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Impact of labour and delivery on pelvic floor: perineometry and clinical evaluation. Any protecting factor?

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ABSTRACT

Objective: Instrumental delivery, anal sphincter laceration and long second stage are considered the main obstetric risk factors contributing to cause injuries to the levator ani muscle (LAM). The primary aim of our study was to compare pelvic floor muscles strength (PFMS) out of labour, during labour and after delivery through clinical evaluation by pubococcigeal test and instrumental evaluation by perineometry. The secondary aim was to investigate some variables related to pregnancy and delivery as potential predictors of pelvic floor dysfunctions.

Materials and Methods: This longitudinal study included nulliparous pregnant women who were enrolled between October and December 2018. Women underwent pubococcigeal test and perineometry to assess PFMS before labour (T_0), during labour (T_1) and at puerperium (T_2). Then we analysed which obstetric parameters had influenced our results.

Results: Forty-nine women completed the study. Pubococcigeal test and perineometry at maximal LAM contraction showed a decrease in strength between T_0 and T_2. Basal perineometry showed no statistical difference throughout the time. Urinary symptoms had not impact on our results while episiotomy, perineal lacerations, duration of labour and participation to a childbirth class were influent on LAM at rest or at contraction.

Conclusion: Labour and delivery alter the contraction force of the PFMs, but not the resting muscle tone. Episiotomy, perineal lacerations and duration of labour have negative impact on PFMs; participation to the childbirth, instead, could be a protecting factor for pelvic floor muscle strength.

Keywords: Pelvic floor dysfunction; pelvic floor muscle strength; perineometry; pubococcygeus test; vaginal delivery

INTRODUCTION

Pelvic floor dysfunctions (PFDs) include disorders like pelvic organ prolapse (POP), overactive bladder, stress urinary incontinence (SUI) and faecal incontinence.[1] Pelvic floor muscles (PFMs) are striated muscles that give support for pelvic organs and provide continuous tone to guarantee urinary and faecal continence together with the urinary and faecal sphincter. Weak PFMs are risk factors for PFDs. Women usually complain of these symptoms after menopause, even if in several epidemiological studies these disorders were associated with vaginal delivery.[2] Uterine contractions and maternal expulsive efforts determine an excessive stretching of the levator ani muscle (LAM) with deformation of collagenous structures, compression of the

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pelvic floor nerves, ischemia and muscle atrophy. This stress can lead to stretch-related injuries, such as muscle tearing and striated muscle atrophy, owing to pudendal denervation, localized primarily to the region of the pubococcygeus muscle. During vaginal birth it needs to be stretched to over three times its original length. This elongation is more than twice that the striated muscle can withstand without damage in a non-pregnant animal model.[3] The main obstetric risk factors that can contribute to cause injuries to the LAM are operative vaginal delivery, anal sphincter laceration and prolonged second stage of labour.[4] There are many different methods used to assess pelvic floor muscle function and diagnose PFDs: magnetic resonance, manometry, anal endosonography, translabial ultrasound, electromyography, perineometry, digital vaginal palpation, and neurophysiological and urodynamic studies of the pelvic floor.[5] Perineometry and digital vaginal palpation are the most frequently used methods to measure pelvic floor muscle strength (PFMS) in clinical practice because they are easily applicable, well accepted by women in general and they are not expensive.[6] Evaluating PFMS can be essential in determining the type of treatment for women who present certain morbidities in the genitourinary tract. It is possible to measure the pressure developed by LAM both clinically through vaginal digital palpation or using perineometer through pressure biofeedback. The primary aim of our study was to compare PFMS out of labour, during labour and after delivery through clinical evaluation by pubococcigeus test and instrumental evaluation by perineometry. The secondary aim was to investigate some variables related to pregnancy and delivery as potential predictors of PFDs.

MATERIALS AND METHODS

We carried out a longitudinal follow up study at the Obstetric Unit of our University Hospital. A written informed consent was obtained from each participant. The women recruited met the following inclusion criteria: nulliparous, pregnancy at 37-41 weeks of gestation, no previous PFDs or pelvic surgery. The exclusion criteria included pluriparous women, twin pregnancy, comorbidities involving muscles or neurological system. Recruitment, examination and data collection were carried out by urogynaecological team of our unit. For each patient enrolled some anamnestic data we recorded as pre-labour delivery course, episiotomy, perineal lacerations (second-degree or more), SUI and other lower urinary tract symptoms (LUTS) complained during pregnancy and active labour duration. Data collection was carried out at before labour (T_0), during labour (5 cm dilatation) (T_1) and during puerperium (36 to 48 hours postpartum) (T_2). The pobococcygeal test (PC test) was our method to misure PFMS. It was performed inserting two fingers in the vagina and asking to contract giving a score for phasic contraction (0-3), endurance (0-3, depending on the duration of contraction from 0 to 9 second) and fatigue (0-3, depending on the number of contraction repetition from <2 to >9); the total score was 0-9, were 0 was the less PFMS and 9 the maximal PFMS. After this evaluation a perineometer was used to register the potential action of PFMS. The perineometer (Laborie-Urostym®) measured PFMS in centimetres of water through a vaginal probe inserted 3 to 4 cm in the vagina and recording both basal muscle tone and mean value of three voluntary maximum muscle contractions. Between contractions there was a relaxation of 20 seconds to release muscles. Perineal laceration and episiotomy variables could not affect T_0 and T_1 clinical and perineometric evauluation, so we assessed their influence only at T_2 evaluation.

Since our study does not involve the administration of drugs or other invasive procedures, the ethics committee replied that authorization was not required, according to the Helsinki declaration.

Statistical Analysis

Arithmetic mean and standard deviation (SD) were calculated for continuous variables. Percentage and frequencies were presented to describe the qualitative information. The relationship between PC test and perineometry was investigated using the Spearman's rank correlation coefficient. One-way repeated measures analysis of variance (RM-ANOVA) was used to assess the changes in PC test, basal perineometry, and maximal perineometry mean score over the predetermined time points (T_0, T_1, T_2), and the means with SD were computed. Two-way RM-ANOVA was used to assess the effect of pre-labour course, duration of labour and urinary symptoms (SUI and other LUTS) on the changes in PC test, basal perineometry, and maximal perineometry mean score over the predetermined time points (T_0, T_1, T_2). When the F-ratio of the ANOVA reached a critical level (corresponding to $p<0.05$), post hoc analysis with Bonferroni adjustment was used. Episiotomy and perineal tears were evaluated only at T_2. The SPSS 21.0 software was used for the statistical analysis. The statistical significance was set at p-value <0.05.

RESULTS

A total of 49 women were included in our study between October and December 2018; of these 34 completed the study, nine dropped out and six women missed labour evaluation because they did caesarean section (Figure 1).

The patients' characteristics and obstetric variables are reported in Table 1. Table 2 shows mean values and SDs of PC test and perineometry at rest and at maximal contraction during the three evaluations. The results highlight a statistically significant decrease in PC test and perineometry values at maximal LAM contraction between T_0 and T_1 and between T_1 and T_2. Particularly, the PC test shows a reduction in muscle contraction strength by 18% between T0 and T1 (p=0.002) and 44% between T_1 and T_2 (p=0.0001). Perineometry evaluation at maximal contraction also differed significantly between time points dropping by approximately 28% between T_0 and T_1 and 45% between T_1 and T_2. Conversely, basal perineometry showed no statistical difference throughout the time.

The results, clinically and instrumentally obtained under maximal contraction, were then compared. A weak statistically significant correlation was found out of labour (rho=0.49, p=0.003) and during puerperium (rho=0.37, p=0.040). At T_1 no correlation was found. Finally, we evaluated potential predictors of PFDs. Urinary symptoms in pregnancy (SUI and other LUTS) did not influence PFMS both at PC test and perineometry during all evaluations. Perineal lacerations and duration of labour (>5 hours), considered at T_2 evaluation, interfered negatively with the values obtained at perineometry at rest and after maximal contraction. No participation to pre-labour course was negatively associated to weak muscle tone at rest perineometry.

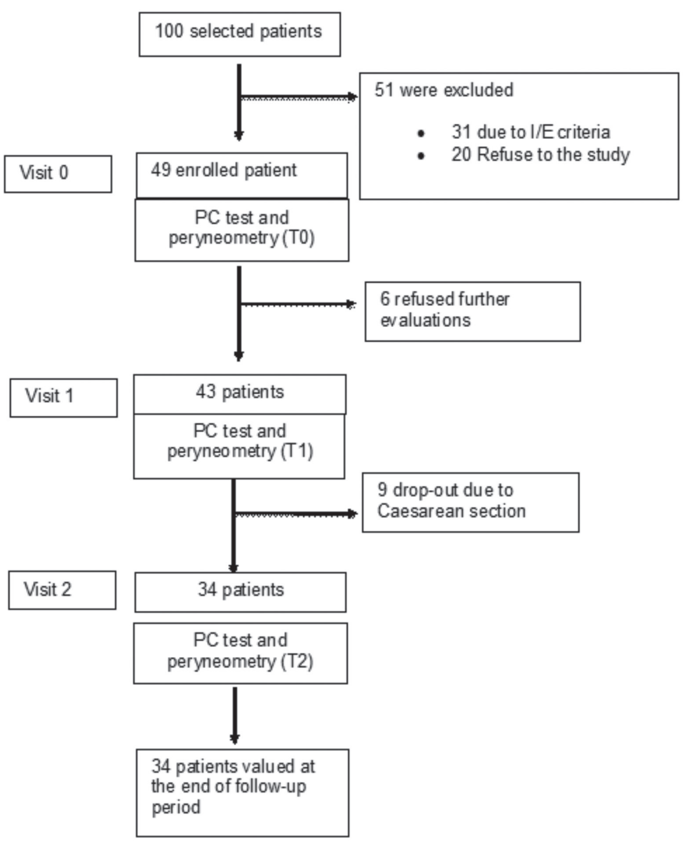

Figure 1. Study flow-chart
I/E: Inclusion and exclusion criteria, PC test: The pobococcygeal test

Episiotomy affected our measurement at maximal perineometry in puerperium (T_2) (Table 3).

DISCUSSION

Our results are both clinical and instrumental, resulting in a modification of the PFMS detected during labour and vaginal

Table 1. Patients' characteristics and obstetric variables (n=49)

Variables	n (%)
Mean age (years) ± SD	28±5.2
Age (years)	
<27	12 (35.3)
28-31	14 (41.2)
>32	8 (23.5)
Pre-labour delivery course	
Yes	10 (29.4)
No	24 (70.6)
Episiotomy	
Yes	12 (37.5)
No	20 (62.5)
Grade of perineal tears	
0	18 (52.9)
1	8 (23.5)
2	8 (23.5)
Time of labour (hours) (IQR)	5 (3-9)
Pre-pregnancy weight (kg) (IQR)	59 (54-71)
Post-pregnancy weight (kg) (IQR)	74 (66-81)
Weight gain (kg) (IQR)	14 (10-16)
SUI	
Yes	14 (41.2)
No	20 (58.8)
LUTS	
Yes	2 (5.9)
No	32 (94.1)

SD: Standard deviation, IQR: Interquartile range, SUI: Stress urinary incontinence, LUTS: Lower urinary tract symptoms, n: Number

Table 2. Values of mean and standard deviation of PC-test, basal and maximal perineometry at 3 time points (T_0, T_1, and T_2)

Dependent variables	T_0	T_1	T_2
PC-test (score 0-9)	5.0±2.1	4.1±1.9	2.3±1.1
Basal perineometry (cmH_2O)	5.1±1.1	4.7±1.4	4.8±2.3
Maximal perineometry (cmH_2O)	26.3±13.4	18.9±9.6	10.3±6.2

PC-test: The pobococcygeal test

Table 3. Two-way RM-ANOVA for baseline-to-endpoint PC-test, perineometry, maximal perineometry level changes

Dependent variable	**PC-test**			
Independent variables	**df**	**F**	**p valuea**	**Error**
Pre-labour delivery course	1.634	2.258	0.124	53
SUI	1.669	1.905	0.165	53
LUTS	2	1.039	0.360	64
Age	1.668	1.422	0.249	53
Labour duration	1.964	1.426	0.248	54
Perineometry				
Pre-labour delivery course	1.615	4.346	**0.025**	51
SUI	1.640	2.054	0.146	52
LUTS	1.596	0.563	0.535	51
Age	1.550	1.325	0.270	49
Labour duration	1.378	7.089	**0.006**	44
Maximal perineometry				
Pre-labour delivery course	1.452	0.162	0.781	46
SUI	1.405	0.837	0.402	45
LUTS	1.479	1.839	0.178	47
Age	1.413	2.331	0.124	45
Labour duration	1.544	11.067	**0.000**	49

RM-ANOVA: Repeated measures analysis of variance, PC-test: The pobococcygeal test, SUI: stress urinary incontinence, LUTS: lower urinary tract symptoms

delivery. Several authors have, already, published that the obstetric factors responsible for anal sphincter rupture are instrumental delivery and prolonged second stage of labor.[7,8] Moreover Kearney et al.[9], through magnetic resonance in nulliparous women, have shown that these obstetric factors are responsible for injuries to the LAM after delivery, with an increased risk of POP. Unlike us that evaluated the birth trauma by perineometry, Dietz[10] assessed the birth trauma with other methods comparing some instrumental diagnostic techniques such as magnetic resonance and 4D ultrasound, concluding that the latter, together with PC test with the digital vaginal palpation, are sufficient methods for the diagnosis of avulsion or injury of the LAMs. In the literature, another study, had evaluated the correlation between the measurements obtained with perineometry and the clinical ones obtained with the vaginal examination.[5] Riesco et al.[5], in fact, showed the possibility of measuring the tone of the pelvic floor musculature with these two methods, demonstrating a concordance between the results obtained. Our data were recorded subjectively by PC test, and objectively by perineometry: the results of clinical and instrumental evaluation agree before delivery and in puerperium but not during labour, probably because this phase is influenced by emotional factors related to pain. Macêdo et al.[11] evaluated the impact of childbirth in nulliparous women on pelvic musculature comparing the data obtained at perineometry and electromyography and demonstrating a strong correlation (r=0.968) between the perineometric and electromyographic findings in the functional evaluation of the PFMs, following appropriate training. Our results showed that the childbirth class was a protective factor for the resting muscle tone, possibly due to the positive effect of various breathing techniques and perineal massage that improve elasticity and the ability to stretch muscle fibers. Indeed, the muscle fibers of the LAM, according to Lien et al.[12], undergo considerable stretching during delivery; each fiber has a stretch ratio that can be increased with perineal massages as preparation for childbirth.

CONCLUSION

These measures can therefore make a protective action on the pubococcygeal muscle with a long-term positive effect on the stability of the structures that support the pelvic floor. Instead, variations in maternal pelvic shape, foetal head shape, the degree of moulding during delivery, ymphyseal diastasis and the types of episiotomies may undoubtedly affect the maximum muscle stretch ratios.[13] Based on our results, the occurrence of SUI or other urinary symptoms in pregnancy, such as urgency and frequency, does not seem to be associated with a decrease nor in perineal tone at rest neither in PFMS. In fact, during pregnancy many factors can explain the transient SUI, such as the release of relaxin, the weight exercised by the foetal head and the increase in maternal weight.[14] Moreover, in our study, we focused on the duration of first-stage of labour, not of the expulsion stage, as possible main risk factor for uterine-vaginal prolapse. Patients in whom labour is prolonged for more than five hours experienced a lower muscle tone at rest and after childbirth as well as a lower strength of contraction. In the literature it has, already, been highlighted that an extension of the expulsion stage is one of the main risk factors for uterine-vaginal prolapse.[15,16] On the contrary, Uma et al.[17] investigated on risk factors related to POP and they found no significant association to labour prolonged >12 hours [Odds ratio (OR): 1.51, 95% Confidence interval (CI): 1.00-2.27]. Finally vaginal lacerations and episiotomy, as already known in the literature, alter PFMS after delivery in the patients studied. It was demonstrated that episiotomy decreased the likelihood of obstetric anal sphincter rupture (OASR) for the primiparous [OR: 0.83, 95% CI: 0.75-0.92], but not for the multiparous women (OR: 2.01, 95% CI: 1.67-2.44). Episiotomy was associated with decreased risks for OASR in vacuum assisted deliveries (OR: 0.70, 95% CI: 0.57-0.85).[18] In a recent study of Bø et al.[19], aiming to compare vaginal resting pressure, PFMS and endurance and prevalence of urinary incontinence at 6 weeks postpartum in women with and without episiotomy, the authors conclude that pelvic floor muscle function and prevalence of postpartum urinary incontinence were not affected by a lateral or mediolateral episiotomy. Oliveira et al.[20], in a biomechanical analysis on the impact of episiotomy during childbirth, demonstrated that a mediolateral episiotomy has a protective effect, reducing the stress on the muscles, and the force required to delivery successfully up to 52.2%. The intervention, also, has benefits on muscle injury, reducing the damage to a small zone. Other studies with the same aim have already been published, considering a time interval of about 6 weeks after delivery.[21,22] Instead, we restricted the interval to 48 hours to evaluate a possible faster return to normal strength. The peculiarity of our study compared to the others present in the literature is the assessment of muscle function even during the active phase of labour and the interpretation of some variables as predictor factors.

The limitations of our study consist in the small number of enrolled patients and the lack of prolonged follow-up giving information on the possible recovery of muscular function of the levator ani.

CONCLUSIONS

We can affirm that labour and delivery alter the contraction force of the PFMs, but not the resting muscle tone. Episiotomy, vaginal lacerations and duration of labour have negative impact on PFMs; participation to the childbirth, instead, could be a protecting factor for PFMS.

Ethics

Ethics Committee Approval: Since our study does not involve the administration of drugs or other invasive procedures, the ethics committee replied that authorization was not required, according to the Helsinki declaration.

Informed Consent: A written informed consent was obtained from each participant.

Peer-review: Externally peer-reviewed.

DISCLOSURES

Conflict of Interest: No conflict of interest was declared by the authors.

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