

## OBSERVATIONS

## A 4-mm Needle Reduces the Risk of Intramuscular Injections Without Increasing Backflow to Skin Surface in Lean Diabetic Children and Adults

Unintended intramuscular insulin injection increases the variation in the insulin absorption rate, thereby increasing the risk of hypoglycemia. To reduce the risk of intramuscular injection, shorter injection needles should be tested, particularly in lean patients (1–3). The objective of this study was to measure the distance from skin surface to muscle fascia in lean diabetic patients and to determine whether using an experimental 4-mm needle reduces the frequency of intramuscular injections as compared with a 6-mm needle. Further, this study tested whether the backflow of simulated insulin (test medium) was unchanged using the new 4-mm needle as compared with the 6-mm needle.

We included 21 lean children (16 male) and 32 lean adults (23 male) with diabetes and a BMI Z score <0. Cutis and subcutis thickness were measured by ultrasound at three points between the umbilicus and the spina iliaca anterior superior and also at three points at the thigh, midway between the spina iliaca anterior superior and the upper edge of patella and both 2 cm above and 2 cm below this point. Two injections of 300  $\mu$ l sterile air were given at the abdomen and thighs with a NovoPen 3 using an exper-

imental 4-mm and a 6-mm NovoFine needle, respectively. The needles were inserted perpendicular to the cutis without a skinfold. Tissue deposition of the air was detected by ultrasound (2). Backflow of test medium was evaluated by injecting volumes corresponding to 10 and 40 units insulin in adults.

When categorizing the distances from skin surface to muscle fascia into the categories <4 mm and >6 mm, the majority of distances were >6 mm (abdomen 67.9%, thigh 84.9%); no patients had a skin surface to muscle fascia distance at the thigh <4 mm, and no adults had a skin surface to muscle fascia distance at the abdomen <4 mm. Significantly more patients injected subcutaneously with the 4-mm needle than the 6-mm needle at the abdomen ( $P < 0.032$ ) and thigh ( $P < 0.001$ ). All patients except two adults and two children injected subcutaneously at the thigh with the 4-mm needle. All adults injected subcutaneously with the 4-mm needle at the abdomen. Leakage of the test medium to skin surface was negligible and independent of injection site and needle length.

We conclude that 1) 4-mm needles reduce the risk of intramuscular insulin injections without increasing the amount of backflow of insulin to the skin surface, 2) most patients can inject with the 4-mm needle without an elevated skinfold in a 90° angle at the thigh, 3) we still propose injecting in an elevated skinfold with a 45° angle when applying a 6-mm needle in lean patients (1).

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C.J. and J.S. are employed at Novo Nordisk and are involved in the development of the 4-mm needles.

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