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Original Research

Extra-Articular Impingement at the Anterior Inferior Iliac Spine: A Cause of Refractory Periarticular Pain After Total Hip Arthroplasty

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ABSTRACT

Background: Periarticular pain after total hip arthroplasty (THA) can significantly impair the postoperative functionality. Extra-articular impingement between the greater trochanter and the anterior inferior iliac spine is presented as a cause of refractive pain after THA.
Methods: Twenty patients were treated for refractive periarticular pain and limited internal rotation between January 2014 and April 2016. All patients underwent a positive chair rise test, pelvic inclination test, and Marcainisation test. Patients were treated with bone resection of the anterior part of the greater trochanter with or without component revision.
Results: At a mean follow-up of 20 months, all functional outcomes had improved significantly. All patients were willing to undergo the surgery again. Sixteen (80%) indicated the result as very good, 3 (15%) as good, and one (5%) as poor. Two patients developed a postoperative heterotopic ossification that required resection.
Conclusions: Extra-articular impingement should be considered as a possible cause of refractive groin pain after THA. Bony resection through the Hueter interval provides immediate pain relief with improved functional outcomes 1 year after surgery.

Introduction

Total hip arthroplasty (THA) is a widely used procedure in the treatment of degenerative hip osteoarthritis. The numbers are increasing [1,2]. Functional results are good to excellent, but 10%-15% of unsatisfied patients with persistent pain have been reported [3]. The incidence of groin after THA can be as high as 18% [4-6]. The groin region is defined as the area extending from the inner thigh to the anterior border of the greater trochanter (GT) and from the anterior superior iliac spine to the base of the GT [5]. Possible causes are iliopsoas impingement, component loosening, or pseudotumors [4,7]. Literature concerning risk factors for the development of groin pain after THA is inconsistent, but groin pain can significantly affect a patient's quality of life [8].

It is often difficult to determine the specific causes of groin pain [9]. Extra-articular subspine impingement at the level of the anterior inferior iliac spine (AIIS) has been reported as a cause of groin pain in the nonarthritic hip [10]. We describe a similar entity as a potential cause of refractive periarticular pain in the groin to the lateral hip region after THA: extra-articular impingement (EAI) between the AIIS and the anterior part of the GT.

Material and methods

We retrospectively reviewed 24 patients who were treated by the senior author for EAI between January 2014 and April 2016. This study was approved by the Ethics Committee of the hospital Oost-Limburg and by the Ethics Committee of the University of Hasselt. Patients with an additional psoas release (N = 2) or who underwent full-component revision surgery (N = 2) were excluded. This left 20 patients, of which 19 filled in all functional outcome scores at a mean follow-up of 20 months (range, 12-40 months). Patients were requested to fill in the Harris Hip Score (HHS), the Hip disability and

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Table 1
Clinical differentiation between extra-articular impingement (EAI) and psoas tendinitis.

Symptoms and physical exam findings	EAI	Psoas
Timing of symptoms	Immediate	Immediate in case of impingement Intermediate in case of overuse/tendinitis
Location	Groin ± lateral	Groin
Sitting	Pain	no pain
Clinical examination		
Midflexion + IR	Pain + limited	No pain, not limited
Deep flexion + IR	Pain + limited	Pain, not limited
Straight leg raise	No pain	Pain at initiation
Active flexion during sit	No pain	Pain at initiation
Chair rise test	Pain in neutral rotation Impossible with IR No, to less pain with ER	No pain
Pelvic inclination test	Pain gone with decrease in inclination	No pain
Marcainisation test	Decrease to no pain with aforementioned tests	No change
Psoas marcainisation	No change	No to less pain

IR, internal rotation; ER, external rotation.

Osteoarthritis Outcome Score, and the Short Form (36) Health Survey score. Patients were asked whether they would be willing to undergo the surgery again. Patients were also asked to rate the result of the surgery from very good to good, poor, or bad.

The mean time after the index procedure was 3 years (range, 6-48 months). All patients complained of groin pain and pain around the GT during driving, stair ascent, and sit-to-stand maneuvers. The pain was described as a pain that had appeared immediate post-operatively and was not present before the surgery (Table 1). The pain was typically felt while sitting and disappeared when lying down. The workup for aseptic loosening (bone scan) or infection (erythrocyte sedimentation rate and C-reactive protein with aspiration) was negative. All anteroposterior pelvic and hip radiographs showed well-seated components without any signs of loosening. Ten patients underwent magnetic resonance imaging scan with metal artifact reduction sequence protocol that was completely normal.

In comparison to the contralateral side, all patients had clinically apparent limited and painful internal rotation at 45° and 90° of midflexion and deep flexion. The pain disappeared when the pelvic inclination was decreased by fully flexing the contralateral hip toward the chest (ie, the pelvic inclination test) (Fig. 1). All patients had a painful chair rise test with the hip in neutral and maximal internal and rotation. The pain significantly improved or disappeared with the hip in maximal external rotation (Fig. 2). Two patients were unable to fully undergo the test in internal rotation because of a feeling of instability. Active elevation of the leg in the supine position was not painful in 15 patients. In 5 cases, this test was positive, but a psoas injection with Marcaine did alleviate the symptoms.

Eighteen patients had a positive Marcainisation test of the soft tissues around the AIIS (Fig. 3). The 2 patients with hip instability did not undergo the Marcainisation test. The soft tissues were injected with 20-40 cc of Marcaine under fluoroscopic guidance, and the clinical tests were conducted again 30 minutes after the Marcainisation test. The pain alleviated immediately in all cases.

The anterior part of the GT was approached through the Hueter interval between the tensor fascia latae (TFL) and rectus femoris. The fascia of the TFL was opened, and the lateral circumflex vessels were coagulated. The fascia innominate was opened, and the gluteus minimus was identified. A retractor was positioned

Figure 1. Pelvic inclination test. The patient feels pain when impingement is induced by internally rotating the leg. Flexion of the contralateral hip and knee toward the level of thorax changes pelvic inclination by reducing the lumbar lordosis. The ipsilateral leg is held in the same position by the examiner, and the patient pulls the contralateral leg against the chest. Because the pelvic inclination decreases, the AIIS shifts away from the GT and the impingement is resolved. Consequently, pain disappears and typically comes back when the contralateral leg is put back on the table.

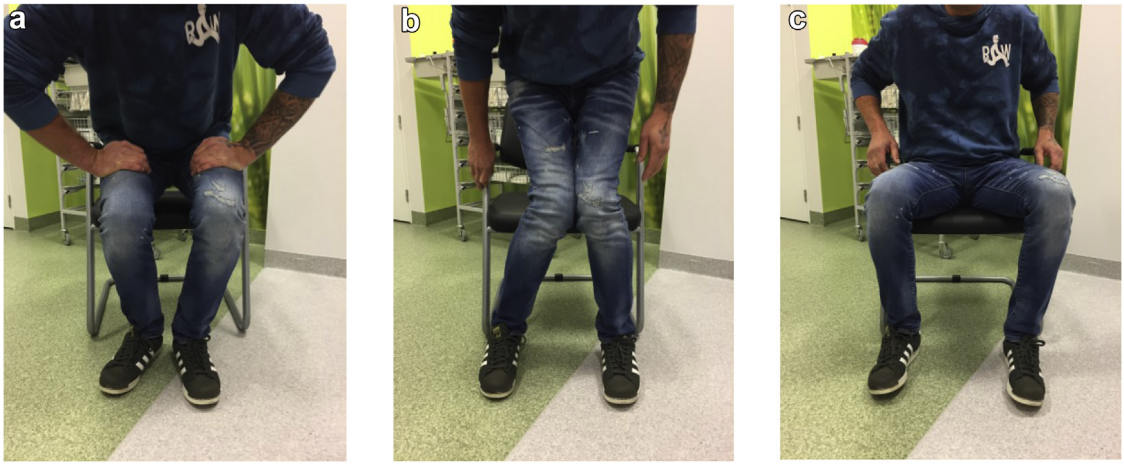

Figure 2. Chair rise test. Patients feel pain when getting up from a chair, when the legs are placed in a neutral rotation (a). Chair rise with the leg in internal rotation induces the EAI and aggravates the pain (b). Chair rise with the leg in external rotation twists the GT away from the AIIS and decreases the pain (c).

between the minimus and the superior capsule. A second one over the calcar and a third one retracted the TFL to the lateral direction. The AIIS was identified. Before resection, the hip was mobilized through a full range of motion (Fig. 4). In all cases, the space between the GT and AIIS was less than one fingerbreadth at mid-flexion and deep flexion. The anterior part of the GT at the intertrochanteric ridge and the anterior tubercle were removed using a straight osteotome. Another full range of motion was evaluated for abutment. It was the goal to have a fingerbreadth of clearance between the GT and the AIIS. In case the impingement was not sufficiently resolved, the AIIS was partially resected underneath the direct head of the rectus insertion (N = 3). In case this was not possible or not sufficient, the femoral head was exchanged to a longer version (N = 10). In 2 cases, the femoral offset was still not sufficient and the liner was exchanged to an offset liner. All hips were deemed stable at the end of the procedure. The EAI was resolved to approximately one fingerbreadth between the GT and the AIIS.

Statistical analysis was performed using the statistical software program SPSS, version 24 (IBM Corporation, New York). The conditions for parametric testing were controlled. Normality of data was controlled using the Shapiro-Wilk test and the Kolmogorov-Smirnov test. Homoscedasticity was tested using Levene's test. After conducting these tests, conditions for a parametric test were not met. The Wilcoxon signed-rank test was used to compare preoperative and postoperative clinical outcome scores. Significance level was set at 0.05.

Results

Eight male and 12 female patients with a mean age of 57 years were treated (range, 30-77). Six patients underwent a THA conducted through the posterolateral, 12 through the direct lateral, and 2 through the anterior surgical approaches. Seventeen implants were metal-on-polyethylene articulations with 32- or 36-mm diameter, and 3 were ceramic-on-ceramic articulations.

All patients were willing to undergo the surgery again, and 16 (80%) indicated the result as very good. Three (15%) patients rated the result as good and one (5%) as poor. The subclinical instability and groin pain disappeared in both patients with these preoperative findings. All functional outcomes improved significantly (Table 2). The mean preoperative HHS was 47 (range: 10-65). This improved to a mean postoperative HHS of 77 (range: 51-99). The mean preoperative Hip disability and Osteoarthritis Outcome Score was 9 (range: 0-13). This improved to a mean postoperative score of 35 (range: 10-56). The mean total preoperative Short Form (36) Health Survey score was 41 (range: 20-71), and the postoperative score was 63 (range: 28-94). All scores significantly improved ($P < .0001$).

Two patients developed postoperative heterotopic ossification that required resection 6 months postoperatively. The chair rise and pelvic inclination test were pain free in all but 3 patients. Three patients required an additional postoperative infiltration of the psoas and required no further treatment although they were not completely pain free. One patient developed an insertion

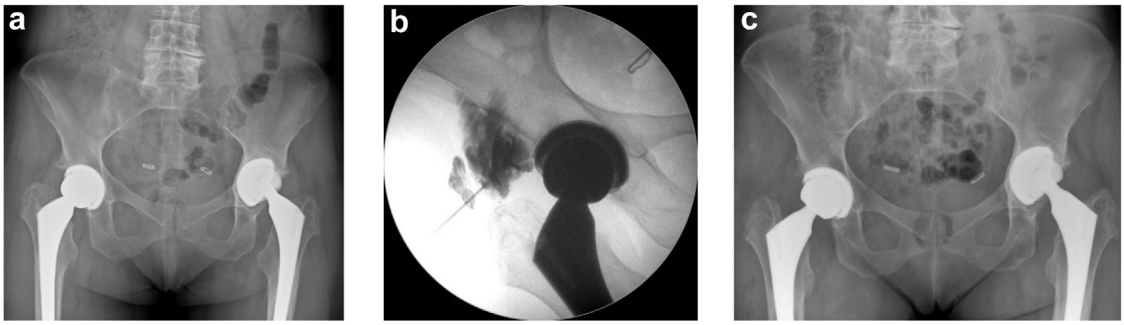

Figure 3. (a) This 54-y-old female patient complained of refractive groin and lateral-sided pain during sit-to-stand maneuvers for 3 y after her right THA. Mark the fixed external rotation of the femur. (b) The soft tissues around the AIIS were injected with 20-40 cc Marcaine and contrast. (c) The bone of the GT and at the AIIS was resected. The fixed external rotation disappeared.

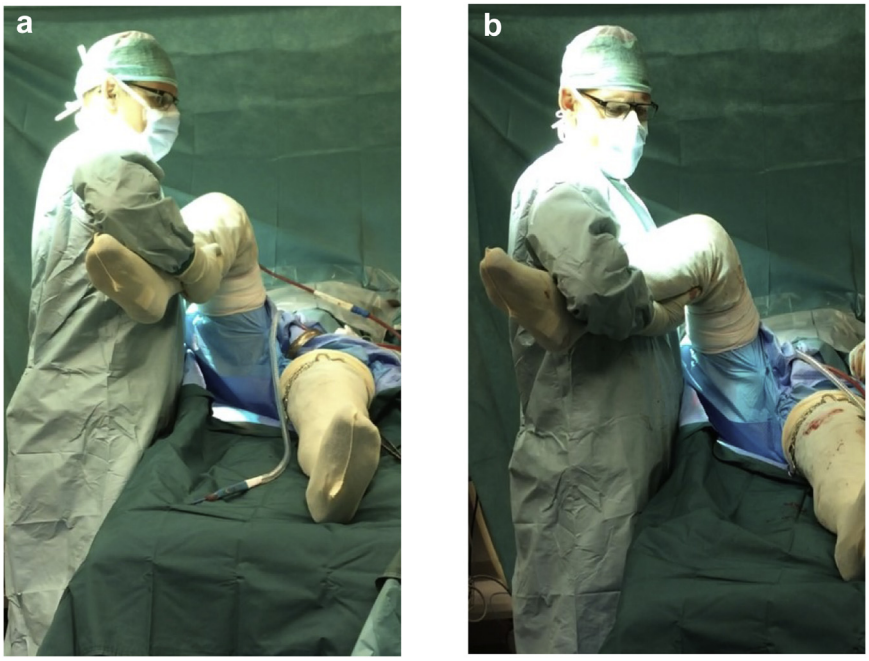

Figure 4. With the finger put at the anterior part of the GT, the hip was put through a full ROM. The ROM was limited (a). At the end of the procedure, the ROM was clearly increased and the finger was no longer abutting between the GT and the AIIS (b). ROM, range of motion.

tendinopathy of the direct head of the rectus femoris at the level of AIIS after partial resection of the AIIS. She was treated with debridement and reinsertion of the tendinous portion of the direct head.

Discussion

THA has a high satisfaction rate, but still, 10%-15% of patients complain of persistent pain around the hip region [3]. The prevalence of groin pain varies from 0.4% to 18% [3-6]. First, infection and component loosening have to be excluded along with extrinsic causes such as inguinal hernia, retroperitoneal pathology, and neurovascular pathology [11]. Iliopsoas tendinitis is one of the most common causes of postoperative refractive groin pain and can be caused by direct contact of the tendon with the prosthesis [12,13]. In patients with a hip-resurfacing prosthesis, groin pain is often attributed to adverse local tissue reactions and pseudotumors [4,14]. In case any of these diagnoses are excluded, one should consider EAI as a possible explanation of refractive pain around a THA.

We defined EAI between the GT and the soft tissue of the AIIS as a new cause of persistent groin pain after THA. To our knowledge, this has not been described earlier in literature. This is in contrast to nondegenerative hip pathology where several forms of EAI have been described such as ischiofemoral impingement, subspine impingement, iliopsoas impingement, and pectineofoveal impingement [10]. EAI after THA resembles the subspine

Table 2
All functional outcome scores and subscores improved significantly compared to preoperatively.

Outcome score	Median (IQR) preoperative	Mean preoperative	Median Interquartile range (IQR) postoperative	Mean postoperative	*P*-value
Harris hip score (HHS)					
Pain	10 (10)	15.3	40 (10)	34	<.0001*
Functionality	24 (8)	23.8	36 (10)	35.8	<.0001*
Total	46 (20)	46.9	82 (30)	77.8	<.0001*
HOOS					
Pain	3 (17)	10.5	45 (38)	43.9	<.0001*
Symptoms	15 (15)	12.7	45 (30)	41.1	<.0001*
Activities of daily living (ADL)	9 (26)	15.8	48 (45)	45.2	<.0001*
Sport	0 (6)	5.6	18 (44)	22.7	<.002*
Quality of life (QOL)	0 (6)	4.5	25 (31)	26.7	<.0001*
Total	6.4 (10.8)	9.8	39.4 (31)	35.2	<.0001*
Short Form (36) Health Survey (SF-36)					
Physical functioning	25 (23)	34.1	65 (54)	60.7	.001*
Physical role functioning	0 (13)	11.9	25 (78)	38.7	.025*
Emotional role functioning	33 (67)	34.9	67 (100)	58.7	.007*
Vitality	50 (25)	49	68 (25)	61.8	<.0001*
Mental health	60 (25)	58.5	72 (29)	68.6	<.0001*
Social functioning	50 (40)	57.6	88 (45)	75.1	<.0001*
Bodily pain	23 (17)	33.1	68 (34)	65.6	<.0001*
General health perceptions	50 (25)	48.1	65 (35)	64.1	<.0001*
Health change	50 (25)	39.3	75 (50)	72.6	<.0001*
Total	36.11 (24.83)	40.7	65.6 (29.50)	62.9	<.0001*

impingement described in the native hip. The latter is considered as a mechanical conflict between an enlarged or maloriented AIIS and the distal anterior femoral neck. In patients who had undergone THA, it is rather the anterior portion of the GT that impinges against the normal AIIS. We believe this is due to slightly changed mechanics such as a slightly decreased femoral offset, leg length shortening, medialization of the center of rotation, or a combination of these changed mechanical parameters.

The diagnosis of EAI after THA can be challenging and is merely based on clinical investigation. First, more common causes of groin pain such as infection or component loosening should be excluded. In case all technical investigations remain normal, a high index of suspicion should be present when the patient clearly states that the groin or lateral-sided pain was present immediately postoperatively. None of our patients had a pain-free postoperative interval. This is in contrast to patients with psoas tendinitis who often develop groin pain during the postoperative phase. Our patients did not have pain with straight leg raise. They typically had pain in midflexion during sit-to-stand maneuvers, which was associated with a decreased and painful internal rotation. A key factor in establishing the diagnosis is a positive chair rise test and pelvic inclination test (Table 1). The latter alleviates the impingement by neutralizing the lumbar lordosis when the contralateral knee is flexed to the level of the thorax. In case these tests are repeated and less painful when the soft tissues are anesthetized, a positive Marcainisation test indicates the soft tissues around the AIIS are involved in the pain syndrome. This is most likely due to bony impingement of the GT against the soft tissues of the AIIS. In addition, a Marcainisation test of the psoas could also be conducted in case of clinical doubt. In 2 cases, we conducted a psoas release along with treatment of the EAI.

The goal of the surgical treatment is to resolve the conflict with a minimum of surgical trauma. This can be easily performed through the interval of the TFL and the rectus femoris. At the start of the procedure, it is impossible to put a finger between the GT and the AIIS. First, the bone is resected off the anterior part of the GT. In case the impingement is not resolved, the joint capsule is opened and the head is exchanged to a longer size. Finally, an exchange of the socket liner toward an offset liner can also be required. We currently use bone wax after the bone resection to minimize the risk for heterotopic ossification. Our study demonstrated that surgery for EAI alleviated the symptoms in 80% of the cases with significant improvements of functional outcomes. However, 4 patients still had groin pain because of psoas tendinitis or rectus femoris insertion tendinopathy.

We acknowledge the relative, small sample size of our series. This study aimed to describe a new clinical entity that should be recognized as a rare but potential cause of postoperative, refractive periarticular pain. We were not able to set up an interobserver or intraobserver reliability study of the clinical examination, nor were we able to reproducibly measure the exact difference in internal rotation at different levels of hip flexion. However, the clinical difference was clearly apparent, with a painful internal rotation especially during the chair rise test in internal rotation. In addition, we were not able to set up an interobserver reliability study of the Marcainisation test. Another limitation is that we did not check for abnormal antetorsion of the stem in the femur. Although this could also have been an explanation for some cases of abutment, we do not believe it would have changed our treatment. Revision of an abnormally rotated stem would have been to another level of difficulty compared with the relative minor procedure that we propose. Finally, we realize that our population represents a heterogenous group of treatments. The ultimate goal was to resolve the abutment between the trochanter and the AIIS by increasing the clearance. We always used the same algorithm starting with bony resection. In case the clearance could not be approved to a fingerbreadth, we decided to exchange the articulating components to improve clearance. We do not believe that pain relief was caused by the exchanged head or liner because we never changed the head diameter and none of the liners was worn out.

Conclusion

EAI should be considered as a possible cause of refractive periarticular pain in the groin to lateral hip region after THA. Specific clinical and diagnostic tests can be used to confirm the diagnosis. Bony resection with or without a head or liner exchange gives good pain relief with improved functional outcomes but is associated with a risk for postoperative complications.

Conflict of interests

K. Corten receives royalties from DePuy Synthes J&J, is a member of the speaker's bureau and a paid employee and consultant for MedEnvision and DePuy Synthes J&J, holds stock ownership in MedEnvision, and receives research support from MedEnvision, DePuy Synthes J&J, and Zimmer Biomet; all other authors declare no potential conflicts of interest.

References

[1] Kurtz S, Mowat F, Ong K, Chan N, Lau E, Halpern M. Prevalence of primary and revision total hip and knee arthroplasty in the United States from 1990 through 2002. J Bone Joint Surg Am 2005;87(7):1487.
[2] Kurtz S, Ong K, Lau E, Mowat F, Halpern M. Projections of primary and revision hip and knee arthroplasty in the United States from 2005 to 2030. J Bone Joint Surg Am 2007;89(4):780.
[3] Hofstede SN, Gademan MG, Vliet Vlieland TP, Nelissen RG, Marang-van de Mheen PJ. Preoperative predictors for outcomes after total hip replacement in patients with osteoarthritis: a systematic review. BMC Musculoskelet Disord 2016;17(1):212.
[4] Bartelt RB, Yuan BJ, Trousdale RT, Sierra RJ. The prevalence of groin pain after metal-on-metal total hip arthroplasty and total hip resurfacing. Clin Orthop Relat Res 2010;468(9):2346.
[5] Girard J, Pansard E, Ouahes R, Migaud H, Delay C, Vasseur L. Correlation between groin pain and cup design of hip-resurfacing implants: a prospective study. Int Orthop 2014;38(5):923.
[6] Bin Nasser A, Beaule PE, O'Neill M, Kim PR, Fazekas A. Incidence of groin pain after metal-on-metal hip resurfacing. Clin Orthop Relat Res 2010;468(2):392.
[7] Bisschop R, Boomsma MF, Van Raay JJ, Tiebosch AT, Maas M, Gerritsma CL. High prevalence of pseudotumors in patients with a Birmingham hip resurfacing prosthesis: a prospective cohort study of one hundred and twenty-nine patients. J Bone Joint Surg Am 2013;95(17):1554.
[8] Forster-Horvath C, Egloff C, Valderrabano V, Nowakowski AM. The painful primary hip replacement - review of the literature. Swiss Med Wkly 2014;144:w13974.
[9] Restrepo C, Ross D, Restrepo S, et al. Adverse clinical outcomes in a primary modular neck/stem system. J Arthroplasty 2014;29(9 Suppl):173.
[10] Nakano N, Yip G, Khanduja V. Current concepts in the diagnosis and management of extra-articular hip impingement syndromes. Int Orthop 2017;41:1321.
[11] Henderson RA, Lachiewicz PF. Groin pain after replacement of the hip: aetiology, evaluation and treatment. J Bone Joint Surg Br 2012;94(2):145.
[12] O'Sullivan M, Tai CC, Richards S, Skyrme AD, Walter WL, Walter WK. Iliopsoas tendonitis a complication after total hip arthroplasty. J Arthroplasty 2007;22(2):166.
[13] Ala Eddine T, Remy F, Chantelot C, Giraud F, Migaud H, Duquennoy A. [Anterior iliopsoas impingement after total hip arthroplasty: diagnosis and conservative treatment in 9 cases]. Rev Chir Orthop Reparatrice Appar Mot 2001;87(8):815.
[14] Lavigne M, Laffosse JM, Ganapathi M, Girard J, Vendittoli P. Residual groin pain at a minimum of two years after metal-on-metal THA with a twenty-eight-millimeter femoral head, THA with a large-diameter femoral head, and hip resurfacing. J Bone Joint Surg Am 2011;93(Suppl 2):93.