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ORIGINAL STUDY

Surgical technique description : Transosseous 'over the top' reconstruction of capsule and tendons in primary total hip arthroplasty using a posterior approach

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Dislocation after total hip arthroplasty (THA) remains a devastating complication and a primary cause for revision arthroplasty. Historical data indicate that a posterior approach is associated with a higher dislocation rate. In this study, we present a highly reliable and anatomical reconstruction, based on the biomechanical findings of a previous cadaveric experiment. The posterior soft tissues were repaired in 2 layers. First a reattachment of the posterior orbicular ligament is performed at the anterior capsule. Subsequently a transosseous 'over the top' reinsertion of both capsule and tendons is performed close to there anatomical insertion.

We prospectively collected data of 408 THAs from January 2004 until December 2013, through a posterior approach and with a capsule and tendon reconstruction based on a previous cadaveric study.

There was a low early dislocation rate in primary THA (one of 408 THAs, 0,2%) and no complications related to the technique.

This anatomical reconstruction of both capsule and tendons is associated with a low dislocation rate without complications at the level of the greater trochanter

Keywords : total hip replacement; dislocation; prevention; posterior approach; capsule repair

INTRODUCTION

Dislocation after total hip artrhoplasty (THA) is a major complication and every effort should be done to prevent it *(4,6,12,19,22)*. The causes of dislocation are multifactorial and can be attributed to patient characteristics, implant design, surgical technique and component positioning. Historically, a posterior approach has been associated with a higher risk of dislocation compared with a lateral or anterolateral approach *(13,18,22,27,37)*. Due to its versatility that allows exposure of the hip and surrounding structures both with minimally and more extensile exposure, it is still preferred by the majority of surgeons, both for primary and revision hip surgery *(7)*. The increased risk of dislocation using a posterior approach is attributed to disruption of the posterior soft tissue structures, including the

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short external rotators of the hip and the posterior capsule. In an attempt to overcome this specific limitation of this approach, a reconstruction of the hip capsule and external rotators of the hip has become increasingly popular *(2,3,5,8,9,14,16,22,23,24,25,26,28,32,33,34,35)*. A recent meta-analysis comparing the posterior approach with and without soft tissue repair demonstrated a dislocation rate of 0.49% and 4.46% respectively *(16)*. However, a variety of reconstructions of the posterior hip capsule and tendons have been described, some using only soft tissue reattachments and other with a tranosseous repair with multiple drill holes.

Multiple transosseous drill holes can weaken the greater trochanter and cause an avulsion fracture *(36)*. Furthermore some of these reconstructions are not anatomical which may induce increased strain and early failure of the repair *(31)*. Biomechanically, a soft tissue reconstruction alone cannot provide the same stability as a transosseous approach *(30)*.

The aim of this paper was to describe and evaluate our current surgical technique of soft tissue reconstruction and its influence on dislocation rate. The technique is based on a cadaveric experiment, in which the functional anatomy of the posterior stabilizing structures was analyzed and a subsequently tested for both torque resistance and rotational stability *(30)*.

The technique has undergone some minor adjustments in the clinical setting, but since 2003 we have been using the same transosseus capsulotendinous repair after THA. The technique we describe offers the advantage of the strength of a transosseous approach without weakening the greater trochanter by using multiple drillholes. It is anatomical, obliterates the posterior dead space and is only stretched in flexion-internal rotation.

Description of the technique

A standard posterior approach is used for exposure. An 8 to 10 cm incision is made centered over the greater trochanter. Fascia and gluteus maximus are identified and split along the muscle fibers. No attempt is made to identify the sciatic nerve. After identification of the piriformis, a retractor is placed superior to the piriformis, under the gluteus

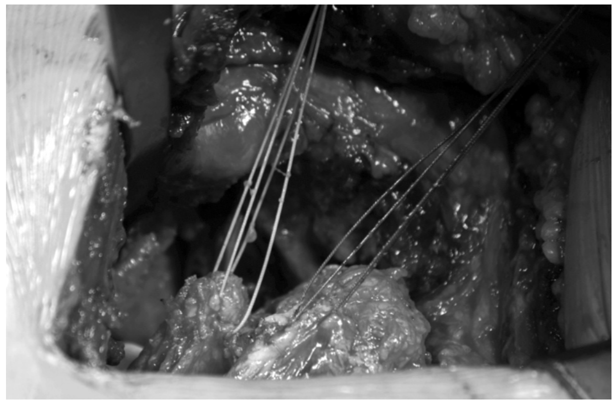

Fig. 1. — Picture showing the tagged tendons and capsule after their release

minimus and superficial to the capsule. With the hip in slight flexion and internal rotation, the piriformis, obturator and both gemellus tendons are detached as close as possible from there femoral insertion on the greater trochanter and trochanteric fossa. Two Ethibond Excel 2 (Ethicon, Johnson and Johnson) sutures are passed through the piriformis and obturator internus tendon and reflected posterior to protect the sciatic nerve. The capsule is detached in an L shaped fashion with the upper limb in line with the piriformis tendon and the lower limb running along the neck of the femur, to release the capsule from the bursa pectinea and neck of femur. Another two Ethibond Excel 2 sutures are passed through the capsule, along the orbicular ligament. Routinely, no further capsular release is performed, but a limited release of the anterior or posterior capsule and the reflected head of the quadriceps at the acetabular rim is sometimes necessary to mobilize the anterior capsule. No transverse incision is made in the inferior capsule. A small teardrop retractor inferior, between the capsule and transverse ligament, an anterior retractor and one to two charnley pins posterior are used for circumferential exposure of the acetabulum. Since its publication in 2006, the transverse acetabular ligament is used for version of the acetabular component as described by Archbold et al. *(1)*. A 10° anteverted liner is used and the liner is positioned as to optimize stability and compensate minor variations of final cup position. The size and position of the femoral component is preoperatively templated and intraoperatively checked with measurements taken from the tip of the greater and lesser trochanter.

The first step in the reconstruction of the posterior capsulotendinous structures is a direct repair of the capsule. An ethibond Excel 2 stitch is passed from the free edge of the anterior ischiofemoral ligament, to the posterior orbicular ligament, in order to close the hip capsule. This direct repair obliterates the posterior dead space. The second step is to secure the capsule and external rotators with a transosseus reconstruction. One drill hole is made at the posterosuperior tip of the greater trochanter. The two inferior Ethibond Excel stitches (one from the capsule and one from the external rotators) are passed through this drill hole, using a loop of Vicryl 1 to pass the sutures. The two superior Ethibond Excel stitches are passed directly through the gluteus medius as close as possible to the anterosuperior tip of the greater trochanter. The sutures are tied with the hip in extension and neutral rotation. The efficacy of the repair is tested by bringing the hip in 90° of flexion followed by gentle internal rotation, until torque resistance is experienced. At the end of the procedure, a repair of fascia, subcutis and skin with absorbable sutures is performed.

PATIENTS AND METHODS

Between January 2004 and December 2013, 1245 primary THAs were performed in our hospital. Data of these patients were collected prospectively in a clinical database. 677 operations were performed by the senior surgeon (AL), using an anterolateral approach, and used as a control group to compare dislocation rates . 567 primary total hip replacements were performed using a posterior approach with capsule and tendon repair. Patients undergoing resurfacing arthroplasty were excluded from this group. This resulted in a cohort of 408 unselected THAs using a posterior approach.

The study cohort was comprised of 258 women (63.2%) and 150 men (36.8%) with a mean age of 72.5 (SD 8). All patients were operated by the same surgeon (WS). In all patiens an Exeter cemented stem (Howmedica Osteonics, Mahwah, New Jersey) was used in combination with a Trident cementless cup (Howmedica Osteonics, Mahwah, New Jersey). The femoral head size depended on the cup size (Table I).

Patients started mobilising the day after surgery. An abduction pillow between the legs was used while the patient is sleeping or resting in bed as a precautionary measure Patients were warned to avoid excessively flexion and interal rotation of the operated hip for the first six weeks. Routine follow-up was done at 6 weeks and 3 months postoperatively.

Dislocation at three months was considered as the outcome variable. Special attention was given to the radiographic integrity of the greater trochanter at routine follow up. After 3 months, patients were only seen if adverse events occurred.

Table I. — Femoral head sizes used in this study

Table 1: THP Head size	
head size	Nr
22mm:	1
28mm:	20
32mm	109
36mm	218
40mm	37
44mm	11
Anatomical heads	12
Total	**408**

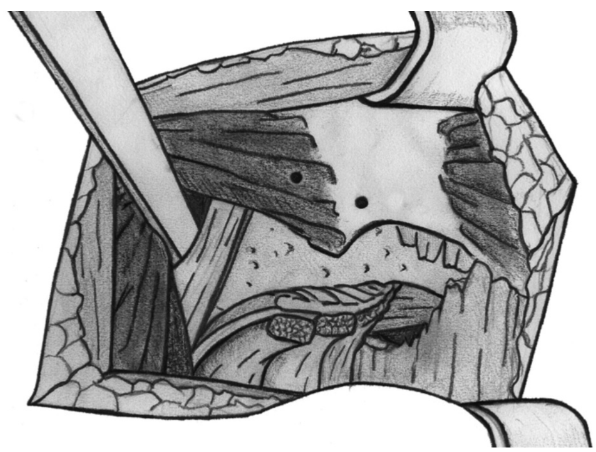

Fig. 2. — Drawing illustrating the capsulotendinous flap and the position of the drillholes for the transosseous reconstruction

Table II. — Dislocation rates of the posterior approach with capsule repair

Author	Journal	Year	Capsule repair	Femoral head size	Number of hips	Follow-up (months)	Dislocation rate
Browne et al	Clin Orthop Relat Res	2012	soft tissue	28-jumbo	178	23	0.6%
Chiu et al	J Arthroplasty	2000	soft tissue	NR	96	38	0%
Dixon et al	J Arthroplasty	2004	soft tissue	22-28	255	> 24	0.4%
Goldstein et al	J Bone Joint Surg Am	2001	soft tissue	NR	500	12	0.6%
Hedley et al	J Arthroplasty	1990	transosseous	NR	259	NR	0.7%
Ho et al	Arch Orthop Trauma Surg	2012	soft tissue	36	421	> 18	0.5%
Kumar et al	Bone Joint J	2014	transosseous	22	512	34	0.8%
Pellicci et al	Clin Orthop Relat Res	1998	transosseous	26-28	519	> 6	0.2%
Suh et al	Clin Orthop Relat Res	2004	transosseous	28	96	NR	1.0%
Tsai et al	BMC Musculoskelet Disord	2008	soft tissue	28	62	15	0%
Van Stralen et al	Arch Orthop Trauma Surg	2003	transosseous	28	884	30	1.4%
Weeden et al	J Arthroplasty	2003	soft tissue	NR	945	77	0.8%
White et al	Clin Orthop Relat Res	2001	transosseous	28	437	> 6	0.7%
Wright et al	J Arthroplasty	2004	NR	NR	37	61	0%
current study		2015	transosseous	32/36	408	>3	0.2%

Fig. 3. — Identification of the anterior capsule at the end of the procedure before closing the posterior capsule

RESULTS

The capsule repair could be successfully performed in all patients. In the study group, 1 patient had an early anterior dislocation, 2 days after surgery, due to a forceful manipulation of the hip (A nurse forcefully pulled at her leg whilst placing a bedpan). The hip was reduced under general anesthesia the next day and was found to be stable both in extension-external rotation and flexion-internal rotation. She was mobilized without special protection and further follow-up was uneventfull. Therefore, the overall dislocation rate in the cohort was 0,2%. There were no greater trochanteric fractures or other complications related to the surgical technique.

In het anterolateral approach, which was considered as the control group, 15 early dislocations after THP occurred (2,2%).

The posterior approach resulted in significantly less early dislocations than the anterolateral approach in the THP group (p = 0.009).

DISCUSSION

Dislocation after total hip replacement is multifactorial. In order to minimise its incidence all possible causes should be addressed. Historically, a posterior approach, by nature of the disruption of the posterior hip capsule and tendons, has an increased incidence of dislocation compared with the lateral and anterolateral approach. Therefore, restoration of the function of the posterior hip structures must be attempted. Several different posterior capsule repair techniques have been described in the literature. Biomechanically, a transosseous repair of the capsule to the greater trochanter reproduces the normal anatomy as closely as possible and provides the most stable construct in terms of torque resistance and rotational stability *(21,30)*. When not repaired correctly, capsular enhanced repairs are unable to withstand forces that occur at the site of repair during the healing process and will lead to failure and potentially a higher dislocation rate *(21)*.

Knowledge of the functional anatomy is essential for a solid reconstruction. In order to fully reconstruct these structures we first perform a reattachment of the posterior capsule onto the free border of the anterior capsule. This suture does not only obliterate the posterior dead space but restores the function of the orbicular ligament. The second part of the reconstruction is a transosseous fixation of external rotators and capsule. In order not to weaken the greater trochanter and to better reposition capsule and tendons to their anatomical (isometrical) point of insertion, we bridge the greater trochanter with one drilll hole near the tip and one 'over the top' suture, passed directly through the gluteus medium, at the anterosuperior part of the greater trochanter. A near anatomical repair is obtained with no stress or strain during physiological flexion/extension of the hip *(29,30)*. This can be tested clinically by bringing the hip in full flexion. The sutures should not stretch during flexion. Only when the hip is internally rotated, resistance is felt.

Correct component alignment is crucial for initial stability and longevity of the implant. The use of the transverse acetabular ligament as a landmark to check the position of the acetabular has been shown to reduce the risk of dislocation and the variability of final cup position *(1,15,20)*.

The relationship between head size and stability is a second way to optimize stability and reduce the risk of dislocation *(10,11)*. A larger head decreases the risk of dislocation although dislocation may still occur in high risk patients *(17)*.

The combination of these three strategies (larger femoral heads, orientation according to the TAL and a transosseous repair) can lead to a significant reduction in dislocation rate *(10)*.

In our patient group we experience the same low dislocation rate.

The early end point at 3 months can be considered as a weakness in the current study. As all patients have been clinically reviewed at that point, it ensures complete follow up. Furthermore, most hip dislocations, as much as 85% according to one study, occur before 2 months after surgery *(24)*. The control group shows a dislocation rate of 2,2% and indicates that the detection of dislocations is accurate. Furthermore, although follow up may not be complete after the 3 month period, we have not encountered any late dislocations in the study group during the 10 year study period.

In conclusion, this anatomical reconstruction of posterior capsule and tendons is biomechanically superior to a soft tissue repair alone *(30)* and offers a reliable reconstruction with excellent clinical results in all patients as shown in the current study. Because only 1 drilhole is needed the risk of a greater trochanteric fracture through the drill holes and osteoporotic bone is minimized. Our dislocation rate compares favorably with other reports in contemporary literature. We have been using the same technique for over 10 years and feel confident to continue its use. In the future, it would be interesting to compare the dislocation rates of different posterior capsule repair techniques to determine which technique is superior.

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