Prospective study of nerve injuries associated with hip arthroscopy in the lateral position using the modified portals

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ABSTRACT

To access the central compartment of the hip, distraction is essential in hip arthroscopy (HA); nerve injuries have long been accepted as a complication of this surgical procedure, with an incidence ranging from 0 to 46%. Only one previous article collected data prospectively, and the authors utilized a supine technique, with a modified mid-anterior portal. Our study also used prospectively collected data, from a group of 200 consecutive patients who had HA performed in the lateral position using the paratrochanteric portals. Our results were that four patients (2%) reported symptoms of neurological deficits after surgery, three patients with traction times ranging from 20 to 41 min, their neurological deficits resolved completely over a time from 6 to 9 weeks. The fourth patient who had the longest traction time of 73 min, and also greater than usual traction, his neurological deficit resolved at 12 weeks. Our hypothesis of 200 hip arthroscopies, performed in the lateral position by the modified paratrochanteric portals, the incidence of nerve injuries would be lower than 46%. We found an incidence of 2%, all affecting the perineum and genitals and all occurring in men, no differences between the age, surgery side or type of surgery performed on the patient were found to have statistical differences. Traction times with <31.5 min were related with fewer incidences of neurological symptoms. On the basis of this study, all patients with traction times below 73 min can be confidently reassured that any deficit will recover within 3 months.

INTRODUCTION

To access the central compartment of the hip joint, distraction is essential in hip arthroscopy (HA) [1]. This may be achieved with traction either with a hip fracture table, a specialized hip distractor or with an external fixator [2]. Generally when distraction is produced, a lateralized counter traction post is placed against the proximal thigh. Several authors have described surgical techniques to avoid the use of posts by the use of a beanbag or by tilting the patient head down and using gravity for counter traction, others don’t use the post at all [3].

The use of traction and a counter traction post inevitably introduces a potential risk of nerve inflammation and injury, either from distraction or nerve compression against the pudendal nerve, although several strategies have been recommended to mitigate this risk, particularly relating to padding and the size of the perineal post and lateralizing the post against the medial thigh.

Nerve dysfunction injuries (NDI) have long been accepted as a complication of HA [4] with a stated incidence ranging from 0 to 46%. However, only one of these articles appeared to collect data prospectively [5], and they have utilized a supine HA position and a technique with a modified mid-anterior portal.

We prospectively study the prevalence of neurologic injuries associated with HA in the lateral position using the
paratrochanteric portals and collected data from a group of 200 patients. Patients were directly, and specifically questioned regarding any neurological deficits, at the groin, pudendal area, genitals, anterior and lateral thigh and foot and ankle, at frequent, early time intervals. An exhaustive search in the literature was performed regarding direct questioning to the patient associated to nerve dysfunction and related injuries.

Our hypothesis was that the incidence of nerve injuries prospectively investigated would be lower than 46% in a typical group of 200 hip arthroscopies all performed in the lateral decubitus position using the paratrochanteric portals. This incidence could increase by increasing the traction time and consequently by compression to the pudendal area by the perineal post.

**MATERIAL AND METHODS**

Two hundred consecutive patients who had HA, which included traction of varying times, performed by the senior author (JOD) at three different institutions. All patients having arthroscopic hip surgery were included in the study, and this included central (91 patients), peripheral (97 patients) and extra-articular (12 patients) arthroscopies (Table I).

The only exclusion criterion was a pre-existing neurological deficit; no patient was excluded during this period of recruitment.

All patients were asked to fill in a preoperative questionnaire regarding any history of neurological abnormality in the groin, thigh, leg and foot or, for males, any history of erectile dysfunction. We deliberately used the same questions as Holmich (Table II) to make the results comparable. The questions applied in the questionnaire format were asked within the first day after surgery, and at post-operative follow-up: 1 week later, at 6 weeks, 3 months and 1 year later (if NDI didn’t resolved at 1 year). The questions were asked directly by the second surgeon (APS) independently, at the end of the consultation. Follow-up was achieved during his year of fellowship training. If the patient had had any such symptoms, which had resolved, they would be asked to record when they had resolved. Lack of, or resolution of symptoms constituted the end point of the study for each patient. The institutional review board of our hospital approved this research study. All participants provided an informed consent.

For the data base analysis, we arrange data in the software IBM Corp. Released 2013. IBM SPSS Statistics for Windows, Version 22.0. Armonk, NY: IBM Corp. Non-parametric tests were performed for the variety of the categories in the sample.

| Age | Side | Diagnosis                | Traction Time |
|-----|------|--------------------------|---------------|
| 43  | L    | MIXT FAI                 | 28            |
| 43  | R    | MIXT FAI                 | 44            |
| 38  | L    | CAPSULOLABRAL ADHESIONS  | 24            |
| 17  | R    | CAM FAI/LTT              | 32            |
| 41  | L    | LTT                      | 14            |
| 21  | R    | LTT                      | 11            |
| 34  | R    | MIXT FAI                 | 49            |
| 34  | L    | MIXT FAI                 | 59            |
| 26  | R    | LTT                      | 20            |
| 27  | L    | LTT                      | 25            |
| 46  | L    | CAPSULOLABRAL ADHESIONS  | 35            |
| 32  | L    | CAPSULOLABRAL ADHESIONS  | 24            |
| 49  | R    | LTT                      | 14            |
| 49  | R    | LTT/PINCER FAI           | 24            |
| 50  | L    | SINOVITIS/OA             | 20            |
| 44  | R    | MIXT FAI/LTT             | 40            |
| 44  | L    | MIXT FAI                 | 32            |
| 18  | R    | CAM FAI/LTT              | 25            |
| 18  | L    | CAM FAI/LTT              | 26            |
| 19  | R    | MIXT FAI                 | 31            |
| 64  | L    | SINOVITIS/OA             | 15            |
| 55  | L    | LTT                      | 18            |
| 70  | L    | PSOAS RELEASE            | 0             |
| 38  | L    | LTT                      | 22            |
| 37  | R    | MIXT FAI                 | 41            |
| 36  | L    | MIXT FAI/LTT             | 65            |
| 47  | R    | PINCER FAI               | 42            |
| 23  | R    | LTT                      | 16            |
| 48  | R    | LTT                      | 18            |
| 48  | L    | LTT                      | 15            |

(continued)
Table I. (continued)

| Age | Side | Diagnosis              | Traction Time |
|-----|------|------------------------|---------------|
| 15  | R    | LTT                    | 17            |
| 38  | L    | LTT/PINCER FAI         | 35            |
| 25  | L    | MIXT FAI               | 45            |
| 25  | R    | CAM FAI/LTT            | 18            |
| 39  | R    | LTT                    | 13            |
| 26  | L    | CAM FAI/LTT            | 30            |
| 58  | L    | LTT                    | 16            |
| 21  | R    | MIXT FAI               | 48            |
| 36  | R    | MIXT FAI               | 40            |
| 36  | L    | MIXT FAI               | 55            |
| 26  | R    | PINCER FAI             | 50            |
| 37  | R    | CAM FAI/LTT            | 25            |
| 37  | L    | OA                     | 20            |
| 53  | R    | MIXT FAI               | 55            |
| 62  | R    | LTT/PINCER FAI         | 30            |
| 15  | R    | CAM FAI/LTT            | 30            |
| 40  | L    | MIXT FAI               | 24            |
| 21  | L    | MIXT FAI               | 60            |
| 52  | R    | PSOAS RELEASE          | 0             |
| 40  | L    | LTT                    | 20            |
| 33  | L    | CHONDROMATOSIS         | 73            |
| 23  | R    | MIXT FAI               | 51            |
| 23  | L    | MIXT FAI/LTT           | 22            |
| 19  | L    | MIXT FAI               | 35            |
| 47  | L    | LTT                    | 25            |
| 47  | L    | CAM FAI                | 28            |
| 42  | L    | LTT                    | 34            |
| 37  | R    | LTT                    | 27            |
| 34  | R    | MIXT FAI/LTT           | 48            |
| 34  | L    | MIXT FAI               | 39            |

(continued)

Table I. (continued)

| Age | Side | Diagnosis              | Traction Time |
|-----|------|------------------------|---------------|
| 46  | R    | LTT                    | 28            |
| 48  | R    | CAM FAI/LTT            | 19            |
| 16  | R    | LTT                    | 17            |
| 38  | R    | LTT                    | 21            |
| 62  | R    | ITB LENGTHENING        | 0             |
| 52  | R    | CAM FAI                | 30            |
| 46  | L    | LTT                    | 10            |
| 57  | R    | LTT                    | 10            |
| 46  | R    | CAM FAI                | 21            |
| 66  | L    | PSOAS RELEASE          | 0             |
| 43  | R    | CAM FAI                | 25            |
| 41  | R    | CAM FAI/LTT            | 30            |
| 34  | R    | LABRAL RECONSTRUCTION  | 70            |
| 36  | L    | CAM FAI                | 37            |
| 39  | R    | CAM FAI/LTT            | 18            |
| 65  | R    | LTT                    | 32            |
| 15  | R    | LTT                    | 15            |
| 17  | L    | MIXT FAI               | 41            |
| 32  | R    | CAM FAI                | 40            |
| 30  | R    | CAM FAI/LTT            | 34            |
| 42  | L    | PINCER FAI             | 32            |
| 24  | L    | LTT                    | 13            |
| 44  | L    | CAM FAI/LT             | 22            |
| 38  | L    | CAM FAI                | 34            |
| 42  | L    | LTT                    | 12            |
| 47  | R    | LTT                    | 18            |
| 16  | R    | ITB LENGTHENING        | 0             |
| 31  | R    | PINCER FAI             | 25            |
| 31  | L    | LTT                    | 35            |
| 31  | L    | LTT                    | 17            |

(continued)
| Age | Side | Diagnosis             | Traction | Time |
|-----|------|-----------------------|----------|------|
| 22  | R    | CAM FAI/LTT           |          | 20   |
| 22  | L    | CAM FAI/LTT           |          | 20   |
| 28  | R    | LTT                   |          | 17   |
| 47  | L    | LT/OA                 |          | 18   |
| 18  | R    | LTT                   |          | 12   |
| 34  | R    | CAM FAI/LT            |          | 36   |
| 33  | R    | LTT                   |          | 20   |
| 48  | L    | PINCER FAI            |          | 44   |
| 47  | R    | LTT                   |          | 36   |
| 26  | L    | CAM FAI               |          | 24   |
| 25  | R    | CAM FAI               |          | 32   |
| 31  | R    | CAM FAI               |          | 38   |
| 45  | R    | CAM FAI               |          | 20   |
| 30  | R    | CAM FAI               |          | 55   |
| 38  | R    | CAM FAI               |          | 26   |
| 46  | R    | OA                    |          | 12   |
| 19  | L    | CAM FAI               |          | 35   |
| 72  | R    | PSOAS RELEASE         |          | 0    |
| 25  | R    | CAM FAI               |          | 32   |
| 25  | L    | MIXT FAI              |          | 52   |
| 56  | R    | LTT/OA                |          | 24   |
| 43  | L    | MIXT FAI              |          | 27   |
| 20  | L    | CAM FAI/LTT           |          | 22   |
| 14  | R    | LTT                   |          | 23   |
| 26  | R    | MIXT FAI/LT/OA        |          | 54   |
| 27  | R    | MIXT FAI              |          | 27   |
| 32  | R    | OA                    |          | 32   |
| 32  | L    | DYSPLASIA/TORN LABRUM |          | 32   |
| 42  | R    | REMOVAL OF HO         |          | 37   |
| 53  | R    | PSOAS RELEASE         |          | 0    |

(continued)
| Age | Side | Diagnosis                          | Traction |
|-----|------|------------------------------------|----------|
| 43  | R    | PINCER FAI                         | 35       |
| 55  | L    | LTT/OA                             | 20       |
| 44  | L    | LTT/OA                             | 20       |
| 26  | L    | OSTEONECROSIS FEMORAL HEAD         | 36       |
| 57  | L    | LTT/OA                             | 25       |
| 14  | R    | LTT                                | 13       |
| 50  | R    | LTT                                | 11       |
| 49  | L    | LTT/OA                             | 25       |
| 45  | R    | LTT                                | 18       |
| 22  | R    | LT REABSORPTION                    | 47       |
| 25  | R    | LTT                                | 20       |
| 25  | L    | LTT                                | 10       |
| 35  | L    | OA                                 | 21       |
| 41  | L    | MIXT FAI/OA                        | 59       |
| 26  | L    | CAM FAI                            | 20       |
| 27  | R    | CAM FAI                            | 20       |
| 28  | L    | MIXT FAI                           | 30       |
| 54  | R    | LTT/OA                             | 15       |
| 64  | R    | LTT/OA                             | 15       |
| 32  | R    | MIXT FAI                           | 45       |
| 23  | R    | LTT/RF                             | 20       |
| 27  | R    | MIXT FAI                           | 60       |
| 27  | L    | MIXT FAI                           | 45       |
| 17  | R    | LTT                                | 33       |
| 63  | L    | LTT/OA                             | 18       |
| 32  | L    | MIXT FAI                           | 55       |
| 42  | R    | CAM FAI                            | 24       |
| 42  | L    | CAM FAI                            | 30       |
| 43  | L    | LTT                                | 36       |
| 41  | R    | LTT                                | 18       |

FAI, femoroacetabular impingement; LT, ligamentum teres; ITB, iliotibial band; OA, osteoarthritis; R, right; L, left.

### Table II. HA and nerve dysfunction questionnaire

Do you have reduced sensibility (numbness, tingling, prickling) in the hip/groin, thigh or leg region?

**YES/NO**

If YES, where and for how long?

**YES/NO**

Have you experienced erectile dysfunction?

**YES/NO**

Questionnaire was applied preoperatively and post-operatively at: 1 day, 7–10 days, 6 weeks, 3 months and 1 year [5].
SURGICAL TECHNIQUE

All patients had HA performed in the lateral position, supported on a specialized hip distractor (Fig. 1). All patients were given a single dose of intravenous cephalothin, 2 g, and enoxaparin 20 mg prior to induction of general anesthesia. No muscle relaxants were used.

Padding was applied to the foot and a traction boot then attached with an additional gel pad placed along the shin and dorsum of the foot and ankle (Figs. 2 and 3). The padded counter traction post was applied against the proximal femur (Fig. 4), deliberately raising this post 2–4 cm above the non-operated leg, to minimize any traction force being applied directly to the perineum.

Traction was applied sufficient to distract the head of the femur ~10 mm from the acetabulum as measured on the image intensifier. This took no direct account of the thickness of the articular cartilage, which was, most often, not directly visible. However, previous measurements had been performed with this operative setup to allow for magnification of the image, and more accurately assess the joint distraction, as well as normal operative records, specific records were kept of operative diagnosis and traction time in all patients.

At both the commencement and completion of the arthroscopic procedure the hip joint and portals were injected with local anesthetic: 20 ml. In total, 0.5% Bupivacaine plus 1 200 000 adrenaline at the beginning of the procedure, and 20 ml ropivacaine, along with ketorolac 30 mg, at the end.

PLACEMENT OF PORTALS

Two portals were used routinely after application of traction: a mid-trochanteric viewing portal was created by incising the skin only, immediately proximal to the midpoint of

Fig. 1. HA in the lateral position with a specialized hip distractor.

Fig. 2. Padding applied to the foot, an additional gel pad placed along the shin and dorsum of the foot and ankle.

Fig. 3. Ski-type boot. Ready to be positioned on the hip distractor clamp.

Fig. 4. The padded and laterally raised countertraction post applied against the proximal femur.
the greater trochanter. A 16G spinal needle was passed into the joint and its position then checked with image intensifier (Figs. 5 and 6). A guide wire was inserted through the needle, and an arthroscopic sheath with a cannulated obturator was inserted along the guide wire into the joint. A second, anterior paratrochanteric instrument portal was created similarly, 3 cm anterior to the anterior border of the femur, in line with the superior border of the greater trochanter. A 16G spinal needle was then inserted through this portal and positioned within the joint under direct vision. When labral repair was performed, a third more distal portal was created, nearer the anterior border of the femur, for percutaneous anchor insertion [6, 7] (Fig. 7).

RESULTS

Two hundred patients who underwent HA were included in the study, 99 males and 101 females, their ages ranged from 15 to 72 years (average 36.9 years) and traction time ranged from 10 to 73 min (average 27.9 min). Patients who presented nerve injuries are summarized and presented in Tables III and IV. Four patients (2%) reported symptoms of neurological deficits after surgery, two patients reported numbness at the tip of the penis and the other two patients reported numbness of the perineum. Interestingly, only two of the four patients volunteered this information spontaneously, and two only in response to direct questioning.

Comparisons were made between the characteristics among the patients that develop neurological symptoms and those who don’t after the surgery. For the patients that developed neurological injury suggested by symptomatology, the median age was 36.02 (SD 13.18, \( P = 0.776 \)), no relations were found to a body side (\( P = 0.9999 \)) or the number of procedures performed on the patients (\( P = 0.964 \)), a Multivariate test was used to explore differences among the variety of surgery techniques (\( P = 0.445 \)) and the incidence of injury had no statistical differences between them. The traction times on the patients with injury had a mean duration of 41.25 (SD 22.84) min, almost 10 min more than the patients who won’t develop any...
symptoms after the surgery ($P = 0.198$) (Graph 1). Given the limitations of the sample size at prediction for development of nerve injury, we looked in the data set predictors for no nerve symptoms after the procedure, a ROC curve was performed for age group ($A = 0.433$), number of procedures ($A = 0.410$) and traction time ($A = 0.706$), later a Youden Index was determined for Traction time and a prediction with a 75% of sensibility and 64.6% of specificity for not developing any neurologic symptom below 31.5 min of traction time was estimated (Graph 2).

In the patients, with traction times ranging from 20 to 41 min, the neurological deficits resolved completely over a time ranging from 6 to 9 weeks. Two of these three patients with combined femoroacetabular impingement (FAI) had with rim trimming, labral refixation and femoral osteochondroplasty (FOC), and one patient had FOC alone. The fourth patient numbness resolved over 12 weeks. This patient had the longest traction time, 73 min, and also greater than usual traction. He had hip chondromatosis but there was a suspicion of a low-grade chondrosarcoma in the acetabular fossa. Particular care was therefore used to be as certain as possible that all abnormal cartilage tissue had been removed from the fossa, and additional traction was added to gain improved access to the most inferior part of the fossa.

There was no case of partial, or complete, lateral femoral cutaneous nerve palsy. No patient suffered any ulceration or bruising of the genitals or perineum, and there was no case of erectile dysfunction (Table III). The traction time for those patients with neurological deficits was a minimum of 20 min and a maximum of 72 min. No patient with traction time <20 min developed a neurological deficit.

### DISCUSSION

The incidence found in our study of nerve injuries was 2%, all affecting the perineum and genitals and all occurring in men. Also, no statistical differences between patient age, surgery performed and body side. The position used for HA was the lateral position with placement of the paratrochanteric portals. Until the article of Holmich et al., there had been no prospectively collected data to accurately

| Patient | Sex | Anatomic site of numbness | Duration numbness (weeks) | Diagnosis       | Traction time (min) |
|---------|-----|----------------------------|---------------------------|-----------------|---------------------|
| 1       | M   | Tip penis                  | 7                         | Cam FAI         | 20                  |
| 2       | M   | Tip penis                  | 12                        | Chondromatosis  | 73                  |
| 3       | M   | Perineum                   | 6                         | Combined FAI    | 31                  |
| 4       | M   | Perineum                   | 9                         | Combined FAI    | 41                  |

FAI, femoroacetabular impingement.

| Measure                  | Present Mean | Absent Mean | P   |
|--------------------------|--------------|-------------|-----|
| Age                      | 33.5 (DE 10.88) | 36.02 (DE 13.18) | 0.776 |
| Traction time            | 41.25 (SD 22.84) | 27.23 (SD 14.47) | 0.198* |
| Side                     |               |             |     |
| Left                     | 1, 25%        | 79, 40.51%  | 0.9999 |
| Right                    | 3, 75%        | 116, 59.49% |     |
| Number of procedures     |               |             |     |
| One                      | 4, 100%       | 160, 82.05% | 0.954 |
| Two                      | 0, 0%         | 35, 17.95%  |     |

No differences were found between the observed samples.

*There is more than 10 min between the median values for the traction time among the groups, the lack of statistical significance in this variable may be explained by a wide standard deviation in the sample and more data from both groups of patients will make this estimations more precise.
estimate the true incidence of nerve injury after hip arthroscopic surgery. However, this article referred to only one method of performing HA, the supine position with a modified anterior portal, and all of the cases were relatively long. This may have been the reason why they did not find a relationship between longer traction time and increased risk of neurologic injury, as there were no short traction times.

It was not clear whether these results would be generalizable to all HA methods, or not, other authors have report nerve disturbance at the distal anterolateral thigh by portal placement close to the lateral cutaneous femoral nerve and its superficial branches.

In both Holmich’s study and ours, particular care was taken with patient padding and positioning. Holmich reported rates of neurological deficit in the perineum of 14%, foot of 14% and the lateral thigh of 22%, which included 10% with multiple areas of numbness.

Our incidence of perineal numbness, which was 2%, cannot be directly compared with theirs, as the range of operative indications and traction times was quite different. However, we had no patient with erectile dysfunction, and no patient with either foot or lateral thigh numbness. It may be that a combination of a molded plastic foot shell applied over padding and a gel pad, combined with the need for only unilateral traction provided better protection against nerve deficit in the foot, and perhaps the perineum and genitals, than the use of a standard hip fracture table using foam foot padding and bilateral traction.

It is of interest that in Holmich’s cohort, there were similar numbers of men and women who sustained nerve injuries, whereas in our study there were only men who reported neurological deficits. The reasons for this disparity are not clear. We have noted occasional nerve injuries in women previously but none since the study commenced.

The lateral femoral cutaneous nerve (LFCN) and its branches are to be the most at risk neurovascular structures in HA when portals are placed more medial like the modified anterior portal, as concluded in their articles by [8].

We did not utilize a modified anterior portal, but rather, an anterior paratrochanteric portal. This lies more posterolateral on the thigh closer to the trochanteric border and was not associated with any injury to the LFCN. We find it a very satisfactory working portal for instrumentation and would recommend it in preference to the modified anterior portal.

Of all the articles in HA published in the literature with nerve disturbances or injuries, only two were performed in the lateral position: the first by Griffin and Villar which identified three sciatic nerve palsy of 640 hip scopes. The second by Dr James Glick who found eight cases of neuropraxia in 60 hip scopes [9, 10].

We had intended to try to correlate traction force, as well as time with risk of neurological deficit, but the numbers of patients with deficits, where the force was recorded, was too low for this to be meaningful in this study. We are continuing to monitor traction force, but in view of the low incidence of nerve injury we have identified, it will take some considerable time to gather enough data to determine whether traction force correlates with risk of nerve
injury and whether there is a level of force above which, risk escalates.

The safe traction time limit, below which there was no case of nerve injury, was only 20 min. Anecdotally, it has been claimed that traction time should not exceed 2 h. However, none of these patients had a traction time >73 min, and there was still a 2% incidence of nerve injury. To attempt to eliminate neurological injuries associated with HA, we could recommend a maximum traction time of 20 min, however, in view of the low incidence of neurological injury, and the universal recovery within 3 months, this restriction does not seem warranted. We do believe that it is extremely important to warn all patients having HA of the risk of nerve injury and to emphasize it more to those having procedures where the traction time is likely to exceed 20 min.

The main limitation to this study was the lack of sufficient data regarding traction force. We believe that it is likely that both duration and magnitude of traction play a role in the development of nerve injuries but have not been able to demonstrate that relationship.

The major advance of this study is that it accurately reflects the patient’s perception of neurological deficits that occur after HA, as patients were directly questioned within the first day of surgery, and again at 2 weeks, 6 weeks and until any deficit resolved, which was the end point for their post-operative follow-up.

CONCLUSION

We found an incidence of 2%, all affecting the perineum and genitals and all occurring in men.

No differences between the age, surgery side or type of surgery performed on the patient were found to have statistical differences.

Traction times with <31.5 min were related with fewer incidences of neurological symptoms.

On the basis of this study, all patients with traction times below 73 min can be confidently reassured that any deficit will recover within 3 months.

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CONFLICT OF INTEREST STATEMENT

None declared.

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