Validation of an Artificial Intelligence-Based Software for Automatic Segmentation and Endovascular Aneurysm Repair Planning in Patients with Abdominal Aortic Aneurysm

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Objective:

This study aims to present and validate a fully automatic software based on artificial intelligence (AI) for segmenting preoperative CT scans and planning endovascular aneurysm repair (EVAR) in patients with abdominal aortic aneurysm (AAA).

Methods:

Fifteen preoperative CT scans from open-source databases of AAA patients were segmented, both automatically using the software and manually by two expert vascular surgeons (SA and IR). The software is based on an artificial neural network integrated into a multiplatform environment (3DSlicer), allowing for the extraction of the aortic volume from the renal arteries to the iliac-femoral junction, including wall thrombus and calcifications. These segmentations were then used to measure metrics relevant to surgical planning using dedicated software (3mensio), particularly proximal and distal sealing zone diameters. The extracted volumes were compared using the Dice Similarity Coefficient (DSC), Sensitivity Index (SeI), and Specificity Index (SpI). Diameters were compared using Bland-Altman plots. Finally, the time taken for automatic and manual segmentation and measurements extraction were compared using the Mann-Whitney test.

Results:

The volumetric coefficients demonstrated excellent agreement between automatic and manual segmentation: DSC 0.91 ± 0.08, SeI 0.92 ± 0.07, SpI 0.96 ± 0.01. Bland-Altman plots of manual and automatic diameter measurements showed no mean bias, with limits of agreement within ±3mm (Figure). The average time for manual segmentation was significantly longer (40 ± 11 min vs. 23.9± 3.4 min; $p<.001$). Similarly, the average time for data extraction was significantly longer when performed by surgeons (24.9 ± 5.3 min vs. 8.8 ± 2.4 min; $p<.001$).

Conclusion:

This study demonstrates the accuracy and efficiency of an automatic tool for segmentation and EVAR planning in patients with AAA. The use of this tool leads to the standardization of EVAR planning and

allows surgeons to save time in daily clinical practice.

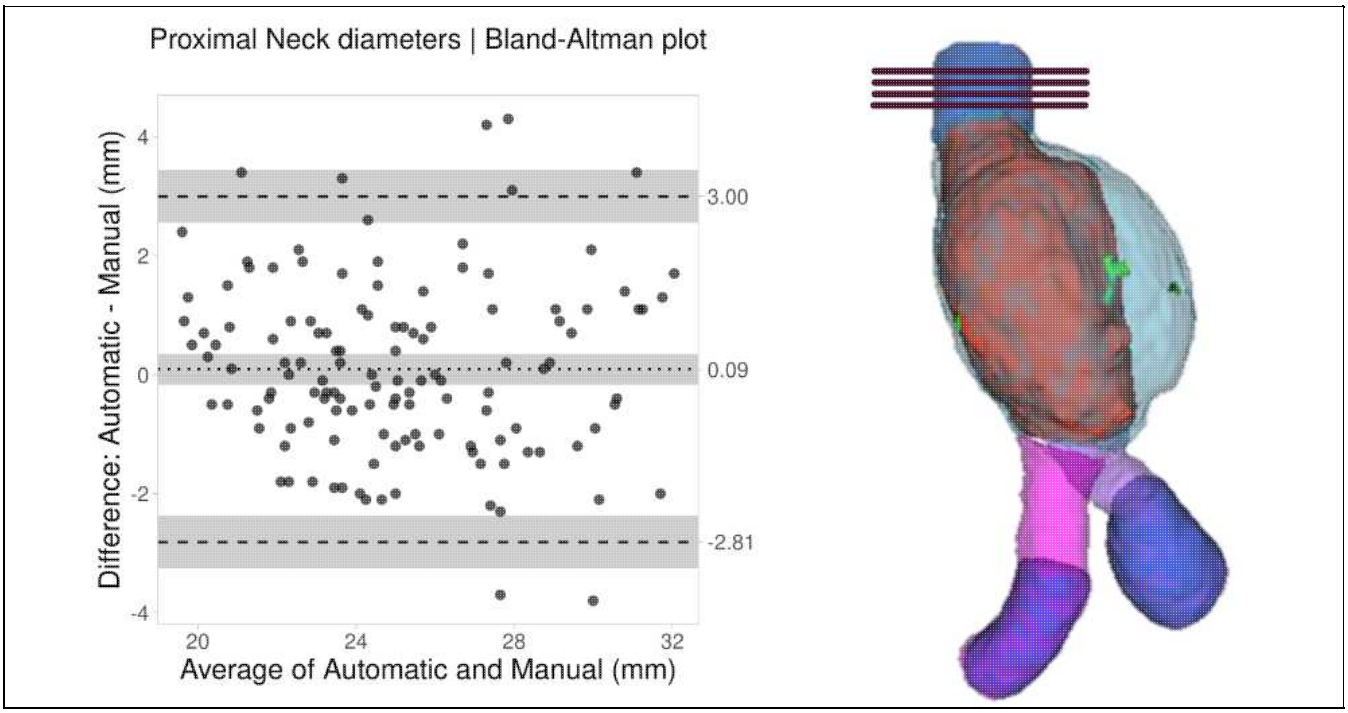

Fig 1 Morphological features extraction: validation results