Estimates of the levator ani subtended volume based on magnetic resonance linear measurements

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BACKGROUND AND AIM

The Levator Ani Subtended Volume (LASV) is a new parameter based on three dimensional (3D) reconstructions from magnetic resonance imaging (MRI) of the pelvis (Figure 1). This parameter is associated with laxity of levator ani muscles, and shows good correlation with Pelvic Organ Prolapse (POP) individual measurements and ordinal POP stages. However, the 3D reconstruction is a time consuming process that limits its clinical applications. Our hypothesis, based on an geometrical interpretation of the levator hiatus (Figure 2) is that the LASV can be estimated through a mathematical formula based on simple linear measurements. Aim: to estimate the LASV based on MRI linear measurements.

STUDY DESIGN AND METHODS

The study is based on a retrospective chart review of 35 women with POP, stages I-IV. The 3D Slicer software was used to obtain the LASV through 3D reconstructions and assumed as reference values. Several linear measurements were performed, as shown in Figure 1, and those that best fit our criteria were chosen. The predictors should present: (1) differences across POP ordinal stages based on analysis of variance; (2) significant and high correlation coefficients with LASV - assumed in this study as ≥0.8; (3) positive and significant correlation with POP-Q measurements and POP ordinal stages. After the measurements, the subjects were randomly divided into groups 1 or 2. The coefficients of the mathematical equation were obtained from a regression analysis using LASV from Group 1 as dependent variable and the predictors previously chosen. Two observers, blinded to POP ordinal stages, performed new linear measurements of the pelvic MRIs from Group 2. The estimated LASV from observers 1 and 2 were called respectively, eLASV-1 and eLASV-2. The LASV, eLASV-1 and eLASV-2 were compared and correlated with each other, and with POP-Q measurements and POP ordinal stages. Also, a residual analysis was performed to validate the mathematical equation. Finally, the reliability analysis was performed. See diagram (Figure 3).

RESULTS

The best chosen predictors were the M-line, H-line and width of the levator hiatus (WLH) (Figure 1). The coefficients of the equation were determined to compound the equation to estimate LASV:

\[ \text{eLASV} = -72.838 + 0.598 \times \text{H-line} + 1.217 \times \text{M-line} + 1.136 \times \text{WLH}. \]

The eLASV-1 was not different from the LASV, but a difference was detected when it was compared with eLASV-2. LASV, eLASV-1 and eLASV-2 showed similar and good correlations with the POP individual measurements and ordinal stages (Table 1). The residual analysis showed normal distribution of the estimate values and errors, from both observers, when compared with reference values. The intra and interclass correlation of the estimated values indicated a good the reliability of the eLASVs. The Cronbach’s alpha and the mean of inter-item correlation are shown in Table 2.

CONCLUSIONS

The 2D MRI measurements may be used to estimate the LASV. This may be an easy strategy for clinical application of this parameter against the time consuming manual or semi-automated segmentation processes. The discrepancies between eLASV-1 and eLASV-2 were credited to the variability of observers’ measurements, but not to the mathematical equation. The clinical relevance of this parameter should be established by further studies.

REFERENCE