INTRODUCTION:
Recent reports have focused attention on the mechanical importance of ligamentum teres (LT) with implications for pediatric hip dysplasia reconstruction. A previously established procedure of antero-inferior acetabular attachment fulfills the function of a check rein and has shown early promising results. However, further research indicated that this technique has limitations of not being isocentric and therefore is likely to restrict motion. The purpose of the present study was to identify the isocentric point for LT re-attachment and then to study the feasibility of the actual procedure in a pig cadaver model. We hypothesized that isocentric re-attachment would be feasible, would not restrict the range of motion between the articulating surfaces, and if performed with adequate tensioning, would prevent occurrence of excessive pressure points within the joint surfaces.

METHODS:
Twelve pelvi-femoral specimens with intact hip anatomy from adolescent pigs were carefully dissected and a medial capsulotomy was performed in all hips. All twelve hip joints were initially evaluated with the ligamentum teres intact to serve as a control group. An initial arthrogram and biplanar radiography confirmed a congruent joint surface without evidence of arthritis or other pathology.

A minimal anteromedial capsulotomy was performed and the ligamentum teres was detached from its acetabular insertion and transferred to one of two reattachment positions: 1) anterolateral lip of the acetabulum or 2) our proposed isocentric position. For the anterolateral lip position, the ligamentum teres was attached to, or slightly above, the anterior transverse acetabular ligament (Figure 1). For the isocentric position, the ligamentum teres was transferred to the center of the cotyloid fossa using an anteromedial tunnel without an intra-pelvic approach (Figure 2).

Additionally, a novel method for tracking the ligamentum teres under intact and refixation conditions was implemented with radioopaque solution being injected into the substance of the ligamentum teres. The ligamentum teres was then visualized and tracked at the two reattachment positions through a full ROM of the hip joint (Figure 4).

RESULTS:
This study has established that isocentric reattachment of the LT is feasible and does not lead to any restriction of hip motion when under appropriate tension. Additionally, this re-attachment position does not lead to limitation of external rotation and abduction unlike the antero-inferior reattachment on the acetabulum. The analysis of the stresses between the femoral head and the acetabulum revealed that with initial division of ligamentum in an immature pig hip-model the pressure mapping significantly decreased. While a low stress level is generally preferable, decreased articulation in dysplasia may be a potential risk for dislocation. The 20N applied to tension the ligament reattachment resulted in pressure mappings more closely resembling the intact hip conditions. However, the stresses were still less than in the intact hip.

DISCUSSION:
Isocentric attachment of the ligamentum teres was feasible using an antero-medial osseous tunnel without an intra-pelvic approach. With adequate ligament tensioning, hip motion is fully preserved and there are no excessive pressure areas within the joint. It serves as a check rein against repeat dislocation and acts as an internal splint or tether. The resultant feasibility of this technique may provide a completely new perspective of treating patients with developmental/neuromuscular dysplasia and/or dislocated hips.

REFERENCES:
2. Troya T, Brown TD, Conzemius MG: Contact stress distributions on the femoral head of the emu (Dromaius novaehollandiae). JBM 2009,10