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APPLICATION NOTE

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Sharpness of hypodermic needles

Animal welfare is one of the primary concerns affecting the public image of the pharmaceutical industry. Continuing to maintain high standards of animal welfare is, of course, a top priority for all those involved. Visual evidence is a very effective technique for communicating this to the public.

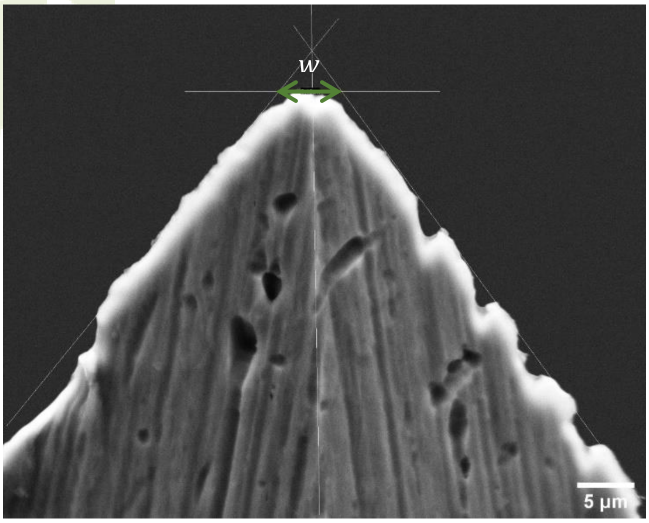
Hypodermic needles used to deliver injections should be as sharp as possible to minimise trauma. This application note examines 15 unused needles to help establish some statistics on needle sharpness as received from the manufacturer.

Techniques and equipment

Scanning Electron Microscopy (SEM) provides high resolution imaging, enabling metrology with nanoscale precision. SEM allows much higher magnifications than optical microscopy, which would miss many surface features vital to the performance of the needles.

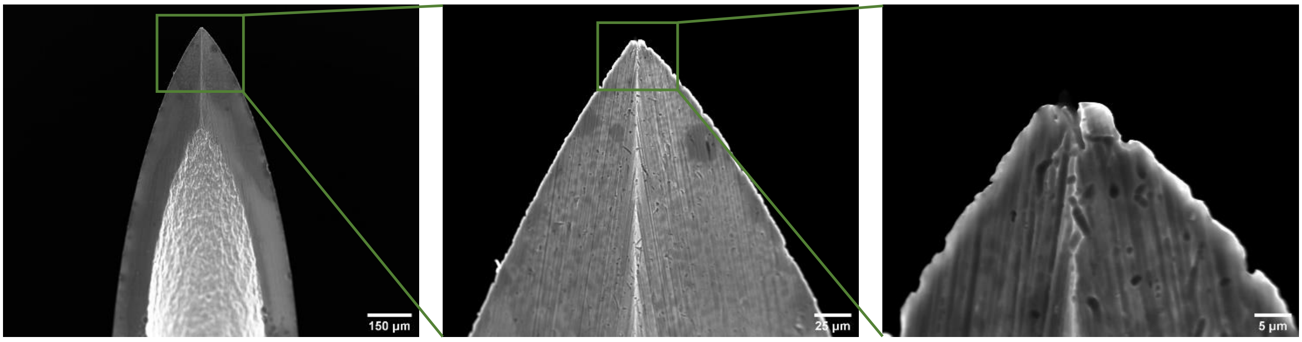
Process

Tangential lines were fitted to the edge of the needle points to form a triangle. Extrapolating the centre line of the needle helped to establish the location of the crossover at the tip. A horizontal measurement was taken between the lines at the end of the needle, labelled w, to determine the width of the tip.



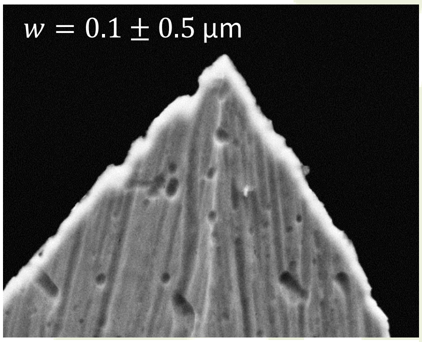
The typical diameter of a skin cell is 30µm [1]. If we assume damaging a single cell is unavoidable during an injection, a needle is therefore deemed blunt if $w > 30$µm, as using such a needle would inevitably cause more damage than necessary.

Results

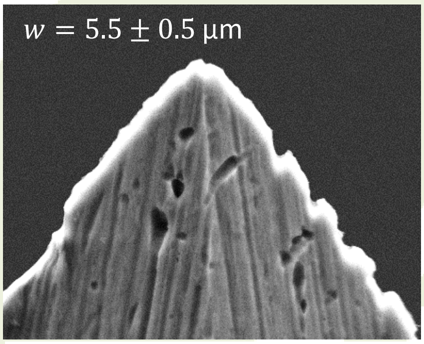


A single needle is shown above at increasing magnifications. A magnification of 5000X reveals far more detail than optical microscopy would be capable of. The porosities in the metal are clearly visible, as well as the lines where the tip was ground to a point.

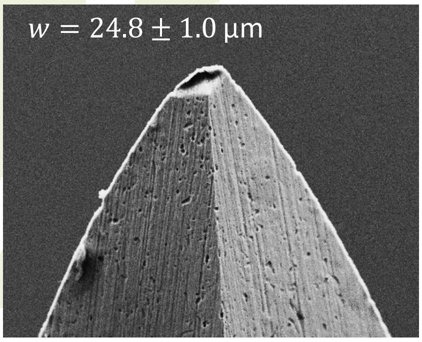
The uncertainty in the tip width measurement is the standard error based on variation observed in repeat measurements of each needle. Three main categories were observed, representative images are shown below.



A couple of needles were extraordinarily sharp with essentially zero tip width.



Most needles appeared sharp, with measured tip widths between 5 – 10 µm.



Two needles were slightly damaged, with tip widths greater than 20 µm.

Discussion

All the needles examined were considered sharp, with tip widths less than the threshold of 30 µm. However, many jagged edges were found, which will cause additional trauma not considered by the analysis presented here. Depending on the orientation of such features, trauma may occur on insertion or withdrawal of the needle, or both. No correlation between tip width and porosity density or edge roughness was observed. Higher quality needles manufactured to tighter tolerances may have smoother surfaces.

[1] Kashibuchi, N., Hirai, Y., O'Goshi, K. & Tagami, H., *Skin Res. Technol.*, **8**, pp. 203–11 (2002)