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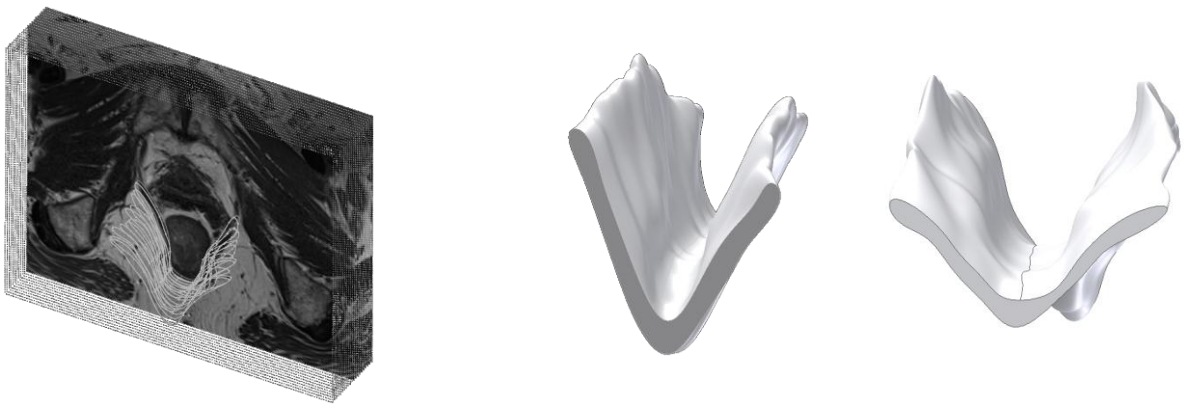
EVALUATION OF PELVIC FLOOR DISPLACEMENTS IN PROLAPSED AND NON-PROLAPSED WOMEN USING A NOVEL TECHNIQUE BASED ON A 3D COMPUTER MODEL

Hypothesis / aims of study

Stress urinary incontinence (SUI) affects 6 to 33% of the female population and has a significant impact on their quality of life. Structural defects of the neuromuscular and connective tissues supporting the bladder neck and urethra are implicated in SUI pathogenesis. Therefore, the association between SUI and genital prolapse is frequent and occurs in approximately 50% of the cases [1].
Pelvic floor muscle training (PFMT) is generally advocated as the first-line intervention to treat female SUI. The rationale of PFMT for this purpose is that a strong pelvic floor muscle contraction will clamp the urethra, increasing the urethral pressure to prevent leakage during an abrupt increase in intra-abdominal pressure [2].
The knowledge regarding the identification of patients with poor outcome after PFMT for SUI is limited. The pelvic floor muscles behaviour in prolapsed women also remains unclear.
The aim of this study is to evaluate pelvic floor displacements under simulated contractions in prolapsed SUI women using a 3D computational model. Represents an attempt to better understand the structure-function of the female pelvic floor and predict the PFMT outcomes in SUI associated to prolapse.

Study design, materials and methods

The study was performed in an asymptomatic, nuliparous woman with 25 year, and another with a diagnosis of SUI and POP degree 1/2 to 51 years. MR examinations were performed with the patient in supine position, an axial plane, using a system of 3.0 T, 2 mm thick with a 2-mm gap.
Finite element Model of pubovisceral muscle (PVM) of each woman was created. After the preparation of images to use, one can start the construction of the model, using appropriate software. The software inventor was used to manually draw the contour of the PVM and to build 3D reconstruction models, as shown in Figure 1.
On the generated model, active PVM contractions with 10%, 50% and 100% intensities were simulated. ABAQUS software with a routine containing the formulation for muscle activation was used for simulation [3].



a) b) c)

Figure 1: Construction the PF model. a) 3D model and yours morphology; b) 3D computational model of a non-prolapsed woman; c) 3D computational model of a prolapsed woman.

Results

As illustrated in Figure 2, the geometrical model shows remarkable differences in PVM morphology in non-prolapsed compared to SUI/prolapsed women. A more flap shaped pelvic floor was noted in SUI/prolapsed patients. The improvement in contraction intensity causes a progressive increase in PVM deformation.
Concerning the process of muscle activation, one can verify that the PVM displacements caused by the simulated contractions were not sufficient to restore the original anatomical position of the PVM observed in non-prolapsed patient.

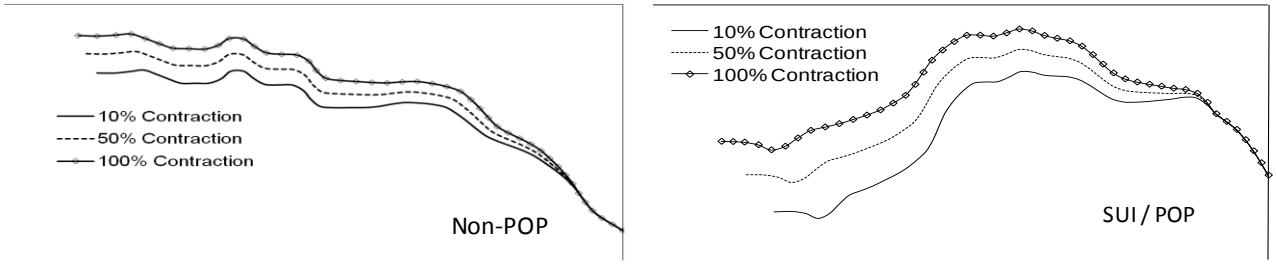


Figure 2: Pubovisceral muscle deformations (in the medial plane) during different levels of contraction.

Interpretation of results

The PVM displacement caused by the simulated contractions was not sufficient to restore the original muscle anatomical position. This finding may suggest that patients with vaginal prolapse will not have benefit of PFMT. The presence of anatomic defects have already been associated with poor outcome in patients with SUI submitted to a conservative approach.
Comparing the 3D model of the non-prolapsed with the prolapsed woman we may notice a difference in the morphology of the structure (Figure 1), which can characterize an anatomical difference between them.
Based on graphs represented in figure 2 one can note the woman without prolapse can maintain contraction in higher values than the prolapsed woman.

Concluding message

Predicting pelvic floor displacements is of great significance in planning treatment to SUI/prolapsed patients. This study found that the muscle strengthening may not be sufficient in restoring the muscle original anatomy observed in continent patients.

References

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Is this a clinical trial?	**No**
What were the subjects in the study?	**HUMAN**
Was this study approved by an ethics committee?	**Yes**
Specify Name of Ethics Committee	**The study was conducted following the Ethical Research Ethics Committee guidelines of Hospital de São João (Porto, Portugal)**
Was the Declaration of Helsinki followed?	**Yes**
Was informed consent obtained from the patients?	**Yes**