Project Background

Legg-Calvé-Perthes Disease (LCPD) is a childhood condition caused by deformation of the femoral head due to osteonecrosis by temporary obstruction of blood flow to the femoral head. This disease affects 1 in 1,200 children in their lifetime. Current treatment involves an external fixator device which distracts the femoral head from the acetabulum. However, this poses several complications, including:

- Exposure to external environment, allowing for potential infections
- Only one axes of movement (Flexion Extension)

Objectives

Texas Scottish Rite has tasked HipHipHooray with developing an internal solution to problems facing the external fixator. The device must include:
- Distraction of 10 - 15 mm
- Biocompatibility
- Hip rotation in the Flexion Extension plane
- Viable attachment points to the pelvis and femur
- Stretch goals achieved:
  - Medial Lateral adjustability to accompany patient variability
  - Hip rotation in the Internal External planes
  - Abduction adjustment in surgery

Device Breakdown

A. Distraction Module

- Allows for the articulation of the hip the Internal External direction.
- Rotation of part is limited by the size of part and allows for ±15° of rotation.

B. Int-Ext Rail

C. Turnbuckle

- Enables adjustability for the distance between the femur and pelvis intraoperatively.
- Distance between parts modulates for patient-specific femur neck-to-head angle.

D. Flex-Ext Component

- Allows for the articulation of the hip in the Flexion Extension direction.
- Rotation of part is limited only by the anatomy.

Device Validation

The device was validated by using SolidWorks Finite Element Analysis to apply static forces. The forces are applied in compression on the device through the trochanter and pelvic plates. Can withstand forces of 1300N without serious deformation (> 10mm). This is within 30% failure rate as specified by the corporate sponsor. Upon further testing the device an perform up to 2000 N which is within 100% of the failure rate. There was some deformation observed at 2000N. Figure A displays the highest stress areas. Figure B displays highest deformation area.

Conclusion

The project scope for this device was not only achieved but also exceeded through the development of an additional surgical reference tool used to aide in implantation. The internal hip implant is a novel medical device that we believe can serve many patients with LCPD better than current treatments can. The impact of this device will significantly reduce the number of complications a patient experiences, and will provide the patient with more flexibility and improved quality of life.

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