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DISPLACEMENT OF THE LEVATOR ANI MUSCLE IN CONTINENT AND INCONTINENT FEMALE ATHLETE

Hypothesis / aims of study

Physical exercise has been highlighted as a factor of primary prevention and therapeutic support of several chronic diseases [1]. In addition to this, there are many other benefits of regular exercise and training that increases cardio- vascular fitness, increases muscle mass and strength, improves physical appearance and neuromuscular coordination, among others. These facts can be used to encourage sedentary women to start exercising regularly. However, exercise has been implicated as a risk factor for onset of urinary incontinence (UI).

Recent studies have suggested that there is a surprisingly high incidence of UI in women who have participated in long-term high impact sports [2]. It seems that, mainly, the high impact exercises create a greater increase in intra-abdominal pressure than other athletic activities, leading to a stress urinary incontinence (SUI). For example, some studies refer that 80% of nulliparous elite trampolinists have involuntary loss of urine [3].

The ability to contract the pelvic floor muscles (PFM) is essential to maintain continence during an abrupt increase in intra-abdominal pressure. The contraction exercises are the foundation of physical therapy for SUI. However, actually we cannot predict whether the muscle has the ability to contract the PFM in all their portions (puborectalis, pubococcygeus, and iliococcygeus). The aim of this study is to assess the displacement of PFM in different parts of the part of levator ani muscle, under simulated contractions in two synchronized swimming athletes, one healthy and one with SUI.

Study design, materials and methods

For this study two synchronized swimming athletes were selected, with 20 years, nulliparous and with a body mass index of 20.6 (SUI) and 23.3 (healthy). One was healthy and the other has SUI, both performed MR examinations with the patient in supine position, an axial plane, using a system of 3.0 T, 2 mm thick with a 2-mm gap.

Twenty images were selected to build the 3D computation model. These models were built with software Inventor, each image was drawn the outline of the “levator ani” muscle, manually, using the RM in background (Figure 1). These 3D solids are imported into the software ABAQUS which applied the finite element method (FEM) and simulated muscle contraction of 100% of maximum contraction.

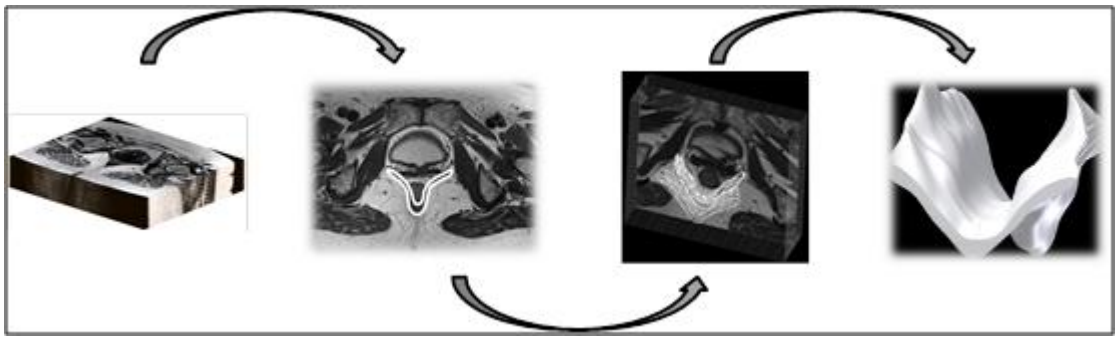

Figure 1: Construction of three-dimensional model

Results

In table 1, we see the obtained displacement of the “levator ani” muscles in their anatomical subdivisions when contracted to 100% of maximum contraction.

Portion of the muscle	Puborectalis Displacement	Pubococcygeus Displacement	Iliococcygeus Displacement
SUI Athlete	1.82mm	2.02mm	0.41mm
Healthy Athlete	2.75mm	1.62mm	0.30mm

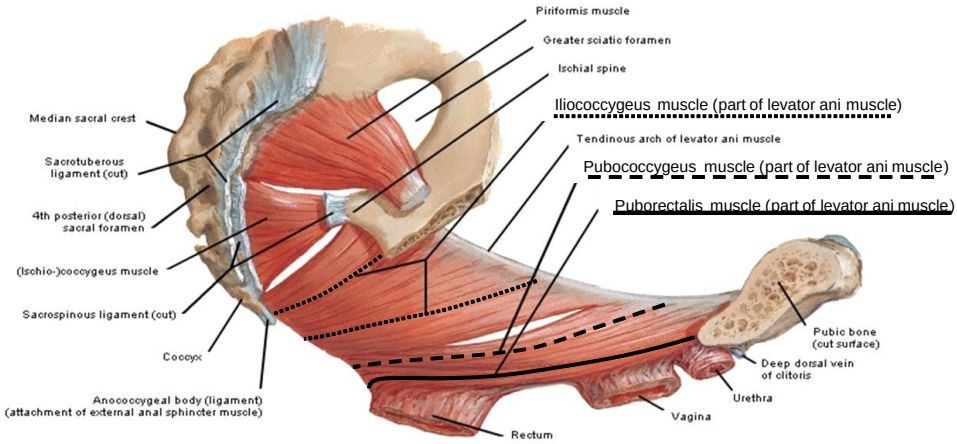

Table 1: Displacement of part levator ani muscle. (adapted from [Netter, 2001]).

Analyzing the area of the levator ani muscle, find an area of 245 mm2 and 325mm2, for part of the puborectalis muscle, and 10521mm^2 and 7849 mm^2 and the total area for the levator ani muscle is 10521mm^2 and 7849 mm^2 for women with urinary incontinence and healthy woman, respectively.

Interpretation of results

We may note that the healthy athlete tends to increase the displacement of the pelvic floor muscles as we approach the puborectalis muscle, while when analyzing the athlete with UI the puborectalis muscle decreases its displacement. The puborectalis muscle may be more associated with the UI, because it is more close to the urethral meatus. Remember that the ability to contract is closely linked to muscle area. In this study, the athlete with UI showed a smaller area than of healthy athlete in puborectalis muscle, 245 mm^2 and 325mm^2, respectively. However, the total area of the muscle in UI women is greater (10521mm^2, in comparison with 7849 mm^2).

Concluding message

These findings may suggest that in female athlete which cannot perform an effective contraction in puborectalis muscle, may grow to be a diminution of the displacement in this portion of the muscle and thus have difficulties in maintaining the continence. In addition, the area of the muscle in its different parts, seems to be a factor of importance to predict urinary continence.

References

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Specify source of funding or grant	**FCT**
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	**Ethics commitee of São João Hospital.**
Was the Declaration of Helsinki followed?	**Yes**
Was informed consent obtained from the patients?	**Yes**