



Pelvic floor healing milestones after obstetric anal sphincter injury: a prospective case control feasibility study

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Abstract

Introduction and hypothesis Severe perineal tears can predict bothersome pelvic floor disorders later in life. We have a poor understanding of pelvic floor changes during the third trimester and the first few postpartum months. We aimed to compare women with severe perineal trauma during childbirth with women who experienced minimal trauma, for condition-specific quality of life, sexual function, mental health and overall quality of life in the first 6 months postpartum.

Methods We recruited primiparous women with third- or fourth-degree tears (obstetric anal sphincter injuries, OASIS) and age-matched controls with no tears or first-degree tears in the immediate postpartum period. Participants completed validated questionnaires at baseline, 2, 4 and 6 months postpartum. Mixed effects linear regression or quantile regression adjusted for baseline score were used to compare the groups as appropriate.

Results A total of 74 women completed at least one questionnaire (35 OASIS, 39 controls). Both groups had similar demographics. Women with OASIS tended to have worse Pelvic Floor Distress Index-40 scores at month 2; median scores were similar in the two groups by month 6. They also had significantly lower Female Sexual Function Index scores (mean difference: -6.1 ; 95% CI: $-11.9, -0.2, p=0.043$) at month 2. There were no mental health group differences and quality of life improved over time, mainly in the OASIS group. Six-month participant attrition rate was 52%.

Conclusions Women with OASIS encounter specific pelvic floor challenges during the first 6 months postpartum. Although our recruitment rate was high, the attrition rate was also high, demonstrating challenges with retention of postpartum women into longitudinal research.

Keywords Obstetric anal sphincter injury · Pregnancy · Postpartum pelvic floor · Quality of life · Sexuality

Introduction

Pelvic floor disorders often begin with severe perineal tears during childbirth [1–3]. Women who sustain third- or fourth-degree tears (obstetric anal sphincter injuries, or OASIS) during childbirth are at a higher risk of adverse pelvic floor symptoms such as incontinence of urine or stool, pelvic pain, dyspareunia, prolapse, poor body image and avoidance of sexual intimacy [4–9]. Current antenatal care is lacking in the area of pelvic floor health education, with only 5% of

women in our maternity units receiving antepartum information about prolapse or incontinence [10]. Pelvic symptoms may begin in the postpartum period but can persist well beyond childbearing age and significantly impact women's quality of life. Owing to the private nature of these symptoms, women may be hesitant to share these concerns with their care providers, who do not routinely evaluate pelvic floor health in the obstetrical context. As such, women may not be offered timely interventions in the postpartum period to prevent or treat pelvic floor symptoms. These interventions may include pelvic floor physiotherapy, patient education and modification of type of delivery for subsequent pregnancies [11, 12].

Studies investigating pelvic floor changes during the third trimester of pregnancy or the 1st year postpartum show that women experience an increase in urinary incontinence, colorectal symptoms and prolapse symptoms at this time [13–16]. However, further data are needed to quantify pelvic

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floor changes in the third trimester and first few months postpartum, and to differentiate healing milestones in women who sustain OASIS versus minimal perineal trauma.

We aimed to characterise pelvic floor healing in the first 6 months postpartum, with a view to collecting feasibility data for a larger study of postpartum healing milestones. We compared women who sustained severe perineal trauma (third- or fourth-degree tears) during their first childbirth with women who experienced minimal perineal trauma (intact perineum or first-degree tears) for pelvic floor condition-specific quality of life, sexual function, mental health, and overall quality of life in the first 6 months postpartum.

Materials and methods

We performed a prospective cohort feasibility study and recruited primiparous women in the immediate postpartum period at two tertiary care obstetrical centres in Vancouver, British Columbia (BC Women's Hospital and St. Paul's Hospital), Canada. We obtained research ethics approval prior to recruitment initiation. We invited women to participate if they were primiparous with a singleton, term gestation, were over 19 years of age, and were able to read and write in English. Women with known pre-pregnancy pelvic floor symptoms, chronic pain syndromes, known or suspected fetal malformations, stillbirth, and admission to the neonatal intensive care unit were excluded. We aimed for a convenience sample of 60 women; 30 with severe perineal tears (third- or fourth-degree tears), and 30 age-matched (within 5 years) controls with minimal perineal trauma (intact perineum or first-degree tears), following vaginal delivery.

We collected the following demographic variables: age, pre- and post-pregnancy body mass index, gestational age at delivery, type of care provider (obstetrician, family physician, midwife), ethnicity, medical history of diabetes, and degree of perineal tear. We collected information about known maternal and fetal risk factors for severe childbirth trauma as outlined in the OASIS guideline [11]: mode of delivery, episiotomy use and type, presence of epidural analgesia, length of second stage, shoulder dystocia, oxytocin augmentation, delivery position, fetal birth weight, fetal presentation, fetal position and fetal distress during labour.

We asked participants to complete four validated questionnaires in-person upon recruitment. Participants reflected on the preceding 4 weeks when answering these questionnaires. As such, the responses at recruitment described pelvic floor symptoms in the third trimester of pregnancy. We used validated questionnaires including the Pelvic Floor Distress Inventory (PFDI-40, measuring pelvic floor condition-specific quality of life) [17], Female Sexual Function Index (FSFI, measuring sexual function) [18], Edinburgh Perinatal/Postnatal Depression Scale (EPDS, measuring mental

health) [19] and the Rand Short Form 36-Item Health Survey (SF-36, measuring general health perception, physical and social functioning and role limitation due to physical, emotional and mental health concerns) [20]. Higher scores on the PFDI-40 indicate more dysfunction [17], whereas higher scores on the FSFI and SF-36 denote better sexual function and quality of life respectively. The cutoff score for sexual dysfunction is an FSFI score of 26.55 or less [18]. EPDS scores of 12 or higher indicate a "fairly high possibility of depression" [19]. Each domain of the SF-36 has a maximum (best quality of life) score of 100 [20]. We then contacted participants at 2, 4 and 6 months postpartum to repeat these validated questionnaires via phone call interviews.

Data were analysed using both descriptive and statistical methods as appropriate. Comparison of baseline characteristics was based on *t* test, Wilcoxon rank sum test, Chi-squared test and Fisher's exact test. Trends in questionnaire scores over time within each tear group were assessed using the Jonckheere–Terpstra trend test. Linear mixed effects regression with woman-specific random intercept was used to compare the questionnaire score between the no tear group and the severe tear group. For questionnaire scores that were skewed, quantile regression was used to compare the two groups to avoid violating the normality assumption required for the linear mixed effects model. In the regression analysis, we adjusted for baseline questionnaire score to account for a potential difference in the score between the tear groups. Results were presented as estimated difference in mean or median score with 95% confidence interval. Proportion of women back to normal urinary, prolapse and colorectal function (based on PFDI-40 scores of zero), and the proportion of women back to normal sexual function (based on FSFI scores of over 26.55) by month 6 were computed based on Kaplan–Meier estimator to properly account for loss to follow-up over time.

Results

Participant recruitment

We reviewed maternity charts February 2019 to January 2020 (phase 1) and September 2020 to October 2020 (phase 2). We approached eligible maternity patients before hospital discharge. We paused recruitment January 2020 to September 2020, owing to the ongoing COVID-19 pandemic and the need to minimise hospital presence of research personnel. On average, we reviewed 42.5 charts per month (510 over 12 months) for eligibility. Of these charts, an average of 14.1 women were eligible per month (169 over 12 months), 8.5 were approached (102 over 12 months), and 7.8 were recruited (94 over 12 months). Recruitment rate was 88.9%. Of the 94 women recruited, only 74 completed at least one

questionnaire at recruitment and were included in the data analysis (35 with OASIS, 39 age-matched controls).

Participant characteristics

Overall, there were 45 completed 2-month follow-ups, 32 completed 4-month follow-ups, and 45 completed 6-month follow-ups. Both groups had similar baseline demographic characteristics (Table 1).

Women with OASIS had a higher mean birth weight (3,406.9 g vs 3,172.4 g, $p=0.023$), a longer length of second stage ($p=0.041$) and were more likely to have a forceps-assisted delivery (34% vs 0%, $p<0.001$) compared with controls (Table 1).

Comparison of questionnaire scores

Women with OASIS had higher PFDI-40 scores in all the subscales (Urinary Distress Inventory [UDI], Colorectal-Anal Distress Inventory [CRADI] and Pelvic Organ Prolapse Distress Inventory [POPDI]) at month 2 (not significant, Fig. 1). The difference in PFDI subscale scores diminished over time (Fig. 1). Within each group, there was a significantly decreasing trend in POPDI subscale from month 2 to month 6. For women with OASIS, CRADI scores also showed a significantly decreasing trend postpartum (Table 2).

Women with OASIS had significantly lower FSFI scores at 2 months postpartum (mean difference -6.1 ; 95% CI $-11.9, -0.2$, $p=0.043$). This was primarily due to worse function in the domains of arousal and orgasm, with no differences in pain or other domains (Fig. 2). When adjusting for differences in SF-36 domains of energy-fatigue, general health and emotional well-being at the same time point, the difference in FSFI total at month 2 between the two tear groups remained significant (estimated difference: -6.8 (95% CI: $-12.7, -0.8$; $p=0.027$). At 4 and 6 months, there were no significant group differences in sexual function ($p=0.48$ and $p=0.22$). Mean FSFI scores were within the range of sexual dysfunction in both groups at all time points.

The SF-36 scores significantly increased over time in the OASIS group for the domains of physical functioning, vitality and social functioning, but no significant change was observed in the controls (Table 2). After adjusting for baseline differences in score, women with OASIS had higher scores on the “General Health Perceptions” section of the SF-36 at 2 months postpartum, with an estimated difference of 8.8 (95% CI: 1.4–16.3, $p=0.021$). No significant difference was found between groups for the other domains.

The 4-month follow-up was removed from the study after the completion of phase 1, to decrease participant time commitment and improve the response rate. Dropout rates were similar in the two groups. Among the 94 recruited participants, reasons for dropping out were “does not want to

participate any longer” ($n=2$); “busy with baby or work” ($n=2$); “questionnaires too long” ($n=1$); “feels questionnaires too invasive/not contributing helpful information” ($n=1$). Twenty of the participants (21.3%) did not complete the initial questionnaires and were thus deemed ineligible for the study. Eleven of the participants (11.7%) were classified as “inactive”; they completed the initial questionnaires but were not reachable at any subsequent follow-up time points and completed no further questionnaires at 2, 4 or 6 months. Twelve (12.8%) completed month 2 and/or month 4 follow-up, but not month 6. Attrition rate was 43% (15 out of 35) in the OASIS group vs 36% (14 out of 39) in the control group ($p=0.54$). Overall attrition rate was 52% (49 out of 94) at 6 months postpartum. There were no demographic differences between responders and non-responders.

Discussion

Our prospective feasibility study measuring postpartum recovery over time and through validated questionnaires showed excellent recruitment rates, with high attrition rates at 6 months. There were differences in pelvic floor recovery, especially with sexual symptoms at 2 months postpartum, between the OASIS and control groups. Mental health and overall quality of life did not seem significantly influenced by OASIS. Women in both groups returned to third-trimester pelvic function and sexual dysfunction persisted at 6 months postpartum.

Our attrition rate demonstrates the difficulty of retaining postpartum women in longitudinal studies of pelvic floor dysfunction. Another study with a similar design of early postpartum recruitment and telephone interviews for questionnaire completion had an attrition rate of 68.4% at 3 months [14]. Reasons for dropping out in our study were related to the length of the questionnaires and their invasiveness. Developing shorter validated questionnaires encompassing all areas of pelvic floor dysfunction postpartum is likely valuable for further research. Women may not want to respond to private questions about sexual function over the phone and a larger longitudinal study could perhaps space out the time intervals for questionnaire completion and administer questionnaires digitally. E-mailed and mailed questionnaires addressing sexual function fared slightly better, with an attrition rate of 48% at 24 months [21].

Women in our study returned to third-trimester level of pelvic floor function at 6 months. However, there is a deterioration in pelvic floor function throughout pregnancy, translating into more symptoms as the pregnancy progresses [13, 16]. Molecular changes, under the influence of steroid hormones, prepare the female body for the birthing process and dysfunctional pathways may lead to a predisposition for pelvic floor disorders [22, 23]. We currently do not fully understand postpartum healing and the time it takes to full

Table 1 Demographics

Variable	All (<i>n</i> =74)	Controls (<i>n</i> =39)	OASIS (<i>n</i> =35)	<i>p</i>
Age, years				0.442
Mean (SD)	32.7 (4.1)	33.0 (4.2)	32.3 (4.0)	
Range	(20.0, 44.0)	(20.0, 44.0)	(25.0, 43.0)	
BMI pre-pregnancy				0.636
Missing, <i>n</i>	3	2	1	
Mean (SD)	22.0 (3.0)	22.2 (3.1)	21.8 (2.8)	
Range	(16.1, 29.0)	(16.1, 29.0)	(16.7, 28.2)	
BMI at delivery				0.780
Missing, <i>n</i>	12	7	5	
Mean (SD)	26.8 (3.0)	26.7 (3.3)	26.9 (2.8)	
Range	(21.2, 34.5)	(21.3, 34.5)	(21.2, 32.9)	
Gestational age at delivery, days				0.070
Mean (SD)	276.9 (8.4)	275.3 (9.0)	278.8 (7.4)	
Range	(252.0, 293.0)	(252.0, 291.0)	(261.0, 293.0)	
Birth weight, g				0.023
Mean (SD)	3,283.3 (447.9)	3,172.4 (477.6)	3,406.9 (382.1)	
Range	(2,260.0, 4,820.0)	(2,260.0, 4,010.0)	(2,640.0, 4,820.0)	
Ethnicity, <i>n</i> (%)				0.233
White	30 (40.5)	20 (51.3)	10 (28.6)	
Hispanic	5 (6.8)	2 (5.1)	3 (8.6)	
Asian	34 (45.9)	15 (38.5)	19 (54.3)	
Other	5 (6.8)	2 (5.1)	3 (8.6)	
History of diabetes (including gestational), <i>n</i> (%)	8/72 (11.1)	4/39 (10.3)	4/33 (12.1)	1.000
Mode of delivery, <i>n</i> (%)				<0.001
Unassisted	56 (75.7)	35 (89.7)	21 (60.0)	
Vacuum	6 (8.1)	4 (10.3)	2 (5.7)	
Forceps	12 (16.2)	0 (0.0)	12 (34.3)	
Episiotomy, <i>n</i> (%)				0.408
Unknown	1	0	1	
Mediolateral	6 (8.2)	2 (5.1)	4 (11.8)	
None	67 (91.8)	37 (94.9)	30 (88.2)	
Degree of tear, <i>n</i> (%)				–
None	7 (9.5)	7 (17.9)	0 (0.0)	
First-degree	32 (43.2)	32 (82.1)	0 (0.0)	
Third-degree	16 (21.6)	0 (0.0)	16 (45.7)	
3a	16 (21.6)	0 (0.0)	16 (45.7)	
Fourth-degree	3 (4.1)	0 (0.0)	3 (8.6)	
Length of second stage, <i>n</i> (%)				0.041
<1 h	21 (28.4)	15 (38.5)	6 (17.1)	
1–2 h	19 (25.7)	12 (30.8)	7 (20.0)	
2–3 h	17 (23.0)	8 (20.5)	9 (25.7)	
3–4 h	5 (6.8)	0 (0.0)	5 (14.3)	
4–5 h	7 (9.5)	3 (7.7)	4 (11.4)	
5–6 h	4 (5.4)	1 (2.6)	3 (8.6)	
6–7 h	1 (1.4)	0 (0.0)	1 (2.9)	
Delivery position, <i>n</i> (%)				1.000
Unknown	24	12	12	
Upright	1 (2.0)	1 (3.7)	0 (0.0)	
Squatting	1 (2.0)	1 (3.7)	0 (0.0)	
Dorsal lithotomy	48 (96.0)	25 (92.6)	23 (100.0)	

Table 1 (continued)

Variable	All (n=74)	Controls (n=39)	OASIS (n=35)	p
Fetal presentation				0.407
Unknown	4	2	2	
OA	66 (94.3)	36 (97.3)	30 (90.9)	
OP	1 (1.4)	0 (0.0)	1 (3.0)	
Other	3 (4.3)	1 (2.7)	2 (6.1)	
Care provider [^]				
Obstetrician	33 (44.6)	16 (41.0)	17 (48.6)	0.514
Family physician	25 (33.8)	12 (30.8)	13 (37.1)	0.563
Midwife	19 (25.7)	11 (28.2)	8 (22.9)	0.599
Fetal position—vertex, n (%)	70/70 (100.0)	35/35 (100.0)	35/35 (100.0)	–
Presence of epidural analgesia, n (%)	50/72 (69.4)	22/37 (59.5)	28/35 (80.0)	0.059
Oxytocin augmentation, n (%)	34/73 (46.6)	19/39 (48.7)	15/34 (44.1)	0.694
Fetal distress during 2nd stage, n (%)	17/72 (23.6)	8/39 (20.5)	9/33 (27.3)	0.501
Shoulder dystocia, n (%)	2 (2.7)	1 (2.6)	1 (2.9)	1.000
PFDI				
UDI, median (IQR)	15.4 (4.2, 28.7)	17.5 (5.0, 28.3)	11.5 (2.5, 30.7)	0.786
POPDI, median (IQR)	10.7 (0.0, 39.3)	9.5 (0.0, 32.1)	25.0 (0.0, 47.6)	0.280
CRADI, median (IQR)	10.7 (0.0, 42.9)	10.4 (0.0, 23.8)	19.0 (3.6, 50.0)	0.292
EPDS, mean (SD)	6.5 (4.9)	6.5 (5.0)	6.5 (4.8)	0.953
FSFI, mean (SD)				
Total	17.5 (10.8)	17.8 (10.5)	17.2 (11.2)	0.823
Desire	2.9 (1.3)	2.9 (1.3)	2.9 (1.3)	0.845
Arousal	2.6 (2.1)	2.6 (2.0)	2.5 (2.1)	0.947
Lubrication	3.1 (2.5)	3.3 (2.5)	2.9 (2.5)	0.537
Orgasm	2.7 (2.4)	2.9 (2.5)	2.5 (2.4)	0.530
Satisfaction	3.4 (1.6)	3.3 (1.6)	3.5 (1.7)	0.490
Pain	2.8 (2.5)	2.9 (2.6)	2.8 (2.5)	0.814
SF-36, mean (SD)				
Physical functioning	66.9 (25.6)	71.5 (22.5)	61.9 (28.0)	0.106
Role limitations—physical	38.8 (38.4)	44.4 (39.0)	32.4 (37.2)	0.181
Role limitations—emotional*	100.0 (33.3, 100.0)	100.0 (66.7, 100.0)	100.0 (0.0, 100.0)	0.088
Vitality	50.5 (19.4)	47.6 (18.2)	53.8 (20.4)	0.171
General mental health	76.8 (16.4)	78.2 (13.8)	75.2 (18.9)	0.442
Social functioning	75.3 (22.5)	79.2 (22.3)	71.1 (22.2)	0.123
Bodily pain	64.0 (21.7)	64.6 (18.3)	63.4 (25.2)	0.801
General health perceptions	79.3 (15.7)	80.6 (14.0)	77.9 (17.5)	0.451

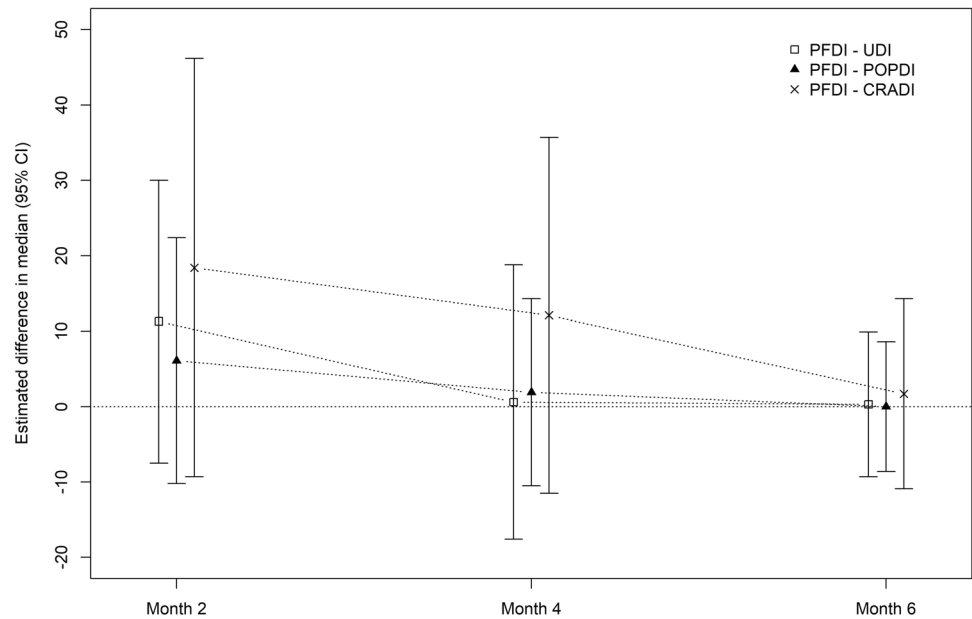
BMI body mass index, *CRADI* Colorectal-Anal Distress Inventory, *EPDS* Edinburgh Perinatal/Postnatal Depression Scale, *FSFI* Female Sexual Function Index, *OA* occiput anterior, *OASIS* obstetric anal sphincter injuries, *OP* occiput posterior, *PFDI* Pelvic Floor Distress Inventory, *POPDI* Pelvic Organ Prolapse Distress Inventory, *SF-36* Rand Short Form 36-Item Health Survey, *UDI* Urinary Distress Inventory

pelvic floor recovery after vaginal birth. Our clinical study offers a glimpse of an estimate of time to full recovery. Assuming a PFDI score of 0 is normal pelvic floor function, only around 30% of women with OASIS and 40% of controls were back to normal urinary and colorectal function and about 60% of women had no prolapse symptoms by 6 months. For a larger study of healing milestones, women will clearly need to continue questionnaire completion beyond 6 months postpartum. This needs to be balanced against intervening new factors, beyond a first pregnancy

and childbirth, which may contribute to the development of bothersome pelvic symptoms.

Mean FSFI scores increased from 0 to 6 months postpartum, indicating an improvement in sexual function. There were significant delays in the severe tear group, with sexual function post-OASIS significantly worse at 2 months postpartum. This difference was mainly due to problems with arousal and orgasm. Interestingly, pain was not a factor and the sexual dysfunction was also not related to fatigue, emotional or general health perception factors. It is plausible

Fig. 1 Difference in Urinary Distress Inventory (*UDI*), Colorectal-Anal Distress Inventory (*CRADI*), and Pelvic Organ Prolapse Distress Inventory (*POPDI*) scores between OASIS and control groups, at 2, 4, and 6 months postpartum. *PFDI* Pelvic Floor Distress Inventory



that OASIS and its associated risk factors are associated with subtle neuropathies of the pelvic floor that can alter sexual function; alternatively, there could be body image impairment associated with sexual dysfunction in this context. Another study agreed with our findings and indicated that sexual dysfunction in OASIS patients persists beyond 6 months; participants with OASIS were 5 times less likely to be sexually active at 1 year postpartum [24]. Although the control group came close to the cutoff for normal sexual function at 6 months postpartum, group means were both in the “sexual dysfunction” category based on FSFI scores. With an FSFI cutoff of 26.55, only 37% of women had normal sexual function post-OASIS by 6 months, versus 59% of controls. This is consistent with a recently published large longitudinal study of postpartum sexual function that showed that 43% of women still had sexual dysfunction at 6 months postpartum [21].

Because of the complexity of pelvic floor disorders, we will likely never be able to fully quantify the involvement of individual risk factors through longitudinal studies. However, women who sustain OASIS likely represent a cluster of risk factors susceptible to being associated with worsening pelvic floor health as they age; OASIS may therefore represent a good model for longitudinal study of pelvic floor disorders. As expected, and even in our small sample, the women with OASIS also had associated known risk factors of higher birth weight, longer second stage and more forceps delivery than controls [11]. Understanding differences in their longitudinal healing milestones will assist with risk stratification and patient counselling. For example, a woman who takes 12 months to fully recover pelvic floor function, when normal is only 6 months or fewer, may be counselled differently regarding future mode of childbirth or

involvement with known occupational hazards of sustained heavy lifting or excessive physical exertion [25].

In the third trimester, emotional well-being was least affected and physical role functioning and energy levels were most affected, consistent with previous research [15]. Although baseline SF-36 domain scores were similar in the two groups, the OASIS group showed a gradual and significant improvement in quality of life up to month 6 postpartum, whereas the control group showed more score fluctuations, with no particular trend observed over time. Overall, women seem to compensate well postpartum and the level of perineal tear does not seem to significantly impact mental health or quality of life compared with controls in this context. This is consistent with prior research showing no association between depressive and urinary symptoms 1 year postpartum [26]. Moreover, 32.5% of women with urinary incontinence during pregnancy do not report an associated impairment in quality of life [15]. Exact reasons for this are unclear and merit further research. It may be that women view incontinence during pregnancy as a normal or transient phenomenon, such as weight gain, which improves after childbirth. However, their level of acceptance of pelvic floor symptoms during pregnancy may change with education around the clear association of symptom persistence and onset during pregnancy [27].

Strengths of our study include the prospective design and abundant feasibility data collected, as well as the use of validated detailed questionnaires covering multiple aspects of postpartum pelvic floor dysfunction. Limitations include our small sample size and the fact that pre-pregnancy pelvic floor function was not assessed in our participants, thus limiting our conclusions about the timeline of return to normal pelvic floor function. The diagnosis of no or minimal tear was based on standard obstetrical practices

Table 2 Comparison of questionnaire scores at various time points

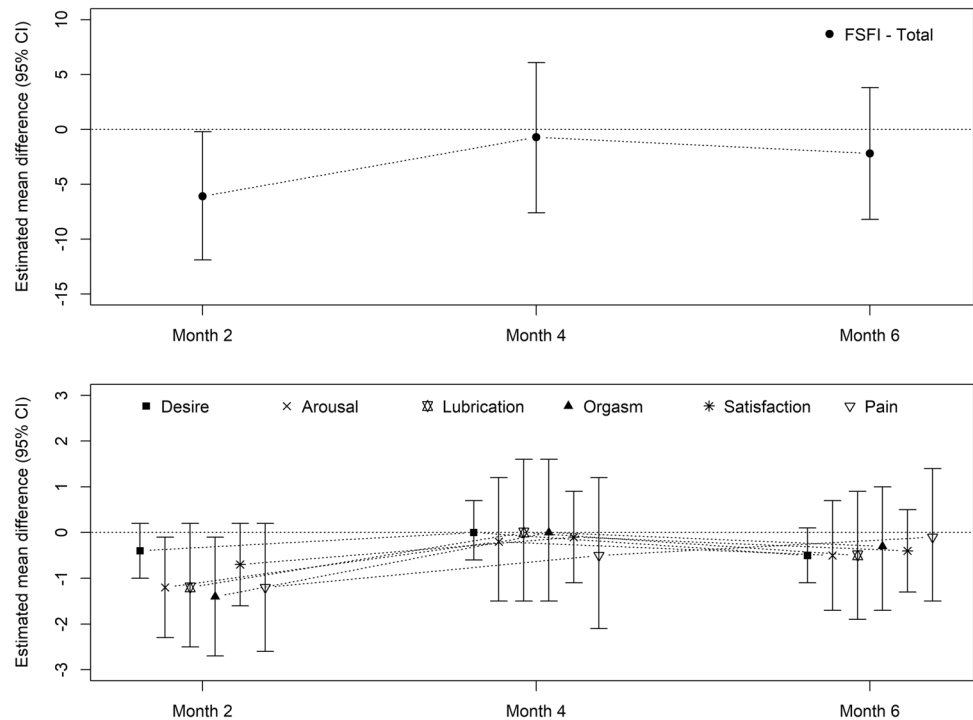
Subgroup and variable	Month 2	Month 4	Month 6	<i>p</i>
Controls				
PFDI, median (IQR)				
UDI	11.5 (2.5, 27.5)	7.0 (0.0, 28.8)	8.3 (0.0, 19.0)	0.554
POPDI	14.3 (7.1, 31.0)	3.9 (0.0, 10.7)	0.0 (0.0, 14.3)	0.016
CRADI	14.3 (7.1, 71.4)	4.3 (0.0, 36.1)	12.5 (0.0, 22.3)	0.099
EPDS, mean (SD)	5.7 (4.2)	–	–	–
FSFI, mean (SD)				
Total	18.3 (10.3)	19.2 (9.8)	22.8 (9.4)	0.109
Desire	2.8 (1.1)	2.9 (1.4)	3.2 (1.1)	0.179
Arousal	2.7 (2.1)	2.9 (2.0)	3.6 (1.9)	0.110
Lubrication	2.9 (2.4)	2.7 (1.9)	4.0 (2.2)	0.075
Orgasm	3.0 (2.4)	3.2 (2.1)	4.0 (2.1)	0.151
Satisfaction	3.8 (1.4)	4.0 (1.7)	4.1 (1.7)	0.328
Pain	3.2 (2.4)	3.6 (2.3)	4.0 (2.3)	0.266
SF-36, mean (SD)				
Physical functioning	92.2 (10.5)	91.4 (14.5)	93.5 (12.4)	0.507
Role limitations—physical	88.0 (26.1)	91.7 (24.3)	90.6 (24.2)	0.565
Role limitations—emotional ^a	100.0 (100.0, 100.0)	100.0 (66.7, 100.0)	100.0 (100.0, 100.0)	0.750
Vitality	51.0 (21.2)	48.3 (20.9)	55.1 (20.4)	0.468
General mental health	76.0 (15.1)	81.1 (11.2)	77.7 (18.7)	0.304
Social functioning	84.0 (15.1)	90.3 (16.4)	88.5 (21.1)	0.071
Bodily pain	89.0 (15.2)	90.7 (11.5)	88.5 (15.3)	0.834
General health perceptions	72.2 (14.9)	72.5 (15.8)	76.5 (15.1)	0.345
OASIS				
PFDI, median (IQR)				
UDI	21.1 (3.3, 39.1)	15.4 (2.5, 37.9)	8.7 (1.0, 28.9)	0.103
POPDI	26.8 (9.5, 44.9)	1.8 (0.0, 29.2)	5.7 (0.0, 19.3)	0.027
CRADI	38.2 (24.6, 59.4)	18.8 (7.1, 48.2)	15.8 (5.4, 25.2)	0.037
EPDS, mean (SD)	5.7 (4.3)	–	–	–
FSFI, mean (SD)				
Total	11.0 (9.0)	20.6 (11.3)	20.1 (10.2)	0.017
Desire	2.1 (0.8)	3.1 (1.1)	2.6 (1.2)	0.185
Arousal	1.3 (1.7)	3.0 (2.0)	2.9 (1.9)	0.010
Lubrication	1.6 (2.3)	3.3 (2.5)	3.5 (2.2)	0.021
Orgasm	1.4 (2.0)	3.6 (2.4)	3.4 (2.3)	0.010
Satisfaction	3.0 (1.1)	4.1 (1.6)	3.9 (1.3)	0.050
Pain	1.6 (2.3)	3.5 (2.5)	3.8 (2.5)	0.004
SF-36, mean (SD)				
Physical functioning	89.1 (12.9)	90.7 (17.4)	96.1 (9.9)	0.003
Role limitations—physical	71.3 (39.1)	87.5 (32.2)	86.8 (31.6)	0.195
Role limitations—emotional ^a	100.0 (33.3, 100.0)	100.0 (100.0, 100.0)	100.0 (100.0, 100.0)	0.056
Vitality	55.0 (14.0)	65.0 (13.6)	66.8 (11.1)	0.005
General mental health	78.2 (12.1)	84.9 (8.8)	82.1 (11.7)	0.254
Social functioning	80.0 (21.2)	83.9 (21.0)	92.8 (14.0)	0.017
Bodily pain	80.5 (21.3)	87.7 (15.8)	86.8 (18.9)	0.303
General health perceptions	79.8 (13.7)	81.1 (14.4)	82.9 (14.7)	0.558

CRADI Colorectal-Anal Distress Inventory, EPDS Edinburgh Perinatal/Postnatal Depression Scale, FSFI Female Sexual Function Index, OASIS obstetric anal sphincter injuries, PFDI Pelvic Floor Distress Inventory, POPDI Pelvic Organ Prolapse Distress Inventory, SF-36 Rand Short Form 36-Item Health Survey, UDI Urinary Distress Inventory

p Value was based on the Jonckheere–Terpstra trend test for the null hypothesis of no trend in score over time

^aMedian and IQR was presented owing to the skewedness of the data

Fig. 2 Difference in Female Sexual Function Index (FSFI) scores and subscale scores between the obstetric anal sphincter injuries (OASIS) and control groups, at 2, 4 and 6 months postpartum



at our institution, which do not include a systematic rectal examination or endoanal ultrasound; as such, some of the controls in our study may have sustained a more severe tear behind an intact perineum. Moreover, we were only able to ascertain the exact type of third-degree tear in half of the women, who were documented to have a 3A tear. This may have been a severe second-degree as opposed to a true third-degree tear, which may have slightly skewed our results. Additionally, our attrition rate was high at 6 months, introducing selection bias into our study.

In the planning of a larger study of postpartum healing milestones, we recommend digital administration of fewer or shorter questionnaires to reduce dropout rates, and follow up to 12 months to capture return to normal pelvic floor function. A larger study will hopefully allow improved clinical risk stratification and patient counseling, in order to initiate timely interventions for earlier pelvic floor disorder prevention efforts.

Authors' contributions M.T.: data collection, manuscript writing/editing; G.K.M.: data collection, manuscript writing; M.G. and N.A.K.: project development, data collection; T.L.: data analysis, manuscript writing; R.G.: project development, manuscript writing/editing.

Declarations

Conflicts of interest M.G. received an Allen Carey unrestricted educational stipend for this project. G.K.M. received summer student research project funding from the University of British Columbia. The other authors have no conflicts of interest.

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