

# Clinical Rehabilitation

<http://cre.sagepub.com>

---

## **The effect of a first vaginal delivery on the integrity of the pelvic floor musculature**

K Marshall, D M Walsh and G D Baxter

*Clin Rehabil* 2002; 16; 795

DOI: 10.1191/0269215502cr556oa

The online version of this article can be found at:  
<http://cre.sagepub.com/cgi/content/abstract/16/7/795>

---

Published by:



<http://www.sagepublications.com>

**Additional services and information for *Clinical Rehabilitation* can be found at:**

**Email Alerts:** <http://cre.sagepub.com/cgi/alerts>

**Subscriptions:** <http://cre.sagepub.com/subscriptions>

**Reprints:** <http://www.sagepub.com/journalsReprints.nav>

**Permissions:** <http://www.sagepub.co.uk/journalsPermissions.nav>

**Citations** <http://cre.sagepub.com/cgi/content/refs/16/7/795>

# The effect of a first vaginal delivery on the integrity of the pelvic floor musculature

**K Marshall, DM Walsh** and **GD Baxter** Rehabilitation Sciences Research Group, University of Ulster at Jordanstown, Northern Ireland

Received 3rd April 2001; returned for revisions 6th June 2001; revised manuscript accepted 7th July 2001.

**Objective:** To assess the specific effect of delivery of the first child on the integrity of the pelvic floor musculature.

**Design:** A prospective study of two groups of females with no symptoms of urinary incontinence.

**Setting:** Physiotherapy Department, Rotunda Lying In Hospital, Dublin.

**Subjects:** Two groups of healthy female physiotherapists (age range 20–28 years) were recruited for the study: group 1 consisted of nulliparous females ( $n = 10$ ) and group 2 consisted of primiparous females who were 9–10 months post delivery ( $n = 10$ ).

**Intervention and main outcome measures:** Assessment of the pelvic floor musculature was performed by digital assessment, electromyography and perineometry.

**Results:** For all data, the nulliparous group showed evidence of greater pelvic floor strength and endurance. Analysis of anterior and posterior electromyography data showed significantly stronger contractions in the nulliparous group ( $p = 0.0001$  and  $0.044$ ). During a maximum contraction of the pelvic floor muscles, the anterior resting EMG activity increased by  $9 \pm 6 \mu\text{V}$  (mean  $\pm$  SD) in the primiparous group compared with an increment of  $22.3 \pm 4.74 \mu\text{V}$  in the nulliparous group. Posterior EMG resting activity increased by  $19.7 \pm 7.65 \mu\text{V}$  (mean  $\pm$  SD) in the nulliparous group compared with  $13.8 \pm 8.19 \mu\text{V}$  in the primiparous group. There were significant differences between the two groups for the four types of digital muscle assessment ( $p < 0.0013$ ). In addition, there was a greater increase in perineometry readings in the nulliparous group (increment =  $5.6 \pm 2.5$ , mean  $\pm$  SD) compared with the primiparous group (increment =  $3.1 \pm 0.9$ ; mean  $\pm$  SD).

**Conclusions:** This study suggests that irrespective of lack of symptoms of urinary incontinence, it would appear advisable that all women should undertake a prescribed programme of pelvic floor rehabilitation exercises after childbirth.

---

Address for correspondence: Deirdre M Walsh, Rehabilitation Sciences Research Group, University of Ulster at Jordanstown, Shore Road, Newtownabbey, Co Antrim BT37 0QB, Northern Ireland. e-mail: dm.walsh@ulster.ac.uk

## Introduction

Electrophysiological studies have suggested that one of the primary causes of urinary incontinence after a vaginal delivery is damage to the innervation of the pelvic floor.<sup>1</sup> There is considerable evidence to suggest that a vaginal delivery may result in impaired function of the pelvic floor musculature due to sphincter disruption or pudendal nerve injury, resulting in urinary or faecal incontinence or both.<sup>2-4</sup> Further studies have indicated that chronic constipation and or straining at stools are contributory factors to pelvic floor dysfunction.<sup>5,6</sup>

A recent survey by the authors has reported that 61% of women in a Dublin population ( $n = 7771$ ) reported the onset of symptoms of urinary incontinence before or during pregnancy.<sup>7</sup> This survey also demonstrated that the incidence of urinary symptoms is directly related to increasing parity, thus emphasizing the importance of early detection of impairment of pelvic floor integrity and appropriate treatment. The aim of the current study was to examine the effect of a first vaginal delivery on the integrity of the pelvic floor muscles by comparing a group of nulliparous females with a group of primiparous females with no clinical symptoms of urinary incontinence.

## Methods

Two groups of healthy female physiotherapists with no symptoms of urinary incontinence were recruited for the current study. Group 1 consisted of 10 nulliparous women and group 2 consisted of 10 primiparous women who were 9–10 months post vaginal delivery (age range 20–28 years). The first 10 females who fulfilled the following inclusion/exclusion criteria in each group were accepted for the study. Inclusion criteria for group 1 (nulliparous females): healthy; no children; age 20–28 years. Inclusion criteria for group 2 (primiparous females): healthy; one child – vaginal delivery; age 20–28 years. Exclusion criteria for both groups: symptoms of urinary incontinence.

All candidates were informed of the nature of the study and gave consent prior to participation.

The inconvenience for each volunteer was kept to a minimum, bearing in mind that their lifestyle was of a busy nature (either practising or studying physiotherapy). The venue for the study was the Physiotherapy Department of the Rotunda Hospital, Dublin. All subjects underwent a detailed assessment of the pelvic floor muscles comprising a manual digital assessment, electromyography (EMG) and perineometry on one occasion only; the assessments were carried out by an experienced physiotherapist who was blind to the subject's group. Subjects were assessed using a standardized procedure: the digital assessment was immediately followed by EMG recording, and after a 10-minute rest, the perineometry readings were taken.

## Digital assessment

During the assessment, subjects rested in crook-lying with one pillow under the head to minimize the activity of accessory muscles. The following four types of assessment of pubococcygeus muscle were used, based upon methods described by Chiarelli and O'Keefe<sup>8</sup> and Laycock<sup>9</sup>:

- 1) Power – muscle strength was assessed using the Oxford scale of 0–5.
- 2) Endurance – assessed by asking subjects to hold a maximum contraction for as long as possible; this was measured in seconds.
- 3) Fatigue – subjects were then asked to perform repeated maximum contractions for the length of time recorded as their 'endurance' value; the number of contractions was recorded.
- 4) Fast – finally, the number of fast repetitions of pelvic floor contractions was recorded. This was defined as the number of fast repetitions a subject could perform until the muscle could no longer perform due to fatigue.

## EMG

Subjects placed their personal vaginal electrode *in situ* using a gloved hand (correct positioning was checked by the assessor). Pelvic floor EMG activity at rest and during a maximum contraction was recorded using the vaginal electrode; the increment value was calculated as the difference between these two values. EMG readings (in microvolts) were taken from both anterior

and posterior aspects of the pelvic floor muscles (data were rectified and integrated; Myomed-432, Enraf Nonius-Delft, Holland). The electrode was positioned to record anterior and posterior activity by the assessor rotating the electrode so that the active recording sensor was directed towards the corresponding part of the pelvic floor muscles. Two readings were taken for rest and contraction activity; the first reading was regarded as a practice run, therefore only the second reading was used for statistical analysis.

### Perineometry

A standard perineometer (model PFX, Cardio Design PTY Ltd., New South Wales, Australia) was used to record the strength of the pelvic floor muscles at rest and during a maximum contraction via a vaginal probe. The pressure of air in the vaginal probe (measured on a scale of 0–12 kPa) was an indicator of the strength of these muscles. As with the EMG data, an increment value was also calculated.

Statistical analysis of the data was performed using one-factor analysis of variance (ANOVA) for EMG data and Mann–Whitney *U*-tests for the digital assessment and perineometry readings, using the Statview 512 program (Abacus Concepts Inc., US).

### Results

Table 1 presents summary data for all outcome measures. Statistical analysis of digital assessment data showed significant differences between groups for all four types of assessment (Mann–Whitney *U*-test: power,  $p < 0.0001$ ; endurance,  $p = 0.0002$ ; fatigue,  $p = 0.0004$ ; fast,  $p = 0.0013$ ). In all four tests, the nulliparous group showed higher scores, thus demonstrating that the performance of the pelvic floor muscles in all these areas was reduced in the primiparous females.

Table 1 indicates the higher anterior resting tone in the nulliparous group ( $4.0 \pm 2.05 \mu\text{V}$ ; mean  $\pm$  SD) compared with the primiparous group ( $2.8 \pm 0.79 \mu\text{V}$ ). One-factor ANOVA showed significant differences for both anterior contraction and increment EMG readings ( $p = 0.0001$  for both), but not resting activity ( $p = 0.10$ ). There was a higher level of posterior resting EMG activity in the nulliparous group ( $4.1 \pm 1.29 \mu\text{V}$ ) versus the primiparous group ( $2.9 \pm 0.88 \mu\text{V}$ ). Upon maximum contraction, the increment for the nulliparous females was  $19.7 \pm 7.65 \mu\text{V}$  compared with  $13.8 \pm 8.19 \mu\text{V}$  for the primiparous females. One-factor ANOVA showed significant differences for both posterior resting and contraction EMG readings ( $p = 0.0254$  and  $0.0435$  respectively) but not for the increment ( $p = 0.1132$ ).

**Table 1** Data for primiparous and nulliparous groups ( $n = 10$  per group)

	Primiparous	Nulliparous
Digital assessment data		
Power (Oxford Scale) (median and range)	2 (1–2)	4 (4–5)
Endurance (s)	$3 \pm 1.05$	$6.7 \pm 1.77$
Fatigue (s)	$4.2 \pm 1.14$	$6.7 \pm 0.95$
Fast (number)	$5.2 \pm 1.4$	$7.9 \pm 1.48$
EMG data		
Anterior resting ( $\mu\text{V}$ )	$2.8 \pm 0.79$	$4 \pm 2.05$
Anterior contract ( $\mu\text{V}$ )	$11.8 \pm 5.51$	$26.3 \pm 4.24$
Posterior resting ( $\mu\text{V}$ )	$2.9 \pm 0.88$	$4.1 \pm 1.29$
Posterior contract ( $\mu\text{V}$ )	$16.7 \pm 7.73$	$23.8 \pm 6.86$
Perineometry data		
Resting (kPa)	$1.8 \pm 1.69$	$2.4 \pm 0.84$
Contract (kPa)	$4.9 \pm 1.97$	$8 \pm 2.31$

All data mean  $\pm$  SD except where stated otherwise.

Statistical analysis of perineometry data using Mann–Whitney *U*-tests showed that while there was no significant difference for resting pressure ( $p = 0.5144$ ), there was a significant difference between groups for squeeze pressure ( $p = 0.045$ ) and increment pressure ( $p = 0.0028$ ). The nulliparous group showed higher values for all perineometry data (see Table 1).

## Discussion

The results of this study have demonstrated changes in pelvic floor muscle strength and endurance between the two study groups. In a recent study of female cadavers, Dimpfi *et al.*<sup>10</sup> demonstrated that vaginal delivery led to histomorphological changes of the pelvic floor muscles consistent with changes of myogenic origin. In an editorial on this paper, DeLancey<sup>11</sup> comments ‘Studies such as this one, by providing data about important changes in the muscles responsible for pelvic floor support, advance pelvic floor science. This should help us reach a better understanding of the injuries occurring in the many women who suffer from pelvic floor dysfunction.’

While EMG recordings are a standard method of assessment of the pelvic floor muscles, no previous studies have compared anterior and posterior EMG activity when assessing the pelvic floor. The current study has demonstrated that the resting EMG readings were approximately the same for both anterior and posterior aspects of the pelvic floor muscles in the two study groups. However, there was a marked difference in the increment values between the two groups: the mean anterior EMG increment was 22.3  $\mu\text{V}$  for the nulliparous compared with 9  $\mu\text{V}$  for the

primiparous females. There was a smaller difference in values for mean posterior EMG increment (19.7  $\mu\text{V}$  for nulliparous group; 13.8  $\mu\text{V}$  for primiparous group). These findings illustrate that differences in increment EMG data between the two groups were more pronounced for anterior EMG recordings; the difference in mean posterior recordings was only 44% of the anterior recordings. This would suggest that there is a greater loss of function in the anterior portion of the pelvic floor following a vaginal delivery. This emphasizes that motor re-education of the pelvic floor should focus on the anterior component, e.g. by selective placement of stimulation electrodes during electrotherapy treatments.

Despite the measured loss of pelvic floor integrity in the primiparous group, there were no clinical symptoms of urinary incontinence. Therefore, this study would suggest that irrespective of lack of symptoms of urinary incontinence, it would appear prudent that all women should have an individual programme of pelvic floor exercises after childbirth.

## References

- 1 Allen RE, Hoskert GL, Smith ARB, Warrell DW. Pelvic floor damage and childbirth; a neurophysiological study. *Br J Obstet Gynaecol* 1990; **97**: 770–79.
- 2 Lee SJ, Park JW. Follow-up evaluation of the effect of vaginal delivery on the pelvic floor. *Dis Colon Rectum* 2000; **43**: 1550–55.
- 3 MacArthur C, Bick DE, Keighley MRB. Incontinence after childbirth. *Br J Obstet Gynaecol* 1997; **104**: 46–50.
- 4 Fitzpatrick M, O’Herlihy C. Vaginal birth and perineal trauma. *Curr Opin Obstet Gynecol* 2000; **12**: 487–90.
- 5 Snooks SJ, Barnes PRH, Swash M, Henry MM. Damage to the innervation of the pelvic floor musculature in chronic constipation. *Gastroenterology* 1985; **89**: 977–81.
- 6 Spence-Jones C, Kamm MA, Henry MM. Bowel dysfunction: a pathological factor in uterovaginal prolapse and urinary stress incontinence. *Br J Obstet Gynaecol* 1994; **101**: 147–52.
- 7 Marshall K, Thompson KA, Walsh DM, Baxter GD. Incidence of urinary incontinence and constipation during pregnancy and post-partum: survey of current findings at the rotunda lying in hospital. *Br J Obstet Gynaecol* 1998; **105**: 400–402.
- 8 Chiarelli PE, O’Keefe DR. Physiotherapy for

### Clinical messages

- Healthy primiparous women demonstrated a loss of integrity of pelvic floor musculature 9–10 months following a vaginal delivery.
- This study suggests that a programme of pelvic floor exercises should be considered post vaginal delivery for all women.

- the pelvic floor. *Aust J Physiother* 1981; **27**: 103–108.
- 9 Laycock J. Assessment and treatment of pelvic floor dysfunction. Doctoral thesis. Postgraduate School of Biomedical Sciences, University of Bradford, 1992.
- 10 Dimpfi TH, Jaeger CH, Mueller-Felber W *et al.* Myogenic changes of the levator ani muscle in premenopausal women: the impact of vaginal delivery and age. *Neurourol Urodynamics* 1998; **17**: 197–205.
- 11 DeLancey JOL. Editorial comment. *Neurourol Urodynamics* 1998; **17**: 205.