Sciatic Nerve Injury in Total Hip Resurfacing

A Biomechanical Analysis

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Abstract: The condition of the gluteal sling was a significant factor in determining the pressure experienced by the sciatic nerve during acetabular exposure in total hip resurfacing via a posterior approach. The position of the knee did not play a significant role at this stage of the procedure. Average pressures were not elevated above a predefined injury level during positioning for femoral preparation. During hip reduction, knee positioning seemed to play a significant role in pressures placed on the sciatic nerve. These findings suggest that releasing the gluteal sling during a posterior approach for total hip resurfacing may help to prevent postoperative sciatic nerve palsies. Consideration should also be given to at least partially flexing the knee during hip reduction in this procedure. **Keywords:** biomechanical, hip, total hip resurfacing, sciatic nerve.

Nerve palsies are a relatively uncommon but catastrophic complication of total hip arthroplasty [1-3]. Only approximately 40% [2] of patients have complete recovery of nerve palsies that result from total hip arthroplasty. Despite research and intraoperative neuromonitoring, approximately 50% of these nerve palsies are due to unknown causes [1,3]. Therefore, any intraoperative factors felt to contribute to potential nerve palsies remain important.

The first new-generation metal-on-metal total hip resurfacing was recently approved for use in the United States after use outside the United States for more than 10 years [4,5]. Early US results suggest concern with complications, including nerve palsy, as compared with traditional hip arthroplasty. One US study of total hip resurfacing found a 1.7% incidence of postoperative nerve palsies at 1-year follow-up [6] as compared with an incidence of 1% in traditional total hip arthroplasty [2]. An Australian study found a 2.1% incidence of postoperative nerve palsies with modern total hip resurfacing [7]. This higher incidence of nerve palsies may become increasingly important as total hip resurfacing gains in popularity. The problem may be further exacerbated by use of this procedure in a younger, more active population in whom nerve palsies will likely result in even greater loss of function. Younger patients' heightened sense of dissatisfaction will result from their desired and expected increased activity level when compared with older patients.

It is important to discover what aspects of the hip resurfacing technique might be associated with risk of nerve injury. Some investigators have suggested that the gluteal sling plays a role in sciatic nerve palsies in total hip arthroplasty. The gluteus maximus has a broad insertion. The upper fibers insert into and blend with the iliotibial band. The lower fibers, referred to as the gluteal sling, insert into the gluteal tuberosity of the femur and the lateral intermuscular septum. This occurs just distal the insertion of the quadratus femoris. At this level, the sciatic nerve lies medial and deep to the gluteal sling and lateral to the ischial tuberosity. Hip flexion and internal rotation, which occur during hip arthroplasty procedures, result in tightening of the gluteal sling and potential entrapment of the nerve against the ischial tuberosity. Hurd et al [8] have stated that an intact gluteal sling can lead to sciatic nerve compression during positioning for femoral preparation during hip arthroplasty. The position of the knee may also play a role as a result of its effects on tensioning of the sciatic nerve. Although the exact pressure required to injure a peripheral nerve in humans is not known, investigators have found endoneural edema indicating nerve injury with compressive pressures as low as 400 mm Hg in as

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Submitted April 16, 2009; accepted August 26, 2009.
Departmental research funds were received in support of this study.
Financial disclosure: The authors state no potential conflict of interest with regard to the subject of this study.
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0883-5403/2508-0019$36.00/0
doi:10.1016/j.arth.2009.08.017

little as 15 minutes using a rabbit tibial nerve model [9]. Although some portions of the total hip resurfacing procedure are transient, such as hip reduction, other portions of the procedure, such as acetabular exposure and preparation and femoral preparation, can take longer than 15 minutes. Using a pressure of 400 mm Hg or greater as an indicator of nerve injury could provide preliminary understanding of potential causes of sciatic nerve injury in humans.

We hypothesized that an intact gluteal sling and an extended knee position would result in higher pressures on the sciatic nerve during acetabular exposure, positioning for femoral preparation, and hip reduction in total hip resurfacing in a cadaver model. Our purpose was to compare pressure in the sciatic nerve at these technique stages with the gluteal sling in intact and released condition and with the knee in both full extension and 90 degrees of flexion, with the posterior approach used in total hip resurfacing.

Materials and Methods

Ten hips from 5 fresh cadaveric lower torso specimens harvested through the thoracolumbar spine were used. There were 4 male and 1 female specimens aged 71.6 years (range, 63-85 years). Each specimen was checked for previous surgical scars around the hip to ensure that no prior hip procedures had been performed. Each specimen was positioned on a peg board in a standard lateral position, and stability of the setup was confirmed by placing the operative leg through a range of motion.

A standard posterior hip incision was made in a curvilinear fashion over the posterior tip of the greater trochanter. Dissection was carried down through the tensor fascia lata and gluteus maximus in a standard fashion. The greater trochanteric bursa was then resected, and the sciatic nerve was identified.

The sciatic nerve was then carefully exposed both proximally and distally (Fig. 1) while leaving the short external rotators intact. The dissection was carried distally to just below the level of the gluteal sling insertion. Next, a 3- to 4-cm incision was made proximal and perpendicular to the previous incision. This incision was used to pass a calibrated 6-panel 6900 I-Scan sensor (Tekscan, Inc, South Boston, Mass). The final sensor was constructed by using 6 sensor panels, each measuring 1 × 1 cm, from two 4-panel 6900 I-Scan sensors. Each 6900 I-Scan sensor has 4 fingers with a 1 × 1-cm sensor panel on the end. These 4-sensor panels and 2-sensor panels from a second 6900 I-Scan Sensor were glued together to construct a 6-panel sensor. The 6-panel sensor covered the nerve from the ischial tuberosity to below the gluteal sling insertion. This includes the area of sciatic nerve compression injury described by Hurd et al [8] from magnetic resonance imaging evaluations. The sciatic nerve was instrumented (Fig. 2) with the I-Scan sensor. The sensor was attached to the sciatic nerve with a thin layer of glue, and secure fixation was confirmed. The interval between the abductors and external rotators was identified. The external rotators were released, and a capsulotomy was performed while

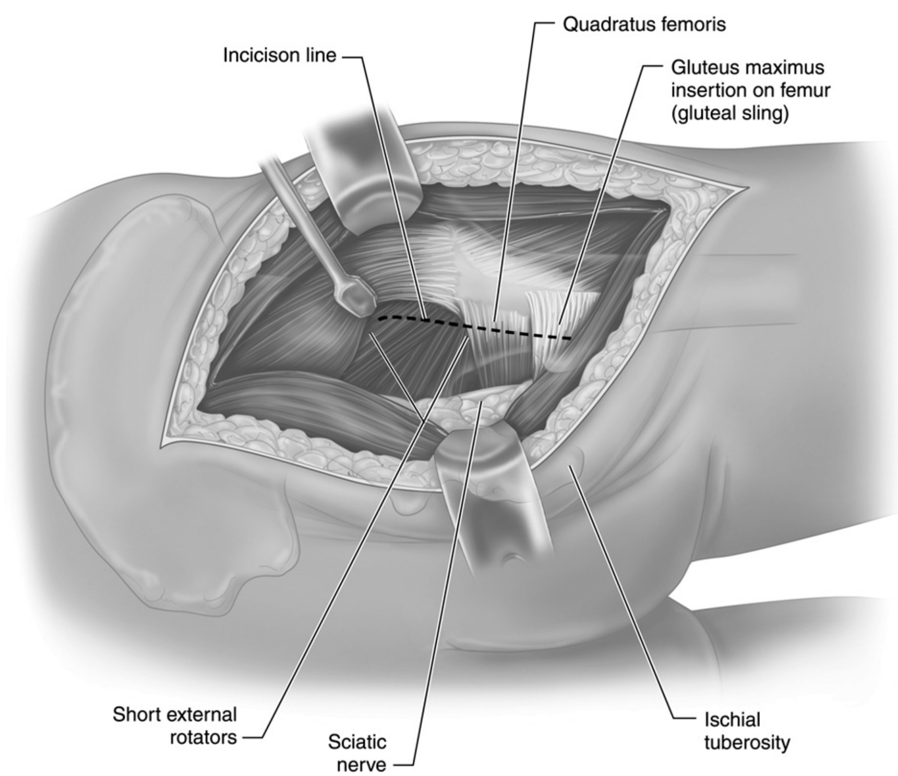

Fig. 1. Illustration shows anatomic detail including the gluteal sling and ischial tuberosity.