

Sciatic nerve injury from intramuscular injection: a persistent and global problem

P. Mishra,¹ M. D. Stringer²

SUMMARY

Background/Aims: An intramuscular (IM) injection into the buttock risks damaging the sciatic nerve. Safe injection practices need to be understood by doctors and nurses alike. The aims of this study were to determine if sciatic nerve injury because of IM injection is a continuing problem and to establish the availability of published guidelines on IM injection techniques. **Methods:** Intramuscular injection related sciatic nerve injury claims to the New Zealand Accident Compensation Corporation between July 2005 and September 2008 were reviewed. Nursing organisations were surveyed to enquire about guidelines on IM injection. IM injection related sciatic nerve injuries in the medical and medicolegal literature (1989–2009) were systematically reviewed. **Results:** There were eight claims for sciatic nerve injury made to the ACC during the 3-year study period; all were in young adults. Only one of the nursing organisations contacted had published guidelines on IM injection technique, and these related specifically to immunisation. Seventeen reports of patients with sciatic nerve injury from IM injection were identified comprising a total of 1506 patients, at least 80% of which were children. Nine court decisions finding in favour of the plaintiff were identified, all from the North American legal system. A broad range of drugs were implicated in the offending IM injections. **Conclusions:** Sciatic nerve injury from an IM injection in the upper outer quadrant of the buttock is an avoidable but persistent global problem, affecting patients in both wealthy and poorer healthcare systems. The consequences of this injury are potentially devastating. Safer alternative sites for IM injection exist. These should be promoted more widely by medical and nursing organisations.

Introduction

Sciatic nerve injury from an intramuscular (IM) injection into the buttock is potentially devastating. In severe cases, the hamstrings and all the muscles below the knee are paralysed resulting in a flail numb foot. This avoidable complication has been known about since the 1920s and highlighted in the nursing research literature (1–3). However, the majority of doctors are involved in prescribing drugs that may be given by IM injection (e.g. vaccines, vitamins, steroid hormones, analgesics and major tranquillisers), and safe injection practices should concern all health professionals. The aims of this study were twofold: to establish if sciatic nerve injury because of IM injection is a continuing problem, and to determine the availability of published guidelines

Review Criteria

We obtained information from the following sources: (i) the Accident Compensation Corporation of New Zealand; (ii) nursing organisations; (iii) a systematic review of the medical (Medline, ISI Web of Science, Cochrane Library) and medicolegal (Lexis, LegalTrac, eCarswell) literature using the terms 'sciatic nerve' and 'intramuscular injection' as keywords.

Message for the Clinic

Avoid the upper outer quadrant of the buttock for intramuscular injection because of the risk of injury to the sciatic nerve. For immunisations, use alternative recommended sites. For drugs that need to be given by intramuscular injection, the ventrogluteal area is safer.

¹Wellington School of Medicine and Health Sciences, University of Otago, Wellington, New Zealand

²Otago School of Medical Sciences, University of Otago, Dunedin, New Zealand

Correspondence to:

Mark D. Stringer, Professor of Anatomy, Department of Anatomy & Structural Biology, Otago School of Medical Sciences, University of Otago, PO Box 913, Dunedin, New Zealand
 Tel.: + 64 3 479 5992 Fax: + 64 3 479 7254
 Email: mark.stringer@anatomy.otago.ac.nz

Disclosures

The authors have no potential conflicts of interest.

on IM injection techniques within nursing organisations in the UK, USA and Australasia.

Methods

Accident Compensation Corporation data from New Zealand

We reviewed IM injection related sciatic nerve injury claims to the New Zealand Accident Compensation Corporation (ACC) between July 2005 and September 2008. New Zealand has a population of 4.2 million, and all New Zealanders and visitors to the country who suffer a physical injury can apply to the Corporation for assistance. This can include claims for injury as a result of treatment. The anonymised data used in this analysis were reviewed by ACC staff and meet the Corporation's Ethics Panel guidelines

for external research and publication of ACC information.

Nursing Organisation Survey

The following nursing organisations were contacted and asked if they published any guidelines on the suitability of alternative IM injection sites and whether they had any position on intragluteal injection: the Royal College of Nursing (UK), New Zealand Nurses Organisation, Australian Nurses and Midwifery Council, American Nurses Credentialing Center, American Association of Colleges of Nursing, American Association of Critical Care Nurses, the National League of Nurses (USA) and the National Council of State Boards of Nursing (USA).

Literature review

A review of the English language literature between 1989 and May 2009 was conducted using Medline and ISI Web of Science databases using combinations of the following keywords: sciatic nerve, peroneal nerve, fibular nerve, tibial nerve, sciatic neuropathy, paralysis, IM, injection injury, iatrogenic, malpractice and medicolegal. Secondary references were retrieved from article bibliographies. A Cochrane Library search was performed using the terms sciatic nerve and IM injection. The English medicolegal literature during the same period (1989–2009) was searched using the legal databases Lexis, LegalTrac, eCarswell and the International Digest of Health Legislation. Google search engine was used to identify any additional cases (restricted to the first 300 hits using the search term 'sciatic nerve injection injury'). Sciatic nerve injury from causes other than IM injection was excluded as were IM injection injuries to other nerves.

Wherever possible, the following information was extracted from each report: number of cases, age and gender of cases; geographic location; clinical setting; type of healthcare worker administering the injection; type of medication and outcome.

Results

ACC data from New Zealand

Eight claims for sciatic nerve injury from IM injection were made to the ACC during the 3-year study period (Table 1). All were young adults. Six instances occurred in a general practice setting. All injections were administered by a registered health professional but the experience and type of professional (doctor or nurse) were not recorded. Four patients were documented during the fiscal year 2007–2008 and one in each of the other fiscal years under study. All affected patients experienced pain and a combination of mus-

cle weakness, sensory disturbance and difficulty in walking. The documented cost per case to the ACC till September 2008 was between 32 and 1503 New Zealand dollars.

Nursing Organisation Survey

Only one of the nursing organisations contacted, the Royal College of Nursing (UK), has published guidelines on the technique of IM injection, and these relate specifically to immunisation (4). The other nursing organisations were unable to direct us to any published guidelines, although the New Zealand Nurses Organisation informed us that they support nurses using the ventrogluteal rather than the dorso-gluteal site for IM injection.

Literature review

Seventeen reports of patients with sciatic nerve injury from IM injection were identified comprising a total of 1506 patients, at least 80% of which were children (Table 2) (5–22). Most of the medications being administered were antibiotics or analgesics but a broad range of drugs were involved. There were no relevant reports in the Cochrane Library. Nine court decisions finding in favour of the plaintiff were identified (Table 3) (23–32). All were in adults and processed by the North American legal system. A nurse was responsible for administering the IM injection in at least eight of the patients.

Discussion

Iatrogenic injury to the sciatic nerve resulting from a misplaced gluteal IM injection is a persistent worldwide problem affecting patients in economically rich and poor countries alike, albeit with a different spectrum of affected individuals. In economically poorer countries, children make up the greatest number of reported cases. In a nationwide study in Pakistan between 2001 and 2003, the estimated annual incidence of traumatic injection neuropathy (more than 90% of which involved the sciatic nerve) was 7.1 per million children under 3 years old (33). In countries such as Pakistan, India and Nigeria, the administration of IM injections by inadequately trained or unqualified staff seems to be an important cause (8–10,12,13). The problem is compounded by erroneous beliefs that IM injections work faster or reflect better quality care.

The effects of injection related sciatic nerve injury are variable ranging from transient sensory disturbance to permanent paralysis and numbness (18). Affected children may be unable to walk or crawl; a significant proportion present with foot drop (9,10,13). The common fibular component of the

Table 1 Characteristics of sciatic nerve injection injuries in New Zealand (July 2005–September 2008)

Age (years)	Gender	Clinical setting	Medication	Indication/background history	Sciatic nerve injury	Signs and symptoms	Potential consequence*
38	F	General practice	Depot medroxy-progesterone acetate	Contraception	Right	'Heavy' right leg. Unable to walk or stand on right leg. Weakness of foot eversion	Minor
17	F	General practice	Analgesic (not stated)	Migraine	Right	Pain and paraesthesiae in right leg. Difficulty in walking	Minor
40	F	General practice	Depot medroxy-progesterone acetate	Contraception	Left	Pain in back of left thigh. Pain when standing from sitting position. Walks with a limp. Wasting of left thigh muscles	Serious
23	F	General practice	Tramadol	Neck pain after fall	Left	Pain at injection site radiating to upper thigh. Difficulty in walking and driving. Altered sensation left leg	Minor
23	M	General practice	Tenoxicam	Lower back injury secondary to heavy lifting	Right	Pain at injection site, numbness and weakness right leg	Major
36	F	General practice	Diclofenac	Migraine	Right	Pain around injection site radiating down right lower limb. Difficulty in flexing knees and doing up shoelaces	Unknown
22	F	Gynaecology unit	Methotrexate	Ectopic pregnancy	Right	Weakness of gluteal muscles, pain radiating down back of lower limb with altered leg sensation. Difficulty in sitting and disturbed sleep	Major
27	F	Nursing unit	Depot medroxy-progesterone acetate	Contraception	Left	Pain and paresthesiae radiating down back of lower limb	Unknown

*Based on an early assessment of the impact of the injury and graded by the ACC as – Minor: minimal reduction in physical function which may require an increased level of care, review and evaluation, further investigation or referral to another clinician. Major: short-to-medium term reduction in physical function leading to an altered outcome of management or either an increased length of stay or surgical intervention. Serious: the potential to result in death or major permanent loss of function. F, female; M, male.

sciatic nerve is more often affected because of its posterolateral position and smaller amount of supporting connective tissue (34). Anatomical variations in the course and division of the sciatic nerve may be a factor in some cases (11). Affected patients typically experience immediate pain radiating down the limb, with weakness and numbness evolving more gradually (35), exacerbated by secondary scarring. The extent of recovery depends on the severity of the initial injury. Many patients (8–11) fail to make a full recovery, even with the benefit of microsurgical repair (11).

Common sites for IM injection are the anterolateral thigh, deltoid and gluteal regions. The latter can be subdivided into *dorsogluteal* (commonly known as the upper outer quadrant of the buttock) and *ventro-*

gluteal (between the iliac crest, greater trochanter of the femur and anterior superior iliac spine). Immunisation guidelines in the UK (4,36), USA (37) and Australia (38) recommend that the buttocks should not be used for IM injection because of the risk of injury to the sciatic nerve; the anterolateral thigh in infants or deltoid region in older children should be used instead. A caveat is generally added that the upper outer quadrant of the buttock can be used for large volume IM injections. However, immunisations aside, the potentially hazardous dorsogluteal site is still widely used for IM injection of drugs (2) and continues to be recommended in nursing texts (39) and clinical practice (40).

The buttocks are an inviting site for IM injection because of their obvious (muscle) bulk but the term

Table 2 Published reports of sciatic nerve injury from intramuscular injection (1989–April 2009)

Reference	Clinical setting	Study period	n	Demographics	Medication	Comments
Van Langenhove et al. (5) Belgium	Not recorded	1980–1987	2	Unknown	Unknown	Patients undergoing electrophysiological evaluation of foot drop because of sciatic nerve injury
Marcuse and MacDonald (6) Canada	Sciatic nerve injury after injection into thigh or buttock	1994–1996	1	2 years boy	Hepatitis B vaccine	Outcome unknown but legal proceedings
Ramtahal et al. 2006 (7) England	IM injections given while in prison in the Congo	2005	1	25 years man	Unknown	Marked muscle wasting and fasciculations in leg. Weak dorsiflexion, inversion and eversion of foot
Ahuja (8) India	Medical and paramedical personnel, mostly in private institutions	2002	16	Children	Unknown	Cases referred to a children's hospital in New Delhi
Pandian et al. (9) India	In 86% of patients, IM injections given by unqualified personnel, 14% by doctors and nurses	1990–2003	36	Mean age 28 years (range 5–75 years) 77% men	Analgesics, antipyretics, vitamins	Retrospective review of patients with nerve injuries referred to a neurophysiology centre
Tak et al. (10) India	83% of injections given by unqualified persons, 17% by qualified nurses	2002–2007	278	Mean age 37 years (two-thirds < 10 years) 46% men	Unknown	Patients attending an orthopaedic department
Senes et al. (11) Italy	13 patients were from IM injections during neonatal resuscitation	1990–2009	17	Infants	Phenobarbital (6), cephalosporins (3), vitamin K (2), naloxone (1), unknown (5)	Children with sciatic nerve palsy referred to a regional orthopaedic unit
Fatunde & Familusi (12) Nigeria	Most injections carried out by staff with minimal training in private medical facilities	1988–1999	27	Children < 12 years (74% ≤ 5 years)	Chloroquine, Procaine penicillin, Antibiotics	Children referred to a University hospital
Adetunji et al. (13) Nigeria	Injections given by nurses in hospitals or health care centres	2004–2005	40	25 boys : 15 girls 77.5% ≤ 5 years	Treatment of malaria (25), Immunisations (2)	Referrals to physiotherapy unit with catchment population of 3 million
Hamzat & Omotade (14) Nigeria	Not stated	1999–2004	95	Children ≤ 12 years	Unknown	Children referred to a University Hospital physiotherapy clinic [same hospital as Fatunde & Familusi (12)]
Ezeukwu (15) Nigeria	Injections given at chemists (51%), private hospitals (20%), tertiary hospitals (9%), health centres (8%) and by relatives (12%)	2001–2005	313	Children (84% ≤ 5 years) 53% men	Unknown	Children referred to a University physiotherapy clinic
Fapojuwo et al. (16) Nigeria	Unknown	2004–2006	160	Children 90%, 60% men	Unknown	Children referred to a physiotherapy department in a State hospital
Napiontek & Ruszkowski (17) Poland	All cases followed IM buttock injection in infancy	1976–1991	8	7 boys, Age < 13 years	Antibiotics	Children referred to an orthopaedic department
Villarejo & Pascual (18) Spain	Half of the cases were from an IM injection in infancy	1965–1984	370	Children < 9 years (184 ≤ 1 years)	Mostly antibiotics	Children referred to a neurosurgery unit. 305 had predominantly motor loss while 65 had predominantly sensory loss
Iyer and Shields (19) USA	Not recorded	1983–1989	3	Not stated	Unknown	Patients referred to a University neurology clinic
Yuen et al. (20) USA	Not recorded	1984–1994	2	≥ 10 years	Unknown	Patients referred for electrophysiological studies
Sobel et al. (21) USA	Treatment of knee pain	1994	1	55 years woman	Ketorolac (NSAID)	Severe pain, difficulty in walking, foot drop, numbness. Residual numbness and weakness 2 years later
Kline et al. (22) USA	Not recorded	1967–1991	136	< 1–75 years (10 children)	Mostly analgesics and antiemetics	Referrals to a State University neurosurgical unit

IM, intramuscular; NSAID, non-steroidal anti-inflammatory drug.

Table 3 Published medicolegal reports of sciatic nerve injection injury (1989–April 2009)

Report	Clinical setting	Drug	Settlement	Comments
De Las Nueces v. Long Island College Hospital (23) New York, USA	Intragluteal IM analgesia for pain after childbirth given by registered nurse	Meperidine	Compensatory damages of \$450 000	37-year-old woman plaintiff claimed that the nurse placed the injection too close to the middle of buttock
Seip v. South Saskatchewan Hospital Center (24) Saskatchewan, Canada	Postoperative intragluteal IM injection by nurse	Not stated in report	\$186 431 awarded	Following surgery for Crohn's disease
Norfleet v. Southern Baptist Hospital (25) Louisiana, USA	Intragluteal IM injection to mother during delivery by hospital employee	Not stated in report	Compensatory damages of \$434 197	Female patient during labour
Lowe v. New York Hospital-Cornell Medical Center (26) New York, USA	Intragluteal IM injection by nurse to treat an infection	Penicillin	Settled for \$240 000	Defendant argued injection was correctly sited and that plaintiff's symptoms were because of a herniated intervertebral disc (confirmed on MRI). 27-year-old woman plaintiff claimed the disc herniation was a result of a fall sustained as a result of the injection injury
Roberts v. Cape Breton Regional Hospital (27) Nova Scotia, Canada	Intragluteal IM injection by student nurse in emergency room for renal colic	Analgesic	\$611 821 awarded	Dorsogluteal site was most commonly used for IM injections at this hospital at the time according to nurse instructor
Perry v. Magic Valley Regional Medical Center (28) Idaho, USA	Intragluteal IM injection by emergency room nurse for treatment of infected cut on toe	Tetanus toxoid and tetanus immunoglobulin	Economic damages of \$1 550 000 & non-economic damages of \$150 000	Nurse documented that the injection was administered to the 'hip area', but plaintiff and witness alleged injection was into middle of buttock
Plaintiff v. Doe Hospital (29) USA	Intragluteal injection of pain relief medication by emergency room nurse for renal colic	Promethazine and hydromorphone	\$305 000 settlement	38-year-old woman
Lovett v. Lorain Community Hospital (30,31) Ohio, USA	Intragluteal IM injection by student nurse supervised by a registered nurse at a community hospital	Meperidine (opiate) Hydroxyzine	Not specified	The patient settled with the student and registered nurse, but pursued a claim against the hospital
Torres-Perez v. U.S. (32) Camuy, Puerto Rico	Intragluteal IM injection by nurse for treatment of a viral infection at a federally supported hospital outside US	Trimethobenzamide (antiemetic)	\$170 000 damages	EMG studies conclusive of a sciatic nerve injury

IM, intramuscular; MRI, magnetic resonance imaging.

'upper outer quadrant' lacks precision. The buttock is defined as 'one of two protruberances of the rump' (41), whereas the gluteal region extends between the

iliac crest superiorly and the gluteal fold inferiorly all the way from the midline posteriorly to a line joining the greater trochanter of the femur and anterior

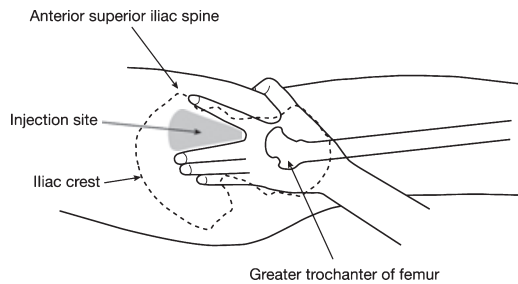


Figure 1 The gluteal triangle for IM injection (ventrogluteal region). The palm of the opposing hand is placed on the greater trochanter and the index finger on the anterior superior iliac spine. A triangle is formed with the middle finger pointing towards the iliac crest. The injection site is the centre of the triangle, with the needle inserted at 90° to the skin surface

superior iliac spine laterally. Use of the dorsogluteal region not only risks damaging the sciatic nerve but it also is not a good site for IM injection. In one study of 100 consecutive adults, the depth of adipose tissue in this region was beyond the 35 mm limit of a 21 g (green) needle in 43% (42). In another study of 50 hospitalised patients receiving an IM injection in the 'upper outer quadrant' of the buttock with a 30 mm length needle, injections were IM in only 32% of patients (8% in women); most were subcutaneous (43).

No IM injection site is without hazard, including the anterolateral thigh and deltoid regions. In the gluteal region, the ventrogluteal area (Figure 1) is safer, with only one reported significant complication (44). This site has less subcutaneous fat (43), offers the combined thickness of gluteus medius and minimus muscles, has relatively minor nerves and blood vessels and can be accessed with the patient on his/her side or lying supine (2). Despite this, nurses have been reluctant to use this site (2,39,40); a recent survey in New Zealand showed that only 9% of nurses had used this site (45). This may partly be because of the lack of confidence in identifying the area (40,45). Perhaps the cumbersome term 'ventrogluteal' should be replaced with an alternative, such as the 'gluteal triangle', to avoid confusion with the dorsogluteal region and the buttock.

Acknowledgements

We wish to thank Dr Dylan Tapp, Clinical Analyst, Accident Compensation Corporation, New Zealand; the Nursing organisations that assisted with our enquiries; Robbie McPhee, Medical illustrator/Graphic artist and staff at the Law and Medical Libraries, University of Otago and the Victoria University Law Library, Wellington, New Zealand.

Funding

None.

Author contributions

MDS conceived the idea and PM and MDS were jointly involved in the design of the study, data collection and analysis, and drafting and critical revision of the article.

References

- Rodger MA, King L. Drawing up and administering intramuscular injections: a review of the literature. *J Adv Nurs* 2000; **31**: 574–82.
- Small SP. Preventing sciatic nerve injury from intramuscular injections: literature review. *J Adv Nurs* 2004; **47**: 287–96.
- Malkin B. Are techniques used for intramuscular injection based on research evidence? *Nurs Times* 2008; **104**: 48–51.
- Royal College of Paediatrics and Child Health (UK). *Position Statement on Injection Technique*. London: Royal College of Paediatrics and Child Health, March 2002. ISBN 1-900954-61-3.
- Van Langenhove M, Pollefliet A, Vanderstraeten G. A retrospective electrodiagnostic evaluation of footdrop in 303 patients. *Electromyogr Clin Neurophysiol* 1989; **29**(3): 145–52.
- Marcuse EK, MacDonald NE. Neurologic injury after vaccination in buttocks. *Can Med Assoc J* 1996; **155**: 374.
- Ramtahal J, Ramlakhan S, Singh K. Sciatic nerve injury following intramuscular injection: a case report and review of the literature. *J Neurosci Nurs* 2006; **38**(4): 238–40.
- Ahuja B. Post injection sciatic nerve injury. *Indian Pediatr* 2003; **40**: 368–9.
- Pandian JD, Bose S, Daniel V, Singh Y, Abraham AP. Nerve injuries following intramuscular injections: a clinical and neurophysiological study from Northwest India. *J Peripher Nerv Syst* 2006; **11**: 165–71.
- Tak SR, Dar GN, Halwai MA, Mir MR. Post-injection nerve injuries in Kashmir: a menace overlooked. *J Res Med Sci* 2008; **13**: 244–7.
- Senes FM, Campus MD, Becchetti F, Catena N. Sciatic nerve injection palsy in the child: early microsurgical treatment and long-term results. *Microsurgery* 2009; **29**: 443–8.
- Fatunde OJ, Familusi JB. Injection-induced sciatic nerve injury in Nigerian children. *Cent Afr J Med* 2001; **47**: 35–8.
- Adetunji OO, Olusola EP, Joseph AO, Dare OJ, Ademola OG, Segun O. Injection-induced sciatic nerve injuries among children seen at a Nigerian physiotherapy unit. *Internet J Third World Med* 2006; **3**. http://www.ispub.com/journal/the_internet_journal_of_third_world_medicine/volume_3_number_2_53/article/injection-induced_sciatic_nerve_injuries_among_children_seen_at_a_nigerian_physiotherapy_unit.html (accessed June 2009).
- Hamzat TH, Omotade TT. Acute flaccid paralysis: a five-year review of cases managed by physiotherapy at the University College Hospital, Ibadan. *Afr J Health Sci* 2006; **13**: 28–32.
- Ezeukwu AO. Injection-induced sciatic nerve injury among children managed in a Nigerian physiotherapy clinic: a five year review. *J Med Rehabil* 2007; **1**(1): 22–4.
- Fapojuwu OA, Akinlade TS, Gbiri CA. A three year review of sciatic nerve injection palsy in the Physiotherapy Department of a Nigerian Specialist Hospital. *Afr J Med Med Sci* 2008; **37**: 389–93.
- Napiontek M, Ruszkowski K. Paralytic drop foot and gluteal fibrosis after intramuscular injections. *J Bone Joint Surg [Br]* 1993; **75-B**: 83–5.

- 18 Villarejo FJ, Pascual AM. Injection injury of the sciatic nerve (370 cases). *Childs Nerv Syst* 1993; **9**(4): 229–32.
- 19 Iyer VG, Shields CB. Isolated injection injury to the posterior femoral cutaneous nerve. *Neurosurgery* 1989; **25**(5): 835–8.
- 20 Yuen EC, So YT, Olney RK. The electrophysiologic features of sciatic neuropathy in 100 patients. *Muscle Nerve* 1995; **18**(4): 414–20.
- 21 Sobel E, Huang EY, Wieting CB. Drop foot as a complication of acupuncture injury and intragluteal injection. *J Am Podiatr Med Assoc* 1997; **87**(2): 52–9.
- 22 Kline DG, Kim D, Midha R, Harsh C, Tiel R. Management and results of sciatic nerve injuries: a 24-year experience. *J Neurosurg* 1998; **89**(1): 13–23.
- 23 De Las Nueces v. Long Island College Hospital (1991) 609 N.Y.S.2d 592; N.Y. App. Div. LEXIS 2813
- 24 Seip v. South Saskatchewan Hospital Center (1992) 97 Sask. R. 39 (Sask. C. A.)
- 25 Norfleet v. Southern Baptist Hospital (1993) 623 So. 2d 891; La. App. LEXIS 2716
- 26 Turkewitz E. (1994) Lowe v. New York Hospital-Cornell Medical Centre. <http://www.turkewitzlaw.com/cases/bronx-personal-injury-attorney-nurse-malpractice-injection.htm> (accessed June 2009).
- 27 Roberts v. Cape Breton Regional Hospital (1997) 162 N.S.R. (2d) 342 (N.S.S.C.)
- 28 Perry v. Magic Valley Regional Medical Centre (2000) 995 P.2d 816; Ida. LEXIS 11
- 29 Vaage R (2001) Plaintiff v. Doe Hospital. <http://www.vaagelaw.com/viewcase.asp?case=45> (accessed June 2009).
- 30 Tammelleo AD. Student nurse punctured sciatic nerve: was hospital liable? Case on point: Lovett v. Lorain Community Hospital, 2004 WL239927 N.E.2d -OH. Nursing Law's Regan Report 2004: p4(1) April 1, 2004
- 31 Lovett v. Lorain Community Hospital (2004) Ohio App. LEXIS 568
- 32 Torres-Perez v. U.S. (2008) 530 F.Supp.2d 429. U.S. Dist. LEXIS 2146.
- 33 Mansoor F, Hamid S, Mir T, Abdul Hafiz R, Mounts A. Incidence of traumatic injection neuropathy among children in Pakistan. *East Mediterr Health J* 2005; **11**: 798–804.
- 34 Sunderland S. The relative susceptibility to injury of the medial and lateral popliteal divisions of the sciatic nerve. *Br J Surg* 1953; **41**: 300–2.
- 35 Streib EW, Sun SE. Injection injury of the sciatic nerve: unusual anatomic distribution of nerve damage. *Eur J Neurol* 1981; **20**: 481–4.
- 36 Salisbury D, Ramsay M, Noakes K (eds.) *Immunisation Against Infectious Disease*. London: Department of Health, 2006: p.27.
- 37 American Academy of Pediatrics. Active Immunization. In: Pickering LK, Baker CJ, Long SS, McMillan JA, eds. *Red Book: 2006 Report of the Committee on Infectious Diseases*, 27th edn. Elk Grove Village, IL: American Academy of Pediatrics, 2006: p.19–20.
- 38 Australian Technical Advisory Group on Immunisation of the Australian Government Department of Health and Ageing. *The Australian Immunisation Handbook*, 9th edn. Australian Government, 2008: p.45–6.
- 39 Carter-Templeton H, McCoy T. Are we on the same page?: a comparison of intramuscular injection explanations in nursing fundamental texts. *Medsurg Nursing* 2008; **17**: 237–40.
- 40 Wynaden D, Landsborough I, McGowan S, Baigamohamad Z, Finn M, Pennebaker D. Best practice guidelines for the administration of intramuscular injections in the mental health setting. *Int J Mental Health Nurs* 2006; **15**: 195–200.
- 41 *Oxford English Dictionary*. Online. Oxford: Oxford University Press, 2009.
- 42 Nisbet AC. Intramuscular gluteal injections in the increasingly obese population: retrospective study. *BMJ* 2006; **332**: 637–8.
- 43 Chan VO, Colville J, Persaud T, Buckley O, Hamilton S, Torreggiani WC. Intramuscular injections into the buttocks: are they truly intramuscular? *Eur J Radiol* 2006; **58**: 480–4.
- 44 Muller-Vahl H. Isolated complete paralysis of the tensor fasciae latae muscle. *Eur Neurol* 1985; **24**: 289–91.
- 45 Floyd S, Meyer A. Intramuscular injections – what's best practice? Why is there such a gap between what is taught in nursing schools about the best sites and technique for intramuscular injections and what actually happens in practice? Two nurses decided to find out. *N Z Nurs J* 2007; **13**: 20–2.

Paper received June 2009, accepted July 2009

Appendix

List of individuals and Nursing Organisations who kindly responded to our enquiries: Cathy Gilmore, Professional Nurse Advisor (Southern), New Zealand Nurses Organisation; Professor Jenny Carryer, New Zealand College of Nurses; Mark Braybrook, Professional Officer, International Section, Australian Nursing and Midwifery Council; Ian Hulatt and Rose Gallagher, Royal College of Nursing (UK); Mary Moon Allison, Director, Accreditation Program, American Nurses Credentialing Center; Linda Christensen, Chief Administration Officer, National League for Nursing (USA); Dr Di Fang, Director of Research and Data Services, American Association of Colleges of Nursing; Laura McNamara, Clinical Practice Specialist, American Association of Critical Care Nurses; Dr Nancy Chornick, Director, Outreach Services, National Council of State Boards of Nursing (USA).