Quantitative Analysis of the effects of Kinesio Tape

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Presentation Outline

Description of tape

- Very stretchy tape applied to the skin
- Claimed benefits:

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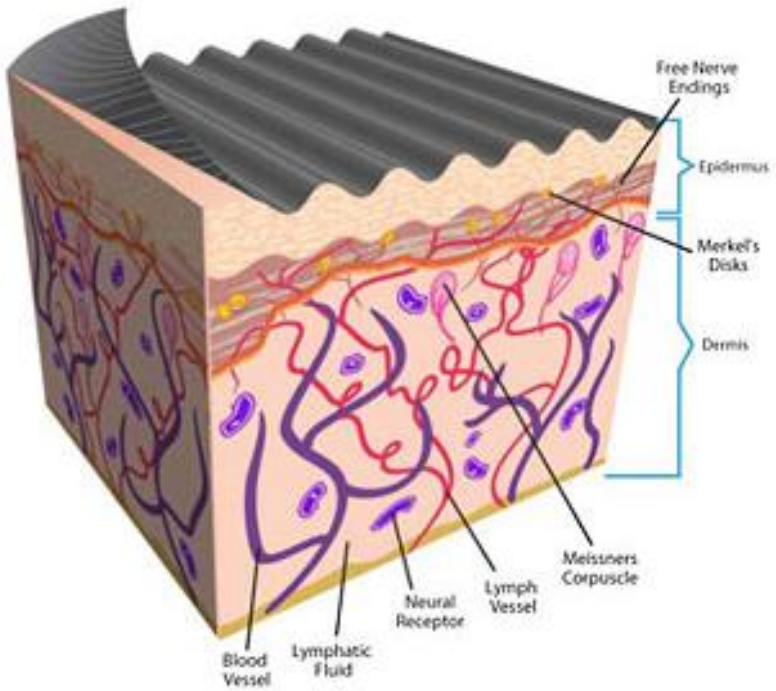
- Very stretchy tape applied to the skin
- Claimed benefits: reduce pain, prevent injury, improve performance...
- Allowed in professional sports.

Hypothesis



- expands region under skin
- relieves pressure on nerves
- allows for more blood flow

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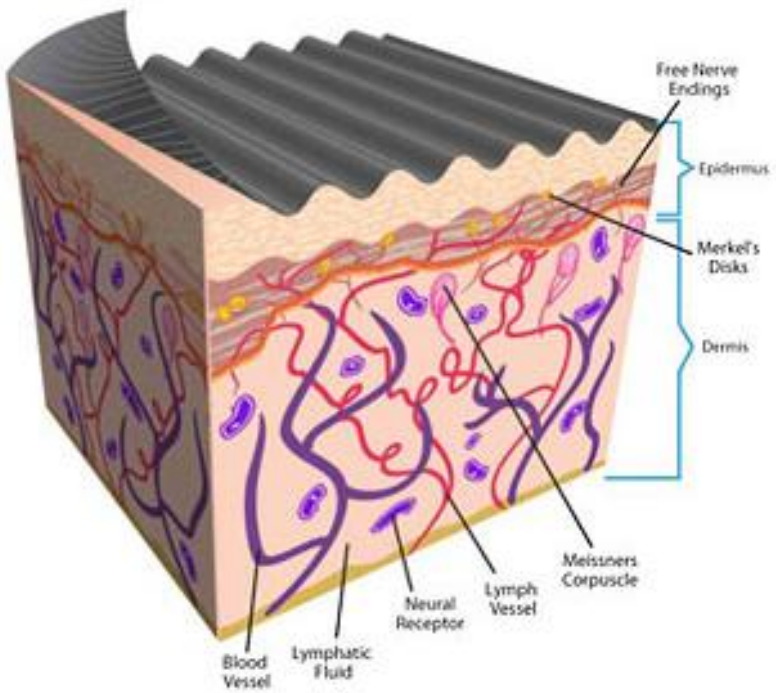

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This is only theory though - No objective studies!

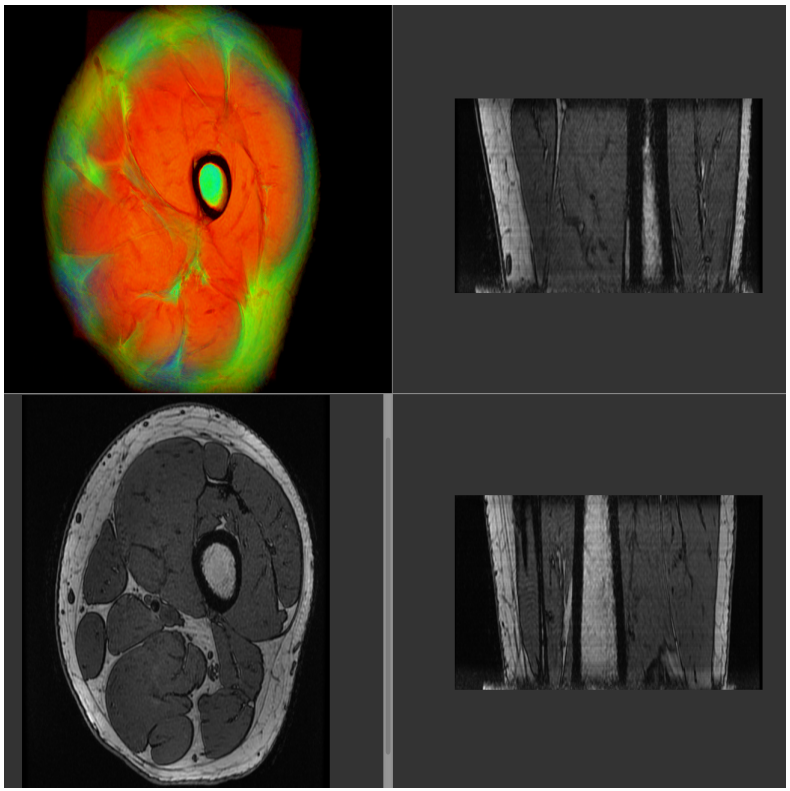
Presentation Outline

Use math!

- Collect MRI images
- Quantitatively analyze the region under the tape
- Distill the change in shape to a simple yes or no.
- Develop a general purpose method.

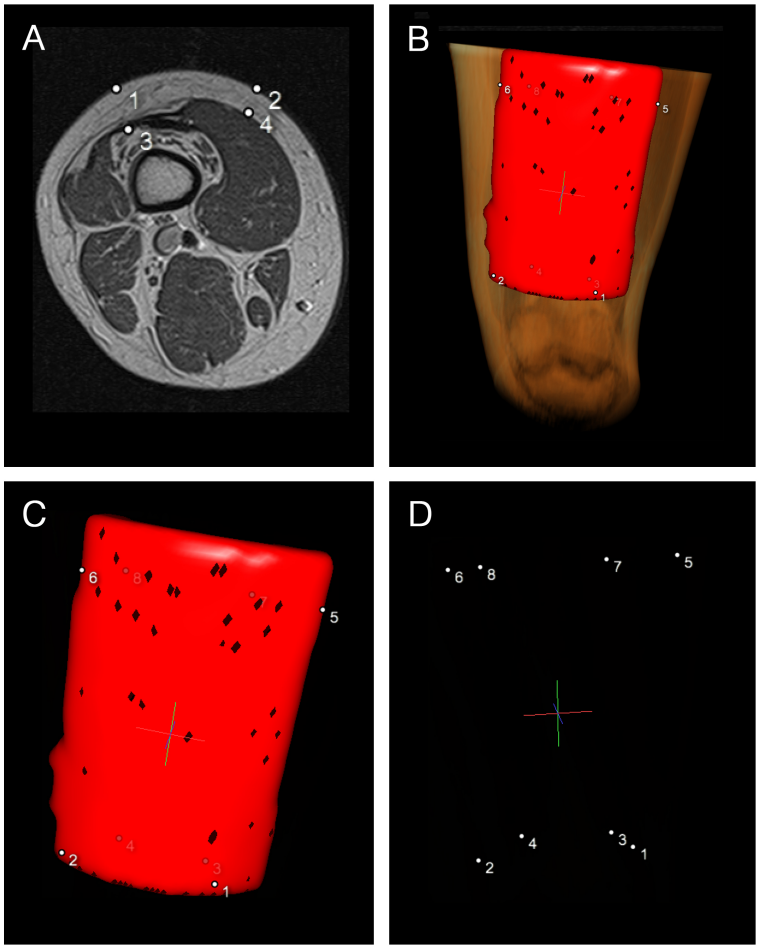
Presentation Outline

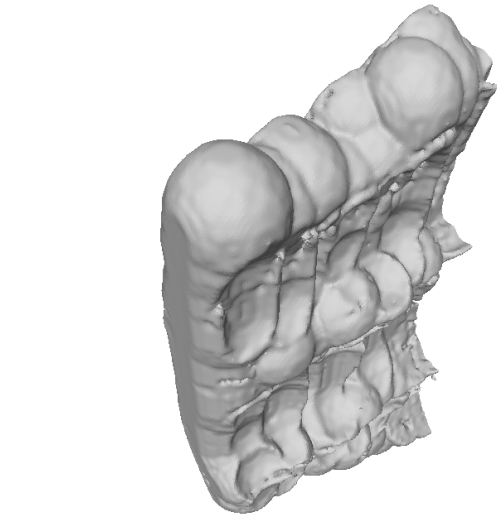
Data

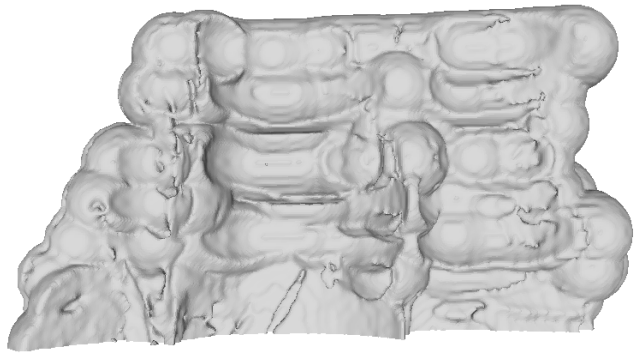


- MRI of 40 patients
- ROI segmented based on density and oil drops
- Triangulations

Region of Interest

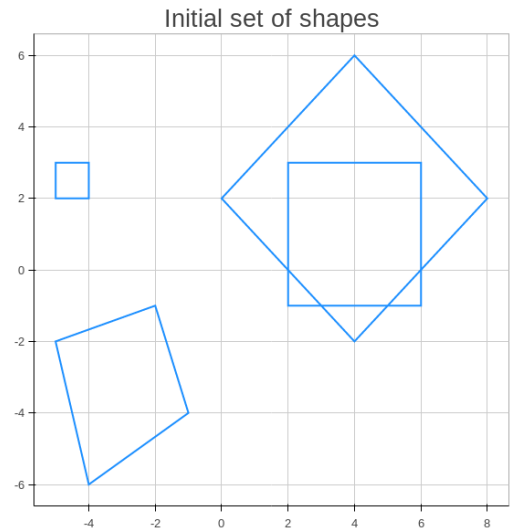


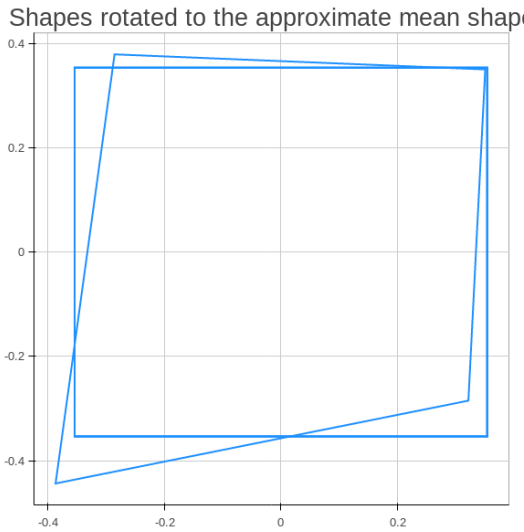




Clean and align

- Use General Procrustes Method to align and resize all the shapes.
  - Affine transformations to align shapes as close as possible.
- Remove separate components and topological impurities.





Landmark based methods

Look only at how the landmarks change between images.

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- Hotelling's two sample t-test
- Euclidean Distance Matrix Analysis

Hotelling's two sample t-test.

- multidimensional generalization of the t-test
- compares the differences in positions of each point over time for each person.

$$W = \frac{\sum_{i=1}^{n_x}(x_i - \bar{x})(x_i - \bar{x})^T + \sum_{i=1}^{n_y}(y_i - \bar{y})(y_i - \bar{y})^T}{n_x + n_y - 2}$$

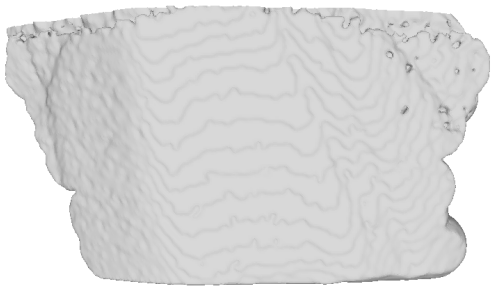
$$t^2 = \frac{n_x n_y}{n_x + n_y}(\bar{x} - \bar{y})^T W^{-1}(\bar{x} - \bar{y}) \sim T^2(p, n_x + n_y - 2)$$

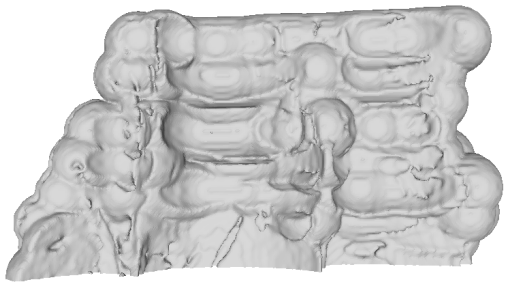
Euclidean Distance Matrix Analysis

- Matrix encodes the distance between each shape
- Difference between shape matrices can be calculated
- Statistics can be done on these differences

Entire ROI methods

what if the corners don't change much?
what if the shape wrinkles a little bit, but the corners stay constant?





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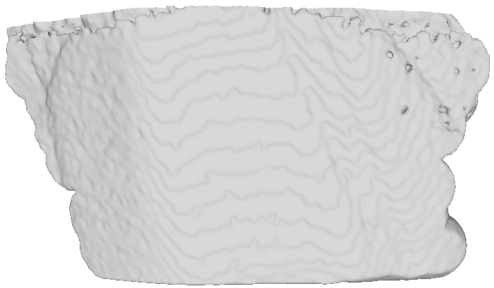
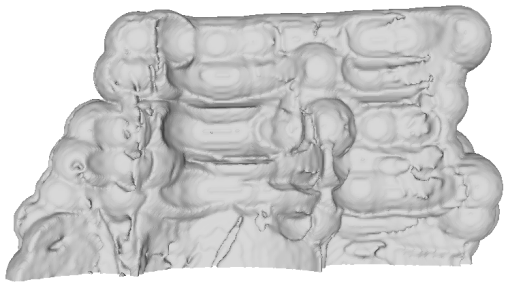


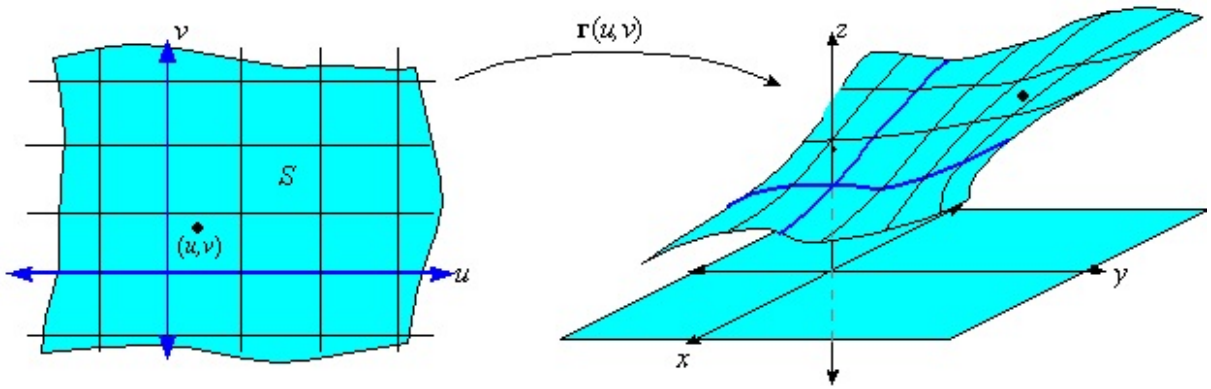


800,000 vertices per shape and we're only looking at 8 of them!

First step - parameterize the surface

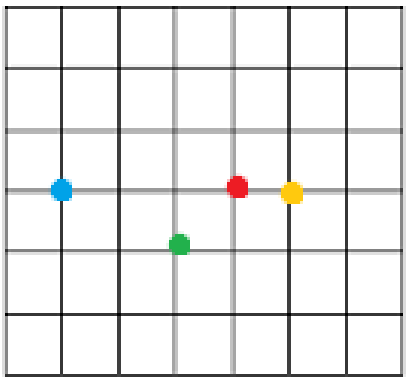
Standardizing all of the shapes by mapping each surface to the unit cube.

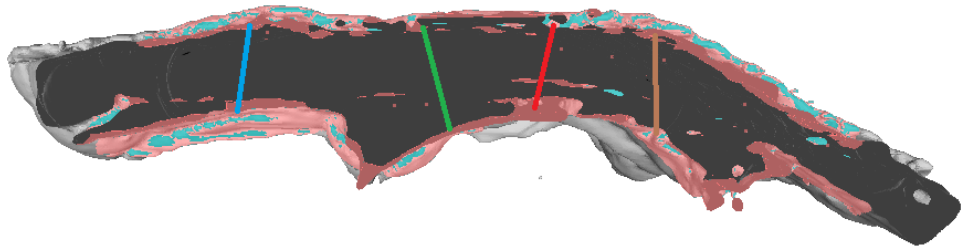
- find the nearest neighboring vertex
- find the shortest paths between these vertices
- cut out the 6 sides of the shape
- map each side to the unit square



Statistics on the parameterization

- distances between the corresponding top and bottom points
- map of p-values describing whether the change at that point across all the patients was significant
- persistence diagrams of parameterization map





work is still continuing

- waiting on the images
- setting the corners of the parameterization.
- computing persistence diagrams

The End

Thank you