Introduction:
The incidence of dislocation in primary total hip arthroplasty has been reported to be between 0.6% and 9.9%. In revision surgery this escalates to as high as 20% in some series. Patient related conditions such as compliance, substance abuse, neuromuscular disorders, which effect hip mechanics, and primary reconstruction for hip fracture have been associated with higher dislocation rates than normal. Iatrogenic issues also play a role. These include improper component position, sources of secondary impingement, operative approach, and poor soft tissue tension at the time of implantation. Constrained acetabular liners have proven themselves to be an effective operative treatment for the recurrent dislocating hip especially when more conventional means of revision surgery fail. Albeit in few reports with relatively short-term follow-up, constrained liners have shown a failure rate as low as 4%, depending on the author and brand of constrained liner. To date, there are no studies examining specifically the failure mechanisms of constrained sockets. Very little information is known on the failure mechanisms of the constrained liners. Our objective was to assess the mechanisms of failure in constrained liners in revision total hip replacement (THR).

Materials and Methods:
Constrained liners implanted in three separate institutions were reviewed. A total of 1735 THR revisions were performed in all three institutions. 140 constrained liners were used during that time, in 131 patients 37 % Males and 63 % Females with a mean age of 70.2 yrs old. 65 Srom, 1 Biomet, 61 Osteonic and 5 Duraloc were used in the study. Indications for use of a constrained acetabular component and the number of patients with each indication were as follows: recurrent dislocation 78, abductor deficiency 12, girdlestone 1, Primary with one or more risk factors 32, and revision with one or more risk factor 8. 12 component failures were identified. Average time to failure as well as procedure done after failure was carefully reviewed.

Results:
118 patients continue to function well at follow up with no dislocations and no failure of the constrained liner mechanism. 12 patients required re-operation specifically for failure of the constrained implant. The mean time to failure was 217 Days.

Three (3) failure mechanism types were identified (Fig I):

I. Screw holding the constrained liner pulled off the bone.
II. Mechanical failure of the liner mechanism.
III. Head pulled off the liner without failure mechanism.

We had 5/12 cases in which the screws pulled off the bone. 5/12 locking mechanism or liner ring mechanism failures and 2 in which the head pulled off the liner. Salvage procedures were successfully done in 11/12.

Conclusion:
Constrained acetabular components have a high success rate in dealing with the significant problem of recurrent instability. In patients with a high risk of dislocation (leg lengthening correction, girdlestone reimplantation), judicious use of these implants appears appropriate. Three modes of failure for constrained sockets have been described: Type I – Bone prosthesis interface failure, Type II – Liner locking mechanism failure, and Type III – Femoral head locking mechanism failure.

Initial concern focused on the effect of this device on bone acetabular component fixation (Type I failure). However, radiographic analysis at 2 – year follow up has shown no accelerated loosening on the acetabular side. We described five type I failures in which the screws pulled off the bone. All of the liners that failed in type 1 mode had screws placed in only one of the zones. Type I failures can be minimized by using supplemental screw fixation for the cementless shell prior to inserting the constrained liner. Cementing constrained liners into cementless shells can lead to Type II failures, if the liner is not properly seated fully into the shell. We describe 5/12 locking mechanism or liner ring mechanism failures. In an effort to avoid cement-polyethylene debonding, scoring the polyethylene lightly with a burr to enhance the grouting bond of the cement is advisable. The type III failures are likely related to the reduced range of motion associated with the constrained liners we found 2 in which the head pulled off the liner, pulling of the head from the socket was an unusual failure mechanism. Little biomechanical data is available on the failure of these implants. Constrained liners are an important tool for the revision THA surgeon, and more resources need to be devoted to assess their failure modes.

Fig 1. The three models of failure of a constrained acetabular sockets. Type I bone- prosthesis interface failure, Type II: liner locking mechanism failure, Type III: femoral head locking mechanism failure.

Fig 2. Type I failure demonstrating the cup pivoting in abduction about its only mode of fixation – superior screws.