Pudendal Nerve Palsy Following Static Intramedullary Nailing of the Femur

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Citation

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Abstract

Objective: To determine the incidence of pudendal nerve palsies following static interlocking nailing of the femur, and to relate its development to age, body mass index, amount of pre-operative shortening, timing of surgery, level and type of fracture, duration of intra-operative traction, and use of muscle relaxants during surgery.

Method: Twenty-nine consecutive patients who were treated with intramedullary nailing for femoral shaft fractures were prospectively studied. The age, body mass index, level and type of fracture, pre-operative traction, timing of surgery, pre-operative shortening, duration of intra-operative traction, and use of muscle relaxants were recorded. Post-operatively, each patient was examined for altered sensation in the perineum. Men were asked about erectile function.

Results: Eight patients (27.6%) developed palsies. All patients regained normal sensation and function. No significant differences were found between pudendal nerve injury and age, body mass index, pre-operative shortening, timing of surgery, level of fracture, muscle relaxant use, and duration of intra-operative traction. Significantly more palsies were present in patients with comminuted fractures.
Conclusion: Intramedullary nailing of the femur is associated with pudendal nerve palsy. There is a significant correlation between pudendal nerve palsy and comminuted fractures.

INTRODUCTION

Pudendal neuropathy is an important complication associated with the application of longitudinal traction to the lower extremities during fracture surgery, especially following static interlocking nailing of the femur. The mechanism of neurologic injury is thought to be a combination of localized ischaemia and direct compression of the perineum against the countertraction post of the fracture table. The exact incidence of pudendal nerve palsy remains unclear due to under-reporting by patient and physician. There are several case reports ([1,2,3,4,5,6]), a few retrospective studies ([7,8,9,10,11]), but only one prospective study ([12]) reported in the literature of pudendal nerve palsy following static interlocking nailing of the femur.

The terminal branches of the pudendal nerve which include the inferior rectal nerve, the perineal nerve and dorsal penile or clitoral nerve are most at risk for injury in the pudendal canal, where they are in proximity to the pubic arch.

This prospective study was undertaken to determine the incidence of pudendal nerve palsy following static interlocking nailing of the femur as well as to relate its development to age, body mass index, the amount of pre-operative shortening, the timing of the surgery, the level and type of fracture, the duration of intra-operative traction, and the use of muscle relaxants during surgery.

PATIENT AND METHODS

Between January 2007 and July 2008, 31 consecutive patients who were treated with closed intramedullary nailing for femoral shaft fractures were prospectively studied. Informed consent was obtained from all of the patients, and the risk of pudendal nerve palsy as a complication of this procedure was explained. They were also informed that they would be examined post-operatively for this complication. No alteration of the operative procedure or post-operative care was involved.

Patients who had concomitant disruption of the pelvic ring, pre-operative erectile dysfunction, pre-operative altered sensation in the perineum, and those who were unable to co-

operate with a subjective examination of the genitalia were excluded from the study. Two patients had concomitant disruption of the pelvic ring and were therefore excluded from the study. The study population thus consisted of 29 patients. The following information was recorded for each patient: age, gender, body mass index, mechanism of injury, femur involved, level and type of fracture, pre-operative traction, timing of surgery, pre-operative shortening, the duration of intra-operative traction, the use of a muscle relaxant and whether the fracture was opened to facilitate the surgery.

Each patient was positioned supine on the fracture table and a padded perineal post was placed between the genitalia and the injured limb. The diameter of the perineal post was 3.8cm and it was padded with cast padding to 8cm thickness. The injured limb was positioned in a traction boot which was attached to the traction unit. The unaffected limb was also placed in a traction boot and positioned in abduction, flexion, and external rotation.

This position facilitated fluoroscopic imaging. Traction was usually required for trial reduction after prepping and draping, passage of the guide wire and intramedullary nail across the fracture site and for the placement of the interlocking screws. Traction was applied indirectly through a crankshaft operated system. Those cases in which closed reduction could not be obtained, had their fracture sites opened to facilitate passage of the guide wire and intramedullary nail across the fracture sites. The amount and duration of the traction was left to the discretion of the operating surgeon. Traction was released once the interlocking screws were inserted. To facilitate insertion of the guide wire and intramedullary nail into the proximal femur, the injured limb had to be adducted.

Post-operatively, each patient was questioned about numbness in the genitalia and a cotton swab was used to compare the sensation on both sides of the genitalia. Men were asked about erectile function. Any abnormality in sensation of the genitalia or erectile function was recorded. Patients who had no evidence of pudendal nerve palsy post-operatively, either during hospital or at the first follow-up visit, were assumed to need no further follow-up for this potential complication. Patients who had evidence of pudendal neuropathy were followed until return of function.

RESULTS

Of the 29 patients, 21 (72%) were males and eight (28%) were females, with a median age of 38 years (range 18 - 75 years). The median body mass index was 24.0 (range 17.7 - 35.60). The femoral fractures resulted from three main causes, motor vehicle accidents (58.6%), gun shot wounds (27.6%) and falls (13.8%). Eight (27.6%) patients developed palsies, and of those eight patients one was female, and seven were males. All eight patients had genital hypoesthesia. Erectile dysfunction was present in four males. The four patients with purely sensory disturbances had return of normal sensation within five days. Of the four males with combined erectile dysfunction and sensory loss, erectile function returned in three males within eight days and in the other male in six months. Sensory function returned at varying times before erectile function.

The median interval between injury and surgery and the range for those patients who did not develop palsies were 22 (5-128) days and 16 (8-31) days for those who did develop palsies. Using non parametric statistics, Mann-Whitney Test, no significant difference ($p=0.35$) was found in the interval between the two groups. No difference ($p=0.42$) was found between the duration of intra-operative traction for the group which developed palsies (median 135 minutes, range 60 - 300 minutes), and the group which did not (median 115 minutes, range 28 – 225 minutes). Pre-operative skeletal traction was used in all patients except two, and one of those two patients developed pudendal nerve palsy (sensory loss only). Muscle relaxants were used by the anesthetist in 22 (75.8%) patients. Two of the seven patients who were not given muscle relaxants developed palsies. Of the 29 patients, nine (31%) had the fracture sites opened during surgery to facilitate reduction, and three of those patients developed palsies.

Two patients had purely sensory loss, and the other had both motor and sensory loss. Nine patients had no pre-operative shortening, and a palsy was noted in one patient. Of the eight patients with palsies, one had no pre-operative shortening. The average pre-operative shortening in those eight patients were 2.3 (range 0-6) centimeters.

The levels of the femoral fractures were 21 (72%) midshaft, five (17.2%) proximal and three (10.3%) distal. Of the eight patients with palsies, five had midshaft fractures, and three had proximal fractures. No significant correlations (Spearman's rank) were found between pudendal nerve injury and age, body mass index, pre-operative shortening, delay to surgery, duration of intra-operative traction and level of the fracture. No relationship was found between pudendal nerve injury and the absence of muscle relaxant during surgery.

There were four types of fractures: comminuted (65.5%), oblique (20.7%), transverse (10.3%), and spiral (3.4%). All eight patients with palsies had comminuted fractures. When the other three types of fractures were combined and compared to comminuted fractures, there were significantly more palsies in comminuted fractures (n=8) than the other group (n=0)(p=0.03, Fisher's Exact Test).

DISCUSSION

Pudendal nerve palsy is a relatively common complication following static interlocking nailing of the femur ([1,2,3,4,5,6,7,8,9,10,11,12,13]). The sensory terminal branches of the pudendal nerve appear more susceptible to injury than do the motor branches which control sexual function. The incidence of pudendal neuropathy is probably higher than that reported in the literature since large series of femoral fractures treated by intramedullary nailing did not comment on its presence post-operatively ([14,15,16]).

In a retrospective study by Kao et al ([7]), ten (15%) of the 63 patients were noted to have pudendal nerve palsies following surgery. Of the ten patients, seven had pure sensory loss and three males had erectile dysfunction. All ten patients regained full sensation and normal function at varying intervals, the longest period for return of sensation and erectile function were 5.8 months and two months respectively. Amarenco et al ([9]) reported on six men who developed pudendal nerve injury following an orthopaedic intervention involving a fracture table. All patients developed perineal sensory symptoms immediately after the operation and reported sexual dysfunction within the first month post-operatively. All patients had perineal electrophysiological studies post-operatively. At six month follow-up, full recovery had occurred in two patients, and almost total disappearance of symptoms in three others. In one patient, hyperesthesia and hypo-orgasmia were still present two years later. Six palsies were noted in a retrospective study be Goldet et al ([8]). All six patients regained sensation and normal function in six months.

In the only prospective study, Brumback et al ([12]) reported ten (9%) of 106 patients who had pudendal nerve palsies after intramedullary femoral nailing. All ten patients had sensory loss and one male gave a history of erectile dysfunction. All purely sensory disturbances resolved within six weeks. The patient who had sensory disturbance and erectile dysfunction had resolution of the symptoms at eleven weeks. In our study, eight (27.6%) of the 29 patients developed palsies. All patients had sensory loss, and erectile dysfunction was noted in four males. The four patients with purely sensory disturbances had return of normal sensation within five days. Of the four males with combined erectile dysfunction and sensory loss, three had return of erectile function within eight days and the other male had return of function in six months. Normal sensation returned before erectile function.

Kao et al ([7]) reported that in one hospital, the average time to surgery for these patients with pudendal nerve palsy was 3.7 ± 3.7 days, and the average time to surgery for those without 4.2 ± 4.5 days. In another hospital, Kao et al ([7]) noted that the average time to surgery for those patients with pudendal nerve palsy was 1.0 ± 0.0 days. The average time to surgery for those patients without palsy was 3.1 ± 3.3 days. In the study by Brumback et al ([12]) each patient had static femoral nailing within twenty-four hours after the injury. Riew et al ([11]) found no significant difference in interval time between the groups with and without palsies. In our study, no significant difference (p=0.35) was found in the interval time between the two groups.

The duration of traction was compared for the two groups in our study and no difference (p=0.42) was found between the group which developed palsies (median 135 minutes, range 60 – 300 minutes), and the group which did not (median 115 minutes, range 28 – 225 minutes). Traction was usually required for trial reduction, passage of the guide wire and intramedullary nail across the fracture site and for placement of the interlocking screws. Traction was released after placement of the screws. As the surgeons became more aware of the neurological complications, the traction times were less. For five patients, each had surgery within one hour. In the study by Kao et al ([7]), the patients with pudendal nerve palsies had operating times that were 34 minutes (p=0.137) and 18 minutes (p=0.149) longer than patients without palsies. Brumback et al ([12]) reported no difference (p=0.15) in the duration of traction between the two groups.

In a retrospective study by Riew et al ([11]), eight (22.2%) of 35 pediatric patients were noted to have neurologic deficits post-operatively. Two of these were pudendal and the remaining six involved the lower extremity. There was no significant difference between the groups with and without neurologic deficits for the following variables: average age (14.9 versus 14.7 years), weight (65.0 versus 61.2 kilograms), and degree of comminution. In our study, no significant correlations were found between pudendal nerve injury and age, body mass index, pre-operative shortening

and the absence of muscle relaxants during surgery. Midshaft fractures were the most common fracture level (72%), and of the eight patients with palsies, midshaft fractures were present in five patients and proximal fractures in three patients. No significant difference was found between the fracture level and the development of palsies.

Nineteen (65.5%) of the femoral fractures were comminuted, and 14 (73.6%) of those were at the midshaft level. The eight patients with palsies had comminuted fractures, and five fractures were midshaft in location.

Nine patients had their fracture sites opened during surgery to make the reduction easier thereby reducing the amount and duration of the intra-operative traction. Trial reduction after prepping and draping identified those fractures which required open reduction.

Many authors have commented on the size of the perineal post and its relationship to the development of pudendal nerve palsy ([2], [7], [12], [13]). The smaller post allows for deeper penetration into the pelvis, thereby compressing the pudendal nerve. In the study by France et al ([12]), the final diameter of the post was 9cm. The diameter of the post was 4.1cm and was increased to a total diameter of 6.8cm in the study by Brumback et al ([11]). Kao et al ([7]) found a higher incidence of palsies with posts which measured 3.5cm in diameter versus those which measured 5cm. In our study, the diameter of the post was 3.8cm and its diameter was increased to 8cm.

A review of the literature revealed that there is no published prospective study which investigated the correlation between the levels and types of fractures, body mass index, age, pre-operative shortening, and the development of pudendal nerve palsies. A major weakness of this paper is the small study population.

Pudendal nerve palsy is a common and important complication following static intramedullary nailing of the femur. Patients should be informed pre-operatively of this complication and they can be assured of complete sensory return.

Erectile function may not always be normal. There is a strong correlation between comminuted fractures and pudendal nerve palsy.

The authors recommend the following guidelines for minimization of pudendal nerve palsies (Table 1).

Figure 1

Table 1: Guidelines for Minimizing the Risk of Pudendal Nerve Palsy

1. Apply adequate pre-operative skeletal traction to reduce pre-operative shortening while awaiting surgery.
2. Complete muscular relaxation of the patient during surgery is necessary.
3. Intra-operative traction should only be used for trial reduction, passage of the guide wire and intramedullary nail across fracture site and for placement of the interlocking screws.
4. Release the traction once the interlocking screws are inserted.
5. Fracture sites should be opened in all cases of difficult reduction to reduce the amount and duration of intra-operative traction.
6. The final diameter of the perineal post should be 6.8 - 9cm.

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