

Time resolved CT angiography in patients with suspicion of peripheral arterial disease: qualitative and quantitative assessment

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Introduction

Peripheral arterial disease (PAD) is a chronic atherosclerotic process that causes partial or complete **narrowing** of the arteries, predominantly in the lower legs. Being the third leading cause of atherosclerotic cardiovascular morbidity, it is necessary to detect and treat PAD. At the moment, the existing **non-invasive** diagnostic tests do not provide information on the dynamics of the blood flow nor on the effects of occlusions. The purpose of this master's thesis is to prove the added value of **4D CT angiography** as diagnostic test for PAD. This is done by means of a qualitative and quantitative assessment.

Material & Methods

The **scan protocol** consists of 2 major acquisitions: a run-off CTA of the legs and a dynamic CTA of the lower leg. (Fig. 1)

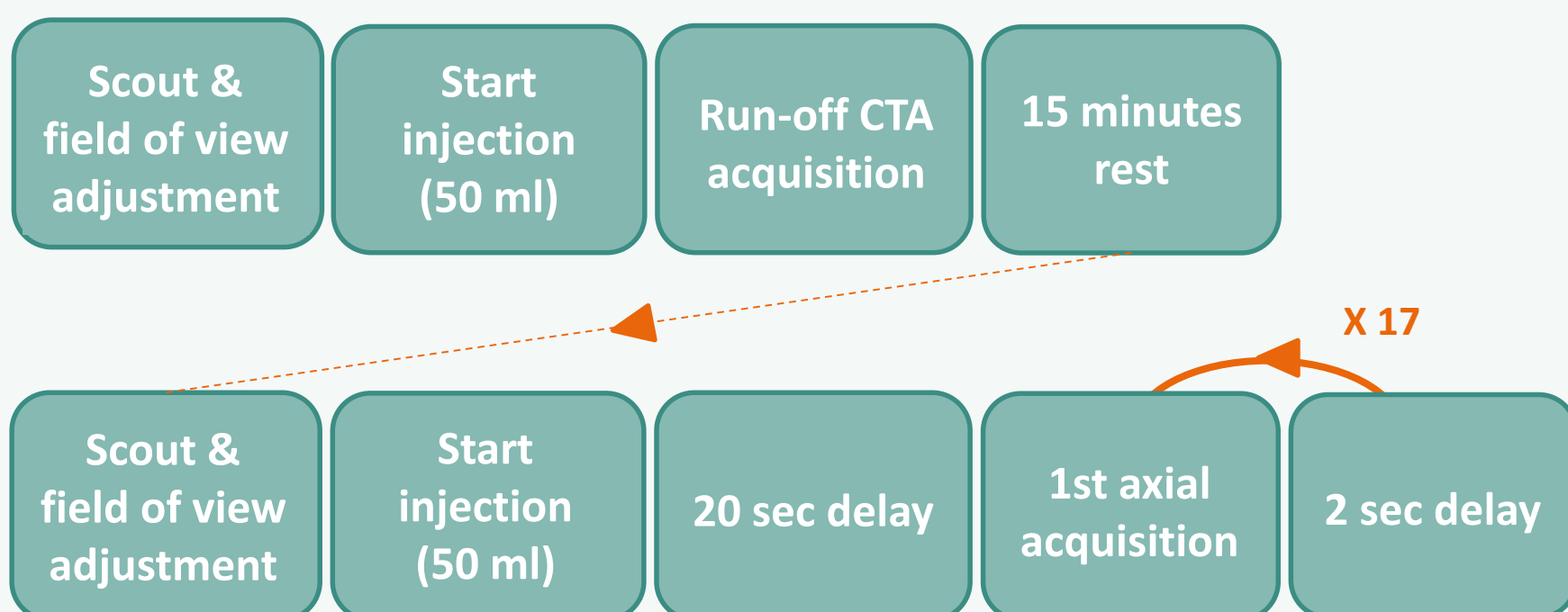


Figure 1: Scan protocol consisting of the run-off acquisition and the dynamic acquisition

For the **segmentation of the arteries**, multiple techniques are applied. The key elements in this process are: pairwise registration and Otsu. The **velocity** of the blood is calculated by tracking the contrast bolus between regions of interest (ROI) and by constructing the time attenuation curves (TAC) in these ROI's (Fig. 2). The key element here is the time to peak (TTP).

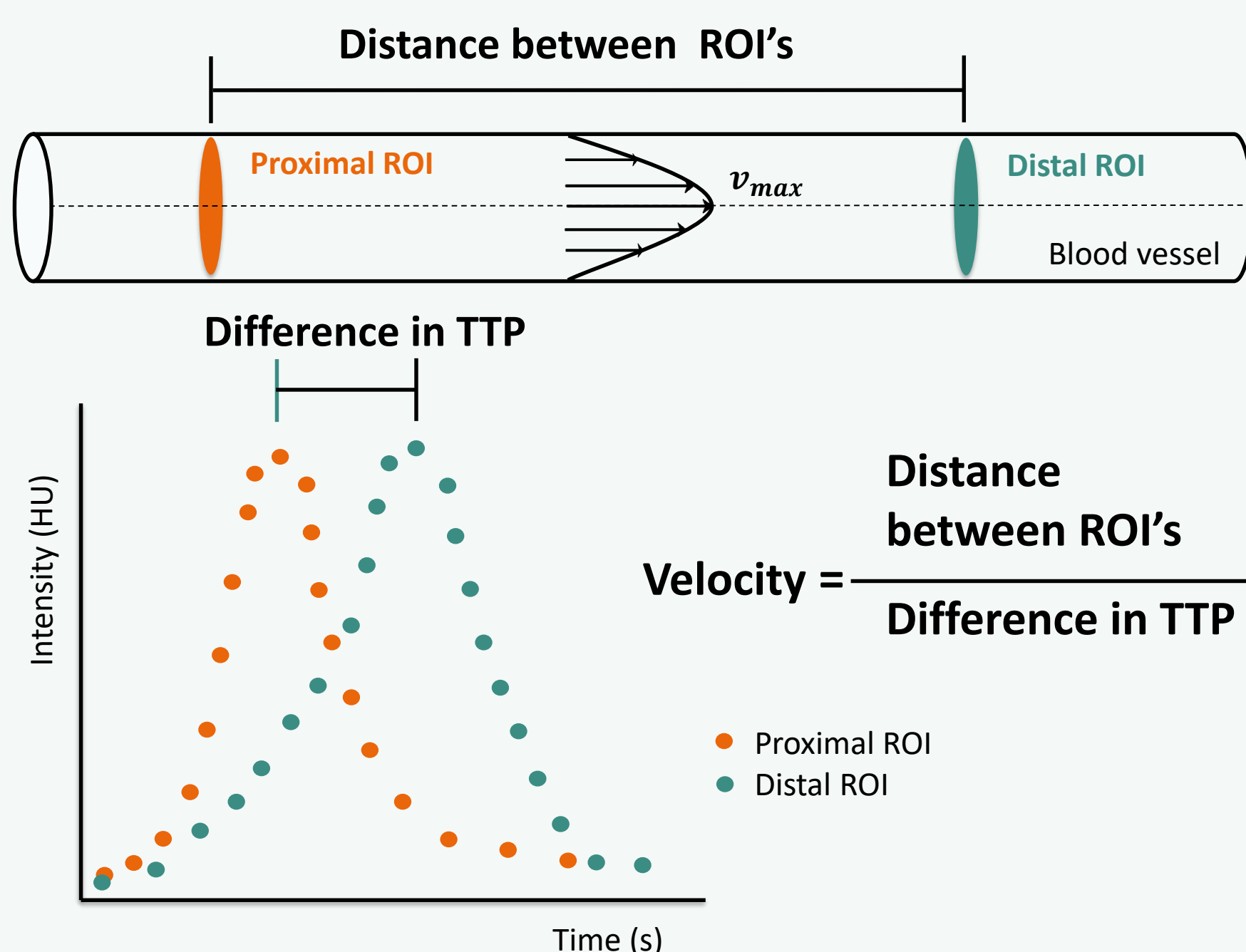


Figure 2: Theory of velocity calculation between 2 ROI's by creating the TAC's

Results

The **segmentation** combined with **TTP** visualises the differences between the arteries. (Fig. 3)

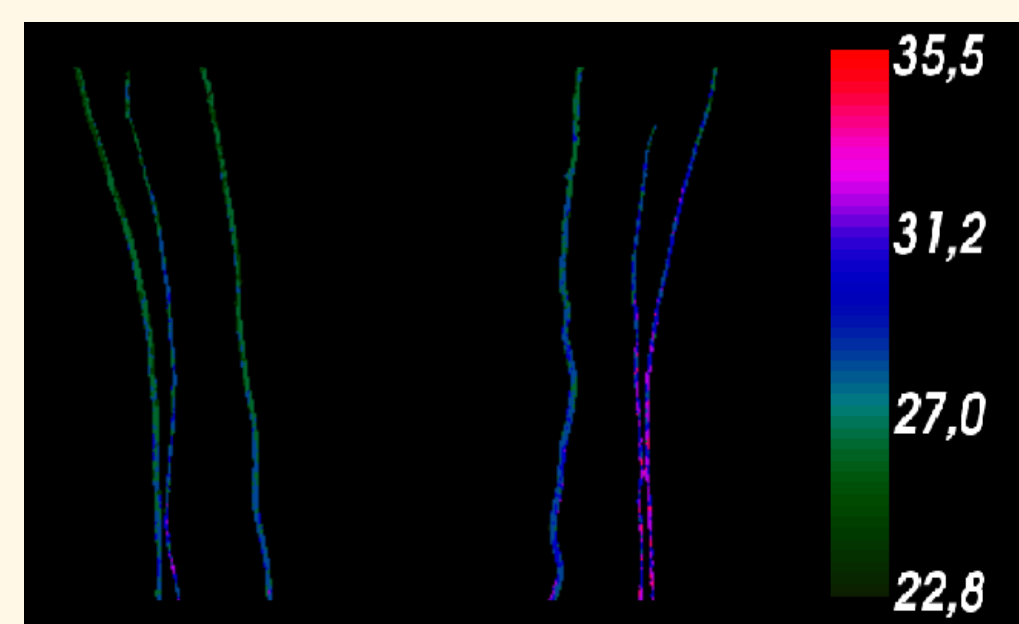


Figure 3: Parametric map of the TTP (s) (Courtesy of ETRO, Jef Vandemeulebroucke)

By plotting the **TTP** in function of the distance, the main velocity in an artery is obtained. (Fig. 4)

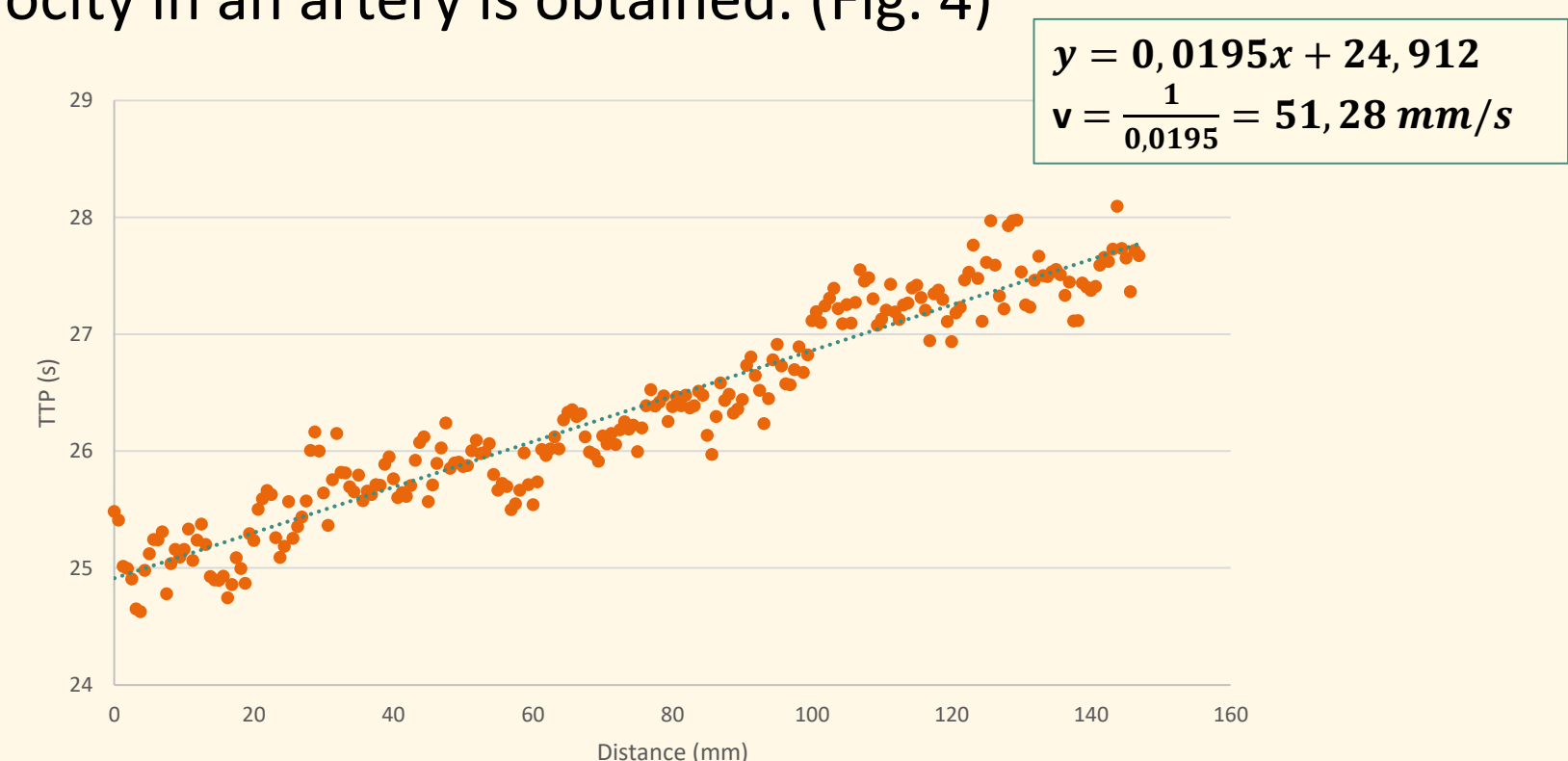


Figure 4: the TTP (s) plotted as function of distance (mm)

Conclusion

The results of the qualitative & quantitative assessments **suggest** that 4D time resolved CT angiography has the potential of being an **added value** as diagnostic examination for PAD.

References:

Barfett *et al.*, "Blood velocity calculated from volumetric dynamic computed tomography angiography.", 2010

N. Westerhof *et al.*, "Law of poiseuille," Snapshots of Hemodynamics, 2010

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