Assessment of left ventricular torsion in long axis view

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SUMMARY
One of the most important biomechanical parameter of myocardial is left ventricular (LV) torsion angle. In present study, we estimated torsion angle in long axis view and compared it with short axis view. In this study, 14 healthy men were evaluated. Two dimensional echocardiography images were scanned in apical and basal segments with parasternal short axis view and then scanned with four chamber view for four cardiac cycles. Left ventricle wall movements in basal and apical segments were detected with echo tracking algorithm. Maximum torsion angle is calculated in short axis and long axis views. Peak rotation angles in basal and apical level in short axis view are 7.96 ± 1.57 and 9.49±1.72 degree and so in long axis view are 18.51±3.41, 14.74±2.91 degree, respectively. Peak torsion angles in short axis and long axis views are 17.45±2.17 degree and 33.26±5.60 degree, respectively. Correlation between estimated LV peak torsion in long axis view and short axis view was calculated (R=0.82, p=0.000). This study suggested that LV torsion in long axis view have similar behaviour with LV torsion in short axis view, and LV torsion in long axis view is promising parameter to assess heart function.

INTRODUCTION
Heart torsion is one of the biomechanical parameter that is sensitive to changes in both regional and global left ventricular function [1]. Clock wise rotation of the basal and counter clock wise rotation of the apical about its long axis, cause the heart torsion during systolic phase. Left ventricular torsion during systolic phase, stores potential energy and causes uniform distribution of stress and equilibrates myocardial fiber shortening. Systolic twist keeps high intraventricular systolic pressure minimal, therefore myocardial energy consumption will be limited [2]. Consequently it seems the assessment of left ventricular torsion in long axis view would be more accurate in comparison with the left ventricular torsion in short axis view. In this study left ventricular torsion is estimated in long axis view and compared with left ventricular torsion in short axis view.

METHODS
We assessed left ventricular torsion in long and short axis plane of 14 healthy men in the age 46 ± 5, they didn't have any history of heart disease. Echocardiography recording were done by a vivid7 GE echocardiograph with M3S probe. For each subject, we scanned basal and apical level in short and long axis view using high frame rate (60-70 frame per second), harmonic B-mode with transmitted and received frequency, 1.7 MHz and 3.4MHz respectively. We defined basal level and apical level in short axis view at mitral valve and distal level of LV with no visible papillary mussels respectively. In long axis view, basal level and apical level has been in high and low of left ventricular axis respectively. The normal case was asked to lay in the left lateral, and the electrocardiogram was simultaneously recorded. Then the images of long-axis (four chambers) view of LV, short-axis views at the mitral valve and apex planes were scanned with high spatial and temporal resolution. The left ventricular end-diastolic/systolic diameters (d LVED/dLVES), interventricular septal diastolic thickness (T IVSD), posterior wall thickness (PW) were measured in the long-axis view of LV ,also calculated ejection fraction based on Simpson equation. At least 4 consecutive cardiac cycles for each view under stable heart rate were acquired and stored.

In this study speckle pattern motion among the consecutive frames were estimated by block matching (BM) algorithm. After selecting best images, we converted B-mode echocardiography movie (Dicom format) to consecutive frame (BMP format), and implemented BM algorithm on those frames. Motion vector (Cartesian coordinates according to frame number) of ROI in horizontal and vertical directions was obtained. After ROI displacement extraction in systolic phase and finding center of basal and apical level, clock wise and counter clock wise rotation peak values of each short axis and long axis view was assessed. Left ventricular torsion in short axis and long axis was calculated based on following equation:

\[
\text{Torsion angle} = \text{apex rotation angle} - \text{basal rotation angle}.
\]

In present study, data was reported as Mean±SD. To determine reproducibility of myocardial displacement and torsion angle in long axis view, Pierson correlation and bland--Altman test was used.

RESULTS AND DISCUSSION
Basic echocardiography parameter value was shown in Table 1. The subjects had normal cardiac function and they had not any heart disease symptoms. After extraction of the displacements in vertical and horizontal directions at the systolic phase and specifying center of desired levels in end diastolic phase frame, rotation and torsion angle in short axis and long axis view were obtained (Table 2). Regression analysis was used for evaluating the correlation of peak torsion angle in short axis and long axis.
The results of linear regression for LV torsion in short axis and long axis view demonstrated very good correlation ($r=0.826$, $p=0.000$).

**CONCLUSIONS**

This study demonstrated that torsion and rotation angle in long axis view had similar behavior in short axis view, and because torsion angle evaluation in long axis view had more accuracy than short axis view, it seems that torsion angle in long axis view can be replaced with torsion angle in long axis view.

**REFERENCES**


**Table 1**: Echocardiography parameter (Mean±SD)

<table>
<thead>
<tr>
<th>N</th>
<th>LVEDd(cm)</th>
<th>LVESd(cm)</th>
<th>PW</th>
<th>IVSD</th>
<th>EF</th>
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</thead>
<tbody>
<tr>
<td>14</td>
<td>4.98±0.39</td>
<td>3.14±0.42</td>
<td>1.11±0.11</td>
<td>1.192±0.08</td>
<td>58.21±2.48</td>
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</tbody>
</table>

**Table 2**: Rotation and torsion angle in short axis and long axis view (Mean±SD)

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Long axis view(degree)</th>
<th>Short axis view(degree)</th>
<th>p</th>
<th>r</th>
</tr>
</thead>
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<tr>
<td>Basal rotation</td>
<td>18.51±3.41</td>
<td>7.96±1.57</td>
<td>0.017</td>
<td>0.646</td>
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<tr>
<td>Apical rotation</td>
<td>14.74±2.91</td>
<td>9.49±1.71</td>
<td>0.008</td>
<td>0.7</td>
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<tr>
<td>Lv Torsion</td>
<td>33.26±5.6</td>
<td>17.45±2.17</td>
<td>0.000</td>
<td>0.826</td>
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</tbody>
</table>