POSTER 1

Implant Survival of 89% in Custom 3D-Printed ONKOS Hemipelvis Endoprostheses

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***Background*:**
Pelvic reconstructions after internal hemipelvectomy or revision hip arthroplasty with massive bone loss present significant challenges to orthopedic surgeons. Saddle-type and pedestal cup designs along with LUMiC and modular endoprostheses and allograft, autograft, or flail reconstructions have been implemented with varied success. Therefore, no consensus exists on the optimal method of reconstruction due to the significant variability in the remaining host anatomy following resection. Recent innovation in 3-dimensionally (3D) printed implant technology has allowed for customized designs to precisely recreate patient anatomy and geometry in the most difficult of pelvic reconstructions after internal hemipelvectomy or revision arthroplasty with massive bone loss.

Questions/Purposes:
This study aims to describe (1) the proportion of custom 3D-printed hemipelvis endoprostheses that achieved durable short-term fixation; (2) the modes of failure; and (3) the surgical complications from this reconstruction technique.

***Patients and Methods**:*
A single institution retrospective review from July 2016 to September 2021 identified a consecutive group of 9 (5 male; 4 female) patients treated with 9 custom 3D-printed ONKOS hemipelvis endoprosthesis. Indications for surgery were malignant bone tumor requiring internal hemipelvectomy (7 patients) or multiply revised, failed hip arthroplasty with massive bone loss (2 patients). All implants were designed to recreate the native anatomic hip center, cut with an iliac shelf, and a monoflange with no reconstruction of the pelvic ring (Figure 1). Mean follow-up was 26.3 months (range, 5.6-60.8 months). Kaplan Meier survivorship analysis was determined for all patients using removal of the custom implant as the primary endpoint. Competing risks including modes of failure and death were determined. Post-operative complications and re-operations were categorized for all patients including indication and time to reoperation.

***Results**:*
At a mean follow-up of 26.3 months (range, 5.6 to 60.8), all 9 patients retained their custom 3D-printed ONKOS hemipelvis implant. In total, 3 patients required reoperation: two superficial wound infections and one periprosthetic joint infection (PJI) with 6 patients going on to re-operation free survival. The PJI required a staged debridement with antibiotic bead placement and partial revision of the hip components with a femoral head replacement. Therefore, this cohort achieved an 89% revision-free implant survivorship (Figure 2). There were no cases of aseptic loosening or implant structural failure.

***Conclusion**:*
3D-printed hemipelvis reconstruction utilizing an ilium monoflange provided durable short-term fixation at a mean 2-year follow-up. Multiple design considerations were implemented in the planning and implantation of the endoprostheses. Monoflange size was generally increased in later cases and was designed to not be flush anteriorly with the iliac crest to aid in osteotome placement and leverage if future explantation was required. The combination of iliac fixation through the ilium-osteotomy shelf with “home run screws” and an angled 2-surface cut allows for weightbearing forces to continually compress the endoprosthesis into the iliac shelf, feasibly achieving osseointegration and augmenting component stability. There were no radiolucent lines, gaps, or issues with bony apposition along osteotomy site or any screws. And despite the design intention of porous metal integrated along the iliac wing monoflange, small intermittent zones of non-apposition were identified on CT but appeared to not effect implant failure.

Reoperation for periprosthetic and superficial wound infections were common without any instances of implant loosening or structural failure. The limitations of this current study include the small size and heterogeneity of the patient population, which make it difficult to compare results by diagnosis or anatomic site in the pelvis. Our data does not include patient reported outcomes or assessments of patient function which limits

the conclusions that can be drawn from it. Further investigation will be necessary to determine optimal designs and surgical techniques to maximize patient function and maintain long-term survivorship.

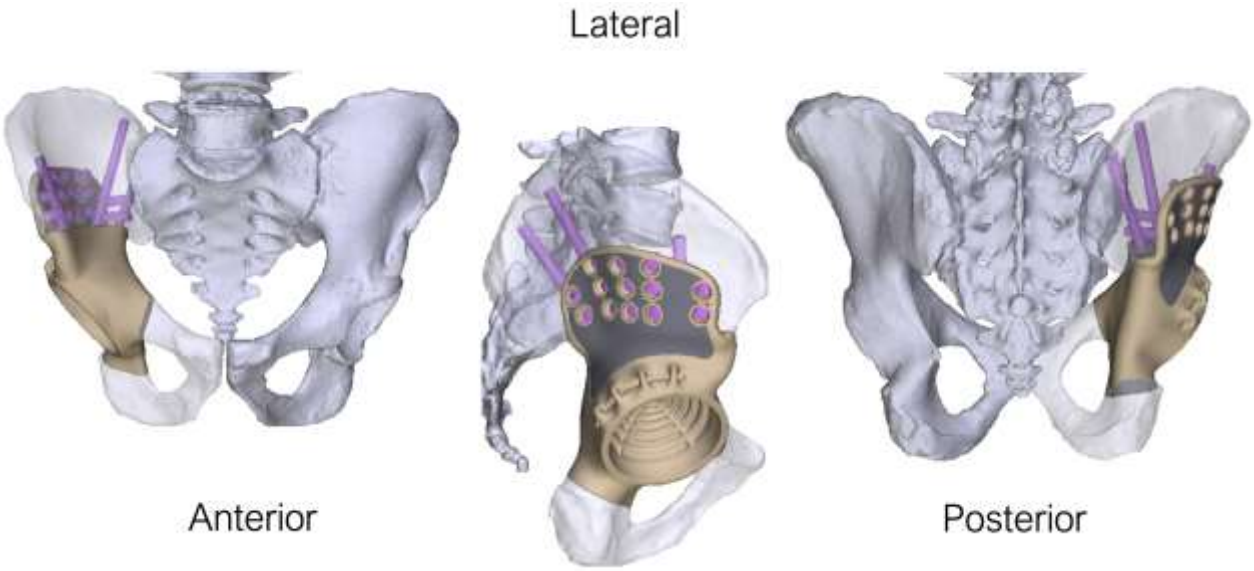

Figure 1 Reconstruction plan illustrating 6.5mm titanium cancellous bone screw trajectories (purple cylinders). Note the orientation of the 3x anterior and posterior iliac column “home run” screws and the 13x iliac flange bi-cortical screws.

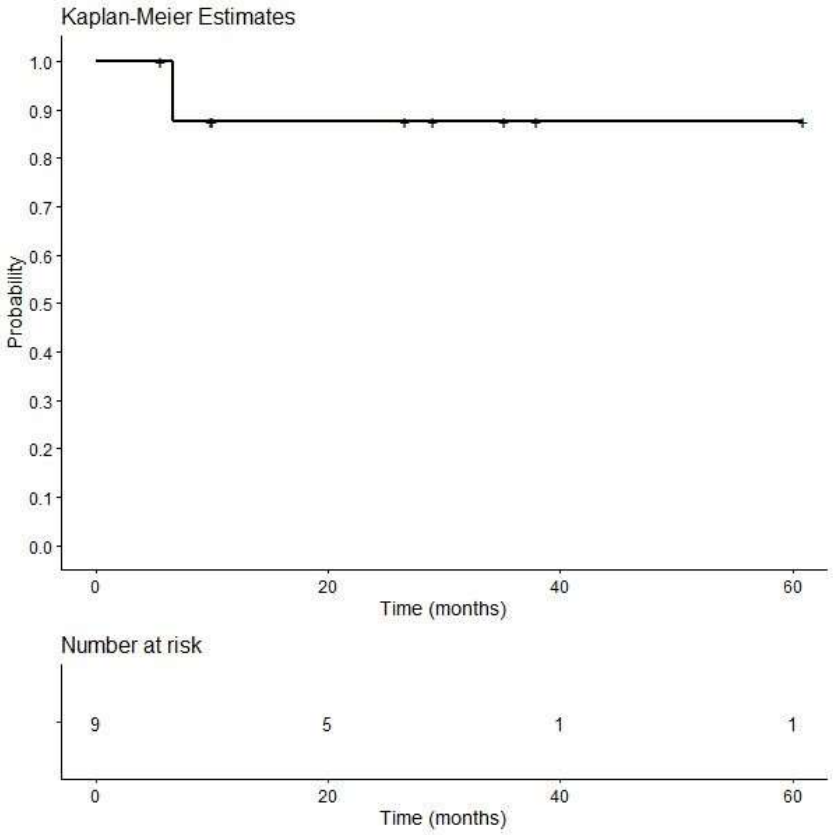

Figure 2 Kaplan-Meier estimates for overall implant survival with implant revision as the primary endpoint.