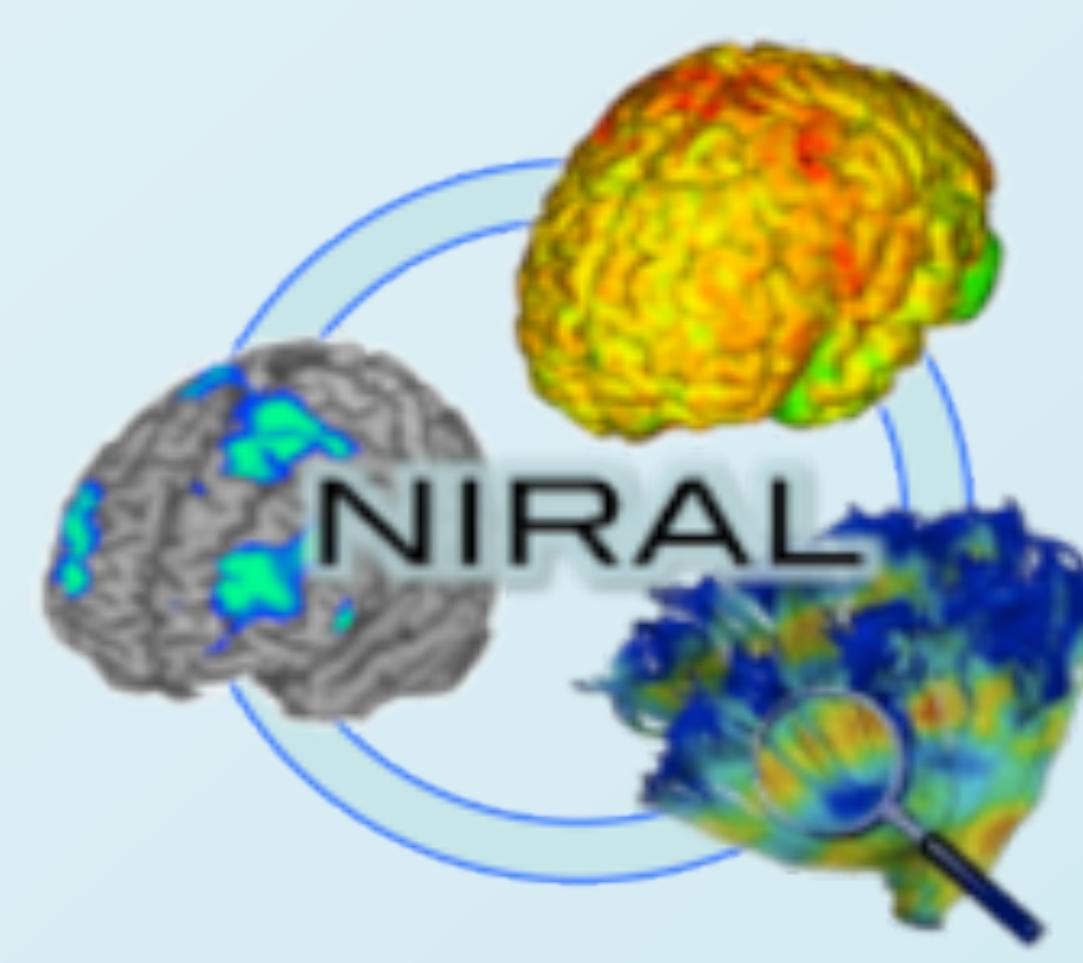




# SVA: Shape Variation Analyzer

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## INTRODUCTION

The primary motivation of this work is to develop a noninvasive technique to provide information about bony changes and disease changing in Temporo-Mandibular Joint (TMJ) Osteo Arthritis (OA), using Shape Analysis.

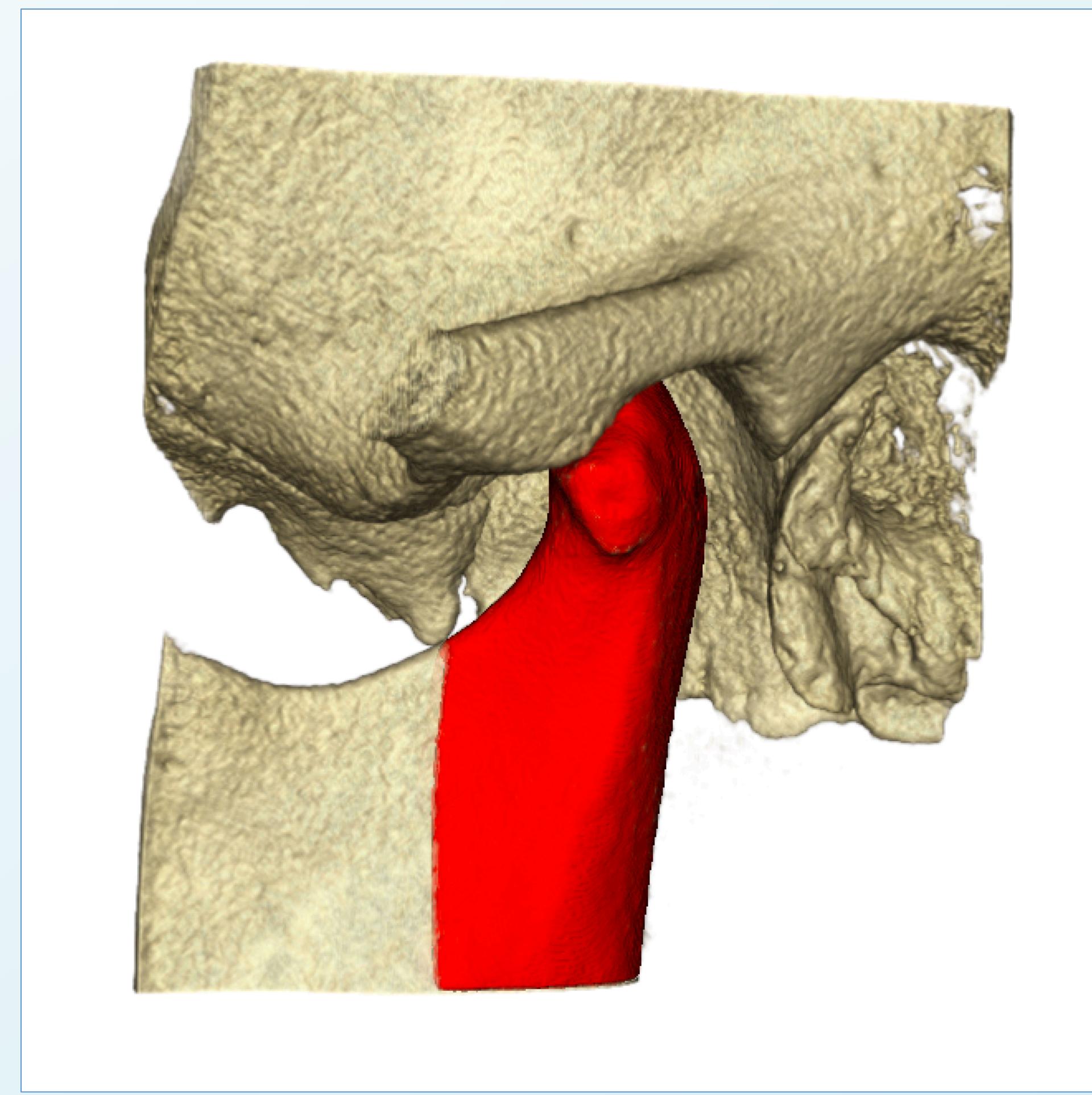


Fig 1. Volume rendering of skull. The surface of the condyle is shown in red.

Patients with OA present a variety of symptoms including pain, limited jaw movement, grinding, clicking, and deviation on opening. There is no method to quantify morphology for early diagnosis, assessment of disease progression and treatment effects.

We present Shape Variation Analyzer (SVA), a shape analysis tool using deep learning to assess disease progression.

## METHODS

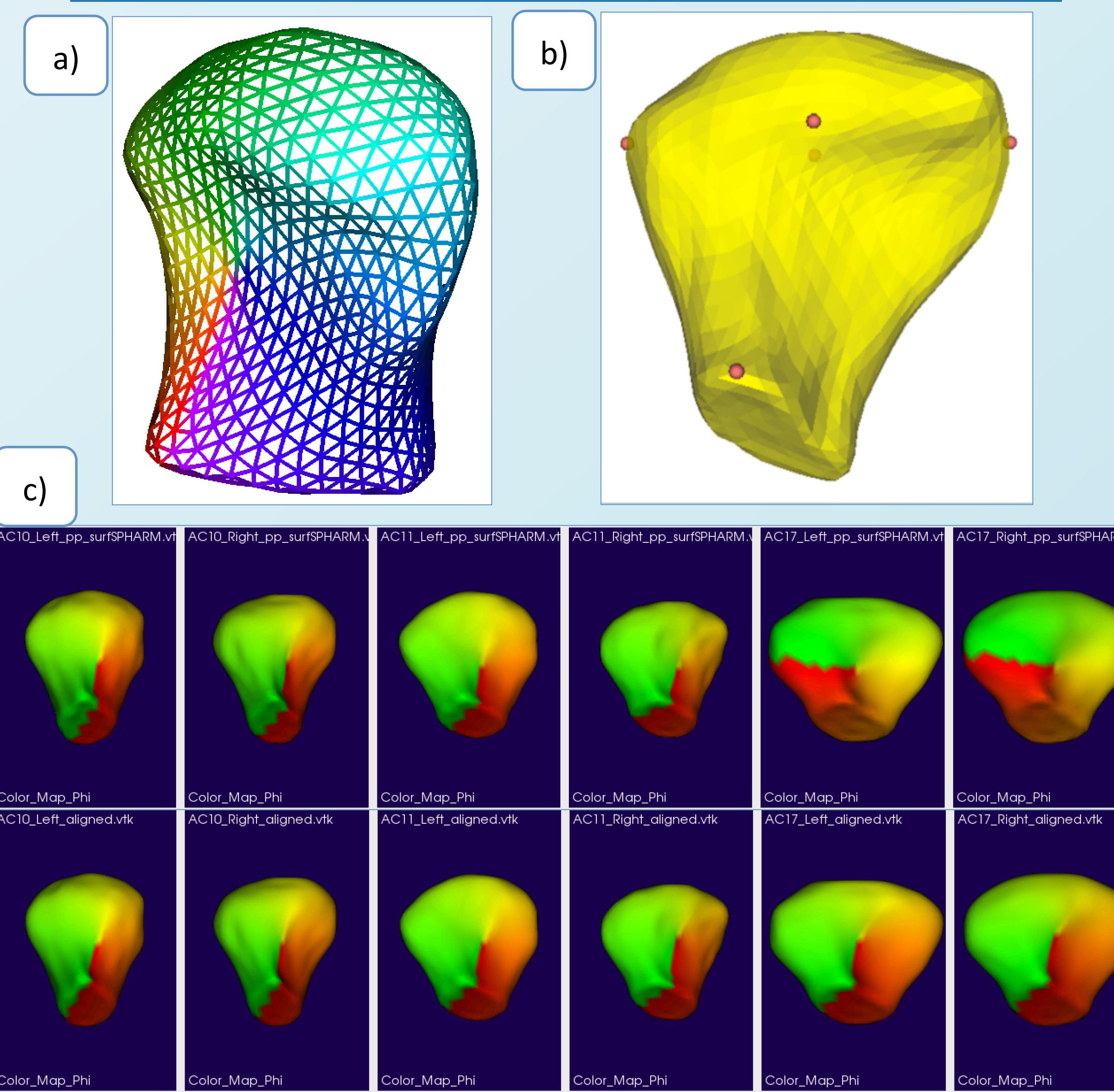


Fig 3. a) SPHARM: regular triangles, 1002 points. b) Landmarks placed on homologous regions for each model. c) Before (top) - after (bottom) GROUPS alignment, similar regions coded by color.

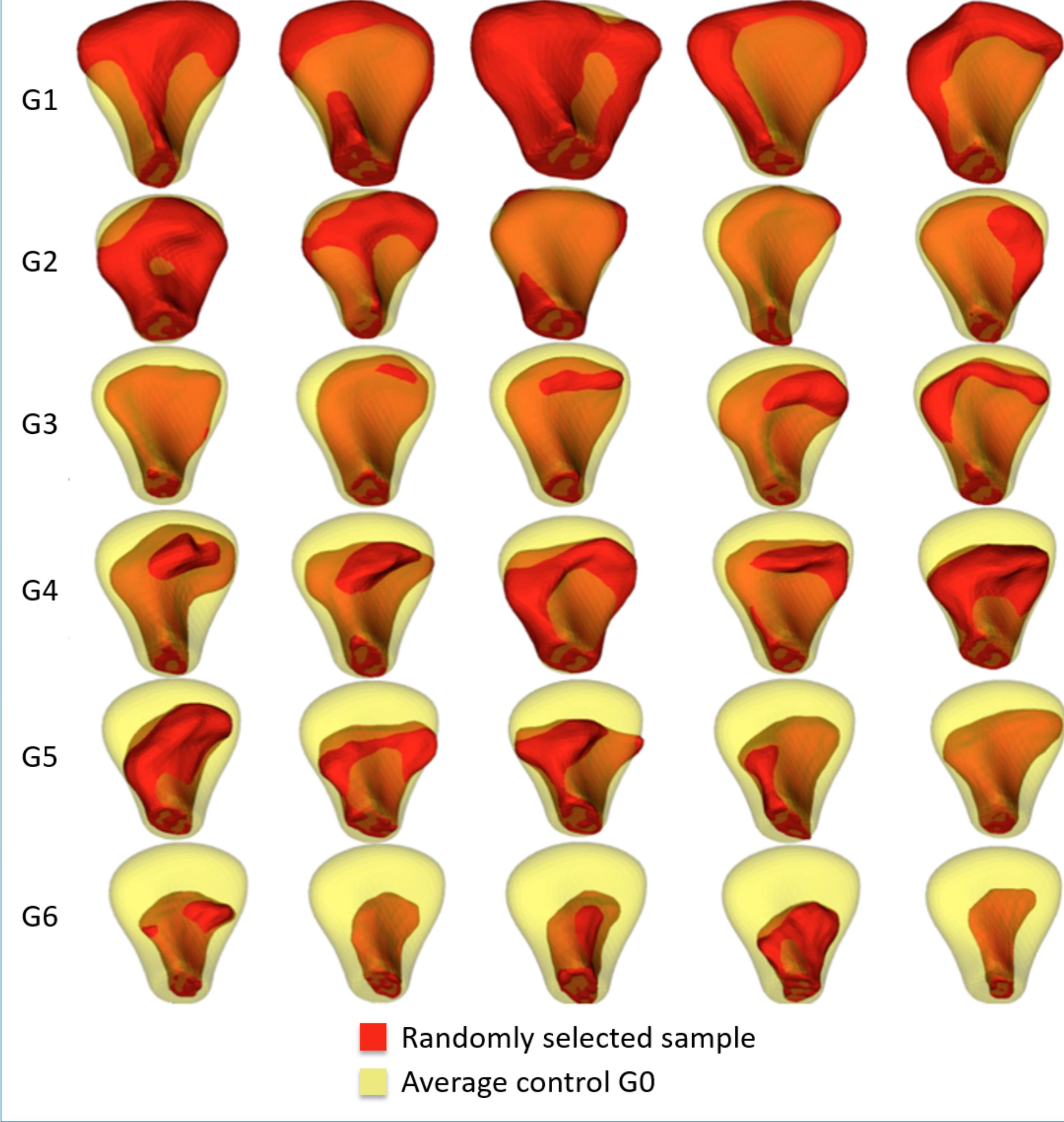


Fig 2. Randomly selected subject samples for each group shown in red. In yellow, the average shape from the control group rendered transparent. G1. Overgrowth, G2. Close to Normal, G3. Degeneration 1, G4. Degeneration 2, G5. Degeneration 3, G6. Degeneration 4

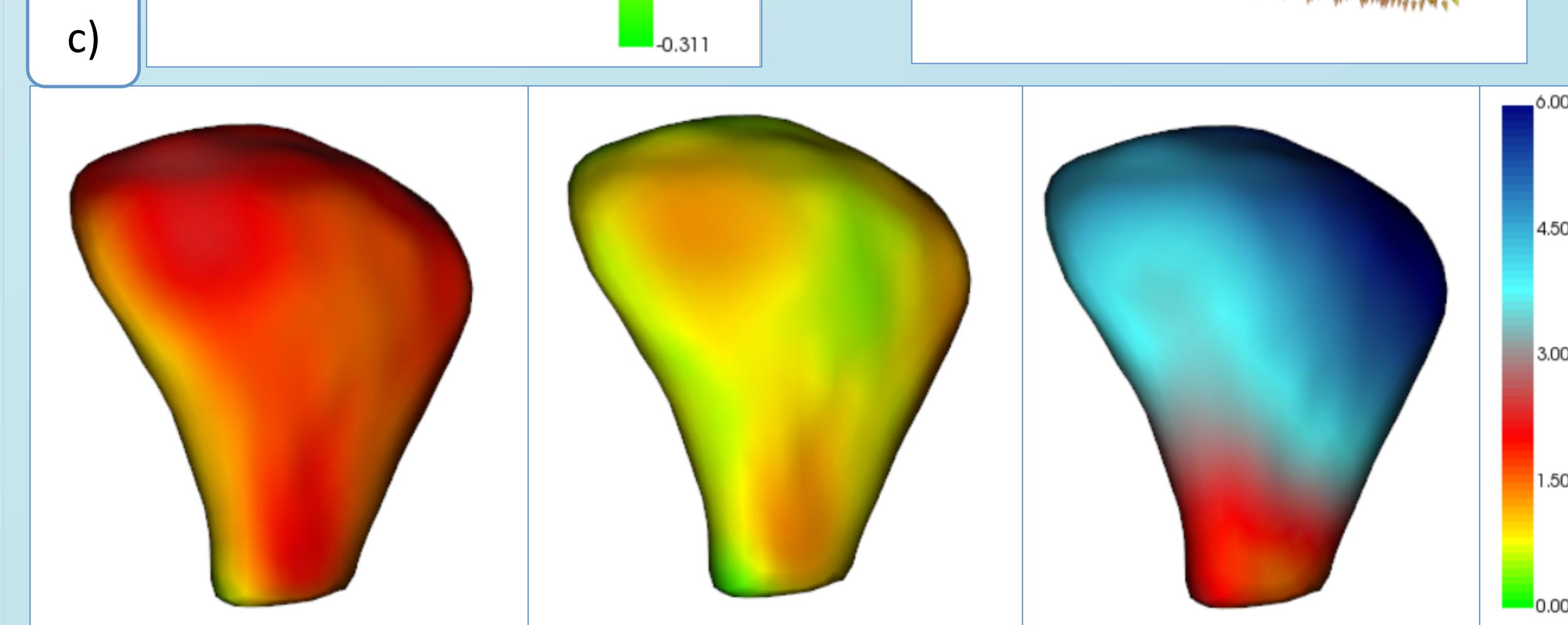


Fig 4. Visualization of shape features. a) Mean curvature b) Surface normals. c) Distance from each point to corresponding points in the average shape for each group. Total number of features per point is 11, i.e., 1002x11.

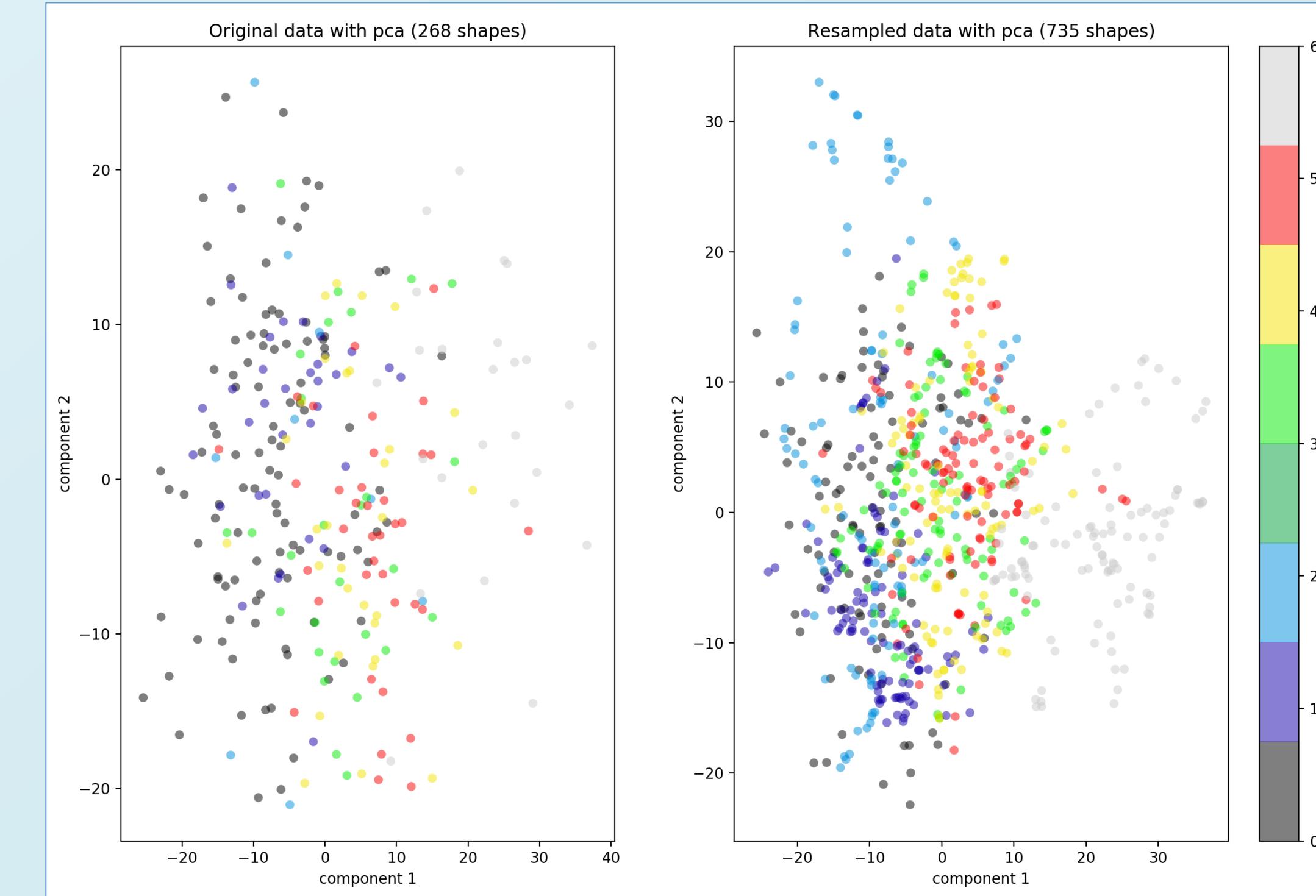


Fig 5. SMOTE resampling in feature space.

## RESULTS

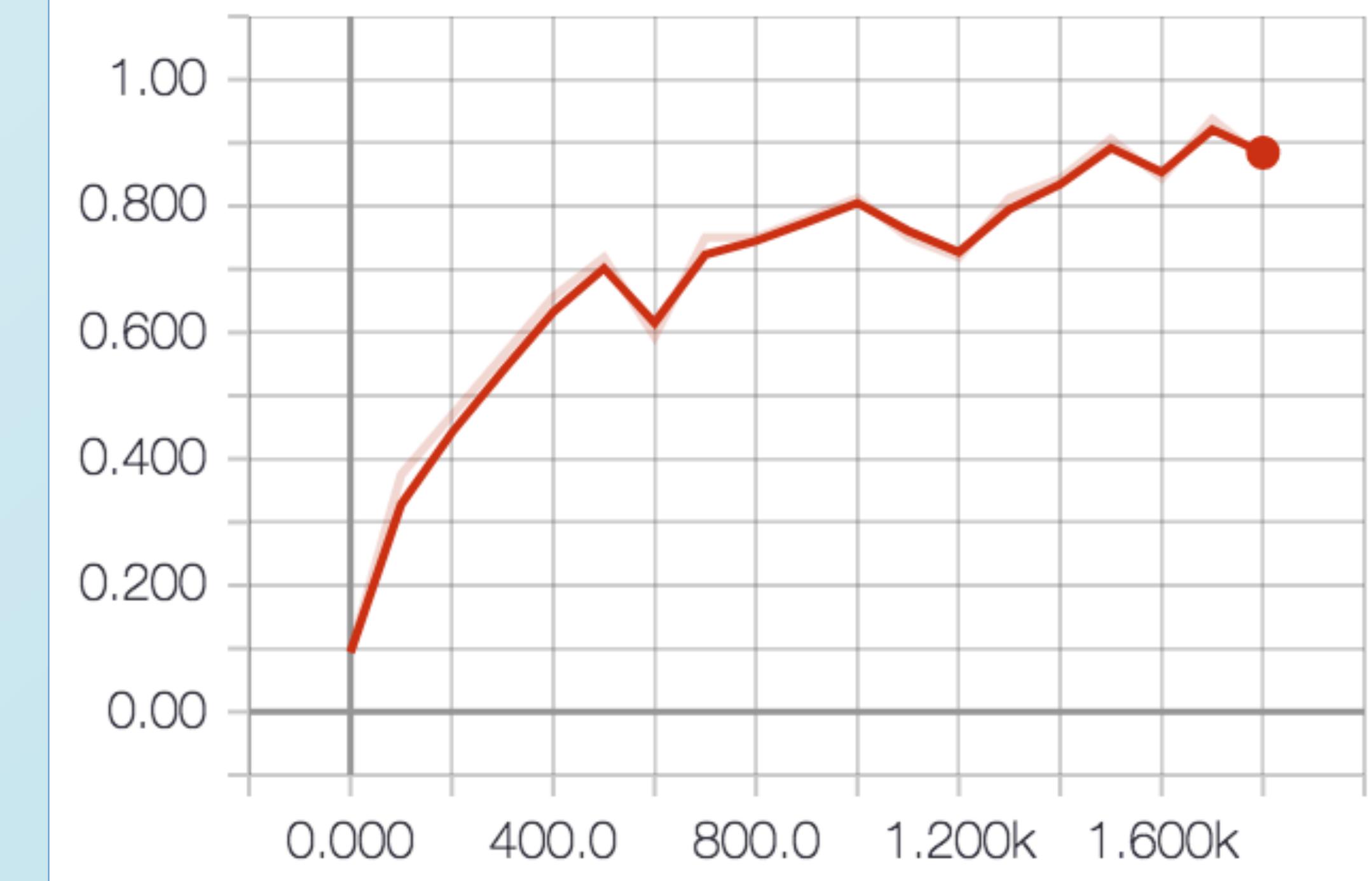


Fig 6. Accuracy during training. Testing accuracy was 92%.

## CONCLUSIONS

Using shape features only favors the classification task, i.e., no position or orientation is used to train the network.

This classification approach seems promising, as it may help us increase our understanding about shape changes that TMJ OA patients undergo during the course of the disease.

Source code is available at  
<https://github.com/DCBIA-OrthoLab/ShapeVariationAnalyzer>

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