

A SHAPE COMPLETION MODEL FOR CORRECTIVE OSTEOTOMY OF DISTAL RADIUS MALUNION

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1. Introduction

3D planning is increasingly being used in treating radius malunion. 3D planning relies on mirroring and aligning the healthy contralateral CT-based radius with the affected radius to assess the degree of malalignment. However, a healthy contralateral radius is not always available. A solution could be the use of a shape completion model (SCM), which could reconstruct a healthy bone from the unaffected portion of the malunited bone.

2. Objectives

To develop a distal radius SCM and to validate this model for clinical use.

3. Methods

A statistical shape model (SSM) was developed based on segmented CT scans of 80 healthy radii. This SSM was expanded into an SCM to predict the distal 12% of the radius based on the proximal 88%. The distal 12% approximately corresponds to the typical distal radius fracture site. Ten additional CT scans were used to validate the SCM and set hyperparameters. Finally, the SCM's performance was tested on ten more CT scans.

4. Results

The SCM's average accuracy, measured by a root mean square difference, was 0.38 mm (SD 0.08) and the average Hausdorff distance was 4.73 mm (SD 1.40). Mean absolute differences were 2.62° (SD 1.74) for radial inclination, 3.55° (SD 2.22) for volar tilt, and 2.56° (SD 2.80) for axial rotation. The most notable difference was found in length (1.74 mm, SD 1.14).

5. Conclusion

The developed SCM produces clinically useable models with error margins comparable to those in literature. The relatively large length discrepancies can be corrected for using the ipsilateral ulna, nullifying the impact of this error.

6. References