Mechanosensitivity before and after hysterectomy: a prospective study on the prediction of acute and chronic postoperative pain

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Editor’s key points

- Persistent pain after surgery, including hysterectomy, is a major clinical problem.
- Preoperative identification of patients most at risk would have many benefits, including informing the decision process about surgery.
- Psychophysical examination of visceral and somatic sensation may reflect changes in pain processing.
- Women with preoperative pelvic pain did show sensory abnormalities that were associated with increased acute, but not chronic pain.
- The only preoperative characteristic that was associated with chronic pain was brush allodynia.

Background. The incidence of chronic pain after hysterectomy is reported to be up to 30%, but the relative role of different pathogenic factors has not been defined. This study aimed to assess the predictive value of preoperative abdominal and vaginal mechanosensitivity for the subsequent development of acute and chronic pain after hysterectomy.

Methods. Ninety women undergoing hysterectomy for benign conditions were studied. Experimental testing was carried out on the day before hysterectomy, on the first postoperative day, and after 4 months. Abdominal testing included brush-evoked allodynia, pinprick hyperalgesia, wind-up-like pain, and pressure pain thresholds. Vaginal testing included pressure pain thresholds. The intensity of pelvic pain was recorded on a numerical rating scale before hysterectomy, daily in the first postoperative week, and after 4 months.

Results. The incidence of pelvic pain was 51% before hysterectomy and 17% after 4 months. Before hysterectomy, brush-evoked allodynia and pinprick hyperalgesia were more frequent in women with pelvic pain (P=0.04 and 0.02, respectively), with abdominal and vaginal pressure pain thresholds being lower in those with preoperative pelvic pain (P=0.04 and <0.01, respectively). Preoperative brush-evoked allodynia, pinprick hyperalgesia, and vaginal pressure pain threshold were associated with the intensity of acute postoperative pain (P=0.04, <0.01, and <0.01, respectively). Preoperative brush-evoked allodynia was also associated with pelvic pain after 4 months (P<0.01).

Conclusions. Preoperative pain sensitization as reflected by cutaneous and vaginal hypersensitivity is associated with acute pain after hysterectomy, but less so with persistent pain.

Keywords: gynaecologic surgical procedures, hysterectomy; hyperalgesia; pain, postoperative

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Chronic postoperative pain is generally accepted as a potential consequence of almost any operation.1 2 The mechanisms underlying chronic postoperative pain are not fully known, but identified risk factors include genetic and psychosocial factors, previous surgery, type of surgery, and intensity of pre- and postoperative pain.1

Experimental and clinical studies have shown tissue injury to be associated with hypersensitivity which usually resolves with healing, but in some cases, neuronal hypersensitivity persists along with persistent pain.3–5 Therefore, preoperative sensory tests of hypersensitivity may be used in the prediction of acute and chronic pain, and preoperative thresholds to electrical, thermal, and mechanical stimuli have been found to predict immediate postoperative pain.6–12 Only a few studies have examined the relation to chronic pain, and in some,13 14 but not
Hysterectomy is a frequent gynaecological operation, and studies suggest that 5–30% still report pain 1 yr after the operation, independent of the type of surgery.17–19 No studies have so far examined whether chronic pain after hysterectomy can be predicted by a preoperative experimental pain test. We therefore decided to carry out a prospective study in order to: (i) examine the relationship between the preoperative response to experimental pain testing and acute and chronic postoperative pain; and (ii) describe hypersensitivity phenomena in women before and after benign hysterectomy.

### Methods

#### Patients

Patients undergoing elective hysterectomy because of bleeding disorders, uterine leiomyoma, or both at the Department of Gynaecology, Aarhus University Hospital, were enrolled after written informed consent. Exclusion criteria were uterine prolapse, endometriosis, malignant disease, pelvic pain (main indication), or inability to provide informed consent. Based on a previously published questionnaire study, in which the chronic pain frequency was 32%, we aimed at enrolling ~100 women.20 The enrolment took place between August 1, 2006, and April 30, 2007. The types of hysterectomy (vaginal, abdominal, or laparoscopic), anaesthesia (general or spinal anaesthesia), and postoperative analgesia (epidural analgesia or i.v. patient-controlled analgesia) were chosen by the attending gynaecologist and anaesthesiologist. Oral pain medication consisted of non-steroidal anti-inflammatory drugs (NSAIDs) and paracetamol. The study was approved by the Danish National Committee on Biomedical Research Ethics (ID: 20060101) and registered according to the Danish law of Data Protection (ID: 2006-41-6917).

#### Assessment of pain

The intensity of pelvic pain was assessed at three time points: (i) on the day before hysterectomy, (ii) during the first postoperative week, and (iii) 4 months after hysterectomy. A numerical rating scale (NRS, 0–10; 0, no pain; 10, worst pain imaginable) was used. No distinction was made between pain at rest and pain during movement. Preoperative pain and postoperative pain after 4 months were defined as average pain within the last week that affected daily living ‘some’, ‘a lot’, or ‘very much’ (if affected ‘not at all’, it was considered as no pain). For the acute postoperative pain, an average of seven daily pain scores was calculated for each patient. The patients also answered more detailed questions about the location of pain, impact on daily living, and consumption of analgesics. These clinical aspects of pain have been described elsewhere.19 Pain after 4 months was considered as chronic postoperative pain.

#### Sensory pain testing

Experimental pain testing was performed on the day before surgery, on the first postoperative day, and after 4 months by the same investigator (B.B.). Two anatomical sites were tested successively: (i) the midline external abdominal wall ~2 cm proximal to the theoretical line of a Pfannenstiel incision and (ii) the ischial spines by vaginal exploration. The methods of testing were chosen based on results from previous studies of pain mechanosensitivity.21 The assessment was planned to be short in order to minimize any effect of fatigue.

Brush-evoked allodynia was assessed by lightly stroking the abdominal wall using a brush (SENSELab™ OS, Somedic AB, Sweden) which was moved from outside the affected area along 12 different lines converging towards the theoretical line of a Pfannenstiel incision, and the area was calculated in square centimetres. Pinprick hyperalgesia was determined in the same manner using a von Frey hair (Sensory evaluator, Stoelting Co., USA; No. 5.88, nominal buckling force 588.2 mN). For brush-evoked pain, individuals were asked if and when the sensation of touch changed to a sensation of pain. For pinprick hyperalgesia, individuals were asked if and when the sensation of pinprick became more painful.

Wind-up-like pain is a pain phenomenon seen clinically as an increased response to repeated stimuli. It is probably mediated via C-fibre afferents and assumed to reflect increased neuronal excitability in the dorsal horn.22 Wind-up-like pain was tested on the abdomen with a von Frey hair (No. 5.88) which was repeatedly applied to the abdomen for 30 s with a frequency of 2 Hz. The women rated their pain on an NRS immediately after stimulation.

Abdominal pressure pain detection thresholds (PPDTs) were measured using a handheld electronic pressure algometer (Somedic AB, Sweden) with a 1 cm² probe area and an application rate of 20 kPa s⁻¹. Patients were instructed to activate a pushbutton when PPDT was perceived. The average of three measurements was used to define PPDT. Vaginal PPDTs at the ischial spine were measured with a modified pressure algometer applicable for vaginal examination.23 24 The tissue around the ischial spine was chosen because of large variability when measuring at other vaginal sites during exploration. The palpometer was attached to the index finger of the examiner with adhesive tape (Micropore) and covered with an examination glove during testing. Patients were instructed to activate a pushbutton when PPDT was perceived, and the average of six measurements (three on each side) was used to define PPDT. The palpometer consisted of a force-sensing resistor (FSR151, Interlink Electronics, Inc.) connected to a meter (Fig. 1a). The FSR was a polymer thick film (diameter: 10 mm, thickness: 0.33 mm), which exhibited a decreasing electrical resistance with increasing force applied to the device. The proportional change in current was converted into arbitrary units (0–2000). Before the study started, the palpometer was calibrated against the pressure algometer, and a linear regression showed a correlation between arbitrary units and kPa ($r=0.97$). Consequently, all results are presented in kPa (Fig. 1a).

#### Statistical analysis

The statistical software was Intercooled Stata version 9, StataCorp LP, TX, USA. Basic data (non-normally distributed) were...
described by median (range). Brush-evoked allodynia, pinprick hyperalgesia, and pressure pain thresholds assessed before operation were compared with the same tests performed on the first postoperative day and after 4 months using McNemar’s test for dichotomous variables (allodynia and hyperalgesia, yes/no) and Wilcoxon’s signed-rank test (preceded by Friedman’s test) for continuous variables (PPDT). \( x^2 \) and Mann–Whitney’s tests were used for comparison between groups at the different time points. Spearman’s \( r \) was used for correlations between preoperative brush allodynia, pinprick hyperalgesia, PPDT, and intensity of pain after 1 week and 4 months. All \( P \)-values of \(<0.05 \) were considered to be statistically significant.

**Results**

**Patients**

Ninety women median aged 46 yr (range 32–71) completed the study. The types of surgery were abdominal hysterectomy \( n=57 \) (63%), vaginal hysterectomy \( n=25 \) (28%), and laparoscopically assisted vaginal hysterectomy \( n=8 \) (9%). Most patients had general anaesthesia either combined with epidural analgesia \( n=42 \) (47%) or without \( n=35 \) (39%), while the remaining had spinal anaesthesia \( n=13 \) (14%). Table 1 shows a summary of baseline characteristics.

**Pre- and postoperative pain**

Forty-six women (51%) had pelvic pain before operation with a median intensity of 4 (range 1–8), and the pain had ‘some’, ‘moderate’, or ‘severe’ impact on daily life in 26 (57%), 14 (30%), and six (13%) of the women, respectively. The pain was most often located to the middle \( n=33 \) (72%) or lateral aspects \( n=34 \) (74%) of the pelvic region, and less frequently to the groin \( n=5 \) (11%) or the vagina \( n=4 \) (9%). Twenty-nine women (63%) took analgesics several times weekly because of their pelvic pain.

![Fig 1](https://academic.oup.com/bja/article-abstract/107/6/940/345341/fig1)

**(A)** The palpometer. a, Force sensing resistor; b, meter (arbitrary units); c, push-button. **(B)** The correlation was assessed with the palpometer (arbitrary units) laid on a table. Different forces were applied to the palpometer with the pressure algometer measuring the force in kPa. A subsequent regression showed correlation between arbitrary units and kPa. Pain pressure threshold (kPa) = (0.15 × arbitrary units) + 26.23.

**Table 1** Baseline characteristics (\( n=90 \)). Data are median (range) or \( n \) (%). ASA, American Society of Anesthesiologists physical status classification system; NSAIDs, non-steroidal anti-inflammatory drugs

<table>
<thead>
<tr>
<th>Age (yr)</th>
<th>46 (32–71)</th>
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<tbody>
<tr>
<td>ASA class I/II</td>
<td>72/18</td>
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<tr>
<td>Main indication for hysterectomy</td>
<td></td>
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<tr>
<td>Leiomyoma</td>
<td>49 (54.4)</td>
</tr>
<tr>
<td>Menorrhagia, metrorrhagia, or both</td>
<td>41 (45.6)</td>
</tr>
<tr>
<td>Type of hysterectomy</td>
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<tr>
<td>Abdominal</td>
<td>57 (63.3)</td>
</tr>
<tr>
<td>Vaginal</td>
<td>25 (27.8)</td>
</tr>
<tr>
<td>Laparoscopically assisted vaginal</td>
<td>8 (8.8)</td>
</tr>
<tr>
<td>Preoperative pelvic pain</td>
<td>46 (51.1)</td>
</tr>
<tr>
<td>Medication for preoperative pelvic pain</td>
<td></td>
</tr>
<tr>
<td>Paracetamol</td>
<td>19 (21.1)</td>
</tr>
<tr>
<td>NSAIDs</td>
<td>15 (16.7)</td>
</tr>
<tr>
<td>Opioids</td>
<td>3 (3.3)</td>
</tr>
</tbody>
</table>

The average intensity of pain during the first postoperative week was median 3.6 (range 0.1–9.4) on the NRS (for each patient, an average of seven daily pain scores was calculated).

After 4 months, 15 women (17%) had pelvic pain with an intensity during the last week of median 3 (range 1–7). Patients reported that the pain had some \( n=10 \) (67%) or moderate \( n=5 \) (33%) impact on daily life. Pain was most often located to the middle \( n=11 \) (73%) or lateral aspects \( n=11 \) (73%) of the pelvic region, and less frequently to the groin \( n=2 \) (13%) or the vagina \( n=1 \) (7%). Of patients with pain at 4 months, nine had abdominal and six had vaginal hysterectomy. Five patients (33%) took analgesics for pelvic pain, and only paracetamol or NSAIDs were used.
**Sensory pain testing**

Before operation, women with pain more often had brush allodynia and pinprick hyperalgesia compared with those without pain ($n=12$ vs 4 (brush) and $n=15$ vs 5 (pinprick), $X^2 = 0.04$ and 0.02, respectively). Brush-evoked allodynia and pinprick-evoked hyperalgesia were significantly less frequent in patients after 4 months compared with before operation ($n=3$ vs 16 (brush) and $n=5$ vs 20 (pinprick), McNemar’s test, $P<0.01$ and <0.01, respectively). Table 2 shows the details of brush-evoked allodynia and pinprick-evoked hyperalgesia, which corresponded to the dermatomes T10–L1, in all patients. Women with preoperative brush-evoked allodynia had a significantly higher intensity of acute postoperative pain (NRS median 4.2 (range 0.1–9.4), Mann–Whitney, $P=0.04$) and a higher intensity of postoperative pain at 4 months (NRS median 1 (range 1–7) vs median 0 (range 0–6), $P<0.01$). Women with preoperative pinprick-evoked pain also had a significantly higher intensity of acute postoperative pain (NRS median 4.7 (range 1.9–9.4) vs median 3.4 (range 0.1–9.4), $P<0.01$), but not postoperative pain at 4 months (NRS 0 (range 0–7) vs median 0 (range 0–6), $P=0.16$).

Wind-up-like pain on the abdomen was median 2 (range 0–9) on an NRS before hysterectomy, unchanged median 2 (range 0–9) on day 1 (Wilcoxon’s signed-rank test, $P=0.89$), and decreased to 1.5 (range 0–7) after 4 months ($P<0.01$). Women with pain before hysterectomy and those with pain after 4 months did not have increased wind-up-like pain at any time points (Mann–Whitney’s test, $P >0.05$). Also, preoperative wind-up-like pain was not correlated to acute or chronic pain intensity (Spearman’s $r=0.21$ and 0.15, respectively ($P=0.06$ and 0.15)).

Pressure pain thresholds in women with and without preoperative pain before and after surgery are shown in Figure 2. For both groups together, abdominal and vaginal PPDTs decreased significantly immediately after surgery (PPDT (abdominal) median 130 (range 9–474) vs median 281 (range 29–897) and PPDT (vaginal) median 74 (range 28–487) vs median 87 (range 26–487), Wilcoxon’s signed-rank test, $P=0.00$ and 0.00), but at 4 months, there was no difference compared with the preoperative baseline values ($P=0.66$ and 0.70, respectively). Before hysterectomy, women with pelvic pain had decreased abdominal pressure pain thresholds, but after operation, there was no difference between women with and without preoperative pain (results in median (range), before: 349 (29–722) vs 296 (112–987), $P=0.04$ (Mann–Whitney); on day 1: 121 (0–474) vs 129 (0–443), $P=0.39$, and after 4 months: 274 (27–919) vs 310 (0–907), $P=0.20$). Women with preoperative pain had decreased vaginal pressure pain thresholds at all time points ($P<0.01$).

### Table 2 Brush-evoked allodynia and pinprick-evoked hyperalgesia ($n=90$). *The number of patients with brush allodynia and pinprick hyperalgesia was significantly reduced at 4 months compared with before hysterectomy ($X^2$, $P<0.01$ and <0.01, respectively)

<table>
<thead>
<tr>
<th></th>
<th>Before</th>
<th>Day 1</th>
<th>4 months</th>
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<tbody>
<tr>
<td><strong>Brush allodynia</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$n$ (%)</td>
<td>16 (17.8)</td>
<td>8 (8.9)</td>
<td>3 (3.3)*</td>
</tr>
<tr>
<td>Area (cm$^2$) [median (range)]</td>
<td>40 (20–60)</td>
<td>40 (30–60)</td>
<td>30 (22–60)</td>
</tr>
<tr>
<td><strong>Pinprick hyperalgesia</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$n$ (%)</td>
<td>20 (22.2)</td>
<td>19 (21.1)</td>
<td>5 (5.6)*</td>
</tr>
<tr>
<td>Area (cm$^2$) [median (range)]</td>
<td>39 (5–60)</td>
<td>34 (11–60)</td>
<td>22 (13–60)</td>
</tr>
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</table>

**Fig 2.** (a) Abdominal pressure pain threshold in women with (striped shaded, $n=46$) and without (white, $n=44$) pelvic pain before hysterectomy. For both groups together, there was a significant change from before to day 1, but no change from before to 4 months (Wilcoxon’s signed-rank test, $P<0.01$ and 0.66). There was a significant difference between the two groups before hysterectomy, but not after [Mann–Whitney, $P=0.04$ (before), $P=0.39$ (day 1), and $P=0.20$ (4 months)]. (b) Vaginal pressure pain threshold in women with (striped shaded) and without (white) pelvic pain before hysterectomy. For all women together, there was a significant change from before to day 1, but no change from before to 4 months (Wilcoxon’s signed-rank test, $P<0.01$ and 0.70). The women with pain before hysterectomy had significantly lower pain thresholds at all time points [Mann–Whitney, $P<0.01$ (before), $P=0.02$ (day 1), and $P=0.03$ (4 months)].
points [results in median (range), before: 73 (26–243) vs 100 (31–487), \( P < 0.01 \) (Mann–Whitney); on day 1: 47 (26–250) vs 69 (26–473), \( P = 0.02 \), and after 4 months: 73 (26–487) vs 88 (26–487), \( P = 0.03 \)].

Figure 3 shows the correlation between the preoperative abdominal and vaginal pressure pain sensitivities and the average intensity of acute postoperative pain in the first week and the intensity of chronic pain after 4 months. As seen, preoperative abdominal PPDT did not correlate to the intensity of acute or chronic postoperative pain [Spearman’s \( \rho = -0.17 \) and \( -0.08 \), respectively (\( P = 0.12 \) and 0.48)]. Vaginal PPDT correlated to intensity of acute, but not to chronic, postoperative pain [Spearman’s \( \rho = -0.30 \) and \( -0.09 \), respectively (\( P < 0.01 \) and 0.43)].

Based on our previous observation that spinal anaesthesia may have a protective effect for the development and maintenance of chronic pain, we specifically looked at this group of patients. As shown in Table 3, there were no differences in terms of pain and mechanosensitivity before and after hysterectomy between women who had or did not have spinal anaesthesia. A separate analysis of patients who had epidural analgesia showed no difference in pain frequency after 4 months compared with those without epidural analgesia (data not shown). Also, there was no difference in pain sensitivity and pain intensity before and 4 months after surgery between those who had vaginal as opposed to those who had abdominal hysterectomy (data not shown).

**Discussion**

In this prospective study, we found that preoperative increased superficial and vaginal mechanosensitivity was related to the intensity of early pain after hysterectomy. Preoperative brush allodynia but not pinprick hyperalgesia or pressure pain thresholds were related to chronic pain after hysterectomy. These findings support previous studies that preoperative pain is related to immediate postoperative pain, and support that preoperative hypersensitivity in the surgical body part is correlated to early pain. However, the correlation to chronic pain is weak and suggests that preoperative pain and pain sensitivity only plays a minor role in long-term pain after hysterectomy.

Before surgery, 51% had pain and this was associated with abdominal hypersensitivity to brush and pinprick and decreased vaginal and abdominal pressure pain thresholds. The cutaneous hypersensitivity was localized in the dermatomes assumed to correspond to the uterus and other pelvic structures. This observation is in accordance with studies of visceral pain conditions associated with appendicitis, cholecystitis, and cholecystolithiasis. The mechanism underlying the association between cutaneous hypersensitivity and ongoing pain is not clear. One possibility is that noxious input from the uterus and other pelvic structures induces a central sensitization in the dorsal horn of the spinal cord, which in turn gives rise to lowered pain thresholds in the skin areas whose afferent sensory...
Other studies of, for example, groin hernia repair have not been able to demonstrate a relationship between preoperative pain and sensory function. It is possible that the low intensity of pain before surgery in groin hernia patients is insufficient to generate a clinically demonstrable sensitization resulting in cutaneous allodynia. Alternatively, postherniotomy pain may be more linked to nerve injury than preoperative pain.

Pain was in this study assessed by two measures: (i) a simple numeric rating measurement before and after surgery; and (ii) a set of psychophysical abdominal and vaginal mechanosensitivity measures in the surgical region before and after surgery. The assessment of vaginal pain sensitivity to mechanical stimuli has only been done in one previous study, in which a pressure algometer was used to identify and quantify pelvic floor pain sensitivity in 19 healthy women, and the algometer proved to be a reliable and valid measure. In the present study, we used the ischial spine to examine vaginal mechanosensitivity, and although women with preoperative pain had lower thresholds before hysterectomy, preoperative thresholds were only correlated to acute, but not to chronic pain intensity. However, it may be questioned if the pain assessed by applying pressure to the ischial spines is somatic or visceral.

Most importantly, we were able to detect a difference between women with and without preoperative pain, and also an association with acute pain which was not found by abdominal pressure pain thresholds. Further studies are needed to determine the usefulness of this method for assessing visceral or deep tissue sensitivity.

The role of potential preoperative risk factors for the subsequent development of persistent pain has been examined in different settings. Pain thresholds to mechanical stimuli have been linked to early, but usually not late pain. For example, in patients undergoing amputation, a weak relationship has been found between the preoperative mechanical pain threshold and early, but not late, postamputation pain, indicating that factors other than preoperative factors play a role in the subsequent persistence of pain. By using techniques to recruit diffuse noxious inhibitory control (DNIC), a predictive value of reduced DNIC responses before surgery was related to the subsequent development of chronic postoperative pain. Also, the preoperative DNIC responses and acute postoperative pain intensity after thoracotomy both independently predicted chronic postoperative pain. These findings suggest that preoperative and perioperative factors play a role for the development of acute and chronic pain.

It is of interest to speculate on the mechanisms behind the lack of long-term severe pain and hypersensitivity in the present study. It has previously been pointed out that persistent postoperative pain may be related to damage of nerve structures in the surgical region. Experimental and clinical studies have shown that damage to nerve structures causes short- and long-term neuroplastic changes in the peripheral and central nervous system such as abnormal and spontaneous neuronal activity in severed nerve endings, increased activity in dorsal root ganglion cells, and secondary changes in spinal cord neuronal activity. The latter includes spontaneous neuronal activity, reduced threshold for activation, and increase in receptive fields of dorsal horn cells. This central sensitization may be transient or in certain cases move into a chronic phase where maladaptive changes occur. In the present study, we could not find the classical characteristics of nerve damage (the paradoxical combination of sensory loss and hypersensitivity in the painful area) seen, for example, after herniotomy and breast surgery. As there are no major nerve structures exposed during benign hysterectomy, the persistent pain after hysterectomy may be more dependent on preoperative factors than intraoperative nerve damage.

The strength of this study is its prospective character and the systematic identical examination of patients by the same examiner. The limitation of the study is the lack of a control group to determine the frequency of pain and mechanohyperalgesia in age-matched non-hysterectomized women.

| Pain before hysterectomy | 6 (46.2) | 40 (51.9) | 0.70 |
| Pain at 4 months | 3 (23.1) | 12 (15.6) | 0.50 |
| Pain intensity at 4 months (NRS 0–10, n=15) | 4 (3–6) | 3 (1–7) | 0.46 |
| Abdominal PPDT (median kPa and range) before | 261 (139–578) | 283 (29–897) | 0.80 |
| Vaginal PPDT (median kPa and range) before | 81 (31–487) | 81 (26–487) | 0.81 |
| Brush allodynia before | 0 (0.0) | 16 (20.8) | 0.07 |
| Pinprick hyperalgesia before | 2 (15.4) | 18 (23.4) | 0.52 |
| Abdominal PPDT (median kPa and range) at 4 months | 321 (171–774) | 275 (27–919) | 0.11 |
| Vaginal PPDT (median kPa and range) at 4 months | 75 (29–487) | 78 (26–487) | 0.88 |
| Brush allodynia at 4 months | 0 (0.0) | 3 (3.9) | 0.47 |
| Pinprick hyperalgesia at 4 months | 0 (0.0) | 5 (6.5) | 0.34 |

Table 3 Spinal anaesthesia in relation to pain and mechanosensitivity. Results are presented as n (%) unless otherwise stated. PPDT, pressure pain detection threshold. Statistics are \chi^2 for dichotomous and Mann–Whitney’s test for continuous variables.
Fifteen women (17%) had pain after 4 months, and this low number may not be sufficient to identify risk factors and predictors of chronic pain. Previous studies have found varying frequencies of persistent pain after hysterectomy ranging from 5% to 32%. In a national questionnaire study of 1135 women, we found 32% to have pain after 1 yr, while 17% had pain in this study. In that study, patients with chronic pelvic pain and endometriosis were included, while the present study was limited to patients with uterine leiomyoma and bleeding disorders and pain that affected daily living ‘some’, ‘a lot’, or ‘very much’. This may in part explain the lower frequency of pain in the present study. Our former questionnaire study suggested that spinal anaesthesia might have a protective effect for the development of post-hysterectomy pain. In the present study, patients were not randomized to spinal vs general anaesthesia. As shown in Table 3, in this limited number of cases, there was no difference in pain intensity or in external and internal mechanosensitivity between those patients who had spinal anaesthesia and those who did not have this type of anaesthesia. The study was not designed to answer this specific question and both the number of patients and the intensity of pain in the two groups may be too low to find a difference. Separate analyses showed no differences in women with and without epidural analgesia either. In a former study, there was no effect of spinal anaesthesia in women who had vaginal hysterectomy. The population of patients in the present study is heterogeneous with regard to the type of surgery (abdominal vs vaginal). However, we did not find differences in chronic pain frequencies between these groups in our previous study, and in a review of the literature, four papers did not find this either. Therefore, all surgical types were included. Allodynia was tested in the same area in patients who underwent abdominal hysterectomy and vaginal hysterectomy. In this study, there was no difference in mechanosensitivity and pain intensity before and 4 months after surgery between those who had vaginal as opposed to those who had abdominal hysterectomy. So, some of the patients without an abdominal scar also had allodynia and hyperalgesia, and this may reflect sensitization in an area of referred pain, which is not necessarily caused by trauma or incision. The acute pain intensity was assessed by an average over the first postoperative week. This is not the most common way of presenting these data, but we chose the average for several reasons: (i) some patients had epidural analgesia for the first postoperative day, (ii) the shift from epidural to oral medication may cause some changes in pain scores, and (iii) women were discharged at different days.

In conclusion, we confirmed the association between preoperative pain hypersensitivity and postoperative pain. Preoperative cutaneous and vaginal mechanosensitivity was related to acute postoperative pain, but only brush allodynia was related to chronic pain. Cutaneous hypersensitivity is therefore likely, but not obligatory, to contribute to the development of chronic pain.

Conflict of interest
None declared.

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