

BACKGROUND

- Acromial and scapular spine fractures after a reverse arthroplasty are a significant clinical concern.
- This structure accepts relatively large forces from the deltoid muscle, acromioclavicular joint, and ligamentous structures
- An understanding of the morphology of this structure is important to ascertain the distribution and quality of bone, and this has implications for implant/screw placement.

OBJECTIVES

- To quantify the distribution and quality of bone in the acromion and scapular spine with a focus on cross-sectional shape and cortical-cancellous bone distribution.

MATERIALS & METHODS

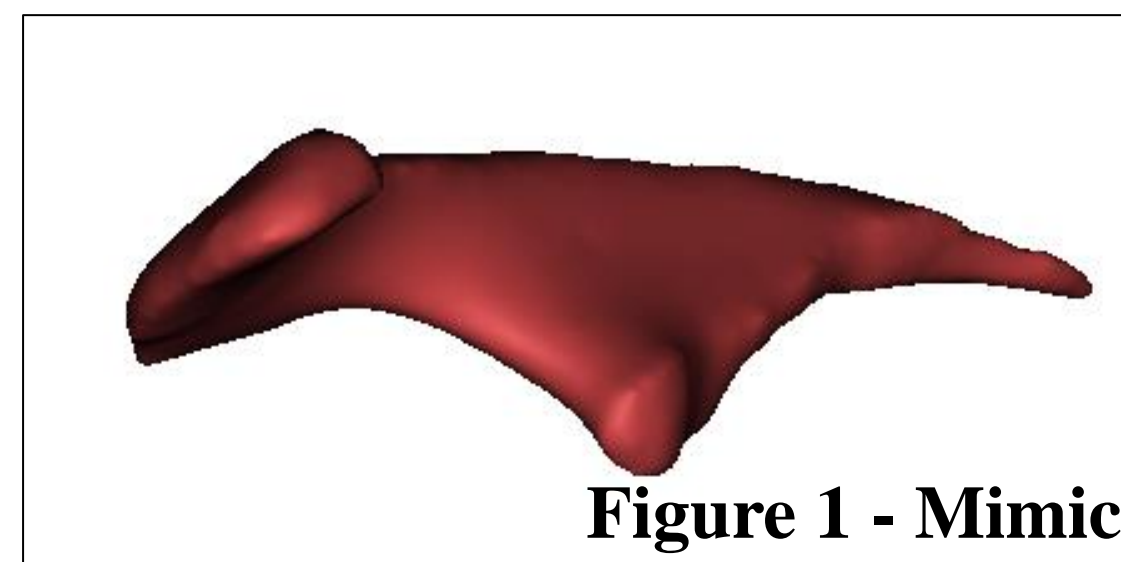


Figure 1 - Mimics

- CT scans of right arms were acquired (n=10).
- 3D models of the scapular spines were created in Mimics (Figure 1).

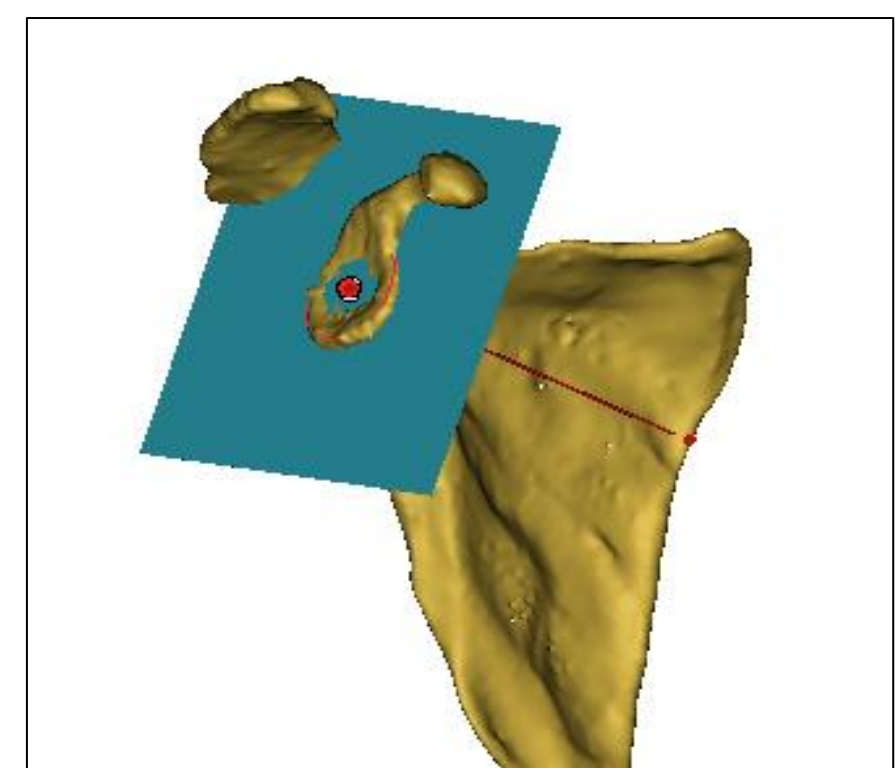


Figure 2 - Mimics

- Using a reference axis from the center of the glenoid to the trigonum spinae, ten perpendicular slices were created in Solid-Works (Figure 2, 3 & 4).

- The centroid and associated areas were determined on each slice.
- Total, cortical, and cancellous bone densities were determined in mimics.

- Total and cortical bone densities were averaged across all 10 specimens for each individual slice.

* Figure 3 shows a CT view of the plane in Figure 2. The scapular spine is highlighted in blue.

** Figure 4 shows the slices obtained from Figure 1.

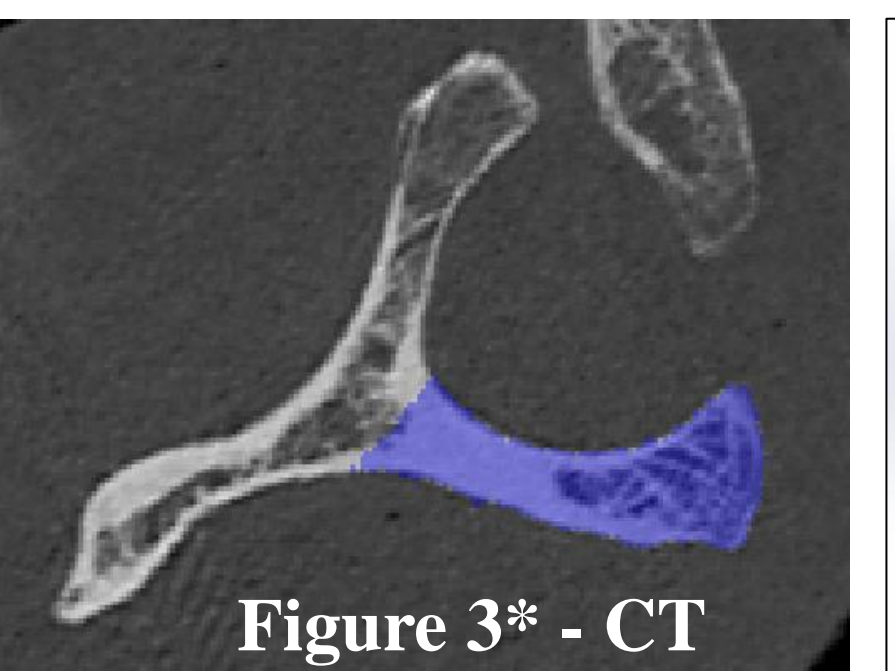


Figure 3* - CT

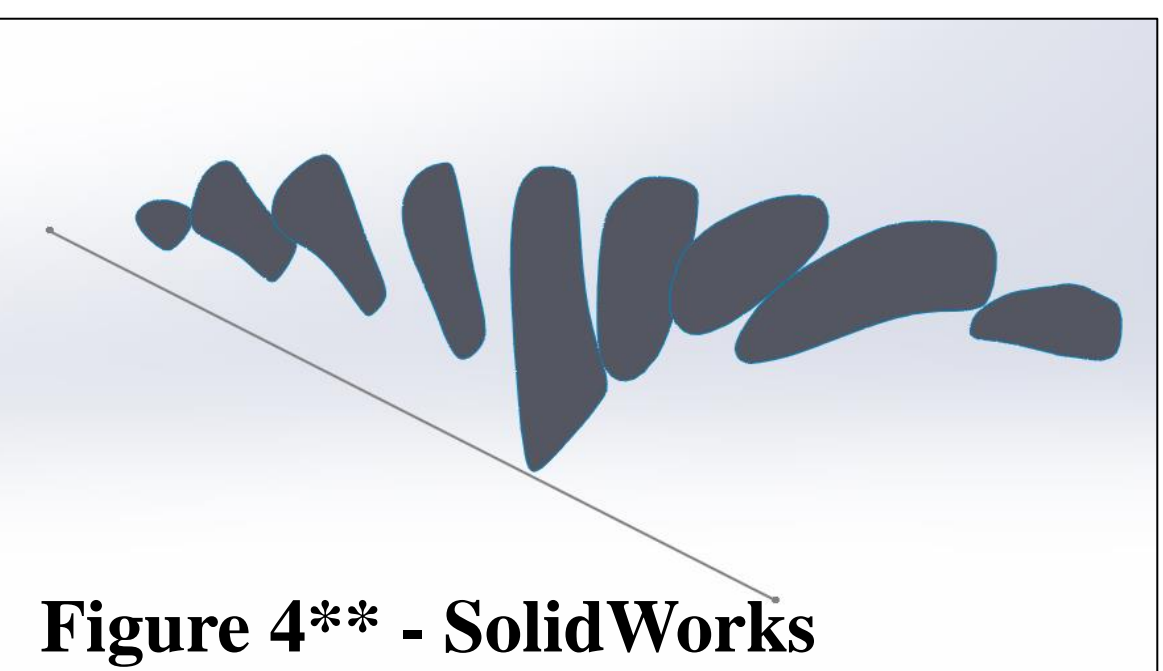


Figure 4** - SolidWorks

RESULTS

- Slices are numbered 1-10 with one being most lateral and ten being most medial (near trigonum spinae)

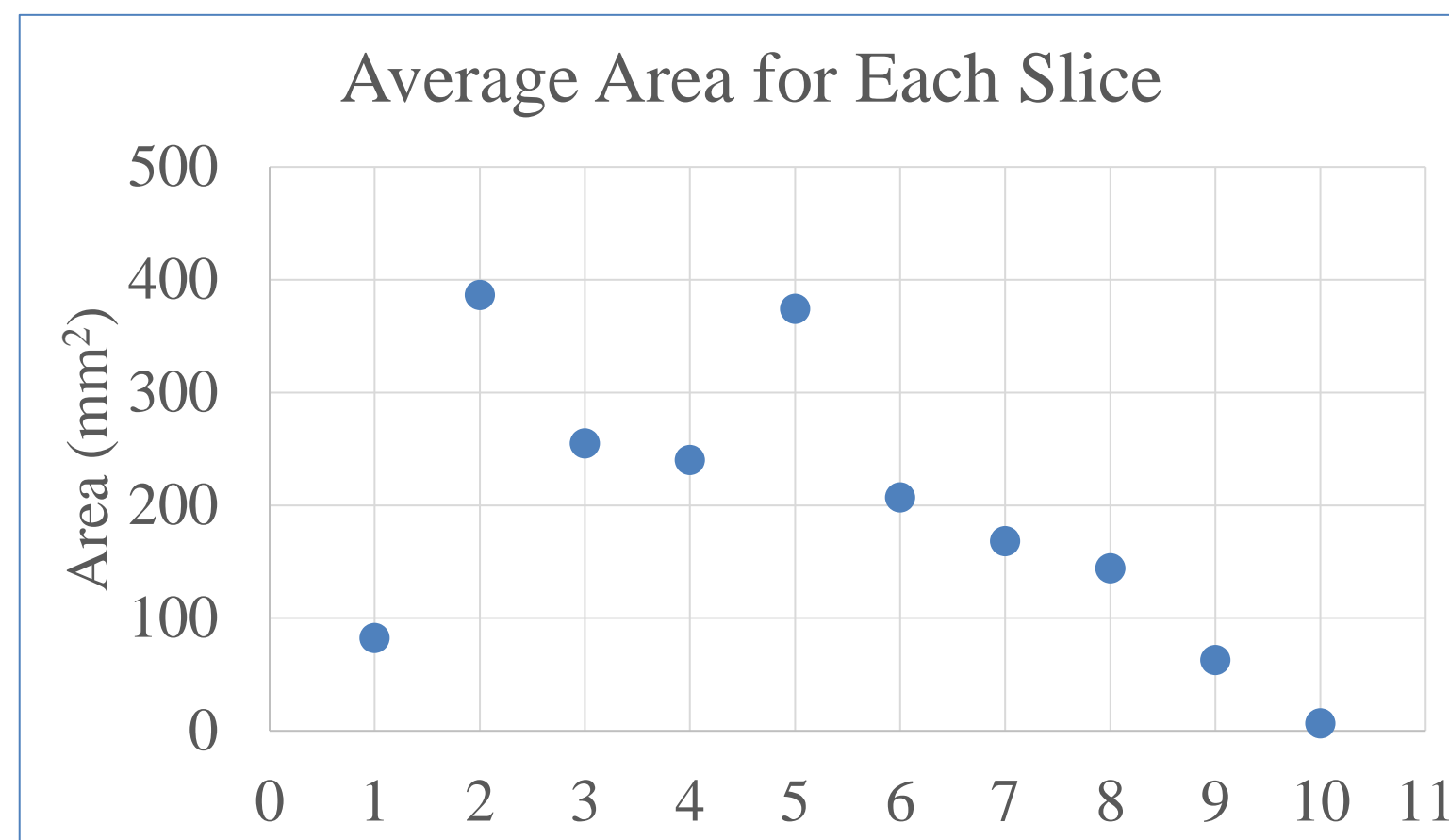


Figure 5 Slice Number (1 to 10), 1 being most lateral

- **Figure 5** shows that slices 2 (main body of acromion) and 5 (slice of the scapular spine slightly medial to the lateral angle) have the highest cross-sectional areas. Cross sectional areas steadily decrease after slice 5.

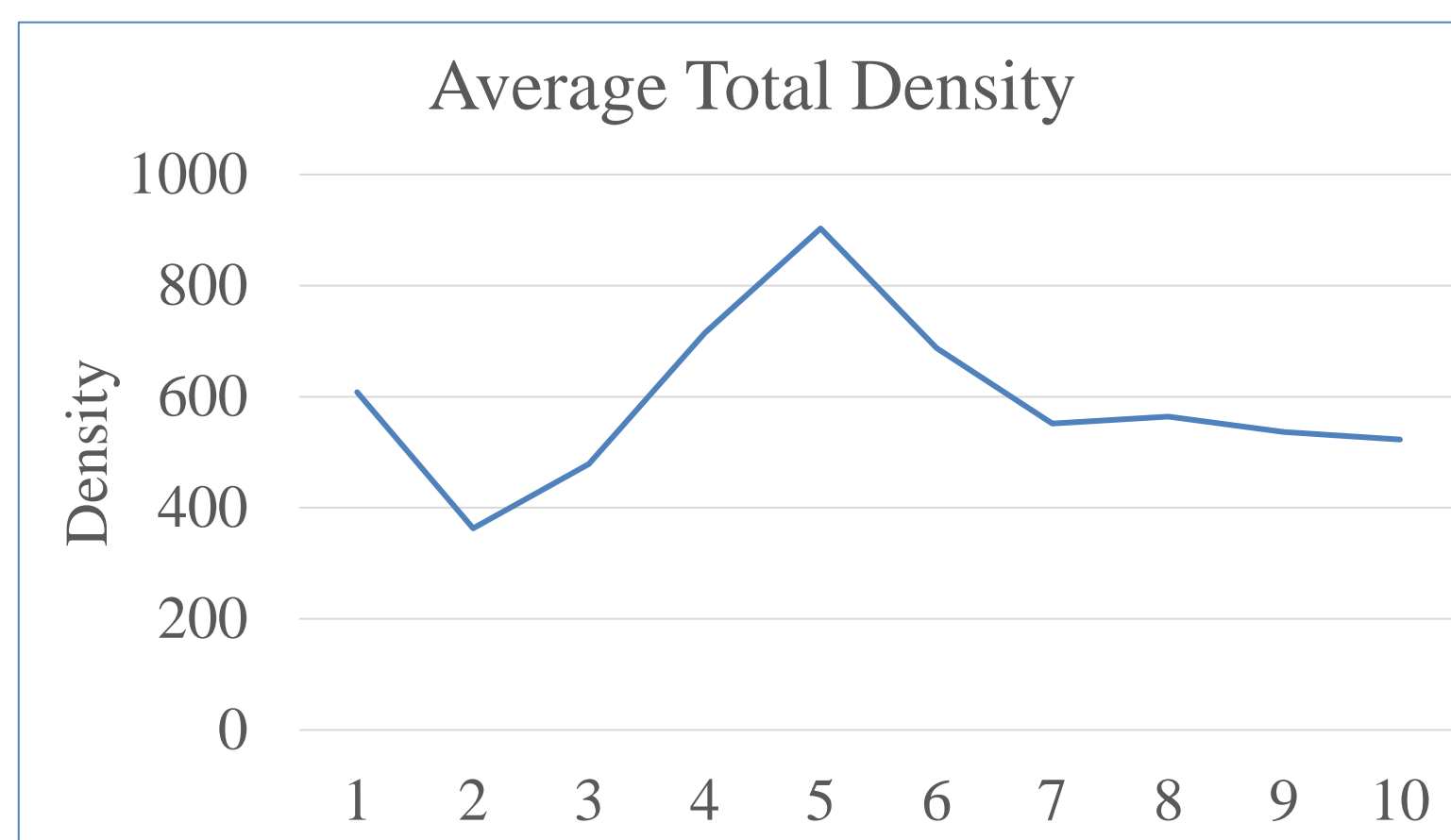


Figure 6 Slice Number (1 to 10), 1 being most lateral

- **Figure 6** shows the average bone densities across the 10 slices, with “Slice 5” having the highest average (cortical and cancellous bone) densities across the specimens.

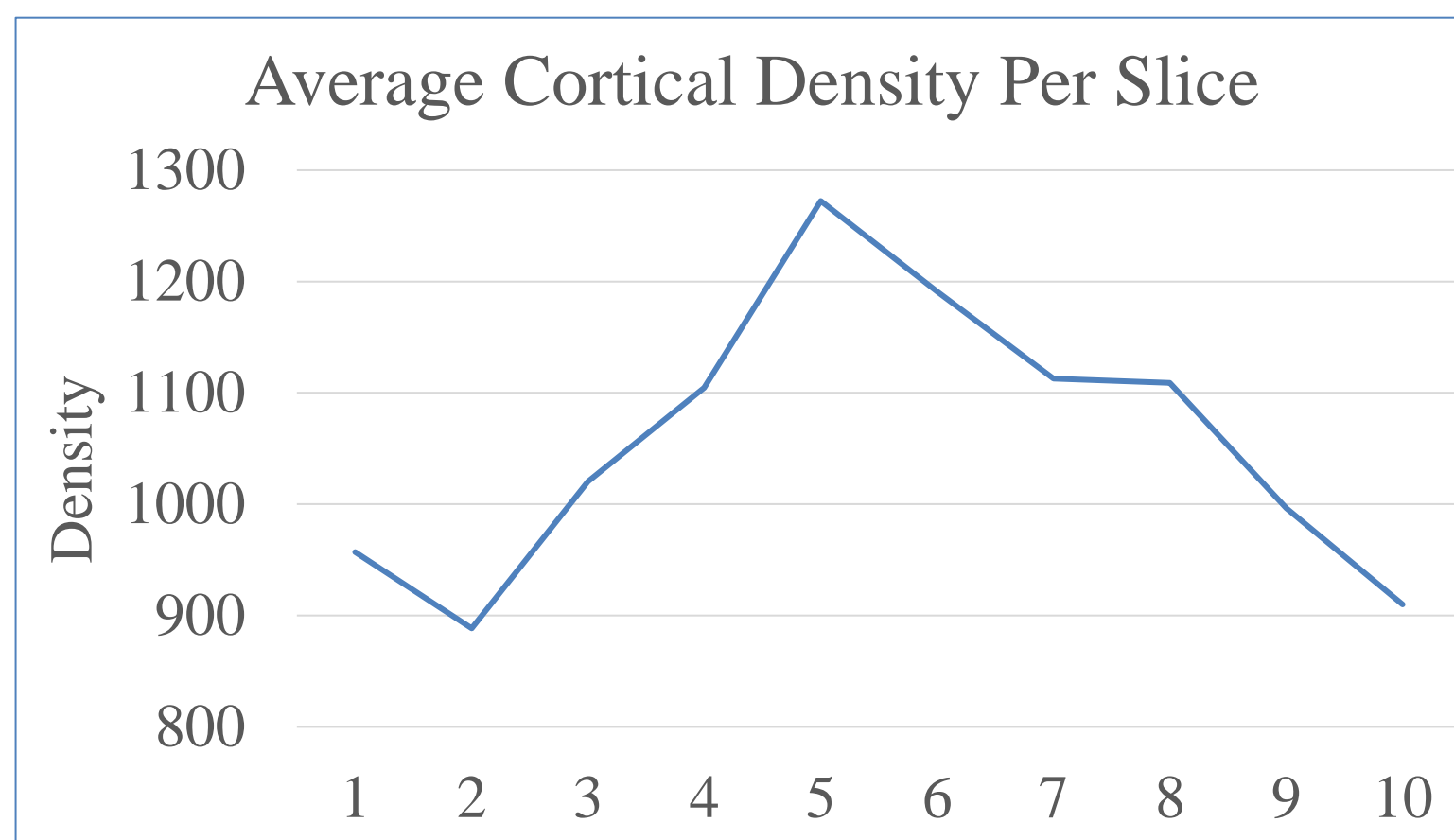


Figure 7 Slice Number (1 to 10), 1 being most lateral

- **Figure 7** shows the distribution of cortical bone across the ten slices, with slice 5 having the highest cortical bone density.

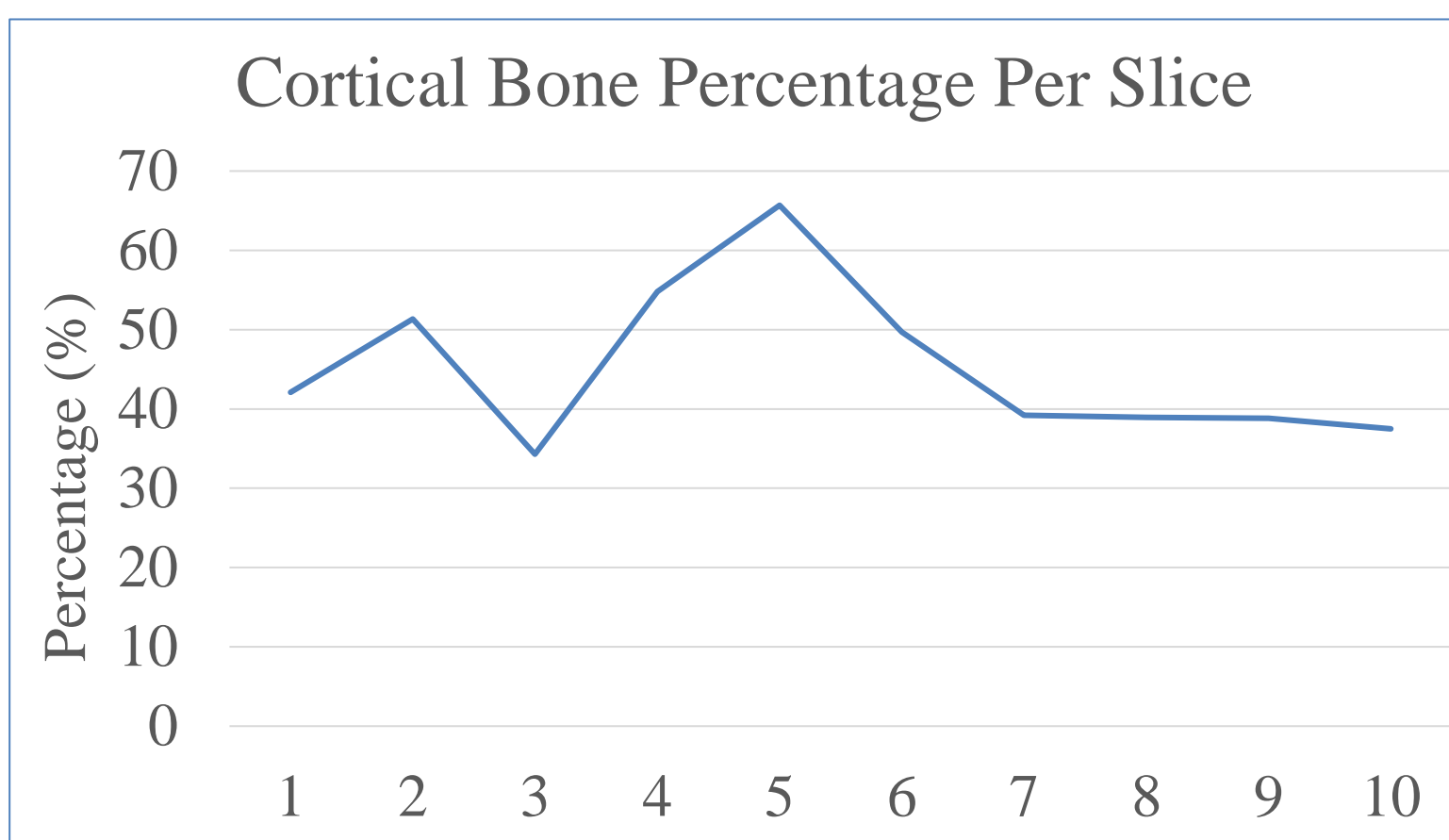


Figure 8 Slice Number (1 to 10), 1 being most lateral

- **Figure 8** shows the cortical bone percentage per slice. Slices 1, 3, and 7-10 are primarily cancellous bone. Slices 2, 4, and 6 have approximately equal amounts of cortical and cancellous bone, and cortical bone dominates slice 5.

DISCUSSION

- Slice 5, (red on Figure 9) shows the greatest cross-sectional area of the ten slices, suggesting this could be a potential candidate for ideal implant screw location due to abundant material.

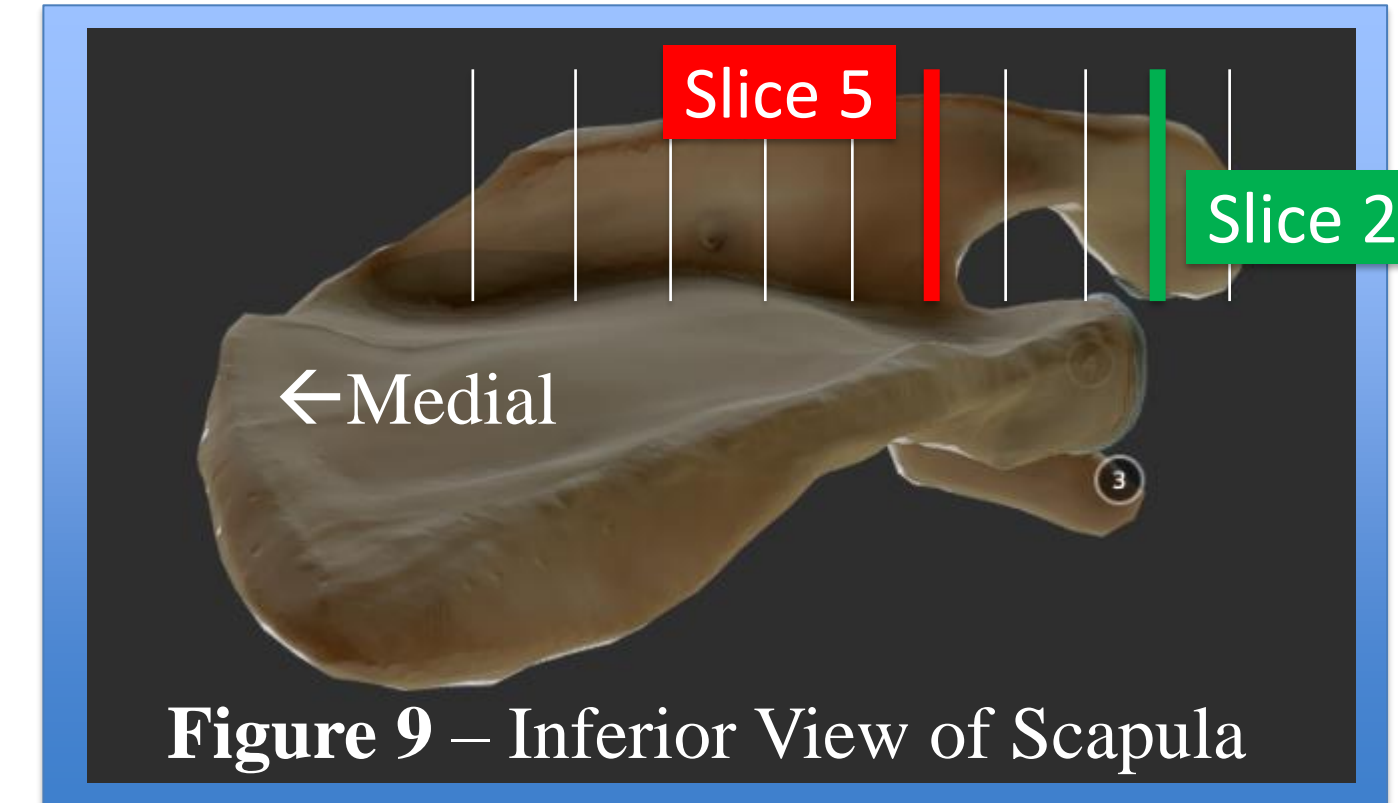


Figure 9 – Inferior View of Scapula

- Cortical bone is an ideal candidate for screw placement due to its hardness compared to cancellous bone. Thus, the highest cortical bone densities across the slices should make for the best implant attachment locations.
- From Figure 8 we see that slice 5, compared to the rest, has the highest amount of cortical bone. Figure 7 further shows that cortical bone found here also has the highest density compared to the rest of the scapular spine. This suggests that anchors/screws placed here would have the sturdiest foundations.

CONCLUSION

- Bone density increases from the acromion medially until a peak is reached at what we defined as “Slice 5”. The same applies to cortical bone density and percentage.
- The section of the scapular spine slightly medial of the lateral angle (slice 5) has the largest surface area, highest density, and highest cortical bone percentage. This makes it best fit for screw attachment locations for various implants.
- These findings have important implications for the design and placement of fixation hardware.

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