Complex Reconstruction of the Knee

Trauma, Infection and Long term Outcome

Herrick J. Siegel, MD
Orthopaedic Oncology & Adult Reconstruction
UAB Medical Center

400 lb female, referred for “loose implant”.



Early intervention to prevent longterm problems

- Ischemia
- Nerve injury
- Bone loss
- Infection
- Non union
- Chronic pain
- Systemic problems

- TEAM approach
  - Ortho trauma
  - General trauma
  - Vascular surgery
  - Plastic surgery
  - Spine
  - Rehab/PT/OT

Not always salvagable

High energy vs low energy

High energy

- Soft tissue loss
- ligament instability
- Avascular tissue
- Diffuse
- Poly articular
- Treated at level 1 center

Low energy

Poor bone density/osteoporosis
Poor generalized health
Often more focal trauma
Less ligamentous injury
Treated in community
r/o pathologic fracture from tumor
Periprosthetic fractures

management- high energy

- Knee fractures
  - Distal femur
  - Tibial plateau
  - Open vs closed
  - Vascular injury
  - Soft tissue injury
  - Swelling/hemorrhage
  - Compartment syndrome
  - Ligamentous injury
  - dislocation
- Treatment options
  - Tibial plateau: ORIF/ EX FIX
  - Distal femur: locking plate, retrograde IM nail
  - Ligamentous reconstruction
  - Wound VAC
  - Immediate flap coverage
  - Serial debridement
  - Bone grafts/autogenous/allografts

Managemement- low energy

- Optimize co-morbidities
- Consider pathologic fracture
- Early return to mobility
- Medicine evaluation/clearance
- Prophylaxis against UTIs, pneumonia & DVTs

- ORIF/IM NAIL
- Joint Replacement
  - Primary total joint
  - Distal Femur Replacement
  - Proximal Tibial Replacement
  - Acute or Delayed

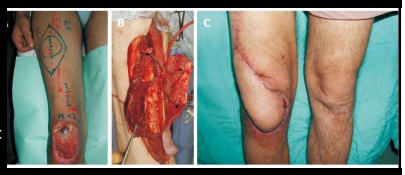
Indications for megaprosthesis in non-oncologic setting

- Comminuted distal femur fracture in elderly with poor quality bone (>80 yrs)
- Comminuted periprosthetic distal femur replacement with loss of collateral ligaments.
- Non union of distal femur in elderly patient (>70 yrs)
- Revision TKA with massive bone loss of distal femur or proximal tibia

Complications

- Wound problems
- Non union
- Ligamentous instability
- Chronic Pain
- Infection, acute vs chronic
  - Plates/screws/nails
  - Prosthesis

Or ALL OF THE ABOVE



Soft tissue envelope: Referred for "wound dehiscence"

- TKA patient
- s/p 2 x 2 stage revisions, no prior flap, s/p 5 revisions

Relative indications/ controversial

- Infected TKA with massive bone loss (one stage procedure)
- Stage 2 TKA revision with massive bone loss
- Comminuted distal femur replacement (acute or non-union) in younger patient 55-70.
- Revision TKA for massive bone loss with extensor mechanism disruption

BMI between 35-45

Absolute contraindication

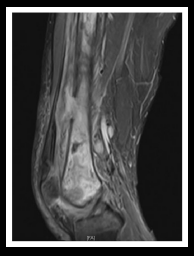
- Acute High Energy Trauma
- Patients <50 yrs of age
- Active infection with insufficient soft tissue coverage
- Super morbid obese >50 BMI

Unstable/ loose implants/chronic infection/ no extensor mechanism

Who should be doing non oncologic megaprostheses?

"My surgeon said that he can't handle my surgery. My surgeon recommended an amputation. I was told you were the best and could save anything."

Chronic osteomyelitis



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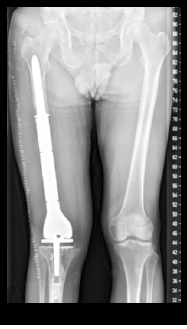
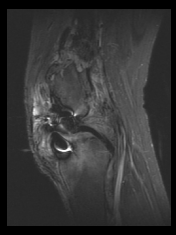


Chronic non union



Injury, Int. J. Care Injured 47S6 (2016) S77–S82

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Injury

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Reconstruction of patellar tendon following implantation of proximal tibia megaprosthesis for the treatment of post-traumatic septic bone defects

Giorgio M. Calori[a], Emilio Luigi Mazza[a], Luca Vaienti[b], Simone Mazzola[a], Alessandra Colombo[a], Luca Gala[c], Massimiliano Colombo[a,*]

[a] Reparative Orthopaedic Surgery Department – ASST Pini-CTO, University of Milan, Italy
[b] Department of Plastic and Reconstructive Surgery, I.R.C.C.S. Policlinico San Donato, University of Milan, Italy
[c] Second division – ASST Pini-CTO, University of Milan, Italy

KEYWORDS

Patellar tendon reconstruction
megaprosthesis
soft tissue coverage

ABSTRACT

Introduction: Latest advances made in joint replacement implants allows reconstruction of entire limbs. These special prostheses or megaprostheses were originally designed for the treatment of severe oncological bone loss. Nowadays, however, the indications and applications of these devices are expanding to other orthopaedic and trauma clinical conditions. Since 2008 we have implanted 152 megaprostheses in non-oncological conditions: 87 were implanted for post-traumatic failures aseptic/septic (represented by complex non-unions and critical size bone defects): 26 total femur, 52 distal femur and 9 proximal tibia. In this group of patients bone and soft tissues

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Megaprosthesis in post-traumatic and periprosthetic large bone defects: Issues to consider

G.M. Calori *, M. Colombo, E. Malagoli, S. Mazzola, M. Bucci, E. Mazza

C.O.R., Reparative Orthopaedic Surgery Department, Orthopaedic Institute G. Pini, University of Milan, Italy

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Keywords:
Non-union
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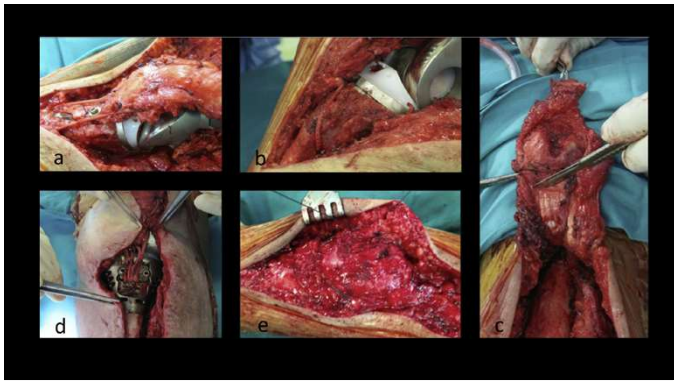
ABSTRACT

Introduction: The recent evolution of prosthesis technology has enabled the surgeon to replace entire limbs. These special prostheses, or megaprostheses, were developed for the treatment of severe oncological bone loss; however, the indications and applications of these devices have expanded to other orthopaedic and trauma situations. For some years, surgeons have been implanting megaprostheses in non-oncological conditions, such as acute trauma in severe bone loss and poor bone quality; post-traumatic failures, both aseptic and septic (represented by complex non-unions and critical size bone defects); major bone loss in prosthetic revision, both aseptic and septic; periprosthetic fractures with component mobilisation and poor bone stock condition. The purpose of this study was to evaluate retrospectively the complications during and after the implantation of megaprosthesis of the lower limb in post-traumatic and prosthetic bone loss, and to propose tips about how to avoid and manage such complications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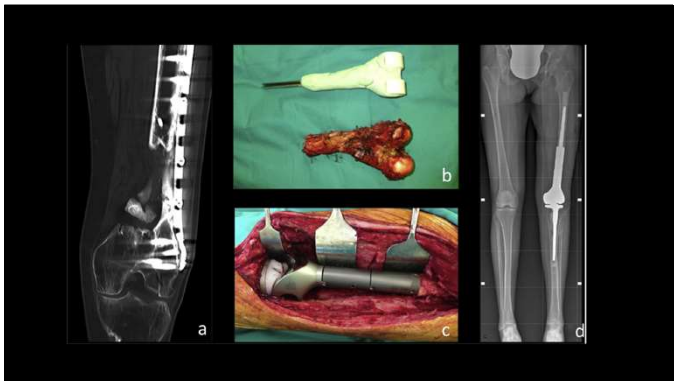
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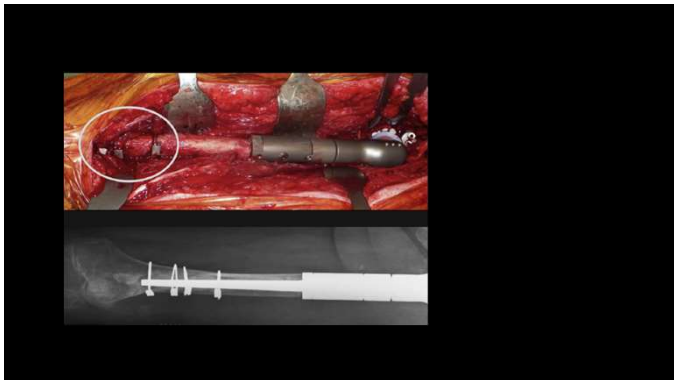

The Knee 20 (2013) 367–375

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The Knee

Review

A systematic review of endoprosthetic replacement for non-tumour indications around the knee joint

Muhammad T. Korim [a,b], Colin N.A. Esler [a], Venuthurla R.M. Reddy [a], Robert U. Ashford [a,b]

[a] Leicester Orthopaedics, University Hospitals of Leicester NHS Trust, Gwendolen Road, Leicester LE5, United Kingdom
[b] Division of Orthopaedic & Accident Surgery, University of Nottingham, United Kingdom

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ABSTRACT

Background: Endoprosthetic replacement (EPR) for limb salvage is an established treatment modality for orthopaedic malignancies around the knee. Increasingly, they are being used for non-tumour indications such as fractures, bone loss associated with aseptic loosening, septic loosening and ligament insufficiencies.

Methods: We reviewed the evolution and biomechanics of knee EPRs. MIDLINE was searched using the PubMed interface to identify relevant studies pertaining to the use of knee EPRs in non-tumour conditions. Failures, mortality and knee scores were the main outcome measures. Subgroup analysis in the non-tumour conditions was also performed.

Results: There were nine studies with an average follow-up of 3.3 years (Range 1–5 years) describing 241 EPRs used in non-tumour conditions. Re-operation for any reason occurred in 17% (41/241) of cases. The most common complication was infection (15%) followed by aseptic loosening (5%) and periprosthetic fractures (5%). The mortality rate averaged 22%. Infected knee arthroplasties were less

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The Journal of Arthroplasty

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Revision Arthroplasty

Open Reduction vs Distal Femoral Replacement Arthroplasty for Comminuted Distal Femur Fractures in the Patients 70 Years and Older

Gavin P. Hart, MD, Jeffrey S. Kneisl, MD, Bryan D. Springer, MD, Joshua C. Patt, MD, Madhav A. Karunakar, MD *

Department of Orthopaedic Surgery, Carolinas Medical Center, Charlotte, NC

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open reduction
distal femoral replacement arthroplasty
comminuted distal femur fractures

ABSTRACT

Background: The ideal management of distal femur fractures in the elderly is unclear. Acute arthroplasty has the theoretical advantage of earlier mobilization. We examined the outcomes of patients 70 years and older who underwent open reduction internal fixation (ORIF) vs distal femoral replacement (DFR) for comminuted, intra-articular distal femur fractures.

Methods: A retrospective review of patients with AO/OTA classification 33C distal femur fractures treated with either ORIF or DFR was performed. Outcomes including all-cause reoperation, length of stay, fracture union, postoperative complications, use of ambulatory device and living situation at 1 year, and mortality were evaluated.

Results: The study cohort included 38 patients: 10 underwent DFR and 28 ORIF. Mean patient age for both cohorts was 82 years. No difference in comorbidities or mechanism of injury was found between groups. The incidence of reoperation was 11% in the ORIF group and 10% in the DFR group. In the ORIF group, the average time to fracture union was 24 weeks, with a nonunion incidence of 18%. Twenty-three percent of ORIF group were wheelchair dependent vs none in the DFR cohort, although not statistically significant. Differences between the groups with respect to all-cause reoperation, living situation or need for ambulatory device at 1 year, and 1-year mortality did not reach statistical significance.

Conclusion: Nearly 1 in 5 patients older than 70 years developed a nonunion after ORIF of an intra-articular distal femur fracture. At 1-year follow-up, all patients in DFR group were ambulatory while 1

Conclusion: 38 patients: 10 DFR & 28 ORIF

- Nearly 1 in 5 patients older than 70 years developed a nonunion after ORIF of an intraarticular distal femur fracture.
- At 1-year follow-up, all patients in DFR group were ambulatory while 1 in 4 in the ORIF group were wheelchair bound.

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Original Article

A 3 year minimum follow up of Endoprosthetic replacement for distal femoral fractures – An alternative treatment option

A. Atrey[a,*], N. Hussain[c], O. Gosling[d], P. Giannoudis[b], A. Shepherd[e], S. Young[e], J. Waite[e]

[a] St Michael's Hospital, Toronto, Canada
[b] Orthopaedics and Traumatology, Leeds, UK
[c] Michigan University, USA
[d] SW Training Rotation, UK
[e] Warwick Hospital Orthopaedic Research Unit, UK

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ABSTRACT

Introduction: Although the use of an endoprosthesis for distal femoral fractures remains a valid treatment option the widespread use is in its infancy.
Methodology: In this retrospective case series, we review cases of distal femoral fracture treated with endoprosthetic replacement (EPR). The outcomes we assessed were the time to start mobilising, the time to discharge, morbidity and mortality as well as an Oxford knee score to assess pain and function and also the early survivorship. 6 of the 11 from the cohort had existing Total Knee Replacements (TKRs) in situ.
Results: There were 11 knees in our cohort with a mean age of 81.5 years (range 52–102 years). The median time to follow up was 3.5 years (range 1.6 to 5.5 years). The median times to theatre was 3 days and to discharge was 16 days.

Conclusion: 11 pts 81.5 years (range 52–102 years)

- In the appropriate patient and fracture pattern, endoprosthetic knee replacement is an excellent option in the treatment of distal femoral fractures whether associated with an existing TKR or not.
- DFR: Earlier return to full mobility post-operatively may save on hospital/care home stay and free up hospital space and minimize complications.

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ORIGINAL ARTICLE - HIP - ARTHROPLASTY

Use of modular megaprosthesis in managing chronic end-stage periprosthetic hip and knee infections: Is there an increase in relapse rate?

Pablo S. Corona[1] · Matias Vicente[2] · Mireia Lalanza[2] · Carles Amat[1] · Luis Carrera[1]

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Clinical outcome data and satisfaction results were acceptable.
Conclusion According our data, MP is a useful tool in treating end-stage PJI cases, achieving acceptable eradication, satisfaction and implant survivorship rates.

Periprosthetic joint infection is a common problem in periprosthetic joint infection (PJI) scenarios. Modular megaprosthesis (MP) could offer a limb salvage solution in such situations. Concerns about risk of infection relapse, reinfection and implant longevity exist regarding MP use in cases of chronic PJI, rather than standard implants. We therefore sought to analyze our results with MP use in chronic PJI cases.
Methods We performed a retrospective analysis of 29 MP patients. Inclusion criteria were the use of this type of modular megaimplant for reconstruction of segmental bone defects in chronically infected lower-extremity arthroplasties (hip or knee) and a minimum follow-up of 18 months. We evaluated the primary outcome of infection control or recurrence. The MPs were classified into 3 groups, according the bone segment replaced (proximal femur, distal femur or total femur). We further analyzed complications, pain, patient satisfaction and functional results.
Results Mean age was 75 years; mean follow-up was 48 months (range 18–82). The most frequently involved pathogens were coagulase-negative staphylococci (62%). Polymicrobial infection was detected in 7 patients. Twenty-eight patients were managed with a two-stage approach. The infection-free rate at the end of follow-up was 82.8% (24 of 29 patients). Aside from infection relapse, the most frequent complication was dislocation. Final-point survival rate was 91.2% (CI 68.1–97.8). Clinical outcome data and satisfaction results were acceptable.
Conclusion According our data, MP is a useful tool in treating end-stage PJI cases, achieving acceptable eradication, satisfaction and implant survivorship rates.

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Complications - Infection

Clinical Outcome of Massive Endoprostheses Used for Managing Periprosthetic Joint Infections of the Hip and Knee

Abtin Alvand, BSc(Hons), DPhil, FRCS (Tr&Orth) [a,*], George Grammatopoulos, DPhil, FRCS (Tr&Orth) [b], Floris de Vos, MD [a], Matthew Scarborough, FRCPath, MRCP, PhD [b], Ben Kendrick, DPhil, FRCS (Tr&Orth) [b], Andrew Price, DPhil, FRCS (Tr&Orth) [a], Roger Gundle, DPhil, FRCS (Tr&Orth) [b], Duncan Whitwell, FRCS (Tr&Orth) [b], William Jackson, FRCS (Tr&Orth) [b], Adrian Taylor, FRCS (Tr&Orth) [b], Christopher L.M.H. Gibbons, FRCS (Tr&Orth) [b]

[a] Nuffield Department of Orthopaedics, Rheumatology & Musculoskeletal Sciences, University of Oxford, Botnar Research Centre, Oxford, United Kingdom
[b] Nuffield Orthopaedic Centre, Adult Hip and Knee Unit, Oxford, United Kingdom

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revision arthroplasty

ABSTRACT

Background: Endoprosthetic replacement (EPR) is an option for management of massive bone loss resulting from infection around failed lower limb implants. The aim of this study is to determine the mid-term outcome of EPRs performed in the treatment of periprosthetic joint infection (PJI) and infected failed osteosyntheses around the hip and knee joint and identify factors that influence it.

Methods: We retrospectively reviewed all hip and knee EPRs performed between 2007 and 2014 for the management of chronic infection following complex arthroplasty or fracture fixation. Data recorded included indication for EPR, number of previous surgeries, comorbidities, and organism identified. Outcome measures included PJI eradication rate, complications, implant survival, mortality, and functional outcome (Oxford Hip or Knee Score).

Results: Sixty-nine EPRs (29 knees and 40 hips) were performed with a mean age of 68 years (43-92). Polymicrobial growth was detected in 36% of cases, followed by coagulase-negative staphylococci (28%)

Table 1
Commonly Used Antibiotic Algorithms Based on the Organisms Identified.

Organism	Initial Therapy	Adjunctive Therapy	Follow-On Oral Therapy	Alternative Oral Therapy Options (Depending on Sensitivities, Interactions, and Tolerance)
Methicillin-susceptible Staphylococcus aureus	IV flucloxacillin (ceftriaxone if discharged to OPAT)	Oral rifampicin	Ciprofloxacin + rifampicin	Doxycycline, cotrimoxazole, clindamycin, fusidic acid, flucloxacillin
Methicillin-resistant S aureus	IV glycopeptide (vancomycin as inpatient and teicoplanin on discharge with OPAT)	Oral rifampicin	Doxycycline + rifampicin	Fusidic acid, cotrimoxazole, linezolid, doxycycline monotherapy
Coagulase-negative staphylococci	IV glycopeptide	Oral rifampicin	Ciprofloxacin + rifampicin	Doxycycline, cotrimoxazole, clindamycin, fusidic acid
Streptococci	IV amoxicillin (ceftriaxone if discharged with OPAT)	–	Amoxicillin	Clindamycin, doxycycline
Enterococci	IV amoxicillin (daptomycin if required)	–	Amoxicillin	Linezolid
Enterobacteriaceae	IV amoxicillin (ceftriaxone or ertapenem if required)	–	Amoxicillin, cotrimoxazole, or ciprofloxacin	Amoxicillin clavulanate, ciprofloxacin, cotrimoxazole
Pseudomonas	IV meropenem	–	Ciprofloxacin	–
Culture negative	IV glycopeptide	Oral rifampicin	Ciprofloxacin + rifampicin	Doxycycline, cotrimoxazole, clindamycin, fusidic acid

IV, intravenous; OPAT, outpatient parenteral antimicrobial therapy.

Retrospectively reviewed all hip and knee EPRs performed between 2007 and 2014 for the management of chronic infection following complex arthroplasty or fracture fixation.

Data recorded included indication for EPR, number of previous surgeries, comorbidities, and organism identified.

Outcome measures included PJI eradication rate, complications, implant survival, mortality, and functional outcome (Oxford Hip or Knee Score).

69 EPRs (29 knees and 40 hips) were performed with a mean age of 68 years (43-92).

Polymicrobial growth was detected in 36% of cases, followed by coagulase-negative staphylococci (28%) and Staphylococcus aureus (10%).

Recurrence of infection occurred in 19 patients (28%):

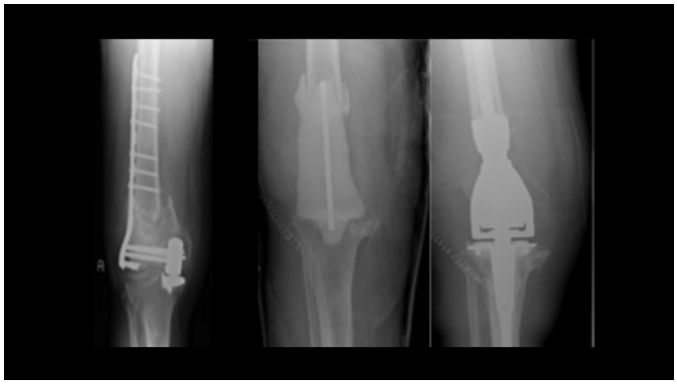
5 were treated with irrigation and debridement, 5 with revision, 1 with above-knee amputation, and 8 remain on long-term antibiotics.

PJI eradication was achieved in 50 patients (72%); the chance of PJI eradication was greater in hips (83%) than in knees (59%) (P ¼ .038).

The 5-year implant survivorship was 81% (95% confidence interval 74-88). The mean Oxford Hip Score and Oxford Knee Score were 22 (4-39) and 21 (6-43), respectively.

This study supports the use of EPRs for eradication of PJI in complex, multiply revised cases.

PJI eradication rate of 72% with acceptable functional outcome.



Type of Complications and Their Management.

Type of Complication	Frequency (%)	Management
PJI recurrence	19 (28)	DAIR (n = 5) Revision EPR (n = 5) Above-knee amputation (n = 1) Life-long antibiotics (n = 8)
Periprosthetic fracture (femur)	4 (6)	Revision EPR (n = 2) Nonoperative treatment (n = 2)
Periprosthetic fracture (acetabulum)	1 (1)	Acetabular component only revision (n = 1)
Nerve injury	3 (4)	Medical input (n = 3)
Dislocation	2 (3)	Closed reduction (n = 1) Open reduction (n = 1)
Arthrofibrosis	2 (3)	Manipulation under anesthesia (n = 2)
Implant loosening	1 (1)	Revision EPR (n = 1)
Wound breakdown	1 (1)	Nonoperative treatment (n = 1)

DAIR, debridement antibiotics and implant retention.

"Following infected soft tissue debridement and excision of necrotic bone, the extent of bone loss may be so great that the joint may not be reconstructable with revision implants. Endoprosthetic replacement may be the only option for limb salvage in patients with massive bone loss."

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[a] Reparative Orthopaedic Surgery Departments – ASST Pini-CTO, University of Milan, Italy
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Fig. 1. Tendon-plasty for lengthening the quadriceps tendon.

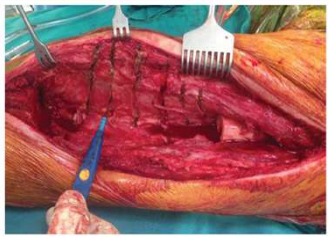
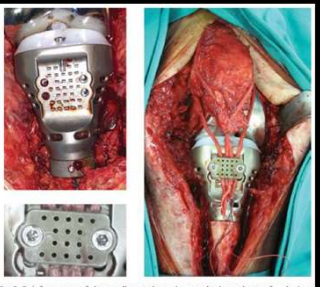


Fig. 2. Pie crusting of quadriceps fascia.



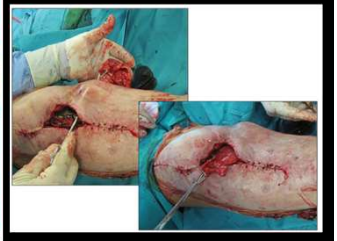


Fig. 3. Reinforcement of the patellar tendon using synthetic tendon graft substitute (LARS) and tendon anchoring at the prosthetic component using dedicated plate.

Fig. 5. On the left: rupture of the reconstructed apparatus after new trauma; on the right: new reconstruction using synthetic tendon graft substitutes in strings (LARS) and mesh (ARTELON).

Summary

Megaprosthetic recontructions of the knee is a viable option for patients with massive bone loss from non-oncologic etiologies.

Megaprostheses may be used successfully in post traumatic and chronically infected patients; however these procedures are technically challenging and should be reserved for highly trained specialist that perform these procedures routinely.

Special considerations

- Proximal tibia replacement is not comparable to a distal femur replacement for trauma and infection.
- Routine use of gastoc flap and early plastics consult for wound issue is essential.
- Beware of the extensor mechanism… Most frustrating problem for patients is weak, deficient quad.
- Beware of propagation of fracture. Consider cerclage cables and the use of intraop fluoro.
- Cement technique is important; fat embolism can be catastrophic

Important considers

- No indications for high energy trauma for megaprosthesis
- If prior surgery, r/o infection and then r/o again.
- Removal all prior hardware.
- Consider activity level of patient
- Consider age of patient
- Consider pre injury ambulatory status
- Optimize co-morbidities when possible
- Beware of abundant callous and hardware near adductor canal.
- Remove heterotopic bone cautiously

- Much like tumor surgery… if the surgeon performing the surgery will not be able to manage the complications long term, they should not be doing the surgery.
- There are too many limb threatened referrals from inexperienced community surgeons that saw their attending doing it during residency.
- YOU ARE MAKING A LIFE-LONG COMMITMENT TO THE PATIENT AND A PARTNERSHIP