Quantitative X-ray elastography of coronary arteries using flexural pulse waves

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Abstract

Dynamic elastography uses an imaging system to visualise the propagation of elastic waves,
the speed of which is directly related to the elasticity felt by palpation. Very few studies have focused on X-ray elastography because of the technical challenges it poses: a planar image of an integration volume at a very slow sampling rate. We demonstrate that tracking a slow elastic wave guided along a one-dimensional structure is the solution. The recently discovered flexural pulse wave, which is naturally generated by heartbeats and propagates along arteries, is the perfect candidate for X-ray elastography. As it reflects the cardiovascular health of patients, arterial elasticity is a biomarker of high clinical interest. We first validate the method by measuring the elasticity in arteries phantom using X-Ray. We then move on to
data obtained in vivo on coronary arteries during a routine angiography examination. During coronary angiography, a catheter is used to inject an X-ray contrast dye into the patient's aorta. X-rays are then taken as the dye spreads through the coronary arteries. It shows the movement of the coronary arteries for a few seconds and allows us to follow the natural flexural pulse waves. The obtained Young's moduli for two patients are E = 41 ± 29 kPa and
E = 12 ± 9 kPa respectively. These preliminary results are expected to pave the way for X-ray elastography.

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