

The dorso–ventro debate: in search of empirical evidence

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Abstract

Identification of safe injections sites is a skill practised routinely by nurses, which, as with all nursing practice, is informed by empirical evidence. Despite this, discussion as to whether the dorsogluteal site should be eradicated from nursing practice in favour of the ventrogluteal site shows no sign of abating. Review of commonly cited evidence in this debate aimed to identify the validity of excluding the dorsogluteal site in favour of the ventrogluteal site by investigating the empirical evidence, which routinely informs this decision. Empirical evidence suggests a case to exclude the dorsogluteal site for children under age 10 for fear of damaging the sciatic nerve, but not so for adults. Recommendations are made for conclusive research into the viability of the dorsogluteal site and an authoritative decision based on empirical evidence, not hearsay, with regard to its continuance or eradication from nursing practice.

Key words: Dorsogluteal site ■ Ventrogluteal site
■ Intramuscular injections ■ Sciatic nerve

Definitive research should inform nursing policy and procedures—this is the basis for evidence-based practice espoused by nursing professionals. How then can a basic clinical skill such as identifying an injection site, performed so routinely by nursing staff as to be considered routine practice, be so contested and potentially influenced by hearsay?

The choice of which site to use for an injection is dictated by the medication for administration. Where multiple sites are an option, it falls to the nurse to choose the site, based on patient preference, clinical need and professional expertise. For intramuscular injections, five sites are indicated: the deltoid (arm); vastus lateralis (VL) and rectus femoris (RF) (thighs); and ventrogluteal (VG) and dorsogluteal (DG) (buttocks) (Dougherty and Lister, 2015) (*Box 1* and *Box 2*). The latter two sites are the most commonly used, yet divisive with regard to clinical practice.

Academics argue for and promote the use of the ventrogluteal site for intramuscular injections by nurses (Workman, 1999; Greenway, 2004). They state that the ventrogluteal site is easy

to locate; requires minimal movement of the patient to access it; is a good size to accept the needle; and is proven to be safe for the patient. Importantly, the ventrogluteal site is also outside the immediate vicinity of the sciatic nerve, which has allegedly been struck when injections have been given in the dorsogluteal site, causing injury to the patient.

The sciatic nerve is the longest, thickest single nerve in the body. It exits between lumbar vertebra 3 and 4, carrying on through the buttocks, passing close to the dorsal gluteal site, to the foot, following the line of the femur (Waugh and Grant, 2014). It could be irreparably damaged if inadvertently struck by an errant needle or impeded by the injected fluid, leading to pain and potentially paralysis. Similarly, the sciatic vein and artery run close to the nerve, and are at risk of being ruptured if penetrated by an errant needle, leading to pain and bruising.

The reported risk of injury is surely sufficient to confine the dorsogluteal site to history, given the proximity of the site to a major nerve and blood vessels, whereas the ventrogluteal is not affected by such factors. At first glance, the evidence appears to support such a notion. Yet, on careful consideration of commonly cited historical and contemporary evidence, the issue is not so clear-cut.

The evidence: analysis of commonly cited references in chronological order

Zelman (1961) states that the dorsogluteal site is safe to use because:

‘It avoids the blood vessels and nerves, which are present in profusion in the upper inner quadrant, and the great sciatic nerve in the lower inner quadrant.’ (Zelman, 1961: 563)

Zelman emphasises the dangers of administering an injection anywhere but the ‘upper outer quadrant’ when using the dorsogluteal for injections:

‘The necessity for meticulous care in carrying out the details of that technique is emphasised, if needless pain and morbidity are to be avoided.’ (Zelman, 1961: 573)

He provides two examples where there were issues following injections into the ‘dorsogluteal area’, one in the ‘buttocks’ and one in the ‘inner quadrant’, both outside the designated dorsogluteal site.

Beechcroft and Redick (1990) discuss administration of injections in paediatric nursing, providing a single sentence that cites Newton and Newton’s (1979) and McConnell’s

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Box 1. Glossary

- Dorso / dorsal = the upper side or back
- Ventro / ventral = to the front
- Medius = middle
- Gluteal = gluteal muscle group (Greek *gloutos* = buttocks)
- Vastus = large (muscle)
- Lateralis = the side
- Deltoid = triangle
- Rectus = straight
- Femoris = femur

Box 2. Procedure

Locating sites for injections is a subjective process—there is no guaranteed means of identifying either site. However, if you follow the guidance correctly, both sites are safe, provided that you:

- Identify the injection sites recommended by the manufacturer of the medication to be administered
- Offer the options to your client (if appropriate) and ascertain their preferred site
- Adhere to the local policy on intramuscular injections, administer and record the injection, then monitor your client

(1982: 23) advocacy of ‘the use of the ventrogluteal for the non-walking, elderly or emaciated’. McIvor et al (1991) note that, from a study of 12 134 patients who had an intramuscular injection, none reported issues with sciatic nerve damage. Citing Gilles and Matson’s (1970) study as their source, they note that the dorsogluteal is deemed to be a problem in paediatrics, although they give no statistics to support this claim. Crucially, McIvor et al (1991) point out that it was ancillary staff who administered injections in their study. This may have a bearing on reported dorsogluteal injection injuries due to inadequate training of the non-registered nurses, as could poor technique by doctors.

This is a point reinforced in part by Pandian et al (2006) who found that from a cohort of 4701 patients in India, 36 had a sciatic nerve injury following an intramuscular injection. They also say that over 40% of ‘doctors’ administering injections had no formal medical degree. Newton et al (1992: 36) identify the dorsogluteal site as being ‘maybe the most dangerous’ because if the needle is inserted outside the designated area it ‘could damage the sciatic nerve or puncture the superior gluteal artery’. They cite no evidence to support their claim, although this does reiterate Zelman’s (1961) stance that it is potentially dangerous if it is not administered in the correct area.

Beecroft and Kongelbeck (1994: 207) state that ‘certain drugs are responsible for nerve damage even when injected near the nerve’ (distance not stated), a point they say should be considered when administering injections, as should the length of the needle, to avoid unintended subcutaneous injections in ‘obese’ patients. Further, they note that:

‘The relationship of poor, inadequate technique to adverse effects is not mentioned sufficiently in the literature, even though recommendations are made to change practice.’ (Beecroft and Kongelbeck, 1994: 210)

Empirical evidence?

Much ‘evidence’ is really little more than opinion. Decisive empirical statistical data that definitively support the use of the ventrogluteal site or rebut the use of the dorsogluteal site are elusive, as the following commonly cited articles show.

Beyea and Nicoll (1995) cite Zelman (1961) in their rationale of promoting the ventrogluteal over the dorsogluteal site, stating that there is ‘an impressive research base’ that supports this, but without presenting the research base. Campbell (1995: 457) correctly identifies that ‘with poor technique, nerve damage is possible. This will not occur if the site is selected carefully’. Beyea and Nicoll (1995), Campbell (1995), Covington and Trattler (1997) and Zelman (1961) cite no empirical evidence to suggest that the dorsal gluteal is ‘ineffective, inappropriate and potentially dangerous’, as later stated by Greenway (2004: 39), who cites them in her discussion. Beyea and Nicoll (1996) suggest the ventrogluteal site, supporting this with uncited research, then go further by suggesting that all other sites have been associated with injury, but they do not provide further discussion or evidence on this point. Winslow (1996) concurs that the ventrogluteal site is preferable to the dorsogluteal site, citing Beyea and Nicoll (1995) and Beecroft and Kongelbeck (1994), although no empirical evidence is presented by Winslow in support.

Covington and Trattler (1997) have no citations for any evidence, but state that the dorsogluteal site should be avoided in case the sciatic nerve is hit, the artery pierced, or the ‘injecturate’ administered subcutaneously. Kline et al (1998) identified 136 cases where sciatic injury had occurred from injections in the dorsogluteal ‘buttocks’ site from 1967 to 1991 in the USA. Kline et al note that:

‘Sciatic nerve injury was encountered when the site of the insertion was located more medial and/or inferior than the recommended site of the upper, outer quadrant of the buttock in an individual of normal habitus’. Kline et al (1998: 16)

Again, this is in line with Zelman’s (1961) assertion to use only the correct area for administration; they do not indicate who administered the injection. Where the needle was reported to be inserted in the ‘correct site’, Kline et al (1998) identified a higher incidence of sciatic-nerve damage in children (10) and in older people (no statistics offered) who were emaciated due to age or debilitating disease, a finding that concurs with Beecroft and Redick (1990).

Contemporary ‘research’

Workman (1999) says there may be:

‘Complications associated with the dorsogluteal site as there is a possibility of damaging the sciatic nerve or the superior gluteal artery’. Workman (1999: 49)

No empirical evidence is cited in support. Rodger and King (2000: 575) contend that ‘injury constitutes a major threat with the use of the dorsogluteal area’ and that there are only ‘a few’ centimetres from the dorsogluteal site to the sciatic nerve and superior gluteal artery. They do not give specific distances between the dorsogluteal site and sciatic nerve or

blood vessels, nor empirical evidence to support their claim. They cite Kozier et al's *Techniques in Clinical Nursing* (1993), which presents no empirical evidence to support their stance either. Gilson (2000) advocates the gluteus medius (ventrogluteal site) for intramuscular injections, although cites no evidence in support.

Nicoll and Hesby (2002) point out that the ventrogluteal and dorsogluteal are so closely associated as to be injected inadvertently and unknowingly into one another by practitioners, a point the author notes anecdotally when observing practitioners giving injections.

Shaw (2002: 18) states that the dorsogluteal 'can be problematic' due to the 'major nerves, and blood vessels and the thick layer of adipose tissue', but does not support this statement with empirical evidence. She says that when using the dorsogluteal site 'great care needs to be taken to accurately identify the landmarks', a point applicable to all injection sites (Shaw, 2002: 18). Marfell-Jones and Scott (2004: 14) believe that it has 'long been established that there are inherent dangers when using this [dorsogluteal] site', citing Craven and Hirnle (2003), Nicoll and Hesby (2002) and Rodger and King (2000). They also note that:

'Gravity, positioning of the client and the needle site too close to the buttock crease, may jeopardise the sciatic nerve and the outer aspect risks finding the bone' (Marfell-Jones and Scott, 2004: 14).

Furthermore, the dorsogluteal site is associated with:

'Poor or slow uptake, as medication deposited in subcutaneous fat takes longer to absorb than that injected into muscle' (Marfell-Jones and Scott, 2004: 14).

However, to inject into the subcutaneous tissue is an injection-administration error, not evidence that the dorsogluteal muscle has a slow uptake. Of note was Grabinski (1983) who compared deltoid and gluteal sites (non-specific) for medication-uptake differences using analgesics, morphine and methadone, for plasma and analgesic differences. Grabinski states that the deltoid is superior to the gluteal sites for uptake speed and effectiveness. Some medications, such as long-acting depot neuroleptics, do not lend themselves to fast uptake and this would be a disadvantage for them (Gillespie and Toner, 2013).

Greenway (2004: 39) states that the dorsal gluteal site is 'ineffective, inappropriate and potentially dangerous'. She identifies five citations with a mean age of 25 years to support her claim, none of which have empirical evidence. Small (2004: 287) makes the distinction that complications that arise from giving injections can be 'attributed to lack of knowledge of the procedure and improper technique' not the actual site, a point supported by Beecroft and Kongelbeck (1994) and Zelman (1961). However, she goes on to identify 'numerous' (71) reports of sciatic-nerve injuries in Canada from 1970 to 1990, which drop dramatically (to 4), without explanation, from 1990 to 1998. The cases themselves are not explained, nor are the people who administered the injections identified, so the statistics are not quantifiable. Small surmises that it is the 'evidenced' preference of authors,

who then, by airing their views, influence easily swayed practitioners to discount the dorsogluteal site—and so the cycle goes on. Despite this, Small inexplicably recommends the ventrogluteal over the dorsogluteal.

Donaldson and Green (2005) refer to commonly cited authors, replicating the same information about the significant risks associated with the dorsogluteal site because the sciatic nerve and superior gluteal artery are 'a few' centimetres from the intended site and may be injured; that adipose tissue may prevent the 'injecturate' reaching the muscle; and that the absorption rate is slowest because the muscle is 'likely' to have atrophied in older people (although the age of 'older people' is not defined). Wynaden et al (2006: 198) note that the dorsogluteal is 'historically associated with potential damage to the sciatic nerve'. They state that Australian nurses are reluctant to abandon the dorsogluteal for the ventrogluteal because of the difficulty in locating the ventrogluteal site accurately, and the perceived perception of self-injury when using the V-finger method of identifying the site before insertion of the needle. This is of particular note where rapid injection is to be used or for non-compliant patients who are under mental-health legislation.

One point of interest is that Wynaden et al (2006) could not, as reported by Cocoman and Murray (2008), be cited as 'supporters' of the dorsogluteal site. They simply question the lack of evidence challenging its use, perhaps suggesting a lack of tolerance of opinions that differ from their own. Greenway et al (2006) refer to Greenway's initial representation of evidence from Small (2004) and Covington and Trattler (1997) that the dorsogluteal site is associated with issues relating to sciatic nerve damage and also to Nisbet's (2006) identification of issues regarding adipose tissue deposits, inhibiting needles reaching both the dorsogluteal and ventrogluteal sites. They identify the anatomy and physiology of the sciatic nerve and gluteal arteries, and the risk these pose 'if' struck, as they are 'a few' centimetres from the dorsogluteal site. Yet they provide no empirical evidence to support the danger, nor do they give specific measurements from the dorsogluteal site to any anatomical hazards.

Nisbet (2006) focuses on subcutaneous fat at the gluteal muscular injection sites. He suggests that computed-tomography (CT) imaging identifies that in a 'minority' of patients, green needles may not be long enough to penetrate the adipose tissue and reach the muscle in the posterior gluteal injection site. He did not carry out the injections but instead measured the adipose tissue without recourse to injection techniques such as Z-tracking or needle selection from clinical judgement. Injecting into adipose tissue is an administration error and can cause problems for the recipient. To eliminate this, obese patients may require a longer needle as well as Z-tracking (*Box 3*). Adherence to policy and protocol will eradicate administration issues with obese patients.

Wynaden et al (2006) cite Beecroft and Redick (1990), McIvor et al (1991) and Covington and Trattler (1997) to support their recommendation of the ventrogluteal over the dorsogluteal. However, they do note—from their own research—that nurses preferred the dorsogluteal over the ventrogluteal due to the difficulty in identifying the

ventrogluteal site. Further, Floyd and Meyer (2007) comment that Nicoll and Hesby (2002), Small (2004) and Scott and Marfell-Jones (2004) all state that the ventrogluteal site (and the vastus lateralis site) are not regularly used, but do not explain why, despite the apparent danger when using the dorsogluteal site. They go on to cite Small (2004: 20) when stating 'the most serious of many injuries associated with IM [intramuscular] injections is associated with the sciatic nerve'. They then refer to Greenway's (2004) claim that the dorsogluteal site is unsuitable due to this, but without presenting any empirical evidence in support.

Current 'research'

Malkin (2008) stated that contemporary evidence-based practice should not rely on old and anecdotal discussion, and said that injection sites needed further exploration and research. She goes on to discount the dorsogluteal site because Plotkin (2008), in his book on vaccinations, considers that neither the World Health Organization nor the UK Department of Health recommends it, although there is no clear pathway to this evidence nor discussion as to why they do not recommend it. Hunter (2008) identifies the dorsogluteal site as one of five that can be used, although she recommends the ventrogluteal and vastus lateralis on the 'evidence' of Donaldson and Green (2005) and Nisbet (2006).

Cocoman and Murray (2008: 1171) state that the dorsogluteal site is 'problematic' due to the 'presence of major nerves and blood vessels'. No anatomy or physiology is presented to indicate distances, instead they suggest a 'few centimetres'. They state that the dorsogluteal site has a 'relatively slow uptake' but do not indicate the time in comparison with other sites, or whether it is problematic for medication efficacy; they also state that 'great care needs to be taken to identify landmarks accurately' (Cocoman and Murray, 2008: 1171, 1171). This, surely, is basic nursing practice that applies to all injections? Cocoman and Murray (2010: 1171) suggested that injections in the dorsogluteal site in the USA 'appear to have lost favour' but do not support this with statistics, whereas Wynaden et al (2006) and Walsh and Brophy (2010) cite evidence to the contrary. Cocoman and Murray (2008) replicate their original discussion without citing any new empirical evidence, and Hunt (2008) refers to Donaldson and Green (2005)

Box 3. Z-tracking prevents the medication 'tracking' back through the hole, made by the needle as it is withdrawn, into the adipose and subcutaneous tissues

- Before administration of the needle, the skin is pulled taught, in any direction, displacing the subcutaneous and adipose layers. The needle is inserted, at a safe distance from the hand, and the medication injected into the muscle. The needle is removed and the skin is released immediately
- As the subcutaneous and adipose tissue return to their resting position, this creates a displacement (stepping of the layers) of the original needle pathway, projecting a 'Z'-type appearance and preventing the medication 'tracking' back along the hole the needle has temporarily made

Source: Antipuesto (2010)

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KEY POINTS

- Identification of injection sites is a basic nursing skill, as with all nursing skills this needs to be based on evidence
- The choice between the ventrogluteal and the dorsogluteal site should be judged on clinical need, patient preference and empirical evidence
- There is a lack of conclusive evidence to exclude the use of the dorsogluteal site in adults
- Nursing students and registered nurses across all disciplines should be trained and regularly refresh their skills to identify all injection sites and administer injections
- Conclusive empirical evidence would be needed for the eradication of the dorsogluteal site from nursing procedures and for the promotion of the ventrogluteal site

and Greenway (2004) when discussing the advantages and disadvantages of the two sites.

Carter-Templeton and McCoy (2008) note that 80% of nurses used the dorsogluteal site, despite recommendations from Craven and Hirnle (2007) who, along with Taylor et al (2005), do not recommend the dorsogluteal site, although they cite no empirical evidence to support their stance. Carter-Templeton and McCoy (2008: 238) cite Taylor et al (2005) who suggest that 'the nurse refer to his or her institutional policy' when considering which site to use, and Potter and Perry (2005), who believe 'the use of the dorsogluteal site may be discouraged by many researchers' and they do not recommend it. Carter-Templeton and McCoy (2008: 238) identify that Nicoll and Hesby (2002), Rodger and King (2000) and Beyea and Nicoll (1995) 'did not advocate the utilisation of this site for injections'. They note that Harkreader and Hogan (2004) do recommend the dorsogluteal site, but not for children under 3 years of age. None of these authors cite empirical evidence to substantiate their stance on either site.

Walsh and Brophy (2011) argue for the ventrogluteal being used instead of the dorsogluteal due to the 'potential' for damage, although they note the dorsogluteal is still the favoured site for most nurses because of its familiarity and the ease of mapping its position, as suggested by Wynaden et al (2006). They cite Greenway et al (2006) when recommending the ventrogluteal site with rapid tranquilisation. One may question the practice of this procedure, given the potential for needle-stick injury to the practitioner when attempting to administer an injection to non-compliant patients by adhering to the procedure for the ventrogluteal site. Finally, Gillespie and Toner (2013) identify the need for further study before conclusions are drawn with regard to excluding the dorsogluteal site, especially for depot medication.

Sciatic nerve damage

Mishra and Stinger (2010) conducted a comprehensive review of statistics pertaining to sciatic-nerve injuries. They identified eight incidents of sciatic-nerve damage resulting from intramuscular injections from the Accident

Compensation Corporation of New Zealand, over a 3-year study period. Of the eight injuries, two had existing neck or back issues and 'the type of professional [administering the injection] was not recorded' (Mishra and Stinger, 2010: 1574). They noted: 'only one of the nursing organisations contacted had published guidelines on IM [intramuscular] injections' (Mishra and Stinger, 2010: 1574). This was the UK Royal College of Nursing (RCN) and was for the purpose of immunisation. Mishra and Stinger go on to identify international reports of sciatic-nerve damage, which indicate numerous sciatic-nerve injuries, mostly in developing-world environments, in children under the age of 10 years, or before 1994.

For the period after 1994, Mishra and Stinger (2010) identify five litigated cases documented in developed countries, where nursing staff, two of whom were students, administered injections into the dorsogluteal site.

- In Canada in 1997 a patient claimed injury following an intramuscular injection into the dorsogluteal site. The defendants cited a disk disorder as the cause of the sciatic pain, not the injection
- In the USA in 2000 the defendant cited chronic back disorder, not the dorsogluteal injection, and accused the patient of lying about the reason for sciatic pain
- In the USA in 2001 the case had no details that could be sourced
- In the USA in 2004 a plaintiff accused a student nurse of rupturing their sciatic nerve, causing injury
- In Puerto Rico in 2008 a patient who had a leg tumour argued that because the nurse had not sufficiently detailed (recorded) where the injection had been sited, this was sufficient to suggest that sciatic-nerve damage 'could' have been caused by injection into the dorsogluteal site. None of these cases is clear and unambiguous.

Discussion

There are 12–16 billion injections given every year in the USA alone (Nicoll and Hesby, 2002, Carter-Templeton and McCoy, 2008) and millions in the UK. Given these statistics and the apparent dangers of the dorsogluteal site, statistically, over a protracted period, reported injuries should be commonplace. Yet this is not the case.

Where sciatic-nerve injury was associated with the dorsogluteal site in adults, there was a documented lack of training and education with regard to injection techniques by the 'practitioners' administering the injections.

With regard to children, Mishra and Stinger (2010) identified that, in their literature review, 87% (1305 of 1506) of cases of sciatic-nerve damage were in children under 10 years. This, along with Barron and Cocoman's (2007) assertion that the vastus lateralis should be used in children under 2 years and the deltoid for children over 2 years due to difficulties with accurately identifying the ventrogluteal site, is reason to exclude children from the use of the dorsogluteal site and the ventrogluteal site, until further research confirms their viability and safety in this age group.

Although this is not an exhaustive list of studies, it does indicate that there are no conclusive empirical data from clinical trials to exclude the dorsogluteal site or promote

the exclusivity of using the ventrogluteal site in adults. Walsh and Brophy (2011) and Cocoman and Murray (2008) make valid points when they suggest that if the ventrogluteal site is to be promoted as the preferred site over the dorsogluteal site, then a sound rationale for this must be presented—just as the dorsogluteal site needs empirical evidence for it to be excluded from clinical practice in adults.

What is needed is a common-sense approach whereby if empirical evidence clearly states that a procedure is unfit for practice, it should be confined to the annals of nursing history; where it does not, the procedure should be taught and used if and when the nurse needs it. There should be no grey area and no place for hearsay in modern nursing. The need for clinical research and empirical evidence is therefore obvious to end conclusively the dorso-ventro debate. **BJN**

Declaration of interest: none

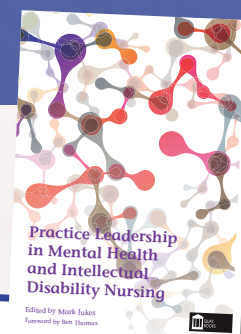
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