Acetabular Width: A Key Parameter for Rapid Preoperative Planning in Crowe III-IV Developmental Dysplasia of the Hip

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Summary

Acetabular reconstruction in Crowe type III and IV developmental dysplasia of the hip (DDH) patients is a challenging orthopedic procedure. While CT-based 3D reconstruction is commonly employed for preoperative planning, traditional 2D pelvic anteroposterior (AP) radiographs contain valuable anatomical information that can also provide a reliable basis for acetabular reconstruction planning. Acetabular width has been identified as a key indicator for preliminarily AI assisted assessing acetabular reconstruction positioning and determining the need for augmentation.

Introduction

Acetabular reconstruction in Crowe type III and IV DDH patients is a challenging orthopedic procedure. While CT-based 3D reconstruction is frequently used for preoperative planning, traditional 2D pelvic AP radiographs offer numerous anatomical details that can reliably assist in preoperative acetabular reconstruction [1,2]. This study aims to extract key indicators, such as the height of the rotational center, cup size, and cup coverage, from 2D pelvic AP radiographs and identify reliable parameters for AI assisted surgical planning [3].

Methods

Between 2010 and 2020, 1852 DDH hips with secondary osteoarthritis who underwent primary total hip arthroplasty (THA) were included in this study. several anatomical parameters were measured on postoperative pelvic radiographs, including: Height of the pelvis, Height of the hip center, Diameter of the acetabular cup, Coverage of the cup, Inclination angle of the cup, Acetabular width above the cup, Height of the superior margin of the cup, Height of the inferior margin of the cup and Distance between the medial margin of the cup and the Kohler line. An automated parameter extraction algorithm was developed by combing nnU-NetV2 region segmentation and the Res-SwinFusion keypoint localization models.

Results and Discussion

Parameters such as the height of the hip center, diameter of the acetabular cup, coverage of the cup, and inclination angle were consistent with the established principles for acetabular reconstruction in DDH patients at different stages [2]. Acetabular width showed a significant correlation with cup coverage (correlation coefficients of 0.765 and 0.576 for Crowe type III and IV, respectively). A threshold acetabular width of 30 mm was identified as a critical indicator for determining the need for augmentation in Crowe type III and IV patients. We developed an AI algorithm to facilitate rapid parameter extraction for acetabular reconstruction in Crowe type III and IV DDH patients.

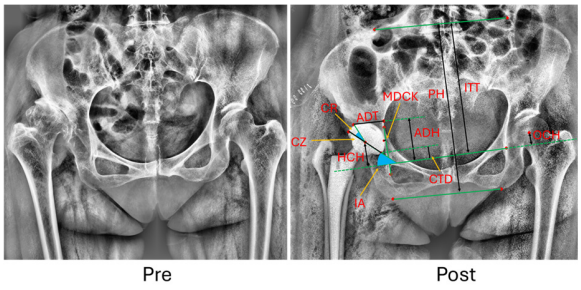

Figure 1: Parameters measured on pelvic radiographs.

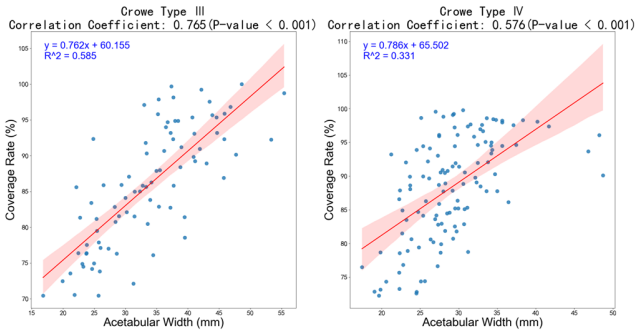

Figure 2: The correlation between acetabular width and coverage.

Conclusions

Acetabular width measured on 2D pelvic AP radiographs serves as a key parameter for guiding AI assisted rapid preoperative planning of acetabular reconstruction in Crowe type III and IV DDH patients.

Acknowledgments

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References

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