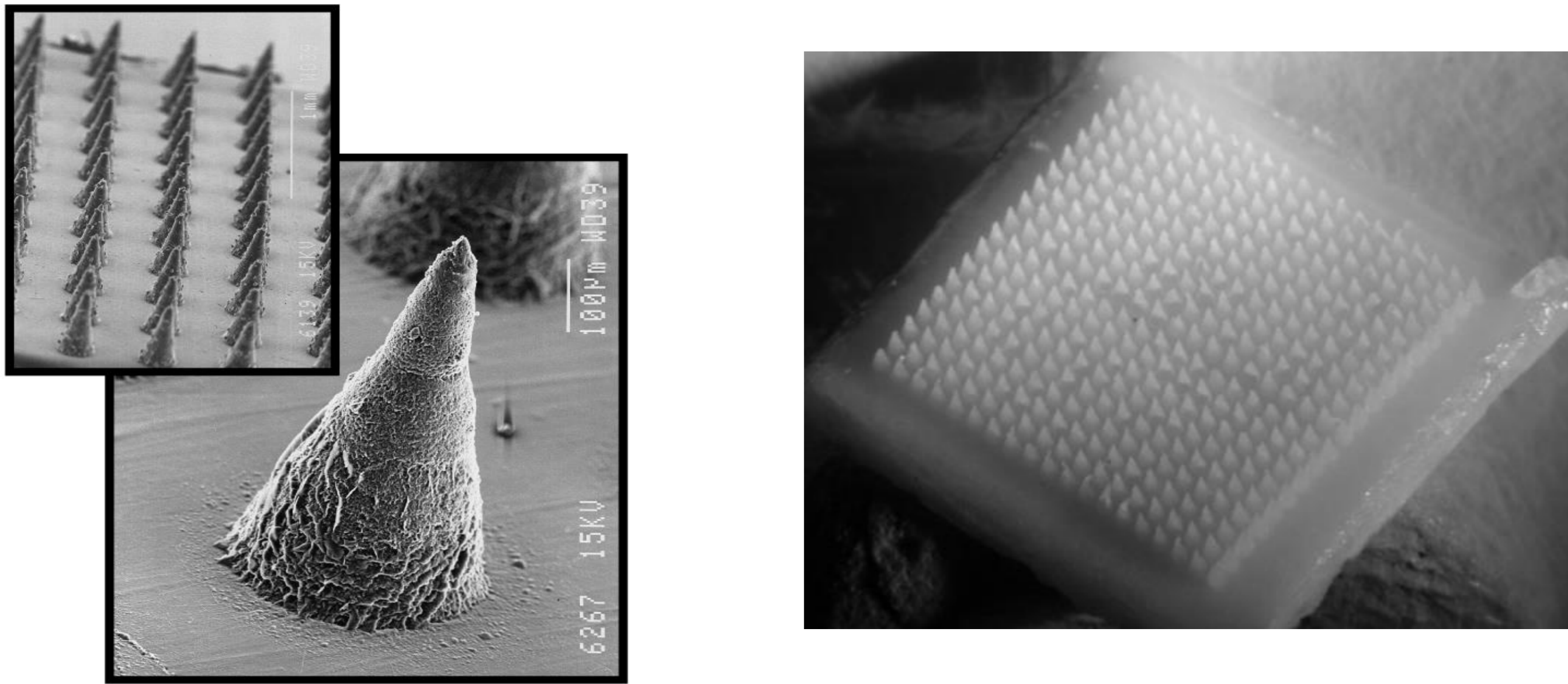


DISSOLVING MICRONEEDLES: A NEW METHOD OF PAINLESSLY DELIVERING MEDICATIONS AND THERAPEUTICS ACROSS THE SKIN

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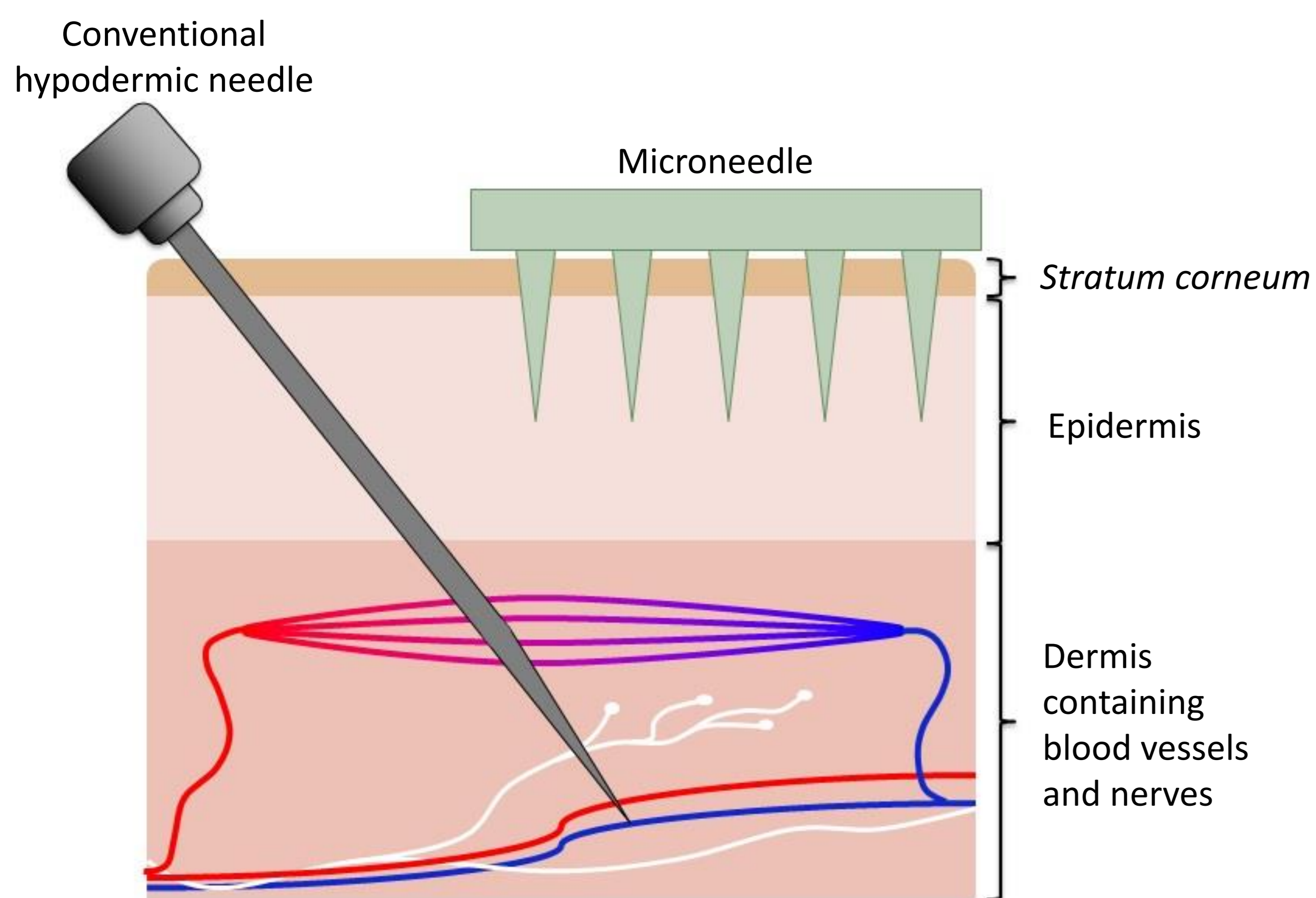
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Introduction: What are Microneedles?



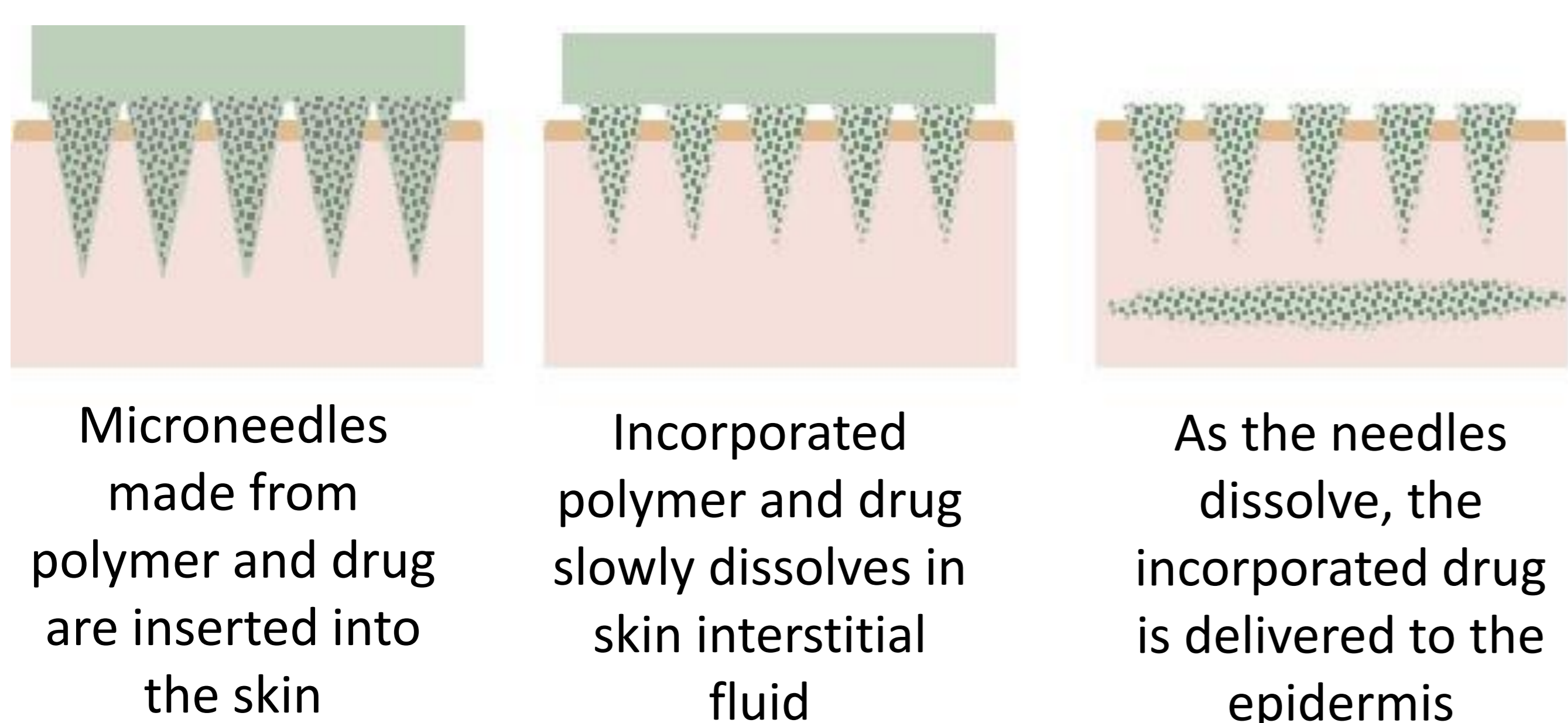
Microneedles (MN) are minimally-invasive devices, consisting of numerous micron-sized projections (each needle is 600 µm in height) amassed on a solid baseplate. These devices are akin to a plaster covered in microscopic needles. The needles are made using water soluble polymers, with a history of safe-usage in dental adhesives, and incorporate the drug of interest within their needle structure. The drug used in these studies was the common anti-inflammatory medication, ibuprofen.

How do Microneedles differ from hypodermic needles?



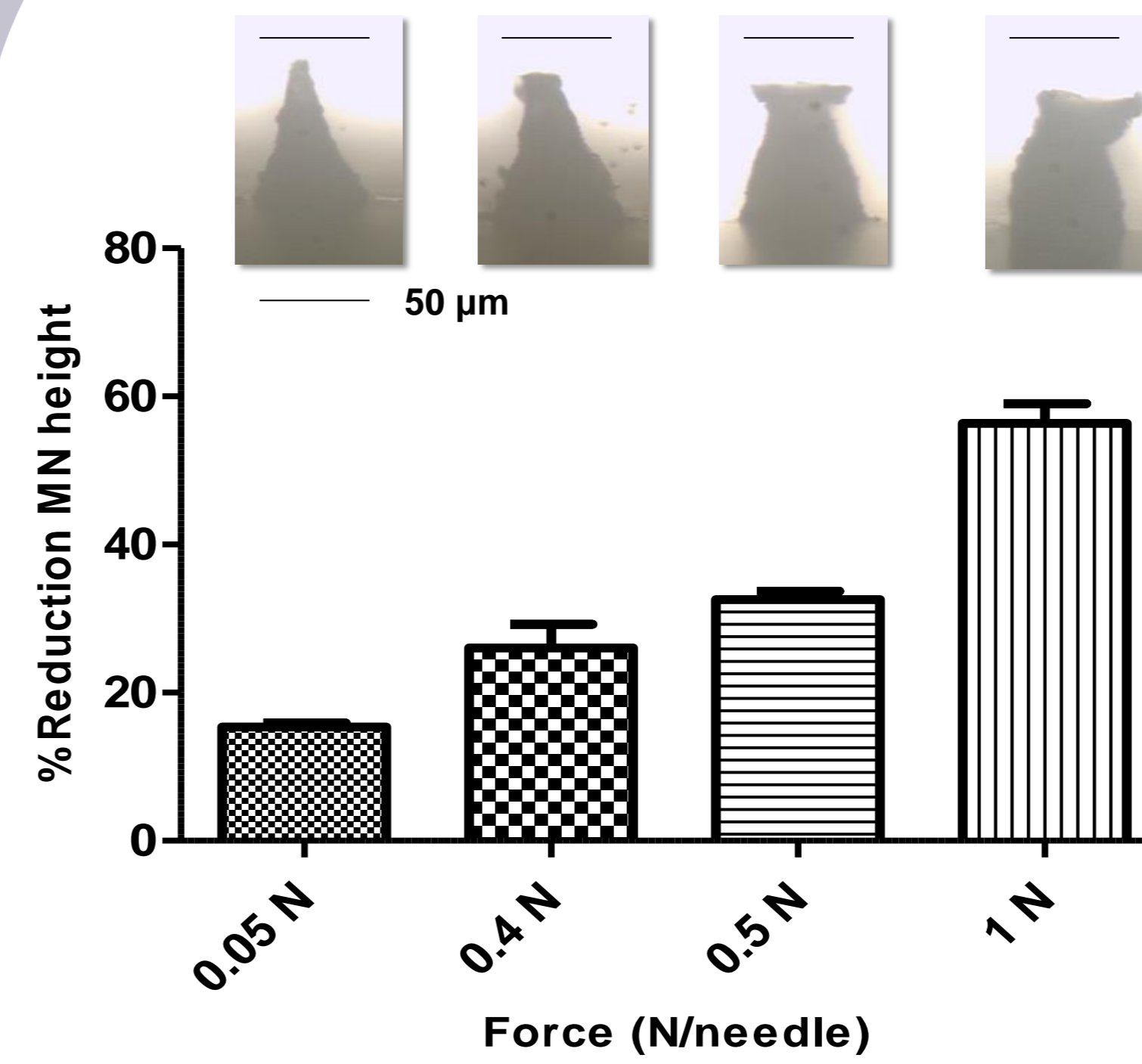
How do dissolving Microneedles deliver medications?

The MNs, exhibiting suitable mechanical strength, puncture the *stratum corneum*, the outermost layer of the skin and form pores through which the drug dissolves and diffuses to the microcirculation of the skin layers. The MN do not cause pain or bleeding as they do not contact blood vessels or nerves.



As both drug and polymer are deposited in the skin when MN dissolve, do these components cause any irritation or cell death in the resident cells?

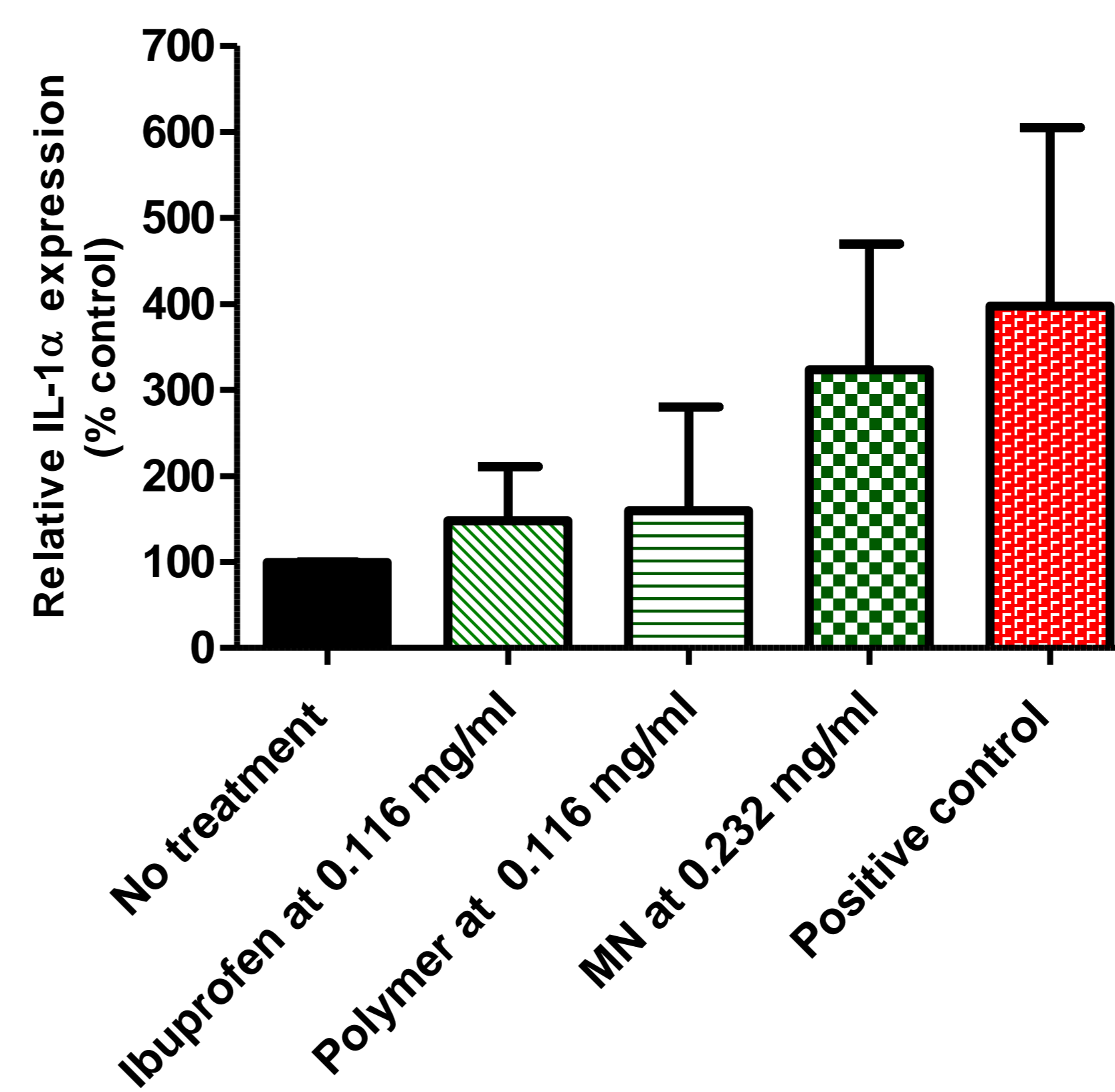
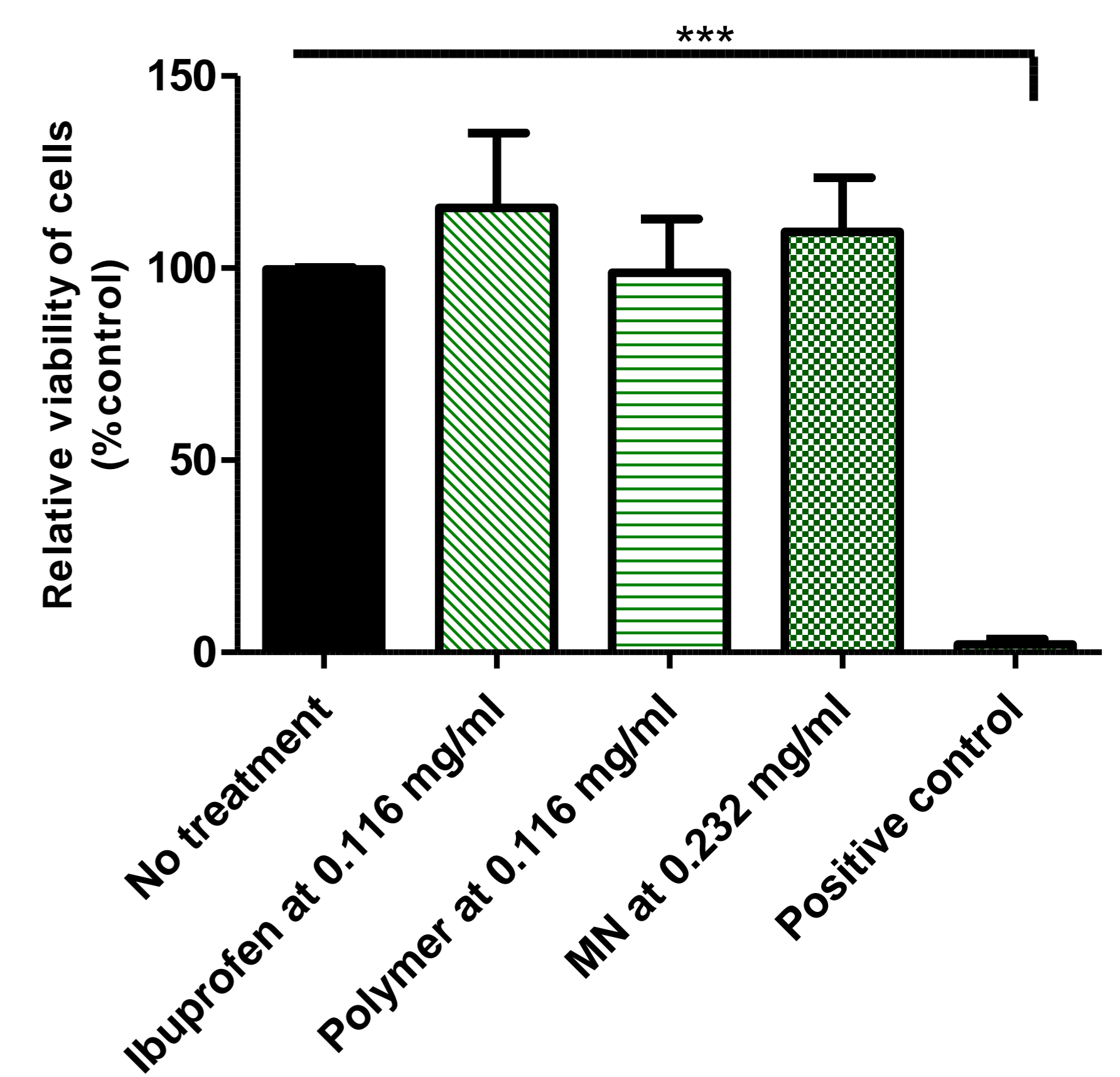
Step 1: Microneedle characterisation



- The MN were prepared, incorporating 30% ibuprofen, and their mechanical strength was tested at different forces (Newtons, N) so as to determine that they could successfully pierce skin.
- Even at this high drug loading, the MN were mechanically sound.

Step 2: Cellular toxicity experimentation

- Epithelial cells line the surfaces of all organs. Therefore, a human lung epithelial cell line, L-132, was used as a model in cellular toxicity studies.
- In comparison to a positive control agent, known to significantly reduce cell viability ($p=0.0001$), the ibuprofen, polymer and dissolved MN did not cause any reduction in cell viabilities.



- A cytokine, interleukin 1-alpha (IL-1α), is a well documented marker of cellular irritancy.
- Although treatment of cells with ibuprofen and polymer caused a slight increase in IL-1α expression, exposure of the cells to the positive control caused a four-fold increase in IL-1α.

Conclusions:

These data indicate that appropriately-formulated, ibuprofen-containing, dissolving MN arrays do not cause any cellular toxicity or associated irritancy in this epithelial cell model. MN-mediated delivery of medications across the skin could have numerous associated benefits including:

- Removal of the need for specialist sharps disposal
- Potential for use of MN in the developing world, as no necessity for cold storage of dry-state, drug-containing MN
- Aid 20% of the population who are needle-phobic
- Elimination of needle-stick injury
- Potential for MN self-application