

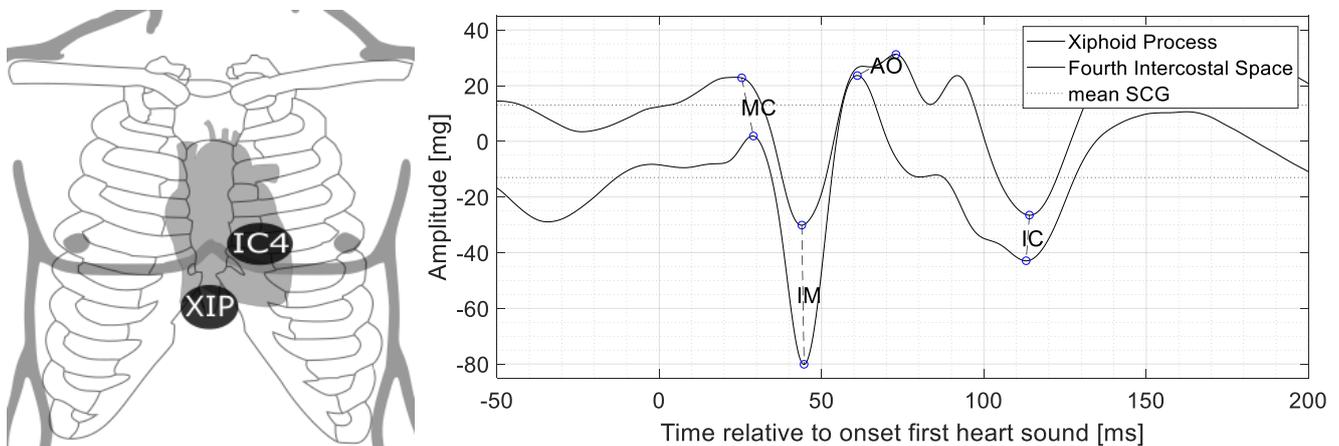
Variation of the Seismocardiogram Depending on Measurement Position

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Intro: Seismocardiography (SCG) has been proposed for a long time as the mechanical counterpart of electrocardiography. Whereas the ECG electrodes have standardized anatomical positions based on anatomical / physiological arguments together with more than a century long clinical experience, such standardized accelerometer placements are lacking. Studies measuring SCG commonly use the xiphoid process, and phonocardiography studies commonly use the fourth intercostal space. This study investigates four fiducial points in the SCG obtained from the xiphoid process and compares them to fiducial points in the SCG obtained from the left fourth intercostal space.

Method: We are currently conducting a large cohort study where SCGs are collected from patients with referrals due to suspected heart failure. The SCGs were collected with accelerometers placed on the xiphoid process and in the fourth intercostal space. For the analysis we used a subset of 30 patients between 44 and 88 years. SCG signals were segmented, aligned with the first heart sound, and annotated according to previous work. We compared amplitudes and time intervals of the four fiducial points, related to the mitral valve closure (MC), isovolumic movement (IM), aortic valve opening (AO), and isotonic contraction (IC), using Pearson's correlation coefficient and the paired-sample t-test.

Results: The fiducial points IM and AO had a 0.0 ± 8.0 ms difference in time interval along with 2.5 ± 22.2 mg and 5.8 ± 23.5 mg higher amplitudes, respectively, when measuring in the fourth intercostal space. However, we found no statistically significant difference between amplitudes or time intervals of any of the fiducial points. Additionally the correlations of the amplitudes ($0.74 > r > 0.49$) and of the time intervals ($0.65 > r > 0.48$) for the two sites were only moderate.



The left figure illustrates the xiphoid process (XIP) and fourth intercostal space (IC4) measuring sites that were compared. The right figure illustrates mean SCG signals from the two measuring sites, and the four fiducial points used for comparison: mitral valve closure (MC), isovolumic movement (IM), aortic valve opening (AO), and isotonic contraction (IC).

Discussion: The moderate correlations of amplitudes and of time intervals from the two measurement points indicated differences in the SCG morphology at the xiphoid process and fourth intercostal space.