prostheses after Lower-Extremity Bone Tumor Resection: Clinical Outcomes of 100 Patients.

Mavrogenis AF[1], Pala E[1], Angelini A[1], Calabro T[1], Romagnoli C[1], Romantini M[1], Drago G[1], Ruggieri P[1].

- 1161 Patients
- Infection rate 8.9%
- Overall survival with definitive management of infection was 88% at 10yr and 84% at 20yr
- Higher success for cementless reconstructions
- Infections resolved completely with one or two-stage surgery in 75% of patients.
- Rate of amputation was 21%.

BMC Musculoskelet Disord. 2013 Jan 31;14:51. doi: 10.1186/1471-2474-14-51.

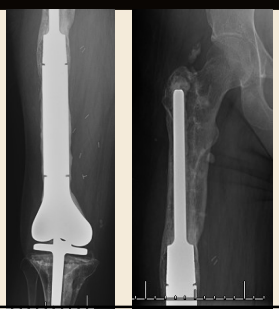
Deep infection in tumor endoprosthesis around the knee: a multi-institutional study by the Japanese musculoskeletal oncology group.

Morii T[1], Morioka H, Ueda T, Araki N, Hashimoto N, Kawai A, Mochizuki K, Ichimura S.

- 57 infections
- 2 year minimum f/u
- Infection controlled 84.2%
- 10 yr survival 39.3%
- Limb salvage 75.6%
- Two stage more successful

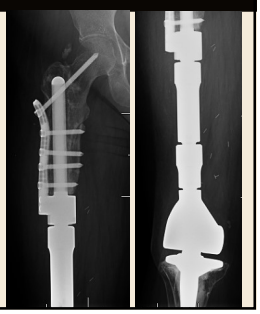
You never know…

- 1992 Jackson Memorial, Miami
- Osteosarcoma
- Converted to DFR 2002
- Sepsis 2006 in DC
- Implant Removed, Autoclaved, Antibiotic Cement wrap
- Long Term Bactrim



Still Early

- Presented with pain 2014 and loose stem
- IDDM
- Chronic pain and narcotics
- Negative infection workup
- Converted to custom stem
- Cultures negative
- Continued with Bactrim suppression



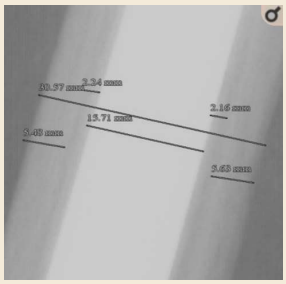
OTHER FACTORS TO CONSIDER?

Clin Orthop Relat Res. 2012 Mar;470(3):743-50. doi: 10.1007/s11999-011-2081-x.

Aseptic loosening rates in distal femoral endoprostheses: does stem size matter?

Bergin PF[1], Noveau JB, Jelinek JS, Henshaw RM.

- 104 DFR
- Aseptic Loosening 2.9%
- Infection 11.7%
- Ream to chatter, 1-1.5mm larger than stem
- Multivariate- Only bone:stem ratio was significant
- 2.02 vs 2.81 Stable to Loose

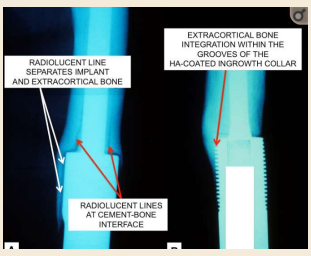


Clin Orthop Relat Res. 2015 Apr;473(4):1505-14. doi: 10.1007/s11999-014-4116-6. Epub 2015 Jan 30.

Hydroxyapatite-coated collars reduce radiolucent line progression in cemented distal femoral bone tumor implants.

Coathup MJ[1], Sanghrajka A, Aston WJ, Gikas PD, Pollock RC, Cannon SR, Skinner JA, Briggs TW, Blunn GW.

- 22 pts
- Pair matched with or without ingrowth collar
- Radiolucent line score lower with HA collar
- Cortical loss at bone implant junction greater without HA collar



J Surg Oncol. 2011 Aug 1;104(2):192-7. doi: 10.1002/jso.21924. Epub 2011 Mar 29.

The impact of amount of bone resection on uncemented prosthesis failure in patients with a distal femoral tumor.

Song WS[1], Kong CB, Jeon DG, Cho WH, Kim JR, Cho Y, Lee SY.

- 117 pts
- cut-off point of 43% for predicting mechanical prosthesis failure
- 10-year survival 65.2%
- 14.5% infection- most common cause of failure

J Surg Oncol. 1999 Feb;70(2):109-15.

Relationship between magnitude of resection, complication, and prosthetic survival after prosthetic knee reconstructions for distal femoral tumors.

Kawai A[1], Lin PP, Boland PJ, Athanasian EA, Healey JH.

- 82 pts, Multivariate
- 3, 5, and 10-year survival rates were 82%, 71%, and 50%
- >40% resection negative predictor for prosthetic survival
- Aseptic loosening main cause of late failure

J Arthroplasty. 2018 Apr;33(4):1275-1287.e3. doi: 10.1016/j.arth.2017.10.051. Epub 2017 Nov 7.

Implant Survival and Complication Profiles of Endoprostheses for Treating Tumor Around the Knee in Adults: A Systematic Review of the Literature Over the Past 30 Years.

Haijie L[1], Dasen L[1], Tao J[1], Yi Y[1], Xiaodong T[1], Wei G[1].

- 40 studies with 4748 DFR cases
- 5, 10, 15, and 20-year implant survival rates of DFR were 78.3%, 70.1%, 61.6%, and 38.3%
- Aseptic loosening 8.8% Infection 8.5% (PTR 16.8)
- Cemented = Cementless
- Compress DFR showed no superiority
- 10 yr survival significantly better for rotating hinge than fixed hinge (similar at 5 yrs)

Native Distal Femur- 36 yrs

- 1982
- Osteosarcoma
- One bushing exchange 97
- Loose tibia revised 2016 (34 yrs)
- Custom, No Collar
- Bone:Stem ratio- marginal
- Cemented
- No infection!

Considerations

- Avoid infection
- Consider larger stem (low bone to stem ratio)
- Resection length
- Ingrowth collars
- Cement vs Un-Cement
  - Age, Disease, Chemo, Radiation
- Fixed vs Rotating Hinge

Thank You