



# Optimizing Insulin Absorption and Insulin Injection Technique in Older Adults

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The objective of our study was to determine the impact of anatomic site and injection technique on insulin absorption in the elderly. Twenty elderly insulin-naïve subjects (age  $80 \pm 1$  years; sex 7 female, 13 male; BMI  $29 \pm 1$  kg/m<sup>2</sup>; diabetes duration  $11 \pm 2$  years; A1C  $7.1 \pm 0.2\%$  [ $54 \pm 2$  mmol/mol]) were studied (clinicaltrials.gov NCT01213901). All subjects provided informed written consent (Declaration of Helsinki). Subjects underwent three 360-min euglycemic glucose clamp studies in random order. In each, 0.1 units/kg of insulin lispro (Humalog; Eli Lilly, Indianapolis, IN) was administered subcutaneously using a 5-mm needle. The investigator conducting the clamp and the technician collecting samples were blind to treatment. In two studies, insulin was given 6.0 cm from the umbilicus using either a skin lift or no skin lift (1). In the third, insulin was injected into the upper arm without skin lift. Pain of injection was evaluated using a visual analog scale. Samples were taken regularly to measure glucose and insulin. Differences among studies were evaluated with repeated measures ANOVA.  $P < 0.05$  was considered significant.

There was no significant difference in glucose values or infusion rates (data not shown). There was a significant study/time interaction among studies in insulin values (Fig. 1) ( $F = 2.5$ ,  $P < 0.05$ ), implying that injection into the abdominal site

resulted in higher peak insulin values, but the difference was not clinically significant. Pain was minimal with injection and did not differ among sites. It was difficult to maintain the skin lift in many elderly subjects because the subcutaneous tissue collapsed before injection could be completed.

In younger subjects, insulin is absorbed more quickly from the abdomen than peripheral sites (2–7). Although most guidelines recommend using a skin lift for insulin injection (1), we could find no studies that evaluated the impact of technique in any anatomic site. Our study suggests that insulin is equally well absorbed from the outer aspect of the arm and the abdomen in elderly patients with diabetes, and absorption is not modified by technique. The difference between our results and those of previous investigators may be explained by age-related changes in the skin (epidermal thinning, dermal atrophy, reduced blood flow, reduced subcutaneous fat) and the older insulin preparations and longer needles used in prior studies.

Most older adults are unable to correctly landmark the outer aspect of the arm and the abdomen is the preferred injection site (1). Health care professionals may choose to use either the arm or the abdomen for injections. We recommend no skin lift because it reduces the likelihood of an inadvertent needlestick.

We conclude that the abdomen without a skin lift is the preferred site and

technique for older adults. Health care professionals may use either the outer aspect of the arm or the abdomen without a skin lift.

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**Author Contributions.** L.A.T. helped design the study, assisted in the conduct of the experiments, and was involved in data analysis and manuscript preparation. G.S.M. helped design the study, assisted in the conduct of the experiments, and was involved in data analysis and manuscript preparation. G.S.M. is the guarantor of this work and, as such, had full access to all the data in the study and takes responsibility for the integrity of the data and the accuracy of the data analysis.

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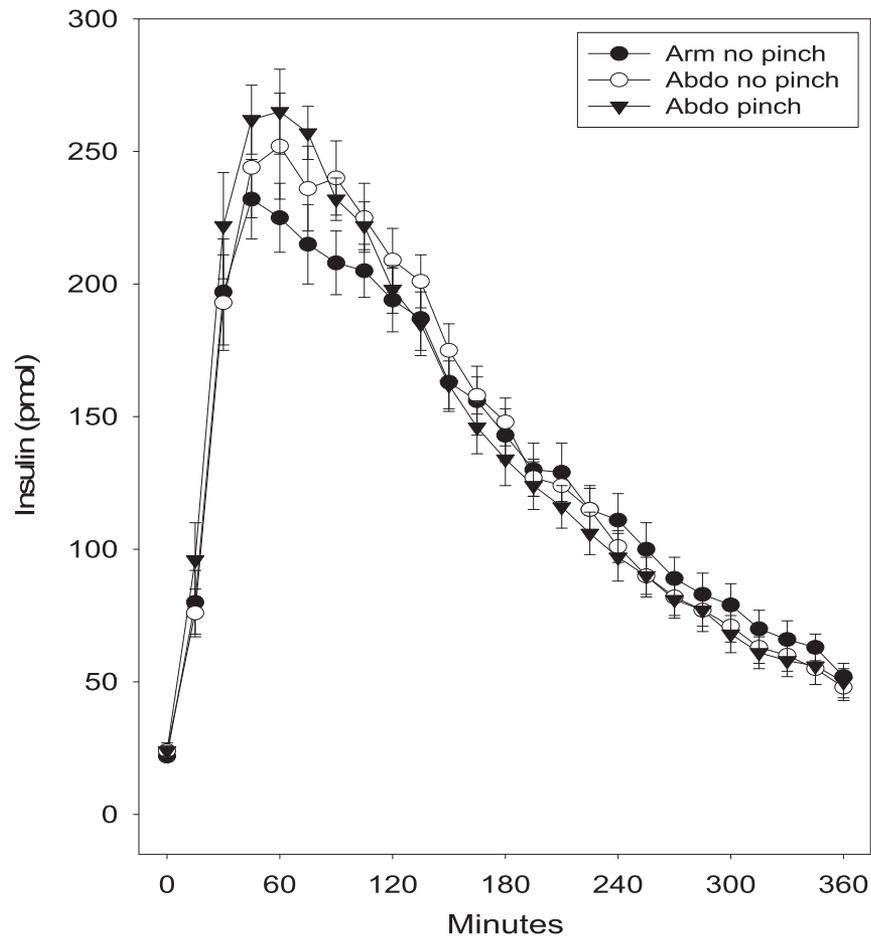


Figure 1—Insulin values. Abdo, abdomen.

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