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## Supplementary Methods

### Implant Design

The design of the endoprosthesis was similar to our previously reported modular hemipelvic endoprosthesis (first generation). The implant consists of two parts, iliac fixation part in three sizes and acetabular cup in three diameters. During operation, the two parts are connected by taper structure and secured by a vertical screw passing through the acetabular cup, taper structure, iliac fixation part and anchored to the cancellous bone of ilium. Anteversion of cup can be adjusted before it is secured. The main fixation structure evolved from residual iliac bone to iliosacral joint by three iliosacral-fixation screws with long axis in line with loading axis, which can provide more biomechanical compatibility with less shear stress on the screws. The vertical screw provides bone-implant interface compression. One or two locking screws were placed to provide extra initial stabilization. The bone-contact surface of the endoprosthesis is 1.5mm thick layer of titanium porous structure with a porosity of 80 vol. % and a mean diameter of 800µm for the pore size. The lateral wing of the iliac fixation component is modified to match the anatomical surface of lateral cortex of ilium. For cases with partial ilium removal (iliac osteotomy being cephalic to the line connecting sciatic notch to anterior inferior iliac spine, AIIS ), a wedged femoral head autograft needs to be used to facilitate fixation of the implant, achieving optimal cup position.



## Postoperative Management

In order to minimize the occurrence of hematoma and subsequent deep tissue infection, passive drain was used for day 1-3 (>200ml/24h), then changed to controlled active drainage starting from -20mmHg then gradually increased to -80mmHg. The removal indication was <50ml/24hr. Anti-thrombotic stockings and calf compression devices were routinely used for prophylaxis against deep vein thrombosis. The use of chemical thromboprophylaxis was indicated based on serum blood coagulation profiles after surgery. Cefoperazone/sulbactam (sulperazone) was administered for the duration of the hospital stay before drainage removal, usually seven to ten days, followed by oral antibiotics for a total of 2 weeks. ESR, CRP, CBC were monitored every 3 days and drainage tube tip cultured for infection high risk patients. Hip sports/support brace (hip Groin compression support wrap) was routinely used to decrease dead space and facilitate gluteus reattachment, thus stabilizing the hip joint. **Generally, the patients are requested to remain bed rested for at least 4 weeks, allowing the scar tissue to stabilize. Longer bed rest is considered when more extensive soft-tissue resection is carried out. However, patients who received standard type II resection are allowed to stand with toe-touch and partial weight bearing 10-14 days after surgery, usually 2-3 times a day. Aggressive weight-bearing rehabilitation actually starts after bed rest. To prevent dislocation of the hip, range of motion was limited in external rotation and flexion <90° for 4 weeks.**

## Histological Study

Bone ingrowth was evaluated by specimens retrieved from two patients who underwent hindquarter amputation due to local recurrence of osteosarcoma at 8 months and 18 months after surgery respectively. The bone-implant interface was not invaded by tumor tissue. Following  $\mu$ -CT, specimens were further trimmed to an

approximately 1-cm thick section in the coronal plane located evenly along the bone-implant interface. These sections encompassed the residual ilium from previous surgery as well as the iliac component. After neutral buffered formalin fixation, the samples were dehydrated in graded solutions of ethyl alcohol. After processing, the samples were cleared with acetone and polymerized into a hardened plastic block (Acrylosin, Dorn and Hart Microedge Inc, Villa Park, IL, USA). Histological sections were taken in the coronal plane through the interface to display the bone ingrowth. Slides were subsequently stained and evaluated by a trained pathologist.