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INFLUENCE OF OBSTETRICS PROCEDURES DURING CHILDBIRTH IN THE FUNCTION OF THE PELVIC FLOOR MUSCLES

Hypothesis / aims of study

Vaginal delivery is commonly accepted as a risk factor in pelvic floor dysfunction (PFD), however, some obstetric procedures such as episiotomy are still controversial. Therefore, the aim of this study is to investigate the impact of episiotomy performed during childbirth in the mechanical behavior of the pelvic floor muscles (PFM).

Study design, materials and methods

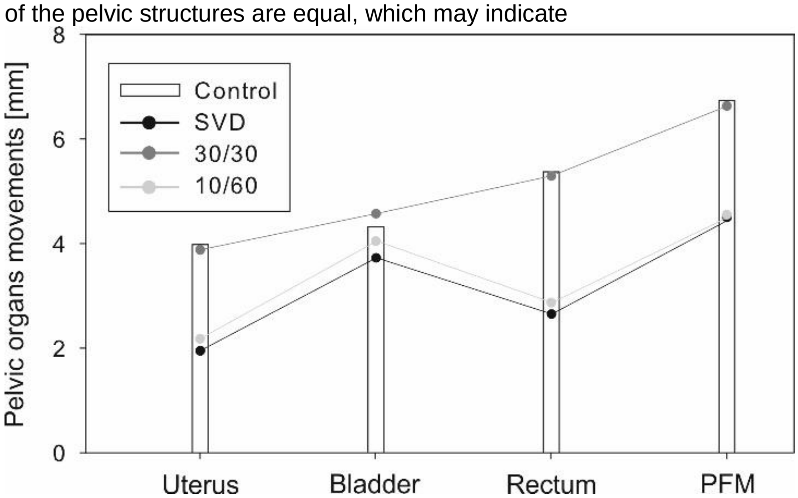
The computational model used is based on MRI data of a nulliparous 24-year female without PFD complaints and includes the PFM, organs of the pelvic cavity (bladder, rectum and uterus) and supportive structures (pubocervical fascia, arcus tendinous fasciae pelvis, the pubourethral, cardinal and uterosacral ligaments and the lateral ligaments of the rectum). The different structures of the biomechanical model are characterized with hyperelastic models (1). Particularly, the constitutive model of the PFM characterizes the passive and active behavior of the skeletal muscles with a specified activation level.
To analyze the relationship between episiotomy and PFD, the mechanical behavior of the PFM has been changed by including the regions damaged during a spontaneous vaginal delivery (SVD), and during deliveries with episiotomy (30/30: 30-mm episiotomy at 30º; 10/60: 10-mm episiotomy at 60º). For comparison, simulations with a healthy muscle is also performed (Control). The passive and active behavior of the PFM are analyzed during numerical simulations of Valsalva maneuver (VM) and contraction, respectively. Common features assessed at screening of PFD are evaluated, such as, bladder neck mobility and levator hiatus length (2).

Results

The results of the VM shows that the higher movements occur in the uterus and bladder with a movement of 27.3 mm and 14.5 mm, respectively. In turn, the movement of the PFM and rectum was only around 2 mm. In spite of the differences in the characterization of the PFM, the results were similar in all cases analyzed. Figure 1 shows the movements of the pelvic organs during contraction for all the numerical simulations performed. During contraction of the pelvic floor, the PFM are the structure with higher movement, regardless of the situation analyzed, followed by the rectum, since the posterior portion of the PFM is the one that lifts more, pulling up the rectum. Contrarily to what occurs during straining, during contraction, the anterior portion of the pelvic floor (uterus and vagina) shows the lowest movements. Additionally, it is observed from Figure 1 that the movement trend of the different pelvic structures is very similar, with larger movements in the control case, followed by the case in which muscle damage is lower (30/30), to the case where damage is higher (SVD). An exception is viewed at the bladder, with the 30/30 case presenting higher movement than the case control.
Regarding the movement of the bladder neck, the maximum value occurs during VM (see Figure 1). During PFM contraction, the movement of the bladder neck depends on the situation assessed. PFM undamaged or nearly undamaged cause greater movements of the bladder neck.
The sagittal diameter of the levator hiatus was measured at rest, and during VM and contraction. VM induced an increase of the levator hiatus length from 51.9 mm to 52.5 mm. Regarding the contraction, the decrease in length of the levator hiatus depended in the wellness of the muscles, the more damaged, the less closure of the diameter. The smallest decrease was of 1.1 mm (SVD case) and the biggest was of 3.4 mm (control case).

Interpretation of results

According to the results of the PFM passive behavior, independently of the level of muscle damage considered, the movements of the pelvic structures are equal, which may indicate



Bladder neck movement [mm]	**VM**	**PFM contraction**
Control	5.41	2.89
SVD		0.90
30/30		2.85
10/60		1.19

Figure 1. Movement of the pelvic organs during contraction of the PFM and movement of the bladder neck during VM and contraction of the PFM, both considering distinct numerical simulations. Control: PFM undamaged. SVD: PFM damaged from spontaneous vaginal delivery. 30/30: PFM damaged from vaginal delivery with 30-mm incision at 30º. 10/60: PFM damaged from

vaginal delivery with 10-mm incision at 60º. The obtained results for the VM are equal, therefore, only the value corresponding to the case control is presented.
that other supportive structures, such as pelvic ligaments and fascia, can also have an important role on the maintenance of the pelvic organs. Regarding the PFM contraction, the less the muscle is damaged, the greater the movements of the pelvic organs, being the internal organs of the female genital system the most affected by the unhealthy of the PFM. When the PFM are significantly injured almost only the inferior portion of the vagina moves, otherwise, the movement of the uterus and vagina is similar. This may be in part because of the maintenance of the mechanical properties of the pelvic ligaments in both simulations, being critical structures in urethral hypermobility (1,3). Additionally, the present study shows that the muscle damage affects more the active component of the muscle than the passive. A weakened muscular structure will overload the remaining supportive structures, which, according to the results of the present study, will be noticeable when the passive component is requested (increased intra-abdominal pressure).
Damaged muscles present a slight variation in the sagittal diameter of the levator hiatus during contraction, resulting in a likely ineffective closure around the pelvic openings.
According to the results of the present study, episiotomy preserves the muscle function after childbirth by preventing muscle damage, resulting in lowest probability of PFD.

Concluding message

The use biomechanical models of the pelvic cavity to study the association between vaginal delivery, with and without episiotomy, and PFD, may offer important insights into the pathophysiology of these disorders. Furthermore, these numerical simulations may lead to the development of preventive strategies. The present study showed that healthy PFM are essential when contraction is needed. However, regarding the mobility of the pelvic organs, the ligaments are apparently the most important structures.

References

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Disclosures

Funding: Direct Grant for Researchers and research project from the Portuguese Foundation of Science and Technology and project from FEDER, Portugal **Clinical Trial:** No **Subjects:** HUMAN **Ethics not Req'd:** The subject used to create the biomechanical model was an healthy volunteer. **Helsinki:** Yes **Informed Consent:** No