Total Femoral Replacement (TFR) : When to do it?

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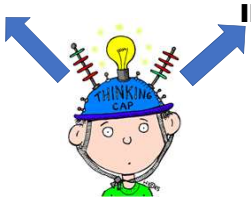
NO DISCLOSURES

Outline

- Overview of total femoral replacement (TFR): Indications, surgical technique, rehabilitation principles and outcomes.
- Case presentation.
- Conclusions.

SEVERE BONE LOSS

EXTENSIVE BONE INVOLVEMENT



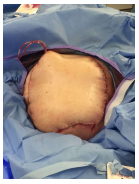
“ Shattered Femur”

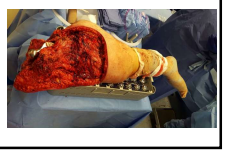
The Journal of Arthroplasty Vol. 21 No. 4 Suppl. 1 2006

The Shattered Femur: Radical Solution Options

Adolph V. Lombardi Jr. MD, FACS.*†‡ and Keith R. Berend, MD*†‡

HIP DESARTICULATION





AP1

Introduction

- Buchman et al. reported on a total femur and knee replacement with custom made Vitallium endoprosthesis in 1965.
- The femur is the most common bone to be affected by primary and secondary malignancies.
- As the yearly number of revision arthroplasty procedures continues to rise, it is anticipated that there will be a correspondingly greater incidence of salvage arthroplasty.

Slide 6

JAP1 Multiple revision surgeries lead to extensive bone loss. Also, repeated surgical debridement in the setting of periprosthetic joint infection ... reduction of femoral bone stock.

Juan A. Pretell, 8/17/2018

GOAL

DEVICE

FORM **Function**

EARLY MOBILIZATION AND FULL WEIGHT BEARING

Reconstructive needs:

- Long operative time ….. Risk for infection.
- Extensive dissection ….. Greater volume of blood loss.
- Multiple comorbidities and intensive physiologic demands of the procedure …. ICU care.

FUNCTIONAL EXPECTATIONS OF THE PATIENT

TYPES

Feature	Intramedullary TFR system	Tumor-style TFR system
Basic design	Modular hip femoral component; Constrained knee femoral component with customized intercalary segments; May require strut allografts and cerclage cables	Modular and available in multiple lengths
Femoral bone stock	Possibility of preservation; can maintain muscle attachment	Absent
Distal femur resection	Can preserve distal femur or remove femoral component using standard revision techniques	Entire distal femur can be removed by subperiosteal dissection (less bleeding)
Tibial component	Suitable for constrained condylar articulation	Suitable for rotating hinge articulation

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DOI: 10.5312/wjo.v6.i11.919

World J Orthop 2015 December 18; 6(11): 919-926
ISSN 2218-5836 (online)

MINIREVIEWS

Current concepts in total femoral replacement

Deepak Ramanathan, Marcelo BP Siqueira, Alison K Klika, Carlos A Higuera, Wael K Barsoum, Michael J Joyce

Indications

ONCOLOGIC:

- Primary bone tumors.
- Secondary bone tumors.

NON-ONCOLOGIC:

- Extensively comminuted peri-prosthetic fracture.
- Biomechanical integrity compromise (Paget's disease/Fibrous dysplasia)
- Severe loss of bone stock (multiple revisions/repeated surgical debridement)
- Radical resection of pseudotumors

SURGICAL APPROACHES

WOUND CLOSURE:

- Pre-existing surgical scars – Wound necrosis.
- Inadequate wound healing – Secondary peri-prosthetic infection.

Surgical technique

STEP	COMPLICATION	WHAT TO DO?
Acetabulum	Dislocation/Wearing	Bipolar head/purse stringing of joint capsule/Total hip.
Proximal femoral anteversion	Dislocation/ patellofemoral maltracking	Femoral anteversion of 15°/ Confirm stability.
Tibial Component	Patellofemoral maltracking	External rotation of tibial component.
Patellar tracking	Patellofemoral maltracking	Check proximal femoral anteversion/tibial component rotation/Lateral retinacular release.
Soft tissue reconstruction	Abduction weakness	Adequate soft tissue re-attachment.
Limb Length	Limb length discrepancy/ dislocation	Contralateral plain radiographs full femur/ comparison to resected femur

SOFT TISSUE - ABDUCTORS

- Suture through configurations of holes.
- Braided metal cables.
- Meshes such as Marlex mesh (Chevron Phillips Chemical).
- Gore-Tex (W.L. Gore & Associates)
- Aortograft (Gore Medical) with Dacron (Teleflex Medical) tape.

Limb Length

Rehabilitation

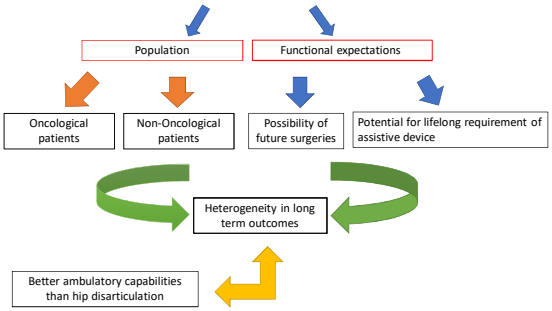
- Quadriceps muscle strengthening – Competence of the extensor mechanism (Ahmed AR. *Arch Orthop Trauma Surg*. 2010)
- Custom-molded polypropylene brace to limit flexion and adduction for up to 6 weeks post-op (Hwang JS et al. *Orthopedics* 20110.

Rehabilitation

Expected Outcome:

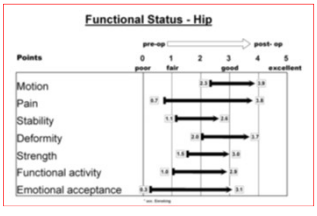
- May take 12-18 months to achieve an optimal outcome.
- ROM at knee 0-120°.
- May have 5° quads lag.
- Independently mobile with a stick.
- Grade 4/5 abduction is optimal – Many patients will walk with Trendelenburg gait or lateral tilt bend.
- Patient independent in relevant personal care and domestic activities.

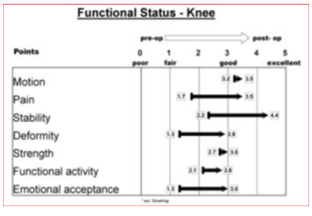
OUTCOMES

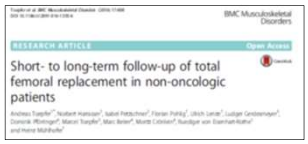


Revision Arthroplasty with Use of a Total Femur Prosthesis

- 100 TFR for revision arthroplasty in 100 consecutive patients.
- THA complication 77 pt/ TKA 04 pt/ Diaphysis of femur 19 pt.
- Mean F/U: 5 years.






BMC Musculoskeletal Disorders

RESEARCH ARTICLE Open Access

Short- to long-term follow-up of total femoral replacement in non-oncologic patients

- 18 patients non-oncologic from 1995-2015 with a mean F/U: 80 months (28-132).
- Two groups: TFR due to peri-prosthetic fracture (11)/aseptic loosening (7).

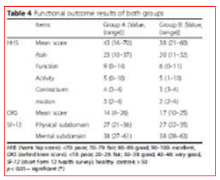


Table 4 Functional outcome results of both groups

	Items	Group A (Value, (range))	Group B (Value, (range))
MSTS	Mean score	43 (16–70)	38 (21–60)
	Pain	23 (10–37)	20 (11–32)
	Function	9 (0–14)	6 (0–11)
	Activity	5 (0–10)	5 (1–10)
	Contractures	4 (0–6)	3 (3–6)
	Motion	3 (2–6)	2 (2–6)
OKS	Mean score	14 (4–26)	17 (10–25)
SF-12	Physical subdomain	27 (21–36)	27 (20–35)
	Mental subdomain	38 (27–61)	38 (28–63)

HHS (harris hip score): <70 poor, 70–79 fair, 80–89 good, 90–100 excellent, OKS (oxford knee score): <19 poor, 20–29 fair, 30–39 good, 40–48 very good, SF-12 (short form 12 health survey): healthy control > 50
$p < 0.05$ – significant (*)

Arch Orthop Trauma Surg
DOI 10.1007/s00402-009-0945-2

ORTHOPAEDIC SURGERY

Total femur replacement

Adel Refaat Ahmed

- 09 consecutive patients from 1993-2007.
- 04 had primary malignant bone tumor/ 04 had primary malignant soft tissue tumor/ 01 metastatic disease (osteosarcoma).

Patient no.	ROM (flexion)[a]	ROM (extension)	Extension power (MMT)	Gait	Enneking's evaluation (%)	X-ray R	X-ray I	X-ray A	X-ray hip
Primary cases									
1	7	0	2	T cane	NA	NA	NA	NA	NA
2	NA	NA	2	NA	NA	NA	NA	NA	NA
3	120	0	2	Without crutches	97	E	E	E	E
4	30	0	2	Single crutch	67	E	E	E	E
5	75	0	3	Without crutches	80	E	E	E	E
6	80	0	2	Lofstrand	87	E	E	E	E
7	30	0	2	T cane	73	E	E	E	E
8	20	5	2	Lofstrand	70	E	E	E	E
Metastatic cases									
1	NA	NA	2	Could not walk	30	NA	NA	NA	NA

ROM range of motion, *X-ray R*, remodeling (ISOLS), *X-ray I* interface (ISOLS), *X-ray A* anchorage (ISOLS), *X-ray hip* hip assessment, *NA* no data available, *E* excellent

[a] Calculation at the end of follow-up or last visit before death or amputation

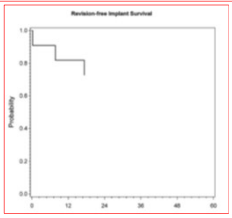
- ROM knee: Mean 60° (20-120°).
- Enneking functional score: Mean 72% (30%-93%)


Clinical Orthopaedics and Related Research®

Clinical Research

Is Total Femur Replacement a Reliable Treatment Option for Patients With Metastatic Carcinoma of the Femur?

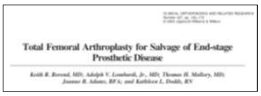
Florian Sevelda MD, Wenzel Waldstein MD, Joannis Panotopoulos MD, Alexandra Kaider MSc, Philipp Theodor Funovics MD, Reinhard Windhager MD



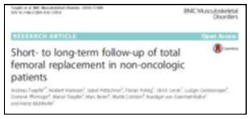
- 11 patients (from 1986-2016).
- All patients died during the first 31 months after surgery.
- Seven patients were able to leave the hospital after surgery after a mean stay of 5 months (1-15 weeks).
- One chronic dislocation, one infection, one local recurrence. Two amputations.
- MSTS: Mean 32 (13-57).

One year revision-free implant survival was 82% (95% CI,51%-98%).

70% at 5 years F/U



65% at 5 years F/U



56% at 5 years F/U

COMPLICATIONS

Author	Journal	Year	# pt.	Population	Infection	Dislocation	Patellar issues	Nerve palsy
Ahmed AR	Arch Orthop Trauma Surg	2009	9	oncologic	22%	0	0	0
Amanatullah et al.	J Arthroplasty	2014	20	non-oncologic	35%	25%	0	0
Berend et al.	CORR	2004	59	non-oncologic	15.50%	11.80%	0	0
Fountain et al.	J Arthroplasty	2007	14	non-oncologic	21.40%	35.70%	0	0
Friesecke et al.	JBJS Am	2005	100	non-oncologic	12%	6%	2%	1%
Lombardi et al.	J Arthroplasty	2006	75	non-oncologic	14.60%	9.30%	0	0
Mankin et al.	CORR	2005	15	oncologic/non-oncologic	6.60%	0.00%	0	0
Nerubay et al. *	CORR	1988	20	oncologic	57.80%	0.00%	0	0
Steinbrink et al.	JBJS Br	1982	32	oncologic/non-oncologic	6.25%	3.10%	3.10%	0.00%
Ward et al.	CORR	1995	21	oncologic/non-oncologic	14.30%	9.50%	4.80%	0.00%

* 50% wound issues

Deep periprosthetic infection

- One of the most common indications for revision surgery of TFR.
- Patients with TFR are at significantly greater risk for acquiring a life-threating infection (multi-resistance drug infections).
- Predisposing factors:
  - ✓ Extensive surgical dissection.
  - ✓ Large metal surface area.
  - ✓ Prolonged operative time.
  - ✓ Multiple comorbidities.
  - ✓ Repeated hospitalizations for past surgical procedures.

Deep periprosthetic infection

High PHYSICAL and FINANCIAL cost …

Distribution of Organisms Complicating TFA.

Infection	Organism Prior to TFA	Organism After TFA
Persistent	Coagulase negative staphylococci	Coagulase negative staphylococci
Persistent	Group B streptococci	Group B streptococci
Re-infected	Coagulase negative staphylococci	Corynebacteria
Re-infected	Coagulase negative staphylococci	Enterococci
Re-infected	Coagulase negative staphylococci	Group B streptococci
Primary	None	Enterococci
Primary	None	Enterococci

Amanatullah et al. / *Arthroplasty*; 2014

Deep periprosthetic infection

One stage prosthesis exchange with chronic antibiotic suppression.

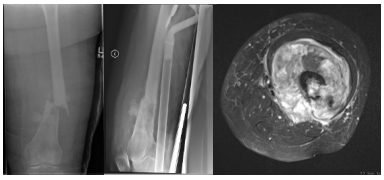
Two stage revision arthroplasty with cement spacer.

Age older than 50 and recipients of secondary TFR (Hwang et al. *Orthopedics*, 2011).

Direct Hip Disarticulation?

CASES

52 yo female.
Left femur pathological fracture.
Dx: Osteosarcoma.

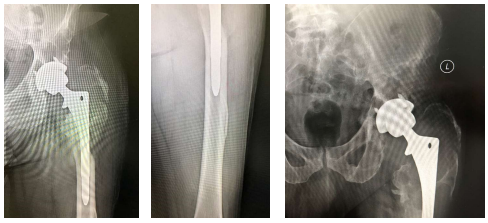


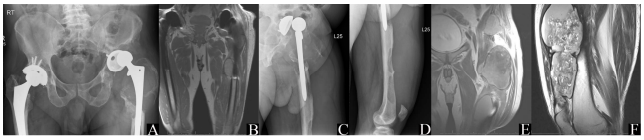
04 cycles of IA Cisplatin/IV Doxorrubicin.

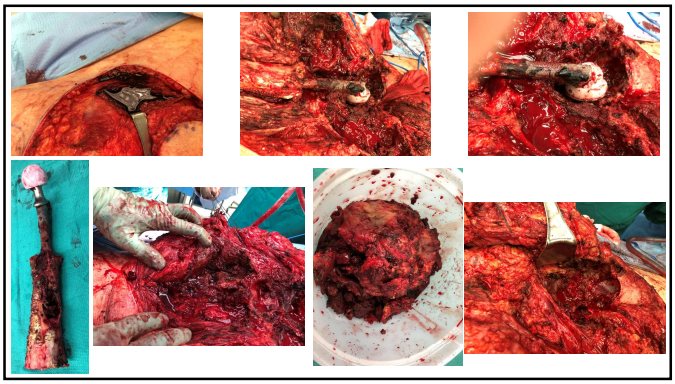
Post-operative radiographs – Developed infection with Candida.

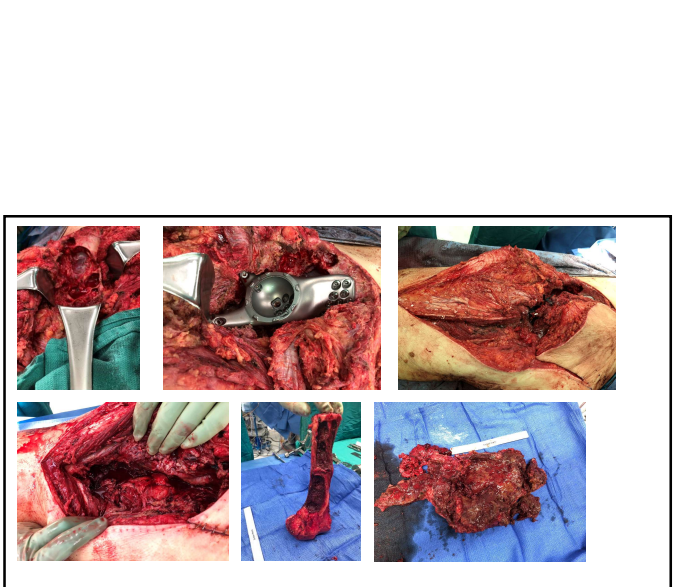
DIED

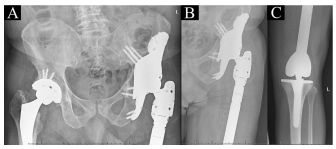
- 71 yo male.
- Left MoM THA in 1999.
- Revision surgery in 2015 (pseudotumor) – Radiolucency proximal femur – Left THA polyethylene liner and femoral head exchange.
- Developed severe pain in the left groin/thigh – walking with walker. No knee flexion.











CONCLUSIONS

- ✓ TFR is anticipated to become an increasingly salvage option in the setting of extensive femoral bone loss.
- ✓ Should probably be performed by an orthopedic oncologist or adult reconstructive surgeon who is familiar with the unique challenges involved.
- ✓ Careful patient selection , excellent surgical technique , and a comprehensive rehabilitation program are essential to ensure optimal outcomes.
- ✓ Post-operative complications are frequent and expensive to manage (financial, physical and emotional).
- ✓ Continued research with larger patient series is needed to better characterize the functional outcomes and complications associated with this procedure.

THANK YOU