

**DIABETES CARE IN THE UK**

**The First UK  
Injection Technique  
Recommendations  
2nd Edition**



optimising injection  
technique in  
diabetes

# The Forum for Injection Technique (FIT)

was developed to establish and promote best practice in injection technique for all involved in diabetes care and the founding members are experienced diabetes specialist nurses.

These recommendations aim to raise awareness of existing and emerging research relating to injection technique and the impact this may have on health outcomes for those with diabetes that require subcutaneous injection therapy.

FIT was established following the 3rd International Injection Technique meeting (Athens 2009). From this meeting a consensus was reached to establish the international injection technique recommendations. Following a very successful inaugural symposium held in London on 4th June 2010, attended by over 40 experienced diabetes specialist nurses from across the United Kingdom (UK) and Ireland, the international injection technique recommendations have been adapted for use in the UK.

These are the first UK recommendations for Injection Technique and these will be revised on an annual basis to include new research evidence as it emerges.

FIT is an autonomous organisation whose overarching mission is to support people with diabetes using injectable therapies to achieve the best possible health outcomes that can be influenced by correct injection technique. There are now nearly 3 million people in the UK with diabetes and of these approximately 800,000 are on injectable therapies.\*

The development of FIT and the subsequent UK recommendations for injection technique have been supported by BD Europe and endorsed by the pharmaceutical companies whose therapies include subcutaneous injections of insulin and GLP-1 agonists.

FIT is committed to supporting the implementation of the recommendations by all those involved in diabetes care and to developing the recommendations further. We welcome any comments, suggestions and active participation in ensuring that the recommendations remain relevant and useful for now and the future.

**Debbie Hicks**

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**Fiona Kirkland**

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**Julia Pledger**

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# KEY

A Scientific Advisory Board (Athens 2009) lead the review of available evidence and decided that for the strength of a recommendation the following scale would be used:

- A** STRONGLY RECOMMENDED
- B** RECOMMENDED
- C** UNRESOLVED ISSUE

For the scientific support the following scale was used.

- 1** At least one randomised controlled study
- 2** At least one non-randomised (or non-controlled or epidemiologic) study
- 3** Consensus expert opinion based on extensive patient experience.

Thus each recommendation is followed by both a letter and number (i.e. A2). The letter indicates the weight a recommendation should have in daily practice and the number, its degree of support in the medical literature. The most relevant publications bearing on a recommendation are also cited. There are comparably few randomised clinical trials in the field of injection technique (compared, for example, with blood pressure control) so judgements such as 'strongly recommended' versus 'recommended' are based on a combination of the weight of clinical evidence, the implications for patient therapy and the judgement of the group of experts.

These recommendations apply to the majority of people with diabetes using injectable therapy, but there will inevitably be individual exceptions for which these rules must be adjusted.

The New Injection Recommendations for Patients with Diabetes: Diabetes & Metabolism 2010. Vol 36. informed these recommendations and we thank the editors of Diabetes & Metabolism for permission to use material from this article.



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“ Diabetes UK both welcomes and supports the FIT initiative. Good injection technique leads to good blood glucose control which is vital in preventing the long term complications of diabetes. As so many people with diabetes are now being prescribed injectable medication, this is a timely and important enterprise which will bring great benefit to them.”

**SIMON O'NEILL, DIRECTOR OF CARE, INFORMATION AND ADVOCACY. DIABETES UK**

“ Advances in the treatment of diabetes have led to an increase in the number of injectable therapies available. Correct technique is of paramount importance in order to ensure the benefits of injectable therapies such as insulin and GLP-1s. The Forum for Injectable Therapy (FIT) provides comprehensive evidenced based guidelines to improve the process and education of self injection technique for people with diabetes. As a company committed to improving the care of patients with diabetes, Lilly UK welcomes the FIT initiative as an important step in supporting diabetes care in the United Kingdom.”

**IAN DANE, SENIOR DIRECTOR, ELI LILLY & COMPANY**

“ Novo Nordisk fully endorse the FIT initiative. The benefits of modern injectable medications for the treatment of diabetes can only be fully realised through the use of correct injection technique. Novo Nordisk believe it is imperative that Healthcare Professionals understand the importance of good injection technique and convey this to people with diabetes under their care. FIT is a superb initiative, from leading professionals in the diabetes care, which will make a big difference in this area.”

**JOHN DAWBER, MARKETING DIRECTOR, NOVO NORDISK LTD.**

“ sanofi-aventis are a company who strive to improve the care for people with diabetes who are using insulin therapy by producing a range of insulins. We are proud to support the FIT (Forum for Injection Technique) initiative which is aiming to improve current practice through demonstration of best practice and the sharing of scientific evidence. We, too, appreciate the importance of good injection technique in ensuring people with diabetes who are using insulin therapy achieve the most benefit from their medication and wish FIT every success. We look forward to working with FIT in the future”.

**JASON BROWN, DIABETES BRAND LEAD, SANOFI-AVENTIS**

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# 1.0

## Psychological Challenges of Injections

### 1.1 Children

- 1** Children have a lower threshold for pain than adults and sometimes find injecting uncomfortable. The Healthcare Professional (HCP) should ask about pain, since many young people with diabetes will not bring it up spontaneously. (18, 20) **A 2**
- 2** Younger children may be helped by distraction techniques (as long as they do not involve trickery) or play therapy (e.g. injecting into a stuffed animal) while older children may respond better to Cognitive Behavioural Therapies (CBT) where available. (19) **A 2**
- 3** CBT includes relaxation training, guided imagery, graded exposure, active behavioural rehearsal, modelling and reinforcement as well as incentive scheduling. (19) **A 2**

### 1.2 Adults

- 1** The HCP should prepare all people with type 2 diabetes for likely future injectable therapy early in the disease pathway, by explaining the natural, progressive nature of the disease, stating that it includes injectable therapy and making clear that injectable therapy treatment is not a sign of patient failure. (30) **A 3**
- 2** Both the short-term and long-term advantages of good glucose management should be emphasised. Finding the right combination of therapies including injectables leading to good glucose management should be the goal. (31,32) **A 3**
- 3** Through culturally-appropriate pictures and stories, HCPs should show how injectable therapy could enhance both the duration and quality of life. (31) **A 2**
- 4** HCPs should reflect on their own perceptions of injectable therapy and avoid using any terms which imply that such therapy is a sign of failure, a form of punishment or a threat. (33,34) **A 3**
- 5** Pen devices may have psychological advantages over syringes and therefore maybe more acceptable. (31,35-37) **A 2**



## 2.0 Therapeutic Education

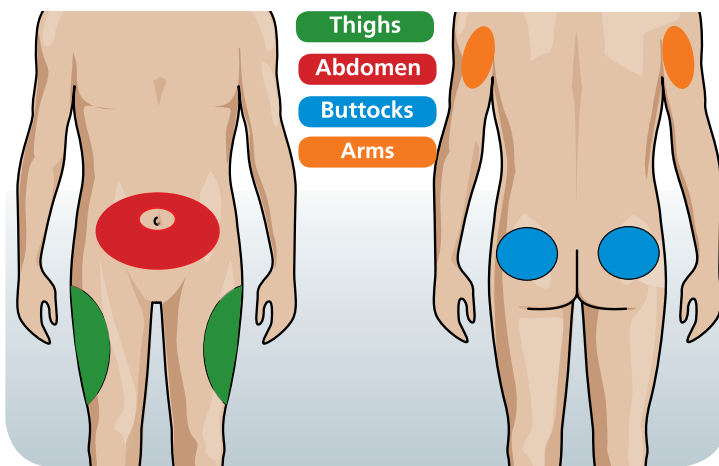
### Adult

- 1 The HCP should spend time exploring the individual's anxieties about the injecting process and the injectable therapy itself. (33,40) **A** **3**
  - 2 At the beginning of injection therapy (and at least every year thereafter) the HCP should discuss:
    - Injecting regimen
    - Choice and management of the devices used
    - Choice, care and self-examination of injection sites
    - Correct injection techniques (including site rotation, injection angle and possible use of skin folds)
    - Injection complications and how to avoid them
    - Optimal needle length
    - Safe disposal of used sharps (32-35, 38-41)
  - 3 Injection technique education should be put in place and regularly reviewed and recorded in the individuals care plan. **A** **3**
  - 4 Current injection practice should be discussed and if possible observed. Injection sites should be examined and palpated, if possible at each visit but at least once a year. (38,40,41) **A** **3**
- Ensure that each of these topics have been fully understood. (34) **A** **3**

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## 3.0 Injection Sites

The diagram shows the current recommended injection sites for injectable therapy



**Figure 1:**  
Recommended injection sites.

## 4.0 Injection Site Care

- 1** The site should be inspected and palpated by the individual prior to injection. (5,6) **A** **3**
- 2** Avoid using a site showing signs of lipohypertrophy, inflammation, oedema or infection until the problem has been resolved. (15,49,50-55) **A** **2**
- 3** Injections should be given into a clean site using clean hands. (56) **A** **2**
- 4** The site should be cleansed with soap and water when found to be unclean. (56) **A** **3**
- 5** Disinfection of the site is usually not required; however, alcohol swabs may be used prior to injections given in the hospital or care home setting. (6, 57-60) **B** **2**



## 5.0 Insulin Storage and Suspension

- 1 Store injectable medication in current use at room temperature (for a maximum of one month after initial use, and within expiry date). Avoid direct sunlight and areas of temperature extremes. Store unopened injectable medication in an area of the refrigerator where freezing is unlikely to occur. (66,67) **A** **2**
- 2 Cloudy insulin (e.g. NPH and pre-mixed insulin) must be gently rolled ten times and inverted ten times (not shaken) until the crystals go back into suspension and the solution becomes milky white. (61-65) **A** **2**

## 6.0 Injecting Process

Tips for making injections less painful include:

- Keeping injectable therapy in use, at room temperature (66,67) **A** **2**
- Using needles of shorter length and smaller diameter (157) **A** **1**
- Using a new needle at each injection (5,6,17,36,68) **A** **2**
- Insert the needle in a quick smooth movement through the skin (69) **A** **3**
- Inject slowly and ensure that the plunger (syringe) or thumb button (pen) has been fully depressed (69) **A** **3**
- If using alcohol swabs, inject only when the alcohol has fully dried **B** **3**

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## 7.0

### The Correct Use of Pen Devices

- 1 Pen devices should be primed (observing at least a drop at the needle tip) according to the manufacturer's instructions before each injection. Once flow is verified, the desired dose should be dialled and the injection administered. (36,68) **A** **3**
- 2 Pen devices and cartridges are for single person use only and should never be shared due to the risk of cross contamination. (37,57) **A** **2**
- 3 Pen needles should be used only once. (3,5,6,17,59,76,77) **A** **2**
- 4 Using a new needle each time may reduce the risk of needle breakage in the skin, 'clogging' of the needle, inaccurate dosing and indirect costs (e.g Abscess). (77) **B** **2**
- 5 After pushing the thumb button in completely, the individual should count slowly for 10 seconds before withdrawing the needle in order to deliver the full dose and prevent the leakage of medication. Counting past 10 seconds may be necessary for higher doses. (61,69,71,74,78,79) **A** **1**
- 6 Needles should be safely disposed of immediately after use and not left attached to the pen. This prevents the entry of air (or other contaminants) into the cartridge as well as the leakage of medication out of the cartridge, which can affect subsequent dose accuracy. (71-75) **A** **2**
- 7 Injecting through clothing should be discouraged. As needle lengths are becoming shorter there is increased risk of intradermal injection. **B** **3**

## 8.0

### The Correct Use of Syringes

- 1 A syringe should be used only once and disposed of safely. (3,5,6,17,59,76,77) **A** **2**
- 2 When drawing up insulin, the air equivalent to the dose should be drawn up first and injected into the vial to facilitate easier withdrawal. **A** **3**
- 3 If air bubbles are seen in the syringe, hold syringe with needle uppermost, tap the barrel to bring them to the top and then remove the bubbles by pushing the plunger to expel the air. **A** **3**



## 9.0 Absorption Rates

### 9.1 Human Insulin

- 1 IM injection of all human insulin should be avoided since rapid absorption and serious hypoglycaemia can result. (95,96) **A** 1
- 2 The thigh and buttocks are the preferred injection sites when using NPH (intermediate acting) as the basal insulin, since absorption is slowest from these sites. (43,97) **A** 1
- 3 The abdomen is the preferred site for soluble human insulin, since absorption is fastest there. (16,44,46,98-100) **A** 1
- 4 The absorption of soluble (short acting) human insulin in the elderly can be slow and this insulin should not be used when a rapid effect is needed. (14,101) **B** 2 (Note: Insulin actions may overlap)
- 5 For those people who require very large doses of insulin U-500 insulin maybe an option instead of U-100. U-500 is only available as soluble insulin. However it has a pharmacokinetic profile more closely simulating NPH human intermediary insulin than soluble short acting human U-100. (5,6,158) **B** 2
- 6 Massaging the site before or after injection may speed up absorption and is not generally recommended. (5,6,70) **C** 3

### 9.2 Premixed Insulin

- 1 Premixed insulin (human or analogue) should be given in the abdomen in the morning to increase the speed of absorption of the short-acting insulin in order to cover post-breakfast glycaemic excursions. (12) **A** 1
- 2 Premixed insulin should be given in the thigh or buttock before evening meal as this leads to slower absorption and decreases the risk of nocturnal hypoglycaemia. (93,97) **A** 1
- 3 Massaging the site before or after injection may speed up absorption and is not generally recommended. (5,6,70) **C** 3

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## 9.0

# Absorption Rates Continued

### 9.3 Insulin Analogues

- 1** **Rapid-acting** insulin analogues may be given at any of the injection sites, as absorption rates do not appear to be site-specific. (81-85) **A** **1**
- 2** **Rapid-acting** analogues should not be given intramuscularly (IM). (82,83,86) **A** **2**
- 3** **Long-acting** insulin analogues may be given at any of the injection sites, as absorption rates do not appear to be site-specific. (87,88) **B** **2**
- 4** IM injections of **long-acting** analogues must be avoided due to the risk of severe hypoglycaemia or erratic control. (89,90) **A** **1**
- 5** When injecting **rapid and long acting** analogue insulin these should be given in different sites even if given at different times during the day. **B** **3**
- 6** Larger doses may cause a delay in the peak and increase the duration of action. (5,6) **B** **3**
- 7** Massaging the site before or after injection may speed up absorption and is not generally recommended. (5,6,70) **C** **3**

### 9.4 GLP-1 Agonists

- 1** Pending further studies, people with diabetes who inject GLP-1 agents (e.g. exenatide - Byetta®; liraglutide - Victoza®) should follow the manufacturers instructions. (72) **A** **2**



## 10.0 Needle Length

### 10.1 Children and Adolescents

- 1 There is no clinical reason for recommending needles longer than 6mm for children and adolescents. (118) **A 2**
- 2 Children and adolescents using a 5/6mm needle should lift a skin fold with each injection. (9,83,86,110,112-117,156,157) **A 1**
- 3 In the majority of cases a 4mm needle may be inserted at 90 degrees without a lifted skin fold. (9) **A 1**
- 4 If children have only an 8 mm needle available (as is currently the case with syringe users), it is essential to use a lifted skin fold or give injections into the buttocks. (111,118,119) **A 1**
- 5 Arms should only be used for injections if administered by a third party and using a lifted skin fold. **A 3**
- 6 Avoid pushing the pen device in to the skin thus indenting the skin during the injection, as the needle may penetrate deeper than intended and enter the muscle. **B 3**

### 10.2 Adults

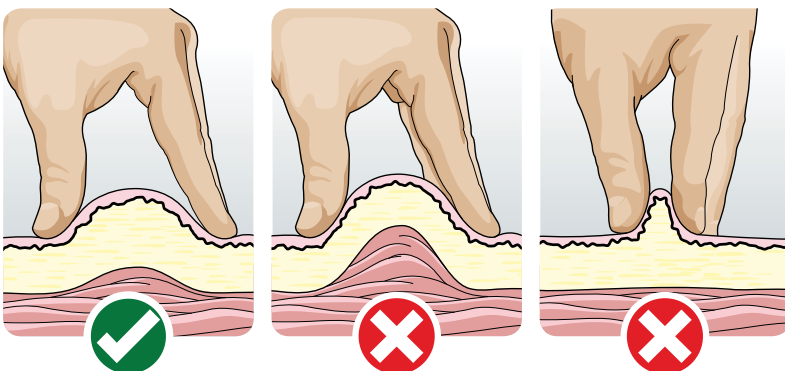
- 1 There is no clinical reason for recommending needles longer than 8mm. (105,119,132) **A 2**
- 2 4, 5 and 6 mm needles are suitable for all people with diabetes regardless of BMI; they may not require a lifted skin fold; particularly if using 4 mm needles. (9,74,104,106 – 108,156,157) **A 1**
- 3 Injections with shorter needles (4, 5, 6 mm) should be given in adults at 90 degrees to the skin surface. (9,74,106 – 108,130) **A 1**
- 4 To prevent possible IM injections when injecting into slim limbs and abdomens, even with short needles (4,5 and 6mm) may warrant use of a lifted skin fold. (9, 105, 106,131) **A 2**
- 5 Individuals using >8mm needles should ensure they are using a lifted skin fold to avoid IM injections. (105,131) **A 2**

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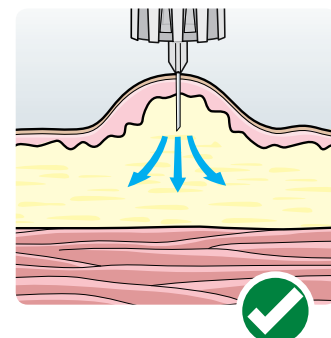
## 11.0

### Lifted Skin Folds

- 1** All people with diabetes/carers should be taught the correct technique for lifting a skin fold from the onset of injectable therapy. (see Fig 2.) **A** **3**
- 2** The lifted skin fold should not be squeezed so tightly that it causes skin blanching or pain. **A** **3**
- 3** The optimal sequence should be:
  - 1) Make a lifted skin fold
  - 2) Insert needle into skin at 90° angle (see Figure 3)
  - 3) Administer therapy
  - 4) Leave the needle in the skin for at least 10 seconds after the thumb button plunger is fully depressed
  - 5) Withdraw needle from the skin
  - 6) Release lifted skin fold
  - 7) Dispose of used needle safely (see section 17)



**Figure 2:** Correct (left) and incorrect (right) ways of performing the skin fold.



**Figure 3:** The correct angle of injection when lifting a skin fold is 90°



## 12.0

# Lipohypertrophy

- 1 Sites should be inspected and any abnormalities documented by the HCP within the individual's care plan. At a minimum, each site should be examined annually (preferably at each visit for children). If lipohypertrophy is already present the sites should be monitored at every review. (41,138) **A** **2**
- 2 Individuals should be taught to examine their own injection sites and how to detect lipohypertrophy. (41,138) **A** **2**
- 3 Using various available tools such as making two ink marks at opposite edges of the lipohypertrophy allows the lipo to be measured and its size recorded for long-term follow up. If visible the area of lipohypertrophy could also be photographed for the same purpose. **A** **3**
- 4 Individuals should be advised (and rationale explained) not to inject into areas of lipohypertrophy until abnormal tissue returns to normal (which can take months to years). (139,140) **A** **2**
- 5 Switching injections from areas of lipohypertrophy to normal tissue often requires a decrease of the dose of insulin injected. The amount of change varies from one individual to another and should be guided by frequent blood glucose measurements. (50,140) **A** **2**
- 6 Caution is needed; too great a reduction in dose could lead to an increased risk of Diabetic Ketoacidosis in people with Type 1 Diabetes. However, too small a reduction could result in hypoglycaemia. **B** **3**
- 7 The best current preventative and therapeutic strategies for lipohypertrophy include rotation of injection sites with each injection, and non-reuse of needles. (136,137,139,141-143) **A** **2**

Lipoatophy, although very rare, is a wasting of the subcutaneous tissue at injection sites. Injecting into these sites should be avoided.



Palpable lipohypertrophy: normal skin (fingertips close together) and lipohypertrophic tissue (fingertips spread apart). Photograph courtesy of Lourdes Saez-de Ibarra and Ruth Gaspar, Diabetes Nurses and Specialist Educators from La Paz Hospital, Madrid, Spain.



Sometimes the "lipo" can have the appearance of a tense, shiny area as on the leg of this 19-year old man. NB: when you see a shiny, indented area at an injection site, SUSPECT "LIPO"



52 year old man injected in his thigh for 25 years, began to rotate. His daily insulin requirement fell from 66 units to 30



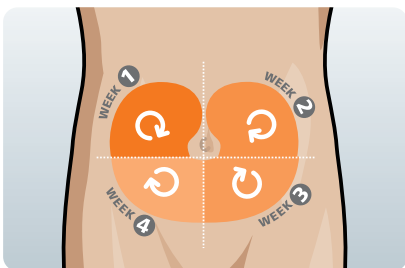
29 year old man said: "it hurts less there".

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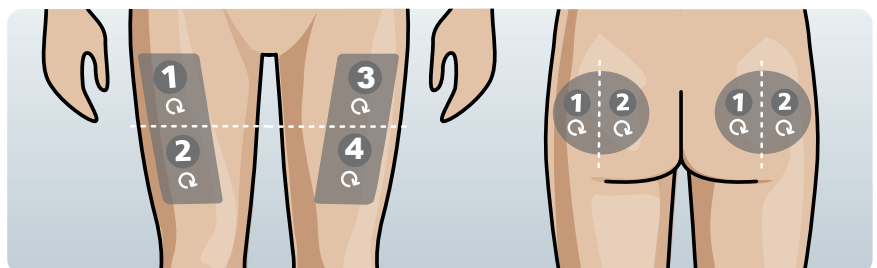
## 13.0

# Rotation of Injecting Sites

- 1** Individuals should be taught an easy-to-follow rotation scheme from the onset of injection therapy. (146,147) **A** **2**
- 2** One scheme with proven effectiveness involves dividing the injection site into quadrants (or halves when using the thighs or buttocks); using one quadrant per week and moving always in the same direction, either clockwise or anti-clockwise (see Figures 4 and 5). (148) **A** **3**
- 3** Injections within any quadrant or half should be spaced at least 1cm from each other in order to avoid repeat tissue trauma. **A** **3**
- 4** HCP should verify that the rotation scheme is being followed at each visit and should provide advice where needed. **A** **3**
- 5** Use a variation of educational approaches and available tools to inform how to detect for lipohypertrophy. **A** **3**



**Figure 4:** 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.



**Figure 5:** 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.



## 14.0 Bleeding and Bruising

- 1 Individuals should be reassured that bleeding and bruising do not appear to have adverse clinical consequences for the absorption or action of injectable therapies. (149,150) **A** **2**
- 2 If persistent bruising occurs review injection technique. **B** **2**

## 15.0 Pregnancy

- 1 Pregnant women with diabetes (of any type) who continue to inject into the abdomen should give all injections using a raised skin fold. (151) **B** **2**
- 2 Massaging the site before or after injection may speed up absorption and is not generally recommended. (5,6,70) **C** **3**

## 16.0 Safety Issues

- 1 Under no circumstances should any HCP re-sheath needles, therefore either syringes or safety needles should be used. (153) **B** **1**
- 2 Any HCP who is required to use a lifted skin fold must exhibit caution to avoid needle stick injury. **A** **3**

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## 17.0

# Disposal of injecting material

- 1** All HCPs and individuals/ carers should be aware of local regulations regarding sharps disposal. HCPs individuals/ carers should be made aware of the consequences of inappropriate disposal of sharps (e.g. needle stick injuries to others such as refuse workers). (154) **A** **3**
- 2** Correct disposal should be taught to people with diabetes from the beginning of injection therapy and reinforced throughout. **A** **3**
- 3** Where available, a needle clipping device could be used. It can be carried in the injection kit. **A** **3**
- 4** Sharps guard (sharps box) is available on FP10. However, disposal is according to local policy. **B** **3**
- 5** Under no circumstance should sharps material be disposed of into the public rubbish or household refuse system. **A** **3**
- 6** Empty pen devices can be disposed of in the normal household refuse when the needle is removed. **B** **3**



## References

- 1 Partanen TM, Rissanen A. Injectable therapy injection practices, *Pract Diabetes Int* 2000;17:252-254.
- 2 Strauss K, De Gols H, Hannet I, Partanen TM, Frid A. A pan-European epidemiologic study of injectable therapy injection technique in people with diabetes with diabetes. *Pract Diab Int* 2002;19:71-76.
- 3 Strauss K, De Gols H, Letondeur C, Matyjaszczyk M, Frid A. The second injection technique event (SITE), May 2000, Barcelona, Spain. *Pract Diab Int* 2002;19:17-21.
- 4 Strauss K. Injectable therapy injection techniques: Report from the 1st International Injectable therapy Injection Technique Workshop, Strasbourg, France—June 1997. *Pract Diab Int* 1998;15:16-20.
- 5 Danish Nurses Organisation. Evidence-based Clinical Guidelines for Injection of Injectable therapy for Adults with Diabetes Mellitus, 2nd edition, December 2006. Available from: [www.dsr.dk](http://www.dsr.dk)
- 6 Association for Diabetescare Professionals (EADV). Guideline: The Administration of Injectable therapy with the Injectable therapy Pen. September 2008. Available from: [www.eadv.nl](http://www.eadv.nl)
- 7 American Diabetes Association Resource Guide 2003: Injectable therapy Delivery. *Diabetes Forecast* 2003;56:59-76.
- 8 American Diabetes Association Position Statements: Injectable therapy Administration. *Diabetes Care* 2004;27:S106-S107.
- 9 Birkebaek N, Solvig J, Hansen B, Jorgensen C, Smedegaard J, Christiansen J. A 4 mm needle reduces the risk of intramuscular injections without increasing backflow to skin surface in lean diabetic children and adults. *Diabetes Care* 2008;22: e65.
- 10 De Meijer PHEM, Lutterman J A, van Lier HJJ, van't Laar A. The variability of the absorption of subcutaneously injected injectable therapy; effect of injection technique and relation with brittleness. *Diabetic Medicine* 1990;7: 499-505.
- 11 Baron AD, Kim D, Weyer C. Novel peptides under development for the treatment of type 1 and type 2 diabetes mellitus. *Curr Drug Targets Immune Endocr Metabol Disord* 2002;2:63-82.
- 12 Frid A, Gunnarsson R, Güntner P, Linde B. Effects of accidental intramuscular injection on injectable therapy absorption in IDDM. *Diabetes Care* 1988;11:41-45.
- 13 Vaag A, Damgaard Pedersen K, Lauritzen M, Hildebrandt P, Beck-Nielsen H. Intramuscular versus subcutaneous injection of unmodified injectable therapy; consequences for blood glucose control in people with diabetes with type 1 diabetes mellitus. *Diabetic Medicine* 1990;7: 335-342.
- 14 Hildebrandt P. Subcutaneous absorption of injectable therapy in injectable therapy-dependent diabetic people with diabetes. Influences of species, physico-chemical properties of injectable therapy and physiological factors. *Danish Medical Bulletin* 1991;38:337-346.
- 15 Johansson U, Amsberg S, Hannerz L, Wredling R, Adamson U, Arnqvist HJ, Lins P. Impaired Absorption of injectable therapy Aspart from Lipohypertrophic Injection Sites. *Diabetes Care* 2005;28:2025-2027.
- 16 Frid A Linde B. Clinically important differences in injectable therapy absorption from the abdomen in IDDM. *Diabetes Research and Clinical Practice* 1993;21:137-141.
- 17 Chantelau E, Lee DM, Hemmann DM, Zipfel U, Echterhoff S. What makes injectable therapy injections painful? *British Medical Journal* 1991;303: 26-27.
- 18 Karlegård M, Eldholm S, Lindblad B, Sigström L. Stickrädsla hos barn och ungdomar med diabetes (Fear of injection in children and adolescents with diabetes). *Sv Läkaresällskapets Handlingar Hygiea* 2001;110:301(32P).
- 19 Cocoman A, Barron C. Administering subcutaneous injections to children: what does the evidence say? *Journal of Children and Young People's Nursing* 2008;2:84-89.
- 20 Hofman, Paul. Personal Communication.
- 21 Hanas R, Ludvigsson J. Experience of pain from injectable therapy injections and needle phobia in young people with diabetes with IDDM. *Practical Diabetes International* 1997;14:95-99.
- 22 Hanas SR, Carlsson S, Frid A, Ludvigsson J. Unchanged injectable therapy absorption after 4 days' use of subcutaneous indwelling catheters for injectable therapy injections. *Diabetes Care* 1997;20:487-490.
- 23 Zambanini A, Newson RB, Maisey M, Feher MD. Injection related anxiety in injectable therapy-treated diabetes. *Diabetes Res Clin Pract* 1999; 46:239-46.
- 24 Hanas R, Adolfsson P, Elfvin-Akesson K, Hammaren L, Ilvered R, Jansson I, Johansson C, Kroon M, Lindgren J, Lindh A, Ludvigsson J, Sigstrom L, Wilk A, Aman J. Indwelling catheters used from the onset of diabetes decrease injection pain and pre-injection anxiety. *J Pediatr* 2002;140:315-20.
- 25 Burdick P, Cooper S, Horner B, Cobry E, McFann K, Chase HP. Use of a subcutaneous injection port to improve glycemic control in children with type 1 diabetes. *Pediatr Diabetes* 2009;10:116-9.
- 26 Polonsky WH, Jackson R. What's so tough about taking injectable therapy? Addressing the problem of psychological injectable therapy resistance in type 2 diabetes. *Clinical Diabetes* 2004;22:147-150.
- 27 Polonsky WH, Fisher L, Guzman S, Villa-Caballero L, Edelman SV. Psychological injectable therapy resistance in people with diabetes with type 2 diabetes: the scope of the problem. *Diabetes Care* 2005;28:2543-5.
- 28 Martinez L, Consoli SM, Monnier L, Simon D, Wong O, Yomtov B, Guéron B, Benmedjahed K, Guillemin I, Arnould B. Studying the Hurdles of Injectable therapy Prescription (SHIP): development, scoring and initial validation of a new self-administered questionnaire. *Health Qual Life Outcomes* 2007;5:53.
- 29 Cefalu WT, Mathieu C, Davidson J, Freemantle N, Gough S, Canovatchel W, OPTIMIZE Coalition. People with diabetes' perceptions of subcutaneous injectable therapy in the OPTIMIZE study: a multicenter follow-up study. *Diabetes Technol Ther* 2008;10:25-38.
- 30 Meece J. Dispelling myths and removing barriers about injectable therapy in type 2 diabetes. *The Diabetes Educator* 2006;32:95-185.

- 31 Davis SN, Renda SM. Psychological injectable therapy resistance: overcoming barriers to starting injectable therapy. *Diabetes Educ* 2006;32:146S-152S.
- 32 Davidson M. No need for the needle (at first). *Diabetes Care* 2008;31:2070-2071.
- 33 Reach G. Patient non-adherence and healthcare-provider inertia are clinical myopia. *Diabetes Metab* 2008;34:382-385.
- 34 Genev NM, Flack JR, Hoskins PL, et al. Diabetes education; whose priorities are met? *Diabetic Medicine* 1992; 9: 475-479.
- 35 Klonoff DC. The pen is mightier than the needle (and syringe). *Diabetes Technol Ther* 2001;3:631-3.
- 36 Bohannon NJ. Injectable therapy delivery using pen devices. Simple-to-use tools may help young and old alike. *Postgraduate Medicine* 1999;106:57-58.
- 37 Bärtsch U, Comtesse C, Wetekam B. Injectable therapy Pen Devices for treatment of diabetes (article in German). *Ther Umsch* 2006;63:398-404.
- 38 Heinemann L, Hompesch M, Kapitza C, Harvey NG, Ginsberg BH, Pettis RJ. Intra-dermal injectable therapy lispro application with a new microneedle delivery system led to a substantially more rapid injectable therapy absorption than subcutaneous injection. *Diabetologia* 2006;49:755, abstract 1014.
- 39 DiMatteo RM, DiNicola DD. Achieving patient compliance. In *The psychology of medical practitioner's role*. Pergamon Press Inc. Oxford 1982.
- 40 Joy SV. Clinical pearls and strategies to optimize patient outcomes. *Diabetes Educ* 2008;34:54S-59S.
- 41 Seyoum B, Abdulkadir J. Systematic inspection of injectable therapy injection sites for local complications related to incorrect injection technique. *Trop Doct* 1996;26:159-161.
- 42 Loveman E, Frampton G, Clegg A. The clinical effectiveness of diabetes education models for type 2 diabetes. *Health Technology Assessment* 2008;12:1-36.
- 43 Bantle JP, Neal L, Frankamp LM. Effects of the anatomical region used for injectable therapy injections on glycaemia in type 1 diabetes subjects. *Diabetes Care* 1993;16:1592-1597.
- 44 Frid A, Lindén B. Intraregional differences in the absorption of unmodified injectable therapy from the abdominal wall. *Diabetic Medicine* 1992;9:236-239.
- 45 Koivisto VA, Felig P. Alterations in injectable therapy absorption and in blood glucose control associated with varying injectable therapy injection sites in diabetic people with diabetes. *Annals of Internal Medicine* 1980;92:59-61.
- 46 Annersten M, Willman A. Performing subcutaneous injections: a literature review. *Worldviews on Evidence-Based Nursing* 2005; 2:122-130.
- 47 Vidal M, Colungo C, Jansà M. Actualización sobre técnicas y sistemas de administración de la inyectable therapy (I). [Update on injectable therapy administration techniques and devices (I)]. *Av Diabetol* 2008;24:175-190.
- 48 Fleming D, Jacober SJ, Vanderberg M, Fitzgerald JT, Grunberger G. The safety of injecting injectable therapy through clothing. *Diabetes Care* 1997;20:244-247.
- 49 Ariza-Andraca CR, Altamirano-Bustamante E, Frati-Munari AC, Altamirano-Bustamante P, Graef-Sanchez A. Delayed injectable therapy absorption due to subcutaneous edema. *Archivos de Investigación Medica* 1991;22:229-233.
- 50 Saez-de Ibarra L, Gallego F. Factors related to lipohypertrophy in injectable therapy-treated diabetic people with diabetes; role of educational intervention. *Practical Diabetes International* 1998;15:9-11.
- 51 Young RJ, Hannan WJ, Frier BM, Steel JM, et al. Diabetic lipohypertrophy delays injectable therapy absorption. *Diabetes Care* 1984;7:479-480.
- 52 Chowdhury TA, Escudier V. Poor glycaemic control caused by injectable therapy induced lipohypertrophy. *BMJ* 2003;327:383-384.
- 53 Johansson UB. Impaired absorption of injectable therapy aspart from lipohypertrophic injection sites. *Diabetes Care* 2005;28:2025-7.
- 54 Overland J, Molyneaux L, Tewari S., et al. Lipohypertrophy: Does it matter in daily life? A study using a continuous glucose monitoring system. *Diabetes, Obes Metab* 2009;11:460-3.
- 55 Frid A, Linden B. Computed tomography of injection sites in people with diabetes with diabetes mellitus. In: *Injection and Absorption of Injectible therapy*. Thesis, Stockholm, 1992.
- 56 Gorman KC. Good hygiene versus alcohol swabs before injectable therapy injections (Letter). *Diabetes Care* 1993;16:960-961.
- 57 Le Floch JP, Herbreteau C, Lange F, Perlemuter L. Biologic material in needles and cartridges after injectable therapy injection with a pen in diabetic people with diabetes. *Diabetes Care* 1998;21:1502-1504.
- 58 McCarthy JA, Covarrubias B, Sink P. Is the traditional alcohol wipe necessary before an injectable therapy injection? Dogma disputed (Letter). *Diabetes Care* 1993;16:402.
- 59 Schuler G, Pelz K, Kerp L. Is the reuse of needles for injectable therapy injection systems associated with a higher risk of cutaneous complications? *Diabetes Research and Clinical Practice* 1992;16:209-212.
- 60 Swahn Å. Erfarenheter av 94000 osterilt givna injectable therapyinjektioner (Experiences from 94000 injectable therapy injections given without skin swab). *Sv Läkaresällskapets Handlingar Hygiea* 1982;92:160(30).
- 61 King L. Subcutaneous injectable therapy injection technique. *Nurs Stand*. 2003;17:45-52.
- 62 Jehle PM, Micheler C, Jehle DR, Breitig D, Boehm BO. Inadequate susPen Devicesion of neutral protamine Hagedorn (NPH) injectable therapy in Pen Devices. *The Lancet* 1999;354:1604-1607.
- 63 Brown A, Steel JM, Duncan C, Duncun A, McBain AM. An assessment of the adequacy of susPen Devicesion of injectable therapy in pen injectors. *Diabet Med* 2004;21:604-608.
- 64 Nath C. Mixing injectable therapy: shake, rattle or roll? *Nursing* 2002;32:10.
- 65 Springs MH. Shake, rattle, or roll?... "Challenging traditional injectable therapy injection practices" *American Journal of Nursing* 1999;99:14.



- 66** Ahern J, Mazur ML. Site rotation. *Diabetes Forecast* 2001;54:66-68.
- 67** Perriello G, Torlone E, Di Santo S, Fanelli C, De Feo P, Santusano F, Brunetti P, Bolli GB. Effect of storage temperature on pharmacokinetics and pharmacodynamics of injectable therapy mixtures injected subcutaneously in subjects with type 1 (injectable therapy-dependent) diabetes mellitus. *Diabetologia* 1988;31:811-815.
- 68** Dejgaard A, Murmann C. Air bubbles in injectable therapy Pen Devices. *The Lancet* 1989;334:871.
- 69** Ginsberg BH, Parkes JL, Sparacino C. The kinetics of injectable therapy administration by injectable therapy Pen Devices. *Horm Metab Research* 1994;26:584-587.
- 70** Ezzo J, Donner T, Nickols D, Cox M. Is Massage Useful in the Management of Diabetes? A Systematic Review. *Diabetes Spectrum* 2001;14:218-224.
- 71** Annersten M, Frid A. Injectable therapy Pen Devices dribble from the tip of the needle after injection. *Practical Diabetes International* 2000;17:109-111.
- 72** Byetta Pen User Manual. Eli Lilly and Company, 2007.
- 73** Bärtsch U, Comtesse C, Wetekam B. Injectable therapy Pen Devices for treatment of diabetes (article in German). *Ther Umsch* 2006;63:398-404.
- 74** Jamal R, Ross SA, Parkes JL, Pardo S, Ginsberg BH. Role of injection technique in use of injectable therapy Pen Devices: prospective evaluation of a 31-gauge, 8mm injectable therapy pen needle. *Endocr Pract* 1999;5:245-50.
- 75** Chantelau E, Heinemann L, Ross D. Air Bubbles in injectable therapy Pen Devices. *Lancet* 1989;334:387-388.
- 76** Maljaars C. Scherpe studie naalden voor eenmalig gebruik [Sharp study needles for single use] *Diabetes and Levity* 2002;4:36-37.
- 77** Torrance T. An unexpected hazard of injectable therapy injection. *Practical Diabetes International* 2002;19:63.
- 78** Rissler J, Jørgensen C, Rye Hansen M, Hansen NA. Evaluation of the injection force dynamics of a modified prefilled injectable therapy pen. *Expert Opin Pharmacother* 2008;9:2217-22.
- 79** Broadway CA. Prevention of injectable therapy leakage after subcutaneous injection. *Diabetes Educator* 1991;17:90.
- 80** Caffrey RM. Diabetes under Control: Are all Syringes created equal? *American Journal of Nursing* 2003;103:46-49.
- 81** Mudaliar SR, Lindberg FA, Joyce M, Beerdsen P, Strange P, Lin A, Henry RR. Injectable therapy aspart (B28 asp-injectable therapy): a fast-acting analog of human injectable therapy: absorption kinetics and action profile compared with regular human injectable therapy in healthy nondiabetic subjects. *Diabetes Care* 1999;22:1501-6.
- 82** Rave K, Heise T, Weyer C, Herrnberger J, Bender R, Hirschberger S, Heinemann L. Intramuscular versus subcutaneous injection of soluble and lispro injectable therapy: comparison of metabolic effects in healthy subjects. *Diabet Med* 1998;15:747-51.
- 83** Frid A. Fat thickness and injectable therapy administration, what do we know? *Infusystems International* 2006;5:17-19.
- 84** Guerci B, Sauvanet JP. Subcutaneous injectable therapy: pharmacokinetic variability and glycemic variability. *Diabetes Metab* 2005;31:457-4524.
- 85** Braakter EW, Woodworth JR, Bianchi R, Cermele B, Erkelens DW, Thijsen JH, Kurtz D. Injection site effects on the pharmacokinetics and glucodynamics of injectable therapy lispro and regular injectable therapy. *Diabetes Care* 1996;19:1437-1440.
- 86** Lippert WC, Wall EJ. Optimal intramuscular needle-penetration depth. *Pediatrics* 2008;122:e556-e563.
- 87** Rassam AG, Zeise TM, Burge MR, Schade DS. Optimal Administration of Lispro Injectable therapy in Hyperglycemic Type 1 Diabetes. *Diabetes Care* 1999;22:133-6.
- 88** Owens DR, Coates PA, Luzio SD, Tinbergen JP, Kurzhals R. Pharmacokinetics of 125I-labeled injectable therapy glargine (HOE 901) in healthy men: comparison with NPH injectable therapy and the influence of different subcutaneous injection sites. *Diabetes Care* 2000;23:813-9.
- 89** Karges B, Boehm BO, Karges W. Early hypoglycaemia after accidental intramuscular injection of injectable therapy glargine. *Diabetic Medicine* 2005;22:1444-45.
- 90** Personal Communication: Anders Frid. Data on file: Novo Nordisk.
- 91** Calara F, Taylor K, Han J, Zabala E, Carr EM, Wintle M, Fineman M. A randomised, open-label, crossover study examining the effect of injection site on bioavailability of exenatide (synthetic exendin-4). *Clin Ther* 2005;27:210-5.
- 92** Broadway C. Prevention of injectable therapy leakage after subcutaneous injection. *The Diabetes Educator* 1991;17:90.
- 93** Kølendorf K, Bojsen J, Deckert T. Clinical factors influencing the absorption of 125 I-NPH injectable therapy in diabetic people with diabetes. *Hormone Metabolism Research* 1983;15:274-278.
- 94** Chen JVV, Christiansen JS, Lauritzen T. Limitation to subcutaneous injectable therapy administration in type 1 diabetes. *Diabetes, Obesity and Metabolism* 2003;5:223-233.
- 95** Frid A, Östman J, Linde B. Hypoglycemia risk during exercise after intramuscular injection of injectable therapy in thigh in IDDM. *Diabetes Care* 1990;13:473-477.
- 96** Vaag A, Handberg A, Laritzen M et al. Variation in absorption of NPH injectable therapy due to intramuscular injection. *Diabetes Care* 1990;13:74-76.
- 97** Henriksen JE, Vaag A, Hansen IR, Lauritzen M, Djurhuus MS, Beck-Nielsen H. Absorption of NPH (isophane) injectable therapy in resting diabetic people with diabetes; evidence for subcutaneous injection in the thigh as preferred site. *Diabetic Medicine* 1991;8:453-457.
- 98** Zehrer C, Hansen R, Bantle J. Reducing blood glucose variability by use of abdominal injectable therapy injection sites. *Diabetes Educator* 1985;16:474-477.
- 99** Henriksen JE, Djurhuus MS, Vaag A, Thye-Ronn P, Knudsen D, Hother-Nielsen O, Beck-Nielsen H. Impact of injection sites for soluble injectable therapy on glycaemic control in type 1 (injectable therapy-dependent) diabetic people with diabetes treated with a multiple injectable therapy injection regimen. *Diabetologia* 1993;36:752-758.

- 100** Sindelka G, Heinemann L, Berger M, Frenc W, Chantelau E. Effect of injectable therapy concentration, subcutaneous fat thickness and skin temperature on subcutaneous injectable therapy absorption in healthy subjects. *Diabetologia* 1994;37:377-340.
- 101** Clauson PG, Linde B. Absorption of rapid-acting injectable therapy in obese and nonobese NIDDM people with diabetes. *Diabetes Care* 1995;18:986-91
- 102** Becker D. Individualised injectable therapy therapy in children and adolescents with type 1 diabetes. *Acta Paediatr Suppl* 1998;425:20-24.
- 103** Uzun S, Inanc N, Azal S. Determining optimal needle length for subcutaneous injectable therapy injection. *Journal of Diabetes Nursing* 2001;5:83-87.
- 104** Kreugel G, Keers JC, Jongbloed A, Verweij-Gjaltema AH, Wolfenbuttel BHR. The influence of needle length on glycemic control and patient preference in obese diabetic people with diabetes. *Diabetes* 2009;58:A117.
- 105** Schwartz S, Hassman D, Shelmet J, Sievers R, Weinstein R, Liang J, Lyness W. A multicenter, open-label, randomised, two-period crossover trial comparing glycemic control, satisfaction, and preference achieved with a 31 gauge x 6mm needle versus a 29 gauge x 12.7mm needle in obese people with diabetes with diabetes mellitus. *Clin Ther* 2004;26:1663-78.
- 106** Kreugel G, Beijer HJM, Kerstens MN, ter Maaten JC, Sluiter WJ, Boot BS. Influence of needle size for SC injectable therapy administration on metabolic control and patient acceptance. *European Diabetes Nursing* 2007;4:1-5.
- 107** Van Doorn LG, Alberda A, Lytzen L. Injectable therapy leakage and pain perception with NovoFine 6 mm and NovoFine 12 mm needle lengths in people with diabetes with type 1 or type 2 diabetes. *Diabetic Medicine* 1998;1:S50.
- 108** Clauson PG, Linden B. Absorption of rapid-acting injectable therapy in obese and nonobese NIIDM people with diabetes. *Diabetes Care* 1995; 18:986-991.
- 109** Seidenari S, Giusti G, Bertoni L, et al. Thickness and echogenicity of the skin in children as assessed by 20-MHz ultrasound. *Dermatology* 2000;201:218-222.
- 110** Smith CP, Sargent MA, Wilson BP, Price DA. Subcutaneous or intramuscular injectable therapy injections. *Arch Dis in Childhood* 1991;66:879-882.
- 111** Birkebaek NH, Johansen A, Solvig J. Cutis/subcutis thickness at injectable therapy injection sites and localisation of simulated injectable therapy boluses in children with type 1 diabetes mellitus; need for individualisation of injection technique? *Diabetic Medicine* 1998;15:965-971.
- 112** Tafait E, Möller R, Jurimae T, Sudi K, Wallner SJ. Subcutaneous adipose tissue topography (SAT-Top) development in children and young adults. *Coll Antropol* 2007;31:395-402.
- 113** Haines L, Chong Wan K, Lynn R, Barrett T, Shield J, Rising Incidence of Type 2 Diabetes in Children in the U.K. *Diabetes Care* 2007;30:1097-1101.
- 114** Hofman PL, Lawton SA, Peart JM, Holt JA, Jefferies CA, Robinson E, Cutfield WS. An angled insertion technique using 6mm needles markedly reduces the risk of IM injections in children and adolescents. *Diabet Med* 2007;24:1400-5.
- 115** Polak M, Beregszaszi M, Belarbi N, Benali K, Hassan M, Czernichow P, Tubiana-Rufi N. Subcutaneous or intramuscular injections of injectable therapy in children. Are we injecting where we think we are? *Diabetes Care* 1996; 19:1434-1436.
- 116** Strauss K, Hannet I, McGonigle J, Parkes JL, Ginsberg B, Jamal R, Frid A. Ultra-short (5mm) injectable therapy needles: trial results and clinical recommendations. *Practical Diabetes* 1999;16:218-222.
- 117** Tubiana-Rufi N, Belarbi N, Du Pasquier-Fediaevsky L, Polak M, Kakou B, Leridon L, Hassan M, Czernichow P. Short needles (8 mm) reduce the risk of intramuscular injections in children with type 1 diabetes. *Diabetes Care* 1999;22:1621-5.
- 118** Chiarelli F, Severi F, Damacco F, Vanelli M, Lytzen L, Coronel G. Injectable therapy leakage and pain perception in IDDM children and adolescents, where the injections are performed with NovoFine 6 mm needles and NovoFine 8 mm needles. Abstract presented at FEND, Jerusalem, Israel. 2000.
- 119** Ross SA, Jamal R, Leiter LA, Josse RG, Parkes JL, Qu S, Kerestan SP, Ginsberg BH. Evaluation of 8 mm injectable therapy pen needles in people with type 1 and type 2 diabetes. *Practical Diabetes International* 1999;16:145-148.
- 120** Strauss K. Injectable therapy injection techniques. *Practical Diabetes International* 1998;15:181-184.
- 121** Thow JC, Coulthard A, Home PD. Injectable therapy injection site tissue depths and localisation of a simulated injectable therapy bolus using a novel air contrast ultrasonographic technique in injectable therapy treated diabetic subjects. *Diabetic Medicine* 1992;9:915-920.
- 122** Thow JC, Home PD. Injectable therapy injection technique: depth of injection is important. *BMJ* 1990;301:3-4.
- 123** Hildebrandt P. Skinfold thickness, local subcutaneous blood flow and injectable therapy absorption in diabetic people with diabetes. *Acta Physiol Scand* 1991;603:41-45.
- 124** Vora JP, Peters JR, Burch A, Owens DR. Relationship between Absorption of Radiolabeled Soluble Injectable therapy Subcutaneous Blood Flow, and Anthropometry. *Diabetes Care* 1992;15:1484-1493.
- 125** Laurent A, Mistretta F, Bottiglioli D, Dahel K, Goujon C, Nicolas JF, Hennino A, Laurent PE. Echographic measurement of skin thickness in adults by high frequency ultrasound to assess the appropriate microneedle length for intradermal delivery of vaccines. *Vaccine* 2007;25:6423-30.
- 126** Lasagni C, Seidenari S. Echographic assessment of age-dependent variations of skin thickness. *Skin Research and Technology* 1995;1:81-85.
- 127** Swindle LD, Thomas SG, Freeman M, Delaney PM. View of Normal Human Skin In Vivo as Observed Using Fluorescent Fiber-Optic Confocal Microscopic Imaging. *Journal of Investigative Dermatology* 2003;121:706-712.
- 128** Huzaira M, Rius F, Rajadhyaksha M, Anderson RR, González S. Topographic Variations in Normal Skin, as Viewed by In Vivo Reflectance Confocal Microscopy. *Journal of Investigative Dermatology* 2001;116:846-852.
- 129** Tan CY, Statham B, Marks R, Payne PA. Skin thickness measured by pulsed ultrasound: its reproducibility, validation and variability. *Br J Dermatol* 1982;106:657-67.



- 130** Solvig J, Christiansen JS, Hansen B, Lytzen L. Localisation of potential injectable therapy deposition in normal weight and obese people with diabetes with diabetes using Novofine 6 mm and Novofine 12 mm needles. Abstract FEND, Jerusalem, Israel, 2000.
- 131** Frid A, Lindén B. Where do lean diabetics inject their injectable therapy? A study using computed tomography. *BMJ* 1986;292:1638.
- 132** Frid A, Lindén B. CT scanning of injections sites in 24 diabetic people with diabetes after injection of contrast medium using 8 mm needles (Abstract). *Diabetes* 1996;45:A444.
- 133** Thow JC, Johnson AB, Marsden S, Taylor R, Home PH. Morphology of palpably abnormal injection sites and effects on absorption of isophane (NPH) injectable therapy. *Diabetic Medicine* 1990;7:795-799.
- 134** Richardson T, Kerr D. Skin-related complications of injectable therapy therapy: epidemiology and emerging management strategies. *American J Clinical Dermatol* 2003;4:661-667.
- 135** Photographs courtesy of Lourdes Saez-de Ibarra and Ruth Gaspar, Diabetes Nurses and Specialist Educators from La Paz Hospital, Madrid, Spain.
- 136** Nielsen BB, Musaeus L, Gæde P, Steno Diabetes Center, Copenhagen, Denmark. Attention to injection technique is associated with a lower frequency of lipohypertrophy in injectable therapy treated type 2 diabetic people with diabetes. Abstract EASD, Barcelona, Spain, 1998.
- 137** Vardar B, Kizilci S. Incidence of lipohypertrophy in diabetic people with diabetes and a study of influencing factors. *Diabetes Res Clin Pract* 2007;77:231-6.
- 138** Teft G. Lipohypertrophy: patient awareness and implications for practice. *Journal of Diabetes Nursing* 2002;6:20-23.
- 139** Hambridge K. The management of lipohypertrophy in diabetes care. *Br J Nurs* 2007;16:520-524.
- 140** Jansà M, Colungo C, Vidal M. Actualización sobre técnicas y sistemas de administración de la injectable therapy (I). [Update on injectable therapy administration techniques and devices (I)]. *Av Diabetol* 2008;24:255-269.
- 141** Ampudia-Blasco J, Girbes J, Carmena R. A case of lipatrophy with injectable therapy glargine. *Diabetes Care* 2005;28: 2983.
- 142** De Villiers FP. Lipohypertrophy - a complication of injectable therapy injections. *S Afr Med J* 2005;95:858-9.
- 143** Hauner H, Stockamp B, Haastert B. Prevalence of lipohypertrophy in injectable therapy-treated diabetic people with diabetes and predisposing factors. *Exp Clin Endocrinol Diabetes* 1996; 104:106-10.
- 144** Bantle JP, Weber MS, Rao SM, Chattopadhyay MK, Robertson RP. Rotation of the anatomic regions used for injectable therapy injections day-to-day variability of plasma glucose in type 1 diabetic subjects. *JAMA* 1990;263: 1802-1806.
- 145** Davis ED, Chesnaky P. Site rotation... taking injectable therapy. *Diabetes Forecast* 1992;45:45-56.
- 146** Lumber T. Tips for site rotation. When it comes to injectable therapy, where you inject is just as important as how much and when. *Diabetes Forecast* 2004;57:68-70.
- 147** Thatcher G. Injectable therapy injections. The case against random rotation. *American Journal of Nursing* 1985;85:690-692.
- 148** Diagrams courtesy of Lourdes Saez-de Ibarra and Ruth Gaspar, Diabetes Nurses and Specialist Educators from La Paz Hospital, Madrid, Spain.
- 149** Kahara T, Kawara S, Shimizu A, Hisada A, Noto Y, Kida H. Subcutaneous hematoma due to frequent injectable therapy injections in a single site. *Intern Med* 2004;43:148-149.
- 150** Kreugel G, Beter HJM, Kerstens MN, Maaten ter JC, Sluiter WJ, Boot BS. Influence of needle size on metabolic control and patient acceptance. *European Diabetes Nursing* 2007;4:51-55.
- 151** Engström L, Jinnerot H, Jonasson E. Thickness of Subcutaneous Fat Tissue Where Pregnant Diabetics Inject Their Injectable therapy - An Ultrasound Study. Poster at IDF 17th World Diabetes Congress, Mexico City, 2000.
- 152** Smith DR, Leggat PA. Needlestick and sharps injuries among nursing students. *J Adv Nurs* 2005;51:449-55.
- 153** Adams D, Elliott TS. Impact of safety needle devices on occupationally acquired needlestick injuries: a four-year prospective study. *J Hosp Infect* 2006;64:50-5.
- 154** Workman RGN. Safe injection techniques. *Primary Health Care* 2000;10:43-50.
- 155** Bain A, Graham A. How do people with diabetes dispose of syringes? *Practical Diabetes International* 1998;15:19-21.
- 156** Gibney MA, Arce CH, Byron KJ, Hirsch LJ. Skin and subcutaneous adipose layer thickness in adults with diabetes at sites used for injectable therapy injections: Implications for needle length recommendations. In press. *Curr Med Res Opin*.
- 157** Hirsch L, Klaff L, Bailey T, Gibney M, Albanese J, Qu S, Kassler-Taub K. Glycemic control, safety and patient ratings for a new 4 mm x 32G pen needle versus 5 mm and 8 mm x 31G pen needles in adults with diabetes. In press. *Curr Med Res Opin*
- 158** Cochran E, Musso C & Gorden P. The use of U-500 in patients with extreme insulin resistance. *Diabetes Care*. May 2005 vol. 28 no. 5 1240-1244

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