

The question

Why do some ears require more force than others to pierce through?

The theory

If you measure multiple factors of each ear pierced in the study you should be able to look at the data and see a correlation between the different factors and the force to pierce. The ear is made up of multiple layers of different tissue so our theory is that the cartilage itself plays a factor but also the connective tissue density and toughness play a part. So we came up with ways to measure the differences and put them on a chart. Here is what we are measuring and our theory on how it plays a factor.

- Hardness of the ear is measured in Newtons of force when being pushed into a special designed cup we made. For this one we put a rounded point of the force gauge and place the cup under the area which is wide enough to cover both piercing sites and press until it touches the bottom of the 12.5mm wide by 5mm deep cup.
- Rigidity of the ear is measured in Newtons of force by pushing the ear till it folds and touches the face. We observed that some people have much tighter ears than others, even if they don't necessarily have hard cartilage. We observed a measurable difference in how much force it took to push the ear into the face, and that the more rigid the ear, the faster and harder it snapped back into place when released versus the less rigid snapped back slower and with less force. This is how we are measuring the difference between ears with more dense or tighter connective tissue.
- The thickness of the ear, measured in millimeters. For this one we chose side by side placements where the ear didn't differ in thickness for consistency.

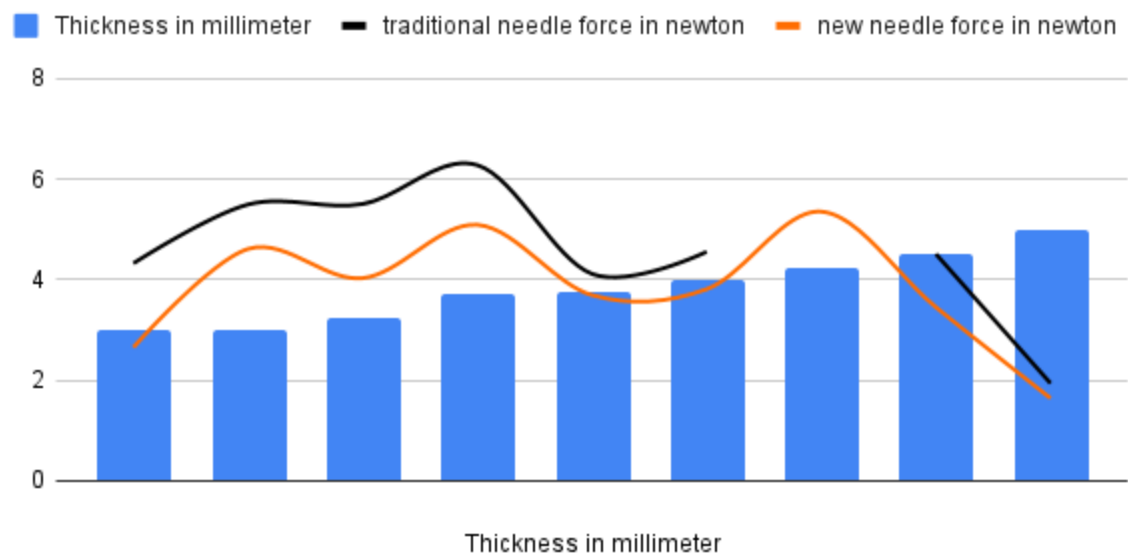
Results

We overall noticed that the bypass needle and stargrind required less force to pierce overall. The thicker the ear the more force it took to pierce. There were some that required less force even though they were thicker which is why we collected more data which we will show later.

Here are the results in list and graph form

Body Part	Thickness in millimeter	traditional needle force in newton	new needle force in newton
Helix	3	4.326	2.656
Helix	3	5.496	4.612
Helix	3.25	5.506	4.032
Helix	3.7	6.278	5.092
Helix	3.75	4.116	3.694
Helix	4	4.556	3.812
Helix	4.25		5.354
Helix	4.5	4.512	3.454
Lobe	5	1.94	1.644

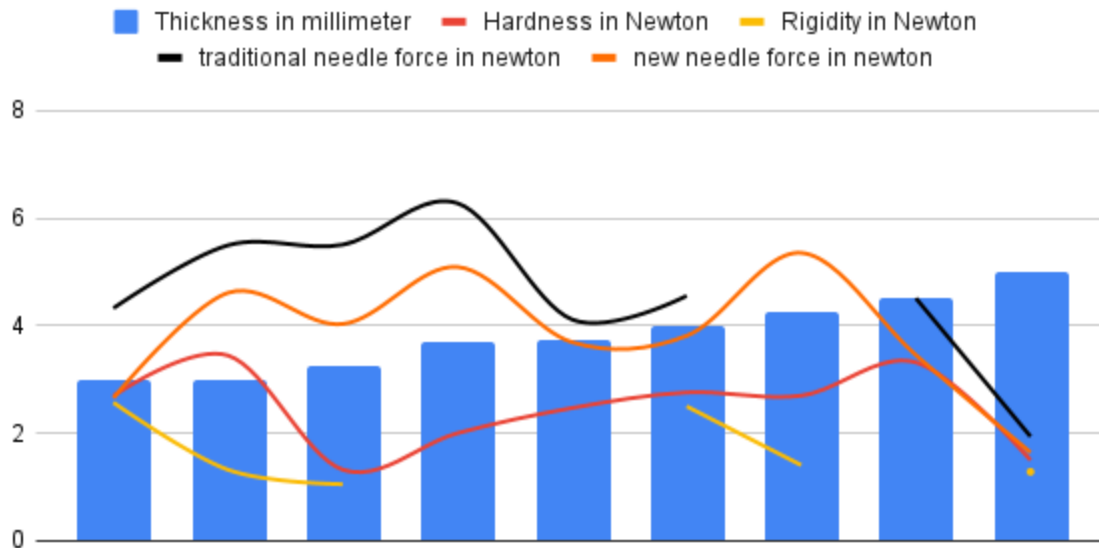
traditional needle force in newton and new needle force in newton



Here is the results with the extra data added

Body Part	Thickness in millimeter	Hardness in Newton	Rigidity in Newton	traditional needle force in newton	new needle force in newton
Helix	3	2.694	2.572	4.326	2.656
Helix	3	3.446	1.322	5.496	4.612
Helix	3.25	1.324	1.054	5.506	4.032
Helix	3.7	2.002		6.278	5.092
Helix	3.75	2.47		4.116	3.694
Helix	4	2.76	2.502	4.556	3.812
Helix	4.25	2.7	1.408		5.354
Helix	4.5	3.318		4.512	3.454
Lobe	5	1.5	1.284	1.94	(bypass heel) 1.644

Thickness in millimeter, Hardness in Newton, Rigidity in Newton, traditional needle force in newton and new needle force in



The hope here is that with a larger sample size we could collect more data and have more ears that fall within a similar range to compare. Then we would be able to try to prove how these extra factors affect the force to pierce. For now with the amount we have it does help to explain why the same needle requires less force sometimes on a thicker ear.

We did have more data, however once the stargrind was incorporated the first force gauge we were using could read low enough to give us an accurate reading. Anything under 2.4N just read as 2.4N but over was reading fine. That is when we contacted Johnson Scale to purchase a calibrated and certified scale. For the sake of keeping everything done and presented on a calibrated machine that complies with National Institute of Standards & Technology certification we omitted those results. The omitted results also consistently showed the bypass heel with reduced force and showed something interesting as well. When the tip of the needle comes out the force let's say for example would read at 4N when it hit the heel there was a second increase in force and would show about 1N higher making the end reading 5N where the bypass did not show that second jump.