Long-term Outcome and Survivorship of Porous Tantalum Acetabulum Components in Complex Primary and Revision Total Hip Arthroplasty: A Ten to Twenty Year

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INTRODUCTION: Complex primary and revision total hip arthroplasty (THA) is challenging in Asians as smaller pelvis limiting usage of large acetabulum components (Jumbo cup) to fill up acetabular defects. As such, the main operative goals: achieving mechanical stability, restoring normal hip center of rotation (COR) and managing bone defects, are difficult to achieve together with limited host bone contact. With limited contact surface, using porous tantalum acetabulum components have theoretical advantages due to better immediate stability with high coefficient of friction and early osteointegration with its high porosity, optimal pore size and similar elastic modulus to bone. Native COR and filling defects could also be achieved by combining with tantalum augments and cementing liners. Despite these advantages, long-term data are lacking. Here we present the world-first long-term survivorship study of porous tantalum acetabulum components in complex primary and revision THA in Asians.

METHODS: The study was approved by ethic committee. 57 hips of 54 patients who have undergone complex primary and revision THA using porous tantalum acetabulum component (Trabecular Metal, Zimmer) between 2005 and 2015 were reviewed. There were 36 female and 18 male patients (mean age: 63.6, range 18–87) with 15 complex primary and 42 revision THA (mean 1.7 revision, range 1-7) with aseptic loosening being the commonest indication. There were nine Type-II, eight Type-IIa, eleven Type-IIb, three Type-IIc, ten Type-IIIa and sixteen Type-IIIb Paprosky Acetabular bone defects with 5 cases of pelvic discontinuity. Kaplan-Meier method was used to estimate survivorship. Clinical outcomes were graded with Harris Hip Score (HHS) and compared between preoperative, 1-year and 10-year after operations. Radiological outcomes were assessed by comparing radiographs after operations and at last follow-up, evaluating for radiolucency lines (DeLee-Charnley's zones) and assessing acetabular cup stability (Massin et al.) Loosening was defined by migration: change ≥3 mm vertically or horizontally or inclination angles difference ≥5° between radiographs; or 2mm radiolucency lines in all DeLee-Charnley zones. Hip COR was measured by Callaghan method and COR normal position was calculated by Pierchon's method. "High" COR was defined as vertical distance > 35 mm (Dearborn and Harris). Wilcoxon signed-rank test was used to compare the changes in HHS, inclination angle, vertical distance, horizontal distance and radiolucency over different time points. Subgroup analysis were performed with Wilcoxon rank sum test and Kruskal–Wallis test for comparing two and two or more independent groups respectively. Statistical analysis was performed using R statistical software 4.3.3. A p-value < 0.05 was considered statistically significant.

RESULTS SECTION: The survivorship of porous tantalum acetabulum components was 95% at a mean follow-up of 14.3 years (range 10.0-20.4) with 1(out of 57) removed 14 years later for periprosthetic joint infection (PJI) and the component was stable intraoperatively(figure1&2). No acetabulum components were loosened clinically and radiologically (mean change: vertical: -0.18mm(p=0.36), horizontal: -0.11mm(p=0.45), angle: 0.23°(p=0.17)). The survivorship with all-cause reoperation as endpoint was 83.6%: 3 patients had early wound infection and treated with debridement; 1 patient had periprosthetic joint infection, treated with debridement and insert exchange; 1 patient had recurrent dislocation and managed with insert orientation change and 1 patient had stem loosening and revised. The mean component size was 55mm (range 46-66) with 10 cases using augments and 4 cases of cup-cage constructs. There were 5 high COR (range 35.5-42.0mm above inter-teardrop line) but all cases' COR were within acceptable range comparable to native COR (mean vertical difference 5.43mm(range: -17.6 to 24.6mm); mean horizontal difference 3.92mm(range: -5.43 to 19.2mm)). All cases had significant improvement in HHS, from mean 45.4 (4.5-88) before operation to 82.5 (56-100, p<0.001) at 1-year and 81.4 (52-100, p<0.001) at 10-year(figure3). There was no significant difference between patients with high and low HHS improvement in term of age, vertical/horizontal distance between native and reconstructed COR, presence of pelvic discontinuity, number of previous revision and indications for operations.
Radiographically, no acetabulum components were loosened nor migrated at latest follow-up and there was no statistically significant difference between groups with history of infection or not (vertical distance p-value=0.51, horizontal distance p value=0.67, inclination angle p-value=0.17). There was overall reduction in width of radiolucent lines over zone 1 to 3 on latest follow-up while groups with history of infection had significant more residual radiolucent lines (zone 1 p-value=0.0002, zone 2 p-value=0.0132, zone 3 p-value=0.0438) but they are less than threshold for loosening criteria.

DISCUSSION: This study reported the first long-term survivorship of porous tantalum acetabulum components for complex primary and revision THA in Asians and demonstrated 95% survivorship of the component and significant functional improvement at a mean follow-up of 14.3 years, despite the challenge of smaller acetabulum among Asians with lower bony contact from defects. In fact, the only one case with component removal done was performed for femoral side sinus and PJI of unknown duration and the acetabulum component was found well-fixed intraoperatively, leading to pelvic discontinuity during removal. We observed our experience of successfully managing cases with infection with debridement without requiring component removal nor signs of component loosening matches and might explain international findings that porous tantalum acetabulum components were associated with lower revision for infection and loosening. Here we detected an unreported, novel finding that cases with history of infection were associated with more residual radiolucent line despite the widths were lower than loosening threshold. This might be explained by the relatively poorer bonebed for complete osteointegration, however, the high coefficient of friction and partial osteointegration were sufficient to maintain the component stability. We observed an overall improvement in hip function (HHS) which did not differ between different subgroup analysis. This could possibly be constrained by our limited sample size and diversity of our cohort, for instance, all cases' COR were restored within a reportedly acceptable range and thus no significant difference was detected.

SIGNIFICANCE/CLINICAL RELEVANCE: In summary, using porous tantalum acetabulum components in Complex Primary and Revision Total Hip Arthroplasty was found having minimal risk of undergoing further major revision in Asians.

Figure 1

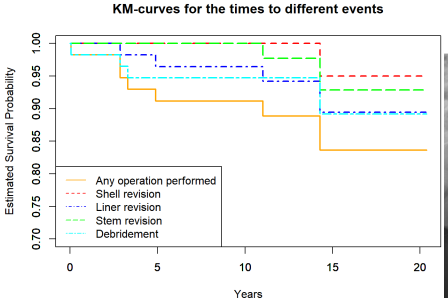

Figure 2

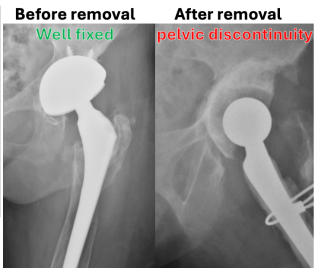

Figure 3