LIMB FLEXION INDUCED DEFORMATION OF FEMOROPOPLITEAL ARTERY STENTS IN THIEL EMBALMED CADAVERS

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Introduction

Nitinol stents placed in femoropopliteal arteries (FPA) are constantly exposed to variable mechanical loads during limb flexion often leading to their failure contributing to disease progression [1]. Thus, it is important to understand FPA behaviour and evaluate nitinol stent designs in this complex biomechanical environment to improve stent performance. Thiel embalmed cadavers present an excellent vascular test bed providing vascular patency and preserving tissue texture for a longer time [2]. Previous studies have used fresh/lightly embalmed cadavers resulting in loss of tissue texture altering FPA biomechanics [2, 3]. The objective of this study was to assess deformation encountered by self-expanding nitinol stents in FPA of Thiel embalmed cadavers due to limb flexion.

Methods

Cadaver specimens and perfusion: Three human Thiel embalmed cadaveric specimens were selected for the study. An arterial perfusion circuit was established to form entry and exit points and the arteries were perfused with Thiel solution at flow rate of 150-400 mL/min. **Clinical Imaging and Segmentation:** Nitinol stents were deployed under fluoroscopic guidance. CT data was acquired, and 3D segmentations were performed for typical postures such as standing, walking, sitting, gardening and crossed leg in pre- and post-stented conditions shown in Figure 1. Limb-flexion induced deformation was quantified. **Curvature Analysis:** Quantified by fitting radius of the circumscribed circle to three centreline coordinates in the range of a window size at constant increments of arc lengths [4]**.**

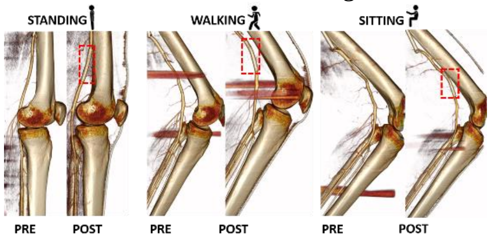

Figure 1: CT Reconstruction of FPA for different postures in pre and post stented conditions. Stented region in the FPA is represented by the red dashed box in the reconstructed image.

Results and Discussion

We report an average increase in curvature values from standing posture to all bent configurations in both pre- and post-stented FPA with distal end in the gardening posture showing maximum average curvature changes shown in Figure 2. A comparison of the pre- vs post-stented regions showed an average decrease in curvature in the stented region for all postures suggesting that the stent could impose restrictions on axial shortening ability of FPA resulting in distal kinking of the popliteal region. Clinical implication of this could be disruption in natural blood flow associated with restenosis and neointimal hyperplasia [5]. Thus, this study presents a novel test bed with arterial perfusion comparable to native FPA for stent placement and its deformation analysis.

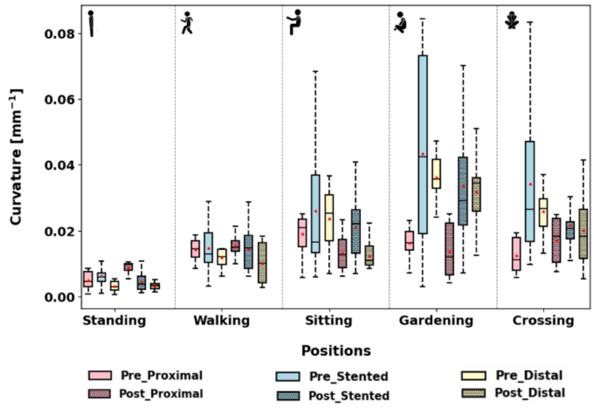

Figure 2: Box and whisker plot presenting mean curvature for Cadaver 1 for different postures. Mean is marked with red triangle and median with black line.

References

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