Long-term results of knee replacement with MUTARS® modular endoprostheses in treatment of primary tumors

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Authors and institutions
MPA Bus[1] (m.p.a.bus@lumc.nl), MAJ van de Sande[1] (majvandesande@lumc.nl), GR Schaap[2] (g.r.schaap@amc.nl), JAM Bramer[2] (j.a.bramer@amc.nl), PDS Dijkstra[1] (p.d.s.dijkstra@lumc.nl)

[1] Leiden University Medical Center, Leiden, The Netherlands
[2] Academic Medical Center, Amsterdam, The Netherlands

Background
Modular endoprostheses are commonly considered to be the gold standard for reconstruction after resection of tumors around the knee. Nevertheless, rates of revision after endoprosthetic reconstruction remain considerable. One of the long-established modular endoprosthetic systems is MUTARS® (Modular Universal Tumor and Revision System; implantcast, Buxtehude, Germany). To date, studies focusing on the long-term results of these prostheses in the treatment of primary tumors are lacking.

Questions/Purposes
We evaluated our dual-center experience with MUTARS® endoprosthetic knee replacements in treatment of primary tumors, with the aims to assess (1) complications and associated risk factors, emphasizing on mechanical complications, and (2) mid- to long-term implant survival rates.

Patients and Methods
We retrospectively evaluated all consecutive patients in whom a MUTARS® knee replacement was performed in the treatment of a primary malignant or benign bone or soft-tissue tumor between 1995 and 2009. All patients had a rotating hinge MUTARS® distal femoral replacement (DFR) or proximal tibial replacement (PTR). Complications and failures were classified according to Henderson *et al*. Kaplan-Meier curves were used for survival analysis, with removal of part of the implant, major revision or cemented re-fixation as the end-point. Failure did not include revision of the polyethylene bushing in case we did not interfere with the metallic implant.

Results
We included 101 patients (55 male, 55%) with a total of 110 reconstructions (89 DFRs, 81%; 21 PTRs, 19%). Mean age at surgery was 36 years (13-82). Twenty-five reconstructions (23%) were preceded by a failed previous reconstruction. Predominant indications for primary surgery were osteosarcoma (n=56, 55%), leiomyosarcoma of bone (n=10, 10%), chondrosarcoma (n=9, 9%), and giant-cell tumor of bone (n=8, 8%). Thirty-nine patients (39%) had an extra-articular resection. Mean length of the reconstructed defect was 16 cm (12-30). Seventy-eight DFRs (88%) were uncemented, 42 (54%) of which were hydroxyapatite (HA) coated. All tibial components of the PTRs were uncemented, 12 of which (57%) were HA-coated. Attachment tubes were used in 14 PTRs (67%) and in two DFRs (2%); rotation of a muscle flap was performed in four PTRs (19%). Complications of soft-tissue or instability occurred in seven reconstructions (six DFRs, one PTR), after a mean of 4 months (0.6-10.0). None resulted in removal or revision of the implant. Aseptic loosening occurred in 15 DFRs (17%) and in two PTRs (10%). Loosening was more frequent in reconstructions performed as a revision of a failed previous reconstruction (7/25, 28%; four within four years, others after 7.1, 15.3 and 17.7 years) than in primary reconstructions (10/85, 12%; seven within 15 months, others after 36, 38 and 70 months) (OR 2.9, 95%CI 1.0-8.7, p=0.06). The risk of loosening was significantly lower for uncemented HA-coated DFRs (2/42, 5%) than for uncemented uncoated DFRs (11/36, 31%) (OR 0.1, 95%CI 0.0-0.6, p<0.01). Structural complications occurred in 15 reconstructions (14%), after a mean of 4.0 years. These included six complications of the locking mechanism (5%), four periprosthetic fractures (3%) and three fractures of the femoral component (3%; two 12 mm stem with bridged defects of 17.5 and 21.5 cm, one 16 mm stem with a bridged defect of 15.5

cm). Deep infections occurred in 14 reconstructions (13%) and resulted in removal of eight implants (7%). Locally residual or recurrent tumors were diagnosed in 10 patients (10%). At final review, 90 patients (89%) had a MUTARS® in situ. Ablative surgery was performed in ten patients (10%; six for local recurrence, three for infections and one for a periprosthetic fracture). With failure for mechanical reasons (type 1-3) as the end-point, implant survival rates at five and 15 years were 79% and 72%. With failure for non-oncological reasons (mechanical and infection, type 1-4) as the end-point, these were 72% and 62%. With failure from any cause as the end-point (type 1-5), these were 69% and 56%, respectively (figure 1).

Conclusions

We report considerable, yet acceptable long-term mechanical complication rates for knee replacement with MUTARS® modular endoprostheses in treatment of primary tumors. Limb-salvage was achieved in 90% and the majority of our patients had a MUTARS® in situ at final follow-up, indicating that most complications were adequately managed. Aseptic loosening was the most important mechanical complication. HA-coating of uncemented implants appears to reduce the risk of aseptic loosening, and we currently consider uncemented HA-coated implants the most viable solution for durable fixation. Revision of the locking mechanism should aid to reduce the risk of structural failure. We conclude that MUTARS® represents a reliable option for knee replacement after tumor surgery.

Figure 1.

Survival curve obtained from Kaplan-Meier survival analysis (n=110), demonstrating implant survival for mechanical reasons (type 1-3; green line), implant survival for non-oncological reasons (type 1-4, mechanical reasons and infection; blue line) and implant survival for all reasons (type 1-5, mechanical reasons, infection and oncological complications; red line).