In this study, we investigated how material infiltrates the skin when it is injected into a cadaver using a needle-free device" Seok et al (2016).

Abstract:

BACKGROUND AND OBJECTIVES: The effectiveness of needle-free injection devices in neocollagenesis for treating extended skin planes is an area of active research. It is anticipated that needle-free injection systems will not only be used to inject vaccines or insulin, but will also greatly aid skin rejuvenation when used to inject aesthetic materials such as hyaluronic acid, botulinum toxin, and placental extracts. There has not been any specific research to date examining how materials penetrate the skin when a needle-free injection device is used. In this study, we investigated how material infiltrates the skin when it is injected into a cadaver using a needle-free device.

STUDY DESIGN/MATERIALS AND METHODS: Using a needle-free injector (INNOJECTOR™; Amore Pacific, Seoul, Korea), 0.2 ml of 5% methylene blue (MB) or latex was injected into cheeks of human cadavers. The device has a nozzle diameter of 100 μm and produces a jet with velocity of 180 m/s. This jet penetrates the skin and delivers medicine intradermally via liquid propelled by compressed gasses. Materials were injected at pressures of 6 or 8.5 bars, and the injection areas were excised after the procedure. The excised areas were observed visually and with a phototrichogram to investigate the size, infiltration depth, and shape of the hole created on the skin. A small part of the area that was excised was magnified and stained with H&E (×40) for histological examination.

RESULTS: We characterized the shape, size, and depth of skin infiltration following injection of 5% MB or latex into cadaver cheeks using a needle-free injection device at various pressure settings. Under visual inspection, the injection at 6 bars created semi-circle-shaped hole that penetrated half the depth of the excised tissue, while injection at 8.5 bars created a cylinder-shaped hole that spanned the entire depth of the excised tissue. More specific measurements were collected using phototrichogram imaging. The shape of the injection entry point was consistently spherical regardless of the amount of pressure used. When injecting 5% MB at 6 bars, the depth of infiltration reached 2.323 mm, while that at 8.5 bars reached 8.906 mm. The area of the hole created by the 5% MB injection was 0.797 mm2 at 6 bars and 0.242 mm2 at 8.5 bars. Latex injections reached a depth of 3.480 mm at 6 bars and 7.558 mm at 8.5 bars, and the areas were measured at 1.043 mm2 (6 bars) and 0.355 mm2 (8.5 bars). Histological examination showed that the injection penetrated as deep as the superficial musculoaponeurotic system at 6 bars and the masseter muscle at 8.5 bars.

CONCLUSION: When injecting material into the skin using a pneumatic needle-free injector,

higher-pressure injections result in a hole with smaller area than lower-pressure injections. The depth and shape of skin penetration vary according to the amount of pressure applied. For materials of low density and viscosity, there is a greater difference in penetration depth according to the degree of pressure.

Reference:

Seok, J., Oh, C.T., Kwon, H.J., Kwon, T.R., Choi, E.J., Choi, S.Y., Mun, S.K., Han, S.H., Kim, B.J. and Kim, M.N. (2016) Investigating skin penetration depth and shape following needle-free injection at different pressures: A cadaveric study. Lasers in Surgery and Medicine. April 13th. .
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