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Transdermal Microneedle Patches Texture Analysis

Understanding the mechanical strength of microneedles in transdermal patches is critical for ensuring effective drug delivery. The durability and integrity of the microneedles during application are essential for patient safety and proper function. This analysis helps assess the robustness of the microneedles, ensuring they can penetrate the skin without breaking.

Test Objective:

- To determine the mechanical strength of microneedles in transdermal patches (Figure 1) by compression using a TA44 probe fitted to the CTX Texture Analyzer (Figure 2).

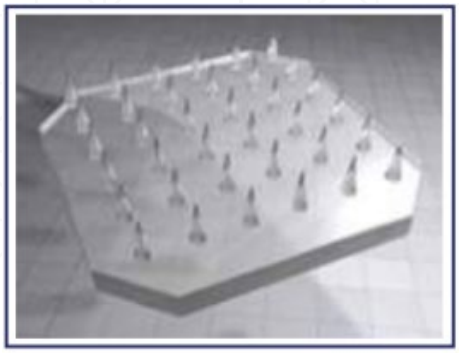

Figure 1

Equipment:

- Instrument: CTX Texture Analyzer with a 5000g Load Cell (Figure 3)
- Probe: TA44 (4 mm) Standard Probe
- Fixture: Fixture Base Table (TA-BT-KIT)
- Software: Texture Pro

Settings:

- Test Type: Compression
- Pre-Test Speed: 1.0 mm/s
- Test Speed: 0.1 mm/s
- Trigger Load: 1 g
- Target Distance: 0.60 mm

Figure 2

Sample Preparation:

- Samples consisted of five batches of 6x6 mm patches with microneedles of about 0.6 mm height, placed on the fixture table.

Procedure:

1. Attach the TA44 probe to the CTX Texture Analyzer.

2. Position the fixture base table and secure it in place.

3. Align the microneedle patch under the probe.

4. Set the test parameters in TexturePro CT software.

5. Begin the compression test, where the probe compresses the microneedles over 0.60 mm, measuring the force required to break the needles.

Figure 3

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Results:

- Figure 4: Data table shows the hardness and deformation at the target for five samples. Hardness values ranged from 4174 g to 4857 g, with consistent deformation of 0.59 mm across all samples.

Parameter		Patch Size				
		Sample 1	Sample 2	Sample 3	Sample 4	Sample 5
1	Hardness Cycle 1	4710.00	4650.00	4468.00	4857.00	4174.00
2	Deformation at Hardness	0.59	0.59	0.59	0.59	0.59
3	Hardness Work Cycle 1	10.70	9.40	9.80	11.00	6.90
4	Deformation at Target	0.59	0.59	0.59	0.59	0.59

Figure 4

Observations:

- Figure 5: Load vs. Time graph shows the hardness of the microneedles, with higher force indicating stronger needles.

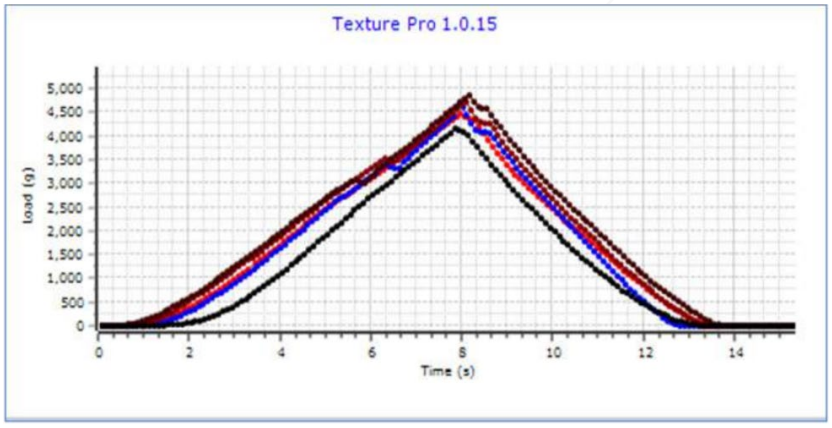

Figure 5 - The Load vs. Time graph indicates the typical hardness of the microneedles.

- Figure 6: Load vs. Distance graph illustrates the work done to bend or break the microneedles. The microneedles started to bend at 0.59 mm and fully broke at the 0.60 mm mark.

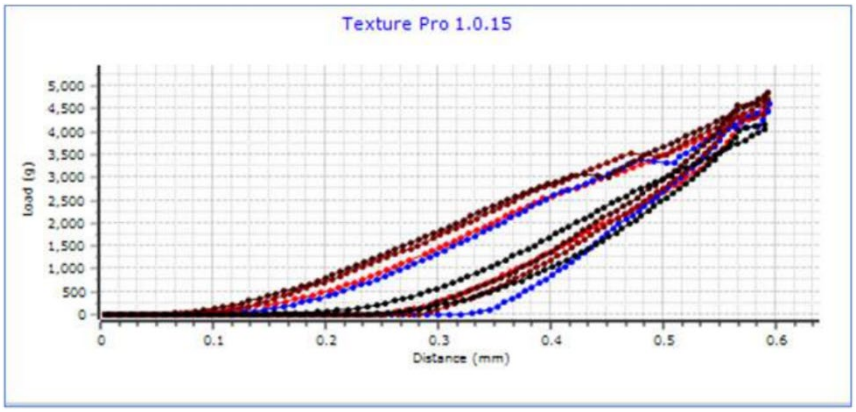

Figure 6 - The Load vs. Distance graph indicates the work done on the patch to bend/break the microneedles.

Conclusion:

This analysis determines the mechanical strength of microneedles in transdermal patches, ensuring they meet necessary standards for safe and effective drug delivery. Proper equipment setup and sample preparation are essential for reproducible results.