

Are you FIT for purpose? The importance of getting injection technique right

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Citation: Diggle J (2014) Are you FIT for purpose? The importance of getting injection technique right. *Journal of Diabetes Nursing* 18: 50–7

Article points

1. A growing number of people in the UK are using injectable therapies, such as insulin and glucagon-like peptide-1 receptor agonists.
2. Correct injection technique is central to optimal glycaemic control for those on injectable therapies; however, evidence suggests that injection technique is often flawed.
3. The initiation and ongoing management of injectable therapies now often takes place in primary care and is generally the role of the practice nurse. Practice nurses are, therefore, ideally placed to reinforce correct injection technique in people with diabetes.

Key words

- GLP-1 receptor agonists
- Injectable therapies
- Injection technique
- Insulin

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Increasingly, people with diabetes who use injectable therapies are being managed within primary care settings, and, as a result, more GPs and practice nurses are taking responsibility for the initiation and ongoing management of people on insulin and glucagon-like peptide-1 (GLP-1) receptor agonists. Correct injection technique is crucial if these injectable therapies are to achieve their optimal effect. This article highlights the importance of effective injection technique for the benefit of all healthcare professionals working with injectable diabetes therapies. Specifically, practice nurses are ideally placed to reinforce the importance of correct injection technique in people with diabetes.

It is estimated that approximately 800 000 people in the UK use injectable therapies to treat their diabetes (Forum for Injection Technique, 2010). It is inevitable that this number will increase, given the rising prevalence of diabetes due to an ageing population and because people are developing diabetes at a younger age (Diabetes UK, 2013).

Increasingly, people with diabetes are being managed within primary care settings, and, as a result, more GPs and practice nurses are taking responsibility for the initiation and ongoing management of people on insulin and glucagon-like peptide-1 (GLP-1) receptor agonists. Correct injection technique is crucial if these injectable therapies are to achieve their optimal effect, yet it is a topic that is rarely focused on and revisited during routine follow-ups (Frid et al, 2010a).

This article highlights the importance of effective injection technique for the benefit of all healthcare professionals working with injectable diabetes therapies. Specifically, practice nurses are ideally placed to reinforce the importance of correct injection technique in people with diabetes.

Current guidelines

All injectable agents rely on correct injection technique for optimal effect; however, despite this, current diabetes guidelines do not include detailed advice on the subject. NICE (2009) makes a short reference to providing education about injectable devices for people with diabetes. The more recently published *Quality standard for insulin therapy* (NICE, 2011) recommends a structured programme of education, including site selection and care. The document also stresses that all healthcare professionals who initiate and manage people on insulin, must complete appropriate training and be able to demonstrate their competency.

In its section on “Injectable therapies, for the safe administration and use of insulin and GLP-1 receptor agonists”, the *Integrated Career and Competency Framework for Diabetes Nursing* (TREND-UK, 2011) states that a competent nurse should be able to demonstrate, and be able to teach, the correct method of insulin or GLP-1 receptor agonist self-administration, including:

- Correct choice of needle type and length for the individual.

- Appropriate use of lifted skin fold, where necessary.
- Site rotation.
- Storage of insulin.
- Single use of needles.

The document also advises that nurses should examine injection sites at least annually for detection of lipohypertrophy or lipoatrophy.

An Introduction to the Forum for Injection Technique (FIT)

The Forum for Injection Technique (FIT) was formed by a group of experienced diabetes specialist nurses in the UK who were committed to establishing and promoting best practice in injection technique, raising awareness of existing research relating to injection technique, and highlighting the impact this may have on health outcomes for people with diabetes who use injectable therapies.

Between 1997 and 2009, more than 130 international experts attended workshops to examine relevant research, debate best practice, and analyse the results of two “International injection technique” questionnaires (Strauss et al, 2002; Frid et al, 2010b). Europe-wide injection technique recommendations were produced, and these were subsequently adapted by FIT for use in the UK.

In October 2010, the *First UK Injection Technique Recommendations* were published by FIT (2010). The recommendations cover topics including: needle length; site selection and absorption rates; rotation of injection sites; lifted skin folds; insulin storage and re-suspension; lipohypertrophy; and safety and the disposal of injecting material. The FIT recommendations are reviewed and revised as new evidence emerges and the latest version is downloadable from the FIT website (www.fit4diabetes.com).

Improving injection technique for practice nurses

Increasingly, practice nurses are responsible for teaching people with diabetes the practicalities of starting injectable therapy. Most practice nurses work in relative isolation and may not have access to specialist supervision or support. It is quite possible practice nurses lack the knowledge and expertise to be able to fully support people with diabetes on insulin and GLP-1 therapy. This is compared to DSNs working within a team, whose knowledge and skills

are more likely to have developed in practice through supervision.

Accessing training and education is becoming increasingly difficult, often due to financial or time constraints, but FIT emphasises that, in order to educate people with diabetes effectively, healthcare professionals must themselves possess the appropriate knowledge and skills. FIT is committed to supporting the implementation of its recommendations for all those involved in diabetes care and recognises the need to develop new and innovative educational approaches.

Raising awareness about the consequences of incorrect injection technique is important in all aspects of diabetes care because many healthcare professionals do not always link erratic blood glucose control with poor injection technique.

Evidence of poor injection technique

Correct injection technique is central to optimal glycaemic control for those on injectable therapies; however, evidence suggests that injection technique is often flawed. Strauss et al (2002) examined insulin injection technique in 1002 people with either type 1 or type 2 diabetes across seven European countries. They looked at injection site rotation habits, incidence of lipohypertrophy, needle length, timing of injections, and the use of a lifted skin fold. Some years later, Frid et al (2010b) examined the injecting habits of 4300 people with diabetes using insulin, 999 of whom were from the UK. Both studies revealed worrying practices in relation to injection technique with little improvement in technique over the years.

UK data from the 2009 Injection Technique Questionnaire (Frid et al, 2010b) showed that:

- 52% of people used needles longer than 6 mm.
- 60% had not changed their needle size since starting injectable therapy.
- 75% did not follow any site rotation routine.
- 54% reported lipohypertrophy at some point.
- 28% admitted injecting into areas of lipohypertrophy.
- 45% experienced bleeding or bruising.
- 43% released the skin fold too soon.
- 17% were using an incorrect technique for lifting a skin fold.
- 41% failed to re-suspend their cloudy insulin adequately.

Page points

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2. Increasingly, practice nurses are responsible for teaching people with diabetes the practicalities of starting injectable therapy. It is quite possible practice nurses lack the knowledge and expertise to be able to fully support their people with diabetes on injectable therapies.
3. Correct injection technique is central to optimal glycaemic control for those on injectable therapies; however, evidence suggests that injection technique is often flawed.

Page points

1. Incorrect technique, including using the wrong needle length, failing to rotate injection sites and reusing needles, can all lead to injectable therapies being absorbed in an unpredictable manner. This can cause immediate problems, such as hypoglycaemia, if insulin is injected into muscle as muscle absorbs insulin more quickly.
2. Lipohypertrophy (LH), which is the accumulation of fatty, rubbery tissue in the subcutaneous layer caused by repeatedly injecting into the same area, is a major problem associated with poor injection technique.
3. People who use injectable therapies should understand LH and its possible impact on their glycaemic control; they should be able to prevent and recognise it, and understand what to do should it develop.

- Only 41% reported frequent and adequate inspection of their injection sites.

Poor injection technique

All diabetes injectable agents rely on correct injection technique for optimal effect. Incorrect technique, including using the wrong needle length, failing to rotate injection sites and reusing needles, can lead to injectable therapies being absorbed in an unpredictable manner. This can cause immediate problems, such as hypoglycaemia, if insulin is injected into muscle as muscle absorbs insulin more quickly. Hyperglycaemia, and possibly diabetic ketoacidosis in those with type 1 diabetes, may occur if the insulin is injected into an area where it is poorly absorbed (Polak et al, 1996; Birkebaek et al, 2008).

In the longer term, we know that poor glycaemic control increases the risk of complications, including kidney failure, blindness, and limb amputation (UKPDS [UK Prospective Diabetes Study], 1998). These complications will have a devastating impact on the individual, but also huge cost implications for the NHS (Diabetes UK, 2012).

The recommended site for insulin and incretin mimetic injections is the subcutaneous layer (Frid, 2006). Injecting into the subcutaneous layer allows the insulin to be absorbed at a more predictable rate, which can result in better glycaemic control (Hofman et al, 2007).

Lipohypertrophy (LH), which is the accumulation of fatty, rubbery tissue in the subcutaneous layer caused by repeatedly injecting into the same area, is a major problem associated with poor injection technique. Lipoatrophy, which is the wasting of subcutaneous fat, can also develop over time.

It has been estimated that about half of people with diabetes will experience LH at some time in their life (Frid et al, 2010b). It is generally understood that injecting into areas of LH or lipoatrophy results in variable absorption and erratic glycaemic control.

To date, there has been a shortage of randomised prospective studies establishing the causative factors of LH. Observational studies suggest a link between LH and a failure to rotate injection sites, repeatedly injecting into the same zone within an injection site, and the re-use of needles (Varder and Kizili, 2007).

Blanco et al (2013) examined the prevalence and risk factors of LH in people who inject insulin. The study found that almost two-thirds of people

had LH (76.3% of those with type 1 diabetes and 56.1% of those with type 2 diabetes) and this was strongly associated with a failure to rotate injection sites. The correct rotation of injection sites was the strongest protective factor against the development of LH; only 5% of people who rotated correctly developed LH. Needle re-use was identified as another causative factor of LH and the risk rose significantly when needles were used more than five times. Glycaemic variation occurred in 49% of those with LH compared to 6.5% of those without. Those with LH required, on average, 56 units of insulin per day compared to 41 units for those without LH. The Spanish study group calculated that the 15 unit difference in the total daily dose of insulin equated to an annual cost to Spain's health system of €122 million.

Potential cost savings could be made if insulin doses were reduced. However, more importantly, addressing poor injection technique improves the quality of life for those people with diabetes using injectable therapies as less glycaemic variability leads to fewer diabetes associated complications.

Tackling the problem

Detection of LH requires both visual inspection and palpation of injection sites, as some lesions are more easily felt than seen. It is important to teach people with diabetes how to examine themselves for LH, in the same way a healthcare professional might advise self-examination to detect signs of breast or testicular cancer. People who use injectable therapies should understand LH and its possible impact on their glycaemic control; they should be able to prevent and recognise it, and understand what to do should it develop.

Healthcare professionals should check injection sites at least annually as part of routine care. It is not adequate to simply ask individuals about their injection sites, as problems such as LH tend to develop gradually and the individual may be unaware of the problem. An experienced nurse can be taught how to identify LH through visual inspection, as well as palpation. Healthcare workers should encourage the individual to adopt systematic site rotation, as this can help to reduce the risk of developing LH.

Teaching correct injection technique

A number of factors contribute to good injection

Page points

1. Therapeutic agents will generally be self-injected and the four preferred sites are the abdomen, thighs, buttocks and arms. Absorption rates from these different areas will depend on the pharmacokinetics of the injected agent.
2. Factors that can speed up absorption and potentially increase the risk of hypoglycaemia include a hot environment, massage, exercise and injecting intramuscularly.
3. There is a misconception that people with greater subcutaneous tissue depth, particularly overweight and obese people, require a longer needle. In fact, it makes no difference whether agents are injected into shallow or deep subcutaneous tissue – they are absorbed at similar rates.

technique, including: injection site selection; injection site care; the injection process from start to finish; needle length; the use of lifted skin folds (if appropriate) and the rotation of injection sites. In the case of insulin, there are additional considerations including the re-suspension of cloudy insulins, as absorption rates vary at different sites (Frid et al, 2010a). All of these issues are addressed in the FIT *Injection technique recommendations* (FIT, 2012) and some are summarised below.

Preferred sites

Therapeutic agents will generally be self-injected and the four preferred sites are the abdomen, thighs, buttocks and arms. Absorption rates from these different areas will depend on the pharmacokinetics of the injected agent. The rate of absorption of GLP-1 receptor agonists does not appear to be site-specific, nor does that of the rapid-acting and long-acting insulin analogues (Mudaliar et al, 1999). However, the rate of absorption of human insulin is affected by site.

The abdomen is the preferred site for the injection of soluble insulin as it is absorbed faster there (Frid and Linde, 1993). The thighs and buttocks are the preferred site for neutral protamine hagedorn (NPH) insulin, as absorption is slowest from these sites (Henriksen et al, 1991). When pre-mixed insulin is being injected, it is suggested that the abdomen is used in the morning and the thigh or buttock in the evening (Guerci et al, 2005).

Rate of absorption

Other factors that can speed up absorption and potentially increase the risk of hypoglycaemia include a hot environment, such as having a hot bath after injecting, which increases blood flow to the injection area (De Meijer et al, 1990). Massage or exercise that occurs immediately after the injection may speed up absorption because of the increased circulation to the injection site. Therefore, individuals should avoid injecting into the thigh after cycling or jogging (Ferrannini et al, 1982). Injecting intramuscularly will also speed up absorption.

Factors that can slow down absorption and cause a rise in blood glucose levels are cold environments (as they reduce blood flow), large volumes of insulin, and injections into damaged, unhealthy tissue.

Needle length

It is essential to assess each person individually when advising on correct needle length. Skin thickness ranges from 1.2–3 mm regardless of gender, age, BMI, or ethnicity (Gibney et al, 2010); subcutaneous depth can vary from person to person according to BMI and gender, but also from site to site. For example, in a person with android obesity, the depth of the subcutaneous layer may be as little as 2–4 mm on the legs and arms but 20–30 mm at the abdomen (Pledger et al, 2012).

A shallow intradermal injection results in unpredictable insulin absorption and there is a risk of leakage and an allergic reaction. Intramuscular injection increases the risk of the injected agent being absorbed too quickly due to the richer blood supply to muscle, leading to an increased risk of hypoglycaemia and greater glycaemic variability. Injections into muscle are more painful and can cause bruising.

There is a misconception that people with greater subcutaneous tissue depth, particularly overweight and obese people, require a longer needle. In fact, it makes no difference whether agents are injected into shallow or deep subcutaneous tissue – they are absorbed at similar rates. When only longer needles were available, the only option for those with little subcutaneous depth was to use a lifted skin fold or an angled injection to avoid an intramuscular injection.

The availability of shorter needles (4 mm, 5 mm and 6 mm) has meant that individuals can inject at a 90° angle without a lifted skin fold. A small minority of people with diabetes, such as children or very slim adults, may still need to perform a lifted skin fold when using the shortest needles. For adults, there is no clinical reason for recommending needles longer than 8 mm.

Lifted skin folds

Teaching how to perform a lifted skin fold is not easy and they are often performed incorrectly. If too much flesh is pinched up, there is a risk of giving an intramuscular injection. Recommendations suggest lifting the skin away from the underlying muscle with two fingers and a thumb (see *Figure 1*). Furthermore, people should be advised to keep the needle in the skin (with lifted skin fold if necessary) for ten seconds after the plunger is completely depressed.

Sequence for injecting

The optimal injection sequence, as recommended by FIT, should be:

- Make a lifted skin fold (if necessary);
- Insert needle into the skin at 90° angle;
- Administer insulin;
- Leave the needle in the skin for at least 10 seconds after the insulin has been injected;
- Withdraw the needle from the skin;
- Release the lifted skin fold, if used.

Re-suspension of insulin

Cloudy insulin must be properly re-suspended before use. This is achieved by rolling the vial, cartridge, or pen, ten times. Following this, it must be gently inverted ten times before visually checking that it is a uniform milky white colour.

Single use of needles

Recommended practice is that needles are used only once so that they do not become “clogged”. If needles are left on devices between injections, air can enter and lead to incorrect doses being given. Injections should not be given through clothing as this blunts the needle and increases the possibility of bruising, bleeding and infection.

With reuse the needle may become distorted and bent and there will be a loss of lubrication. This can lacerate the skin (American Diabetes Association, 2002) and result in a more painful injection (Chantelau et al, 1991).

Site rotation

Systematic site rotation helps to reduce the risk of developing LH. One scheme with proven effectiveness involves dividing the injection sites into quadrants or halves and using one section per week, rotating within that section from day to day and then moving clockwise each week to a new area (Figure 2 and Figure 3).

Site selection

The injection site should be inspected and palpated by the individual prior to injection. Where LH is detected, the person should be advised not to inject into the site until the tissue returns to normal, which may take many months. Abnormalities should be documented and sites monitored at every subsequent review. It is important to note that, when switching

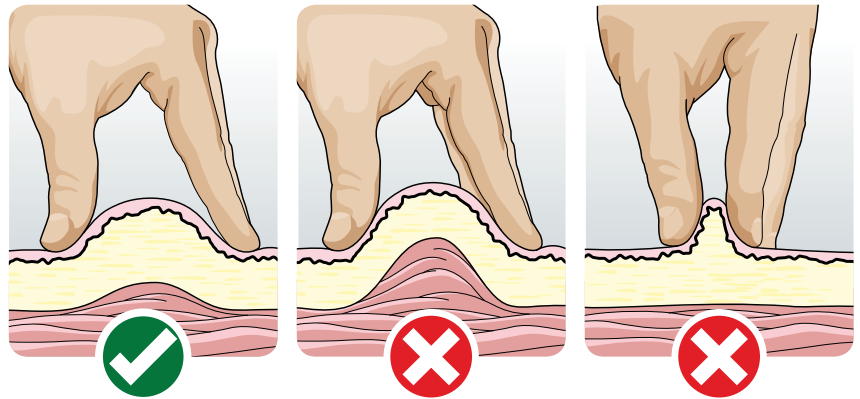


Figure 1. Correct (left) and incorrect (right) ways of performing the skin fold (FIT, 2012).

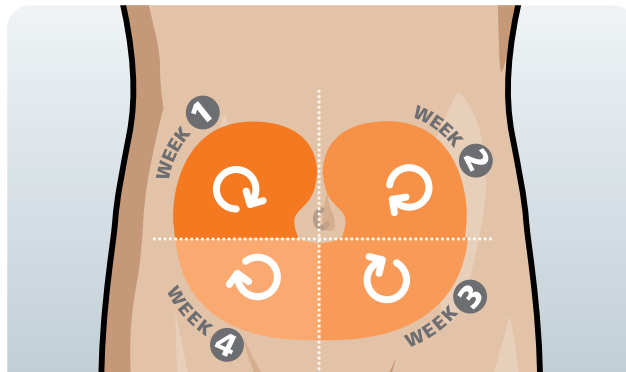


Figure 2. Abdominal rotation pattern by quadrants. Diagram adapted from Lourdes Saez-de Ibarra and Ruth Gaspar, Diabetes Nurses and Specialist Educators from La Paz Hospital, Madrid, Spain (FIT, 2012).

from areas of LH where insulin is likely to be poorly absorbed to injecting into normal tissue, the improved, quicker insulin absorption may require a reduction in dose. How much a dose should be reduced by will depend on the individual and should be guided by frequent blood glucose testing. The reduction may be as much as 50% (Overland et al, 2009).

Ongoing review of injection technique

Giving good advice at the initiation of an injectable therapy is vital, but it is often at a later stage that problems related to poor injection technique arise. It is, therefore, important to re-visit injection technique and examine injection sites as part of routine, ongoing management. Starting injectable therapy, especially insulin, is a daunting prospect for most people. Those with type 1 diabetes may be struggling to come to terms with their diagnosis and those with

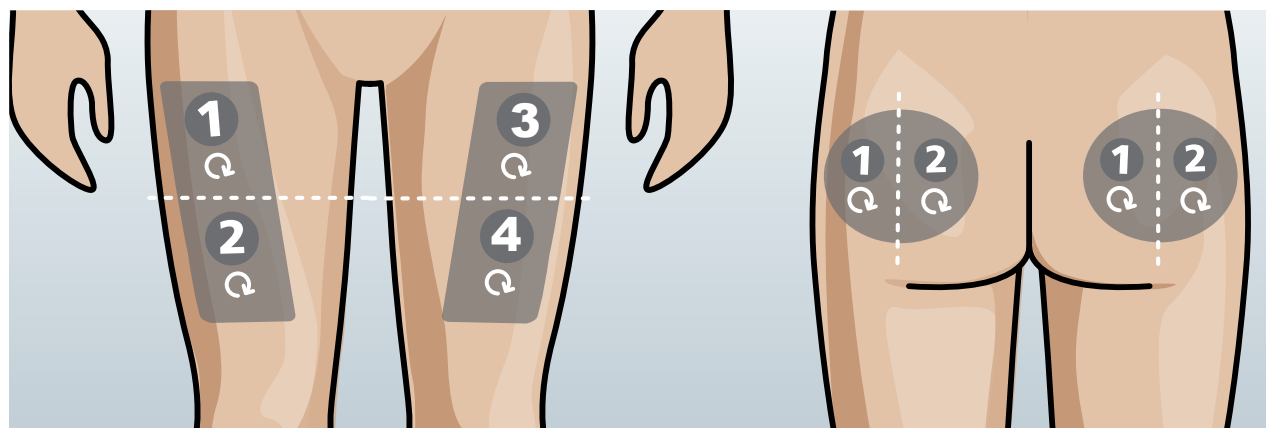


Figure 3. Thigh and buttocks rotational pattern by halves. Diagram adapted from Lourdes Saez-de Ibarra and Ruth Gaspar, *Diabetes Nurses and Specialist Educators from La Paz Hospital, Madrid, Spain (FIT, 2012)*.

type 2 diabetes often experience feelings of failure (Polansky et al, 2005). Additionally, with so much new information to take in, it is not surprising that people with diabetes forget some of the practicalities associated with good injection technique. There is evidence to show that revisiting education on injection technique is often rare. In one study, around 30% of participants did not recall being educated on length of needle, how long to hold a lifted skin fold for, the angle of needle entry, or re-suspension of cloudy insulin (Frid et al, 2010b).

Personal experience has demonstrated that it is critical to reassess how people with diabetes are delivering injectable therapies on a regular basis. At reviews, people are often seen with erratic blood glucose levels and healthcare practitioners scrutinise blood glucose monitoring diaries to look for lifestyle patterns that may be the cause. However, a quick assessment of the person's injection technique may indicate a cause of erratic blood glucose levels. A positive development would be for healthcare professionals to regularly reassess injection technique as part of routine follow-up, as, regardless of how efficacious a therapy is, if it is not administered properly, it will not have optimal effect.

For those working in general practice, checking inhaler technique is an important part of a review for people on inhaled therapies. Up until 2009, a *Quality and Outcomes Framework (QOF)* indicator rewarded practices that recorded education around inhaler technique. This indicator was subsequently retired, but it could be argued that this firmly embedded inhaler technique within routine practice. Perhaps both people with diabetes who are using injectable

therapies and healthcare professionals would benefit from a similar scheme in diabetes care.

Conclusion

People who use injectable therapies should be taught correct injection technique when injectable therapies are initiated, but the subject must also be revisited and reviewed at subsequent consultations. Healthcare professionals have a responsibility to acquire knowledge, skills and competencies concerning current best injection technique practice to support people who use injectable therapies effectively and safely. FIT's resources have been developed to provide such support and it remains committed to establishing and promoting best practice in injection technique, raising awareness of existing research relating to injection technique, and highlighting the impact that this may have on health outcomes for people with diabetes who use injectable therapies. ■

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Forum for Injection Technique (FIT)

The Forum for Injection Technique (FIT) is an autonomous organisation with the aim of supporting people with diabetes using injectable therapies by educating and supporting healthcare workers.

The latest edition of the recommendations can be accessed via the FIT website: www.fit4diabetes.com.