*Original Article*

# The Perioperative and Anesthetic Adverse Events in Thailand (PAAd Thai) Study: Peripheral Neurological Deficit in 2,000 Incident Reports

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***Background***: Perioperative peripheral neurological deficit is an uncommon but debilitating complication after surgery. Despite the awareness of the injury after surgery, there are still some neurological deficit events that occurs.

***Objective***: To investigate the contributing factors and preventive strategies of peripheral neurological deficit incidents.

***Materials and Methods***: The authors conducted the prospective, multi-centered, observational study as part of the Perioperative and Anesthetic Adverse Events Study in Thailand (PAAd Thai) among 22 hospitals from all regions across Thailand. The critical incident reports during a 12-month-period, between January 1 and December 31, 2015, were reviewed and analyzed by three senior anesthesiologists to identify possible contributing factors and potential corrective strategies. The data were reported using descriptive statistics.

***Results***: Among the first 2,000 critical incidents that occurred in 2015, there were 19 perioperative peripheral nerve neurological deficits reported under both general and regional anesthesia. The most common reported events were lumbosacral injury (42.1%) and brachial plexus (31.6%). Reported incidents were related to surgery (26.3%), anesthesia (36.8%), and malpositioning (36.9%). The major contributing factor was inexperience, while suggested corrective strategies included having vigilance and experience by providing quality assurance activity and additional training.

***Conclusion***: Perioperative peripheral neurological deficit after anesthesia might be related to surgery, anesthesia (both general anesthesia and regional anesthesia), or position during operation. Having more vigilance and experience, including training, for anesthesia providers may prevent this catastrophic complication.

***Keywords***: Anesthesia, Adverse events, Incident report, Neurological deficit, Peripheral nerve injury

**J Med Assoc Thai 2019;102(2):164-70**
**Website:** http://www.jmatonline.com

Perioperative peripheral neurological deficit has been documented as one of a debilitating anesthetic complication, which occurs under both general and regional anesthesia. The mechanism of injury is usually uncertain but may be associated with direct trauma by surgical or anesthetic procedures, chemical irritation or toxic effect of anesthetic agents, and malpositioning of patients on the operating table causing stretching or compression of nerves.

The clinical manifestations of nerve injuries include anesthesia, paresthesia, hypoesthesia, hyperesthesia, and pain in the areas supplied by injured nerves. There may be paresis or paralysis of affected

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**How to cite this article:** Vorapaluk P, Burimsittichai R, Ittichaikulthol W, Tangwiwat S, Lorsomradee S, Wongswadiwat M, et al. The Perioperative and Anesthetic Adverse Events in Thailand (PAAd Thai) Study: Peripheral Neurological Deficit in 2,000 Incident Reports. J Med Assoc Thai 2019;102:164-70.

muscles and disabling autonomic dysfunction. In severe cases, muscle wasting, joint stiffening, and demineralization of bone can be present. The symptoms may present immediately after recovery of anesthesia or take several days to be detected. Due to the varied clinical features, the true incidence of perioperative nerve damage remains unclear and probably under-reported[1]. In Thailand, the incidence from the Thai Anesthesia Incidents Study (THAI Study) on nerve injury associated with anesthesia was 1.6 per 10,000[2]. Although being recognized as a significant complication and several preventive strategies are recommended during anesthesia, the perioperative peripheral nerve injury is still a persistent problem.

The objective of the present study was to report the patients that underwent anesthesia who experienced perioperative peripheral nerve injury and their clinical outcomes. The authors also aimed to identify possible contributing factors, minimizing factors, and suggested corrective strategies.

## Materials and Methods

The present prospective, multi-centered, observational study was a part of the Perioperative and Anesthetic Adverse Events Study in Thailand (PAAd Thai)[3,4] conducted by the Royal College of Anesthesiologists of Thailand (RCAT). The study was approved by each Institutional Ethical Committee and informed consent was exempted.

During a 12-month-period (between January 1 and December 31, 2015), all anesthesiologists and nurse anesthetists in 22 participating hospitals across Thailand were invited to report the critical incidents on an anonymous and voluntary basis by completing the standardized incident report form as soon as possible after the adverse event occurred. The adverse events of interests included peripheral neurological deficit. The narrative description of detailed injuries covered clinical presentations, affected areas, onset and duration of the symptoms, and immediate and long-term outcomes of the patients. The incident report forms of peripheral nerve injury collected from the first 2,000 incidents were reviewed and analyzed by three senior anesthesiologists to identify and delineate the clinical risk factors, associated factors, and possible mechanisms of injury, and to provide preventive strategies.

Perioperative peripheral nerve neurological deficit in the present study was defined as the new damage of conducting fibers within a nerve that caused changes of skin sensation or muscle power of relevant neuroanatomical distributions. An autonomic dysfunction was also included. Brain damage and vocal cord palsy were excluded. The mechanism of injury was defined as an abnormality that played the primary role in producing the injury, such as direct trauma by surgical or anesthesia instruments or explicitly observed hyperextension or compression of extremities, as reported by the reviewers based on all available information in the incident report forms. Data were analyzed using SPSS program version 23 and presented with descriptive statistics.

## Results

From the first 2,000 incidents occurred in the year 2015, there were 19 critical incidents of perioperative peripheral nerve neurological deficit according to the operational definition reported to data management unit.

Most of the patients were female (63.2%) and ASA physical status II and III (57.9% and 31.6%, respectively). Patients' age ranged from 16 to 72 years with mean and standard deviation of 43.8±19.4 years. Five (26.3%) patients had a body mass index (BMI) of more than 35 kg/m$^2$ and three of them were morbidly obese (BMI of 40 and above). The median operative time was 165 minutes, ranging from 35 to 460 minutes. Regarding anesthetic techniques, general anesthesia was conducted in seven patients (36.8%), whilst three (15.8%) and one (5.3%) patients received combined general with spinal, and epidural anesthesia, respectively. Seven patients (36.8%) received spinal anesthesia, however, one of them required general anesthesia later on during surgery because the local anesthetic wore off. Two patients developed peripheral nerve neurological deficit under brachial plexus anesthesia. Patients characteristics and anesthetic techniques of 19 incidents are shown in Table 1.

The most common reported events were lumbosacral injury (eight cases, 42.1%), followed by brachial plexus (six cases, 31.6%), and phrenic nerve injury (two cases, 10.5%). Common peroneal nerve, obturator nerve, and pudendal nerve injury were reported in one case each, as shown in Table 2. The most common position during surgery was supine with arms abducted (15 of 19, 78.9%) followed by lithotomy (two, 10.5%), prone (one, 5.3%), and fracture table (one, 5.3%).

All patients suffering from lumbosacral injury received spinal anesthesia whereas patients presented with brachial plexus injury underwent general anesthesia. Half of lumbosacral injured patients were parturients underwent cesarean section. Among two

**Table 1.** Patients characteristics and anesthesia techniques (n = 19)

| Characteristics | Number (%) |
|---|---|
| ASA physical status | |
| I | 2 (10.5) |
| II | 11 (57.9) |
| III | 6 (31.6) |
| Sex | |
| Male | 7 (36.8) |
| Female | 12 (63.2) |
| Age (year) | |
| 16 to 30 | 7 (36.8) |
| 31 to 45 | 2 (10.5) |
| 46 to 60 | 6 (31.6) |
| >60 | 4 (21.1) |
| BMI (kg/m$^2$) | |
| <35 | 14 (73.7) |
| ≥35 | 5 (26.3) |
| Anesthesia technique | |
| GA | 7 (36.8) |
| GA+epidural block | 1 (5.3) |
| GA+spinal block | 3 (15.8) |
| Spinal block | 6 (31.6) |
| Brachial plexus block | 2 (10.5) |

ASA=American Society of Anesthesiologists; BMI=body mass index; GA=general anesthesia

**Table 2.** Injured nerves (n = 19)

| Nerve | Number (%) |
|---|---|
| Lumbosacral root | 8 (42.1) |
| Brachial plexus | 6 (31.6) |
| Phrenic nerve | 2 (10.5) |
| Common peroneal nerve | 1 (5.3) |
| Obturator nerve | 1 (5.3) |
| Pudendal nerve | 1 (5.3) |

patients that underwent brachial plexus block (BPB), one developed sudden dyspnea and desaturation after ultrasound-guided supraclavicular approach for arterio-venous fistula graft. Chest ultrasound demonstrated the paradoxical movement of ipsilateral diaphragm without pneumothorax. The patient received oxygen supplement and continued uneventful surgery with postoperative complete recovery. The other patient underwent BPB with landmark technique for forearm operation. After surgery, the patient complained paresthesia radiating from shoulder to tip of the second and fourth fingers while extending the arm.

**Table 3.** Factors associated with perioperative peripheral nerve neurological deficit (n = 19)

| Analyzing factors | Number (%) |
|---|---|
| Incident-related factors | |
| Surgical | 5 (26.3) |
| Anesthesia | 7 (36.8) |
| Position | 7 (36.9) |
| Contributing factors | |
| Inexperience | 11 (57.9) |
| Communication defect | 1 (5.3) |
| Factors minimizing incident | |
| Having experience | 13 (68.4) |
| Experienced assistant | 3 (15.8) |
| Vigilance | 14 (73.7) |
| Effective supervision | 1 (5.3) |
| Effective communication | 1 (5.3) |
| Improvement of training | 1 (5.3) |
| Suggested corrective strategies | |
| Guideline practice | 1 (5.3) |
| Additional training | 12 (63.2) |
| Improved supervision | 4 (21.1) |
| Improved communication | 1 (5.3) |
| Quality assurance activity (morbidity & mortality conference) | 15 (79.0) |

Data are not mutually exclusive

Positioning-related peripheral nerve damage was reported in patients that underwent general anesthesia in supine position with arms abducted. There was a record that the affected arm was abducted more than 90 degrees during the operation.

Intraoperative surgical transection of phrenic nerve occurred during thymectomy and the obturator nerve was cut during the laparoscopic assisted vaginal hysterectomy with pelvic lymph node biopsy.

Most patients completely recovered within one week after surgery, except the patient with phrenic nerve transection after thymectomy who needed prolonged ventilatory support.

The incident analysis revealed that common contributing factors of perioperative peripheral nerve neurological deficit were mainly inexperience and a minor of communication defect. Factors minimizing the incidents were having vigilance and experience in this aspect. The availability of experienced assistant, improvement of training, and effective supervision and communication were reported to reduce the incidence. Finally, the suggested corrective strategies most reported to be effective included the quality assurance activities (morbidity and mortality conferences) and additional training. Other strategies were improved

**Table 4.** Characteristics of cases of perioperative peripheral nerve neurological deficit

| Case number | Sex/age (year) | ASA class | Weight/ height (kg/cm) | BMI ($kg/m^2$) | Surgical procedure | Choice of anesthesia | Position | Arm position | Duration of anesthesia (minute) | Injured nerve/ symptoms |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | M/63 | III | 72/155 | 30 | AVBG | BPB | Supine | Abduct | 160 | Dyspnea, desaturation |
| 2 | F/54 | III | 42/148 | 19 | Remove plate right forearm | BPB | Supine | Abduct | 40 | Paresthesia radiating to shoulder and tip of $2^{nd}$ and $4^{th}$ fingers |
| 3 | M/18 | III | 130/180 | 40 | LYRGB | GA | Supine | Abduct | 225 | Numbness in both hands |
| 4 | M/16 | II | 49/170 | 17 | Tibial bone transportation | GA | Supine | Abduct | 270 | Numbness in right hand |
| 5 | M/72 | III | 63/170 | 22 | Hepatectomy | GA | Supine | Abduct | 225 | Right arm weak, numb |
| 6 | F/68 | III | 50/155 | 21 | Thymectomy | GA | Supine | Tucked | 165 | Phrenic nerve transection |
| 7 | F/53 | III | 100/157 | 41 | TAH with BSO and staging | GA and EB | Supine | Abduct | 220 | Paraparesis |
| 8 | F/59 | II | 88/150 | 39 | Transpedicular screw L3-5 | GA | Prone | Abduct | 300 | Numbness in both hands |
| 9 | M/27 | I | 64/183 | 19 | Sex reassignment surgery | GA and SB | Lithotomy | Abduct | 460 | Common peroneal nerve |
| 10 | F/57 | II | 61/152 | 26 | LAVH with lymph nodes dissection | GA | Lithotomy | Tucked | 135 | Obturator nerve resection |
| 11 | F/66 | II | 72/165 | 26 | TKA (right) | SB | Supine | Abduct | 135 | Numbness above right knee |
| 12 | F/57 | I | 49/157 | 20 | Ovarian tumor surgical staging | GA and SB (3 attempts) | Supine | Abduct | 165 | Numbness in groin area, left thigh |
| 13 | F/27 | II | 60/147 | 28 | Cesarean section | SB | Supine | Abduct | 35 | Paresthesia left leg |
| 14 | F/32 | II | 85/150 | 38 | Cesarean section | SB | Supine | Abduct | 40 | Paresthesia left leg |
| 15 | M/26 | II | 53/167 | 19 | ORIF with intramedullary nail femur (right) | SB | Fracture table | | 150 | Numbness in perineal area and erectile dysfunction |
| 16 | F/59 | II | 67/154 | 28 | Total gastrectomy | GA | Supine | Abduct | 165 | Wrist drop |
| 17 | F/21 | II | 63/160 | 25 | Cesarean section | SB | Supine | Abduct | 65 | Numbness below L3 |
| 18 | M/35 | II | 75/180 | 23 | Reconstruction pubic symphysis, left acetabulum | SB then GA | Supine | Abduct | 240 | Numbness in dorsum left foot |
| 19 | F/22 | II | 109/161 | 42 | Cesarean section | SB (3 attempts) (paresthesia at right thigh during $2^{nd}$ attempt) | Supine | Abduct | 110 | Numbness in right thigh |

ASA=American Society of Anesthesiologists; AVBG=arteriovenous bypass graft; BMI=body mass index; BPB=brachial plexus block; EB=epidural anesthesia; F=female; GA=general anesthesia; LAVH=laparoscopic-assisted vaginal hysterectomy; LYRGB=laparoscopic Roux-en-Y gastric bypass; M=male; ORIF=open reduction and internal fixation; SB=spinal anesthesia; TAH with BSO=total abdominal hysterectomy with bilateral salpingo-oophorectomy; TKA=total knee arthroplasty

supervision and communication and a provision of the guideline practice (Table 3). Individual patient's details of injury are demonstrated in Table 4.

## Discussion

Among the first 2,000 incident reports in 2015, 19 patients suffered from perioperative peripheral nerve neurological deficit. The most common injuries were lumbosacral nerve root, which was similar to the results from THAI Study[2]. The perioperative peripheral nerve neurological deficit consistently occurs despite the awareness of this complication. In the PAAd Thai Study, the incidence of peripheral nerve injury was 0.63:10,000, which was considered an uncommon event[3,4]. However, those incidents might be underestimated.

An introduction of ultrasound-guided regional anesthesia (UGRA) provides direct visualization of the needle approaching target nerves, the surrounding vascular structures, and the spread of local anesthetic. These benefits are assumed to reduce complications of regional anesthesia, but it is still inconclusive that UGRA improves patient safety. In terms of peripheral nerve injury, ultrasound is more sensitive to identify the needle-to-nerve contact than traditional techniques[5]. However, this advantage has not been associated with a reduction of peripheral nerve injury due to the limitation of technical skills in distinguishing nerve from surrounding tissues and the attempt to place the needle close to the nerve by anesthesiologists. Neal conducted an evidence-based analysis and concluded that UGRA did not reduce surrogate outcomes of nerve injury, such as paresthesia during the block or temporary postoperative neurological symptoms[6]. Nevertheless, serious nerve injury is rare; therefore, most trials were under-powered, and the best evidences came from large case series.

Hemidiaphragmatic paresis (HDP) is the most common complication of interscalene BPB, which occurs in 100% of patients using paresthesia or nerve stimulation technique[7]. The mechanism is the spread of local anesthetic directly to the phrenic nerve or rostrally to C3 to C5 roots, but at the caudal level of supraclavicular BPB, the phrenic nerve paresis may occur if large volume of local anesthetic is used[8]. The reported incidence of HDP after a single-injection supraclavicular BPB was 50% to 67%[9-11]. Although Renes et al[12] demonstrated that this complication can be avoided using US-guided supraclavicular BPB compared with nerve stimulation technique using 20 ml of 0.75% ropivacaine, Perlas et al[13] reported 1% of symptomatic HDP after ultrasound-guided supraclavicular block using mean local anesthetic volume 33±8 ml. In the present study, the patient received totally 30 ml of local anesthetic, which may explain the occurrence of HDP.

Malpositioning during surgery is associated with significant perioperative neurological deficit. The most common mechanisms of injury are compression and stretching[14]. Most of the patients reported with brachial plexus injury were in supine position with abducted arms and underwent upper abdominal surgery. The over-stretching of arms from surgeons leaning against the arm board might explain the mechanism of injury. It is recommended that, in the supine position, arms abduction be limited to 90 degrees or less to avoid excessive stretching on brachial plexus, particularly if the neck was rotated to the contralateral side. The forearm and hand should be kept neutral when the arm is tucked or placed supinated on the arm board with slight elbow flexion. Proper padding is also used to reduce pressure on the spiral or ulnar groove[1]. In addition, frequent checking of the arm position during prolonged period of surgery should be encouraged. In prone position, brachial plexus can be stretched if arms were placed above the patient's head. On the arm boards, shoulders should not be extended nor abducted beyond 90 degrees with elbows flexed and downward facing of palms[15].

Position-related peripheral nerve injury of lower limbs reported in the present study were common peroneal and pudendal nerves. The common peroneal nerve is the most frequent affected nerve of the lower limb neuropathy in the lithotomy position[16]. It can be compressed against the head of the fibula particularly in thin patients and prolonged surgery. Careful positioning and adequate padding at fibular head may help prevent this complication. One patient manifested with perineal dysesthesia and transient erectile dysfunction after femoral intramedullary nailing on fracture table, which is commonly associated with pudendal nerve palsy[17]. The mechanism of injury may be the prolonged pressure on perineal post induced by traction forces during reduction. To minimize this iatrogenic injury, the large-diameter perineal post should be used and placed between the genitalia and the contralateral leg with proper padding[18]. Moreover, avoidance of surgical leg adduction beyond neutral and periodic release of prolonged traction is advised[19].

The inexperienced physician was reported to be the major contributing factor of perioperative peripheral nerve neurological deficit. Therefore, it is important that the medical personnel need

more vigilance and experience for preventing this complication. By providing the quality assurance activities via morbidity and mortality conferences, the additional training might be the most effective method to gain experiences.

There were some limitations in the present study. First, the critical incidents were based on an anonymous and voluntary reports. However, the authors minimized this problem by arranging several meetings for the participant hospitals to agree before starting the study. Second, the data completion of the incident reports depended on the narrative descriptions of the anesthesia personnel. Thus, some information regarding clinical presentation, affected area, onset and duration, as well as outcomes might be missing. The data analyses and interpretation could be limited on that account. Finally, there was no critical incidents in the children reported. It might be due to problems of communication.

## Conclusion

Perioperative peripheral nerve neurological deficit is one of the most undesirable complication after surgery, which can occur during either general or regional anesthesia. The cause might be related to anesthesia, surgery, or patient positioning. The anesthesia providers should be encouraged to have more vigilance and additional training in order to prevent these events.

## What is already known on this topic?

Perioperative peripheral nerve neurological deficit is one of the most debilitating complication after anesthesia. It can occur during both general and regional anesthesia and might be surgical-, anesthesia- or position-related caused.

## What this study adds?

Vigilance and experience of anesthesia providers are suggested as corrective strategies for perioperative peripheral nerve neurological deficit. Therefore, additional staff training and increased quality assurance activity should be implemented in clinical settings to improve patient safety.


## Acknowledgement

The present research was accomplished through the personal sacrifices and inspiration of the Thai anesthesiologists together with all personnel and with the cooperation of the heads of the department of anesthesiology of all participating sites in this multicentered study. The Royal College of Anesthesiologists of Thailand and the PAAd Thai Study group express their deep gratitude to the project advisors Professor Thara Tritrakarn, Professor Somsri Paosawasdi, Associate Professor Khun Wanna Somboonwiboon, and Associate Professor Oranuch Kyokong for their exceptional encouragement, suggestions, and advice. The present study was financially supported by the Royal College of Anesthesiologists of Thailand, Faculty of Medicine of Chiang Mai University, Chulalongkorn University (Rachadapisakesompotch fund), Khon Kaen University, Mahidol University (Siriraj Hospital and Ramathibodi Hospital), Prince of Songkla University National Research Council of Thailand, and the Health System Research Institute and National Research Council of Thailand.


## Conflicts of interest

The authors declare no conflicts of interest.

## References


1. Sawyer RJ, Richmond MN, Hickey JD, Jarrratt JA. Peripheral nerve injuries associated with anaesthesia. Anaesthesia 2000;55:980-91.
2. Sirinan C, Akavipat P, Srisawasdi S, Tanudsintum S, Weerawatganon T. The Thai Anesthesia Incidents Study (THAI Study) on nerve injury associated with anesthesia. J Med Assoc Thai 2005;88 Suppl 7:S102-5.
3. Punjasawadwong Y, Sriraj W, Charuluxananan S, Akavipat P, Ittichaikulthol W, Lapisatepun W, et al. Perioperative and Anesthetic Adverse Events in Thailand (PAAd Thai) incident reporting study: hospital characteristics and methods. Asian Biomed 2017;11:33-9.
4. Charuluxananan S, Sriraj W, Punjasawadwong Y, Pitimana-aree S, Lekprasert V, Werawatganon T, et al. Perioperative and anesthetic adverse events study in Thailand (PAAd Thai) incident reporting study: Anesthetic profiles and outcomes. Asian Biomed 2017;11:21-32.
5. Perlas A, Niazi A, McCartney C, Chan V, Xu D, Abbas S. The sensitivity of motor response to nerve stimulation and paresthesia for nerve localization as evaluated by ultrasound. Reg Anesth Pain Med 2006; 31:445-50.
6. Neal JM. Ultrasound-guided regional anesthesia and patient safety: An evidence-based analysis. Reg Anesth Pain Med 2010;35(2 Suppl):S59-67.
7. Urmey WF, Talts KH, Sharrock NE. One hundred percent incidence of hemidiaphragmatic paresis associated with interscalene brachial plexus anesthesia as diagnosed by ultrasonography. Anesth Analg 1991; 72:498-503.
8. Kessler J, Schafhalter-Zoppoth I, Gray AT. An ultrasound study of the phrenic nerve in the posterior

cervical triangle: implications for the interscalene brachial plexus block. Reg Anesth Pain Med 2008; 33:545-50.
9. Knoblanche GE. The incidence and aetiology of phrenic nerve blockade associated with supraclavicular brachial plexus block. Anaesth Intensive Care 1979;7:346-9.
10. Neal JM, Moore JM, Kopacz DJ, Liu SS, Kramer DJ, Plorde JJ. Quantitative analysis of respiratory, motor, and sensory function after supraclavicular block. Anesth Analg 1998;86:1239-44.
11. Mak PH, Irwin MG, Ooi CG, Chow BF. Incidence of diaphragmatic paralysis following supraclavicular brachial plexus block and its effect on pulmonary function. Anaesthesia 2001;56:352-6.
12. Renes SH, Spoormans HH, Gielen MJ, Rettig HC, van Geffen GJ. Hemidiaphragmatic paresis can be avoided in ultrasound-guided supraclavicular brachial plexus block. Reg Anesth Pain Med 2009;34:595-9.
13. Perlas A, Lobo G, Lo N, Brull R, Chan VW, Karkhanis R. Ultrasound-guided supraclavicular block: outcome of 510 consecutive cases. Reg Anesth Pain Med 2009;34:171-6.
14. Britt BA, Gordon RA. Peripheral nerve injuries associated with anaesthesia. Can Anaesth Soc J 1964; 11:514-36.
15. Kamel I, Barnette R. Positioning patients for spine surgery: Avoiding uncommon position-related complications. World J Orthop 2014;5:425-43.
16. Warner MA, Martin JT, Schroeder DR, Offord KP, Chute CG. Lower-extremity motor neuropathy associated with surgery performed on patients in a lithotomy position. Anesthesiology 1994;81:6-12.
17. Chan PT, Schondorf R, Brock GB. Erectile dysfunction induced by orthopedic trauma managed with a fracture table: a case report and review of the literature. J Trauma 1999;47:183-5.
18. France MP, Aurori BF. Pudendal nerve palsy following fracture table traction. Clin Orthop Relat Res 1992; 272-6.
19. Brumback RJ, Ellison TS, Molligan H, Molligan DJ, Mahaffey S, Schmidhauser C. Pudendal nerve palsy complicating intramedullary nailing of the femur. J Bone Joint Surg Am 1992;74:1450-5.