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Intramuscular injection technique: an evidence-based approach

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Abstract

Intramuscular injections require a thorough and meticulous approach to patient assessment and injection technique. This article, the second in a series of two, reviews the evidence base to inform safer practice and to consider the evidence for nursing practice in this area. A framework for safe practice is included, identifying important points for safe technique, patient care and clinical decision making. It also highlights the ongoing debate in selection of intramuscular injection sites, predominately the ventrogluteal and dorsogluteal muscles.

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Aims and intended learning outcomes

This article, the second in a series of two, aims to address safe injection practice with particular reference to intramuscular techniques. Methods of minimising the particular risks to the patient of intramuscular injections are discussed and a framework to promote safer practice is provided. Good patient assessment is integral to any injection, and also a fundamental aspect of any nursing procedure – principles of this vital skill are presented. After reading this article and completing the time out activities you should be able to:

- ▶ Describe the common injection sites for intramuscular injections and discuss the advantages and disadvantages of each.
- ▶ List the risks associated with intramuscular injections.
- ▶ List the main steps in injection technique that minimise potential adverse effects.
- ▶ Discuss the principles of patient assessment to maximise the success of intramuscular injections.

Introduction

The first article in this series addressed best practice in injection technique with reference to subcutaneous injections. This article discusses the nurse's role in providing safe and effective intramuscular injections. Intramuscular injections are used for administering medication that requires relatively quick absorption by the body but with reasonably prolonged action (Rodger and King 2000). A range of medicines can be administered intramuscularly in both

the acute and community settings and in a range of disciplines.

The intramuscular injection technique has changed in recent years in response to changes in equipment, and evidence and research have influenced best practice in site selection and patient assessment (Engstrom *et al* 2000, Chung *et al* 2002, Chan *et al* 2003, Zaybak *et al* 2007, Hunter 2008). This article provides an overview of the evidence.

Complete time out activity 1

Injection site

The intramuscular injection deposits medication under the muscle fascia, below the fatty subcutaneous layer, and comparatively large volumes of a drug can be injected because of the rapid absorption into the bloodstream

through muscle fibres (Newton *et al* 1992).

The intramuscular injection site is dependent on the type of medication to be injected, its volume and the patient's age and condition. There is mixed evidence on the recommended sites for intramuscular injections, and good clinical judgement plays an important role in determining the optimum site for the medication prescribed.

There are three muscle groups identified for intramuscular injections: the deltoid muscle of the upper arm, gluteal muscles of the buttocks and the quadriceps muscle – specifically the rectus femoris and vastus lateralis – in the thigh (Figure 1).

Volume of injection

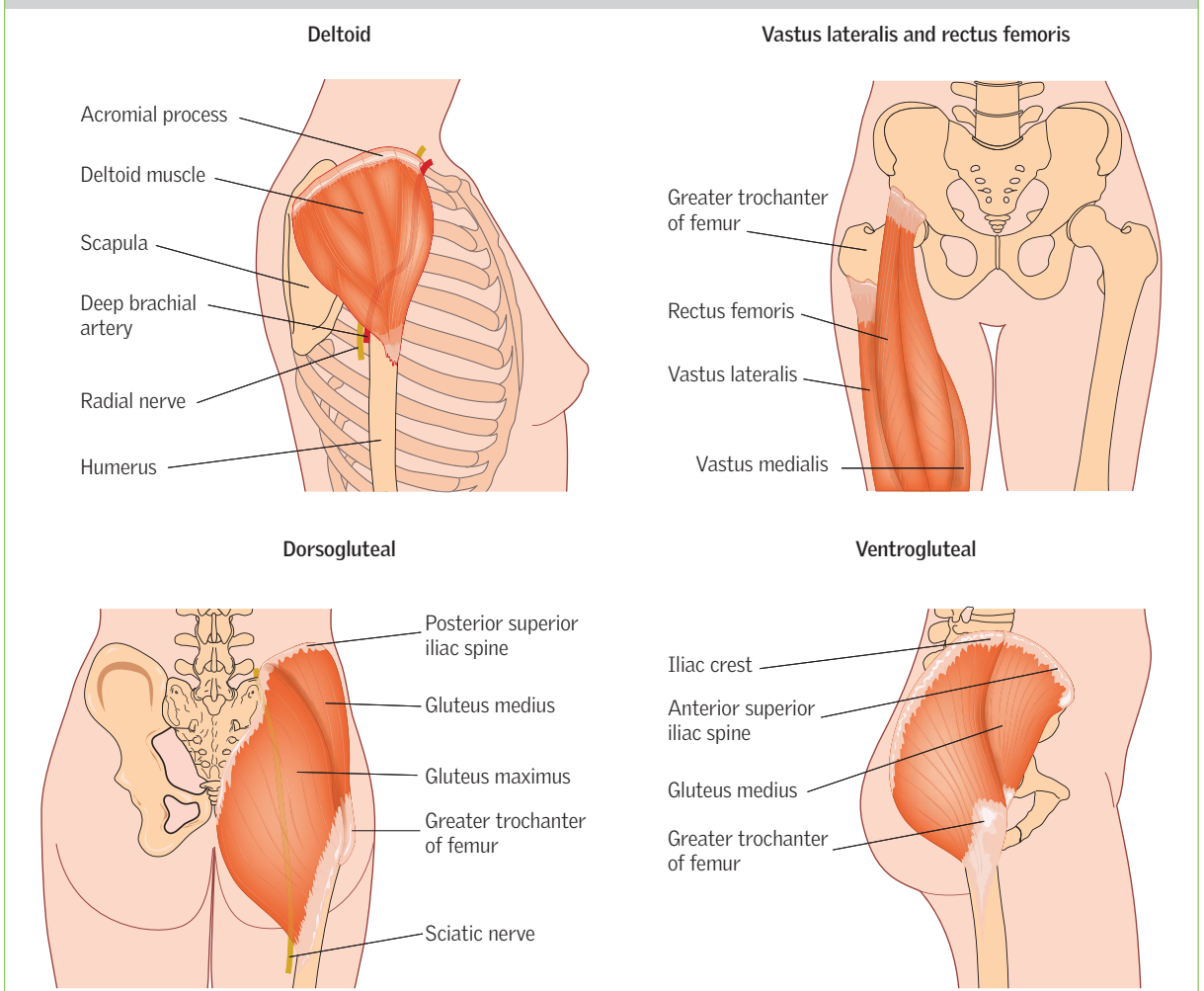
The deltoid site is recommended for small volumes up to 1mL (Covington and Trattler

TIME OUT

1 Consider the medications you administer intramuscularly in your practice, and choose one on which to reflect. Where do you administer this medication and how do you identify the site of injection?

FIGURE 1

Sites for intramuscular injection



1997, Workman 1999, Malkin 2008), although a maximum volume of 2mL can be administered at this site (Rodger and King 2000, Cocoman and Murray 2010). The rationale for small volumes is physiological because the mid-deltoid site has a small muscle mass (Rodger and King 2000). The deltoid site is recommended for immunisations and for older children (Royal College of Paediatrics and Child Health (RCPCH) *et al* 2002).

For 'deep' intramuscular injections, the recommended volume ranges from 2 to 5mL. Volumes of up to 4mL can be administered in the dorsogluteal muscle (Workman 1999, Rodger and King 2000). The ventrogluteal muscle can accommodate up to 2.5mL (Rodger and King 2000, Endacott *et al* 2009), with a maximum volume of 3mL (Bolander 1994, Cocoman and Murray 2006). The rectus femoris and vastus lateralis remain the recommended sites for volumes up to 5mL in adults (Rodger and King 2000). The anterolateral thigh is recommended for intramuscular injections (and deep subcutaneous injections) for children and infants; the buttock is not recommended (RCPCH *et al* 2002). The recommended volume in children and infants is 1 to 3mL (Workman 1999).

Drug tolerance is more important than volume when considering the site (Butterwick 2005), and there is evidence to suggest that smaller volumes aid absorption and reduce adverse reactions (John and Stevenson 1995). The Department of Health (DH) (2013)

recommends that volumes above 3 and 4mL be administered in divided doses (Malkin 2008).

Complete time out activity 2

Landmarking

It is imperative nurses can identify the bony prominences and anatomical landmarks for each of the intramuscular injection sites to locate the muscle and injection site with accuracy and confidence (Tables 1 and 2).

Skill and knowledge are needed to perform an individual patient assessment, which should include consideration of injection history, muscle mass and tone, adipose tissue and obesity, weight and body mass index (BMI), gender, posture, gait and patient positioning (Cook and Murtagh 2003, Greenway 2004, Hunter 2008).

Site selection

There has been inconsistency in choosing which intramuscular site is best for deep injections, and so there has been a lack of clarity over 'best practice'. There is reluctance to use the ventrogluteal site; historically the dorsogluteal site has been favoured by healthcare practitioners, particularly in mental healthcare settings (Wynaden *et al* 2006). Lack of familiarity with and confidence in using the ventrogluteal site may lead to nurses believing this site to be more difficult to identify (Wynaden *et al* 2006). However, familiarity with anatomical references and practice can improve confidence and skill.

Ventrogluteal versus dorsogluteal

In the past decade, greater emphasis has been placed on using the ventrogluteal site for deep intramuscular injections, compared with the dorsogluteal site (Bolander 1994, Cook and Murtagh 2003, King 2003, Greenway 2004, Donaldson and Green 2005, Cocoman and Murray 2006, Nisbet 2006, Zaybak *et al* 2007). There is sufficient evidence to promote the use of the ventrogluteal site wherever possible (Small 2004). There are risks associated with the dorsogluteal site, with sciatic nerve injury identified as a serious complication of iatrogenic injury associated with dorsogluteal injections (Small 2004); and this site has major nerves and blood vessels (Bolander 1994, Tortora and Derrickson 2008).

The pharmacokinetics and pharmacodynamics of drugs suggest there is a relatively slower absorption of drugs from



2 Which of the following bony prominences can you identify confidently on a patient?

Acromial process; iliac crest; greater trochanter; patella. Describe how you find these locations on a patient.

TABLE 1

Intramuscular injection sites and useful anatomical landmarks	
Anatomical landmark	Description
Acromial process	Bony prominence where the humerus articulates with shoulder joint.
Axilla	Armpit.
Brachial artery	Major blood vessel in the arm.
Deltoid muscle	Small triangular muscle of the upper arm.
Femur	Long bone of the thigh/upper leg.
Gluteal muscles (minimus, medius, maximus)	Muscle groups forming the buttocks.
Greater trochanter of femur	Bony prominence of hip joint.
Humerus	Long bone of the upper arm.
Iliac crest	Flared bony prominence of the pelvis.
Quadriceps muscles (rectus femoris and vastus lateralis)	Muscle groups of the thigh.
Sciatic nerve	Nerve running through the buttocks.

the dorsogluteal site (Mitchell and Whitney 2001, King 2003, Diggle and Richards 2007). Although slower absorption is also true of the vastus lateralis and rectus femoris muscles, the gluteal muscles enable comparatively better drug serum concentrations (Bolander 1994). The slower rates of dorsogluteal absorption and efficacy can lead to drug build-up in the tissues and possible risk of overdose (Malkin 2008). With the ventrogluteal site, the medication is more likely to reach the muscle for which it is intended (Donaldson and Green 2005). Further, this site can be used for oily medications such as depot injections (Rodger and King 2000).

Complete time out activity 3

The ventrogluteal site offers the greatest thickness of muscle, it is free of nerves and blood vessels, with a narrower layer of fat (Cocoman and Murray 2006) and is therefore the recommended site for intramuscular injections (Workman 1999, Rodger and King 2000, Greenway 2004). The DH (2013) and the World Health Organization (WHO) (2004) report no advantages in using the dorsogluteal site.

Equipment

Changes in technology, for example patient-controlled analgesia and infusion devices in pain management, pharmaceutical

development (Small 2004), methods of delivery, and advances in modern medicine (Avidan *et al* 2002, Hutin 2003) have reduced the frequency of intramuscular injections. Changes in equipment use have also affected needle selection and size.

Complete time out activity 4

Any needle selected for intramuscular injection must be of sufficient size to penetrate the subcutaneous fat and travel into the muscle layer (DH 2013). A 25mm or 38mm needle should be used for intramuscular injections in adult patients (Warren 2002, DH 2013) and 16mm is recommended for children, although decisions depend on other factors such as age and subcutaneous fat (DH 2013). In addition, there is a difference in fatty tissue between males and females, and longer needles are recommended in women weighing between 60 and 90kg (Zaybak *et al* 2007, Nisbet 2006).

Skin preparation

The guidance on skin preparation before needle insertion has changed over the past decade (Pratt *et al* 2005) and the need to disinfect the skin before injection remains controversial, mainly as a result of a lack of evidence. Although current guidelines do not favour pre-injection site disinfection in young, healthy individuals with visibly clean skin, skin disinfection for injections into the



3 Reflect on your practice: are you more likely to use the ventrogluteal or dorsogluteal site for deep intramuscular injections? What is your rationale for this?

4 Consider the needle selection available in your practice area and compare these in terms of length, diameter and size of the needle and bevel diameter. Make notes on which size is commonly used and when.

TABLE 2

Intramuscular injection sites

Injection site	Recommended volume	Patient positioning	Site selection/landmarking
Deltoid	1–2mL	Standing or sitting, with arm placed on the waist to relax the muscle.	Identify the acromial process. Place two fingers or measure 2.5cm from this location along the lateral aspect of the humerus. Alternatively, draw an imaginary line from the axilla across to the humerus and inject just above this.
Ventrogluteal	2.5–3mL	Lying on the side in the prone position facing away. Bend the knee or gently point the toe outward to relax the muscle.	Identify the greater trochanter of the femur and place the base of the hand over this. Reaching toward the iliac crest, so the forefinger is toward or touching the iliac crest, spread the fingers apart. The injection should be placed at the 'V' when the forefinger and second digit are splayed.
Rectus femoris and vastus lateralis	Up to 5mL	Sitting or lying, with the toes gently pointed away to relax the muscle.	Place the base of one hand over the greater trochanter of the femur and the base of the other hand over the kneecap. In the space between the fingertips, the injection should be placed on the lateral or anterior surface, in the upper two-thirds of the thigh.

The dorsogluteal site is not recommended for intramuscular injections

thigh, in older people or immunocompromised patients or for injections close to infected or colonised lesions is recommended (Pratt *et al* 2005). There is agreement that further research is needed. However, what seems apparent is the need for individual patient assessment and good clinical decision making.

Complete time out activity 5

Current guidance recommends that, other than ensuring that the injection site is 'visibly clean', it is unnecessary to disinfect the skin before administering immunisations (RCPCH *et al* 2002) and many NHS trusts in the UK no longer recommend skin preparation before injections. Previously, disinfecting the skin before subcutaneous and intramuscular injections using a 70% isopropyl alcohol-saturated swab and allowing the disinfectant to dry was practised (Pratt *et al* 2005). However the Health Protection Agency reported that administering injections without cleaning was not associated with increased infection rates in young, healthy individuals (Ayliffe *et al* 1993). The WHO advises that swabbing of visibly clean skin before giving an injection is unnecessary (Hutin 2003).

Patient positioning

Positioning is important in reducing patient discomfort during the intramuscular injection (Bolander 1994). Ideally the patient should be positioned so that the muscle is relaxed (McGarvey 2001). The prone position encourages lying on the stomach and is thought to be relaxing for the patient (Wynaden *et al* 2006). Greenway (2004) recommends placing the patient in a seated or lying position. When injecting into the deltoid muscle, asking the patient to place his or her hand on the hip relaxes this muscle (Workman 1999).

Injection rate

The speed at which the needle penetrates the skin is important (Wynaden *et al* 2006). When the needle is inserted too slowly or too fast this can cause patient discomfort (Katsma and Smith 1997, Egekvist *et al* 1999). The needle should therefore penetrate the skin quickly, up to the hub of the needle. The recommended plunger depression rate is 1mL per second (Mitchell and Whitney 2001). However, Brazeau *et al* (1998) reinforce the need to follow instructions supplied with the medication by the manufacturers regarding

diluent and injection speed. Waiting at least ten seconds before removing the needle is also recommended, to prevent leakage of the medication at the site. However, this may not be needed with the Z-track method (Keen 1986) (see below).

Technique

The technique of injecting should be a dart-like action (Workman 1999, Greenway 2004, Hunter 2008, Plotkin *et al* 2008). This reduces accidental depression and inadvertent deposition of the injectate when the needle is being inserted (Plotkin *et al* 2008). The recommended angle of the needle is 90° (Workman 1999, Warren 2002, Greenway 2004, DH 2013).

Aspiration is not required except for highly vascular areas such as the dorsogluteal site (WHO 2004, DH 2013). However, one could argue that this site is not generally recommended and therefore aspiration is not necessary in routine practice. Malkin (2008) suggests that, if the use of the dorsogluteal site were removed from routine practice, aspiration could be removed from consideration altogether. In addition, some auto-disable devices, or automatic retraction in syringes with this technology, are triggered by the aspiration manoeuvre (Malkin 2008) so this technique should not be used.

Z-track method

The Z-track method is not a new concept and has been used in international clinical practice for years (Keen 1986), but has been adopted in the UK only comparatively recently. Many researchers have found this to be the best technique for routine use and to prevent back-tracking of medications, and they recommend the technique for intramuscular injections (McGarvey 2001, Wynaden *et al* 2006). The Z-track method also prevents leakage of medication around and into surrounding tissues (Hunter 2008).

Bunching up the skin has been suggested to cause less pain than stretching the skin; however adopting the Z-track method requires the skin to be stretched in one direction (Grosswasser *et al* 1997, Rodger and King 2000, Greenway 2004). In terms of comfort for the patient, there are other means of lessening the associated pain with an injection (as indicated below) and stretching the skin is recommended as part of the Z-track method.

Complete time out activity 6



5 Consider the local policy for skin preparation with intramuscular injections. Reflect on your own practice to reduce infection risk.

6 List at least five risks associated with intramuscular injections and indicate how these can be prevented.

Risks of intramuscular injections

Intramuscular injections have the potential to cause adverse events for the patient as a result of poor practice (National Patient Safety Agency (NPSA) 2007). Unnecessary complications can arise from poor technique, lack of understanding, and lack of skill and confidence on the nurse's part. A skilled injection technique can make the patient's experience less painful (Floyd and Meyer 2007, Ağac and Güneş 2011). Sciatic nerve injury can be caused by erroneous injections, resulting in discomfort, morbidity and lasting disability, and may lead to negligence claims (Small 2004).

Complications of poorly performed intramuscular injections include bleeding (Plotkin *et al* 2008), abscess, cellulitis, tissue necrosis, granuloma, muscle fibrosis, contractures, haematoma and injury to blood vessels, bones and peripheral nerves (Small 2004). There is a risk of pain (Schechter *et al* 2007, Malkin 2008) and in some cases tendonitis. Infection is also a risk (Plotkin *et al* 2008).

Evidence suggests that a range of factors are associated with painful intramuscular injections: patient anxiety, patient position, drug volume and speed of delivery, injection technique, injection site and size of the needle bore and length (Chung *et al* 2002, Alavi 2007, Malkin 2008). An important factor associated with increased patient discomfort is the technique used by clinicians (Ağac and Güneş 2011).

Knowledge and skill are required to prevent complications and minimise risk to patients. Nurses should understand the relevant anatomy and the proximate anatomical structures so that they are able to identify landmarks and site boundaries safely and confidently (Small 2004). Small (2004) states the administration technique should be meticulous. A skilled injection technique can make the patient's experience less painful and avoid unnecessary complications (Ağac and Güneş 2011).

Pain

Pain can be minimised by good technique and confidence on the part of the nurse. Injecting slowly, using the smallest diameter of needle size and entering the skin quickly are strategies to reduce pain (Campbell 1995, Workman 1999, Rodger and King 2000, Schechter *et al* 2007). Manual pressure on the injection site for ten seconds before needle insertion has been

advocated and shown to reduce pain (Chung *et al* 2002). Ensuring the needle tip is sharp and free from residue by adopting a 'two-needle' approach (drawing up with one needle and injecting with another) has also been shown to reduce pain and discomfort (Rock 2000). This is further supported in the literature (Workman 1999, Engstrom *et al* 2000, Rodger and King 2000, Nicoll and Hesby 2002, Wynaden *et al* 2006, Floyd and Meyer 2007, Ismail *et al* 2007).

Pain can also be reduced by using a longer needle and choosing the ventrogluteal over the dorsogluteal site (Cook and Murtagh 2003, King 2003, Nisbet 2006, Zaybak *et al* 2007). An understanding of pain theories can help nurses to appreciate and understand how minimising pain is central to the patient experience. As previously stated, applying manual pressure to the site can reduce pain (Schechter *et al* 2007, Malkin 2008). This serves as a distraction technique and as emotional interference with the perception of pain (Chung *et al* 2002, Alavi 2007, Ogston-Tuck 2011).

Patient assessment and safe practice

There is a link between pain perception and gender differences (Ağac and Güneş 2011). Compared with men, women consistently report more pain from all intramuscular injections (Mitchell and Whitney 2001, Chan *et al* 2003), which might be attributed to the physiology of muscle and fatty tissues, where pain receptors are located – women have more subcutaneous tissue in the buttocks than men. Studies carried out by Zaybak *et al* (2007) identified that there is a marked difference in fatty tissue between men and women, and Nisbet (2006) concurs that BMI should be a consideration in the selection of needle size, injection site and pain reduction.

Assessing the patient is therefore vital to minimising pain and reducing the risks of intramuscular injections. However, an assessment of the patient, performed before the intramuscular injection is given, is often not performed in clinical practice. Spending time with a patient, providing information and gaining consent, is an ideal opportunity to perform this assessment. The patient's underlying medical condition and previous experience are also important considerations.

Having a full discussion with the patient may affect their perception of pain and

even reduce their experience of pain from intramuscular injections (Schechter *et al* 2007). An individualised assessment of the patient is recommended (Small 2004), and this should take into consideration the patient's status, weight, skin integrity, noted lesions, and rash or other skin conditions that may have an effect on the site of injection. Recommendations for safe practice include:

- ▶ Patient assessment and consent – this should be prioritised. A discussion with the patient offers the opportunity to gather relevant information to determine the equipment, site and volume for injection. Obtaining a patient's history, understanding previous experience, determining weight and BMI, skin condition and overall condition will inform safe practice and good clinical decision making.
- ▶ Medication for administration – understanding the pharmacological principles, along with the volume and therapeutic effect, of the drug can help in choosing and landmarking correct sites, injection rates and patient positioning.

This can also help to reduce unnecessary risk and minimise pain.

- ▶ Infection control – minimising risks to the patient by correct handwashing, use of sterile equipment and thorough skin assessment.
- ▶ Patient positioning and landmarking of injection sites – this is necessary to minimise risk and maximise the benefits of treatment and comfort for the patient. It reflects individualised care and good clinical decision making.

Box 1 lists a proposed framework for safe practice for intramuscular injections.

Conclusion

The intramuscular injection technique requires skill, knowledge and a good understanding of the implications for administering the injection. This article has provided an overview of this technique and guidance on safe practice, offering a framework for nurses to use in clinical practice **NS**

BOX 1

Framework for safe practice for intramuscular injections

- ▶ Perform handwashing to minimise the risk of infection to the patient.
- ▶ Check the patient's identification as per hospital policy.
- ▶ Prepare the patient and obtain consent.
- ▶ Position the patient sitting or lying (prone if accessing the ventrogluteal site).
- ▶ Know the drug, its formulation, indication, route, volume and side effects.
- ▶ Two-needle technique – change needles after preparation and before administration (so they are clean, sharp and dry).
- ▶ Select needle size based on patient gender, weight and body mass index, condition, site, drug and volume.
- ▶ Make the ventrogluteal site the first choice wherever possible for deep intramuscular injections.
- ▶ Assess the skin and the patient's condition.
- ▶ Use the Z-track method: smooth/stretch the skin.
- ▶ Rotate sites for frequent injections and document to this effect.
- ▶ Inject at 90°, dart-like, to the hub of the needle and inject at 1mL per second.
- ▶ Wait at least ten seconds before withdrawing the needle.
- ▶ Do not massage or rub the site afterwards unless otherwise indicated.
- ▶ Reassess for therapeutic effect and any side effects.
- ▶ Document accurately and appropriately.

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