



# Persistent Pain and Sensory Abnormalities after Abdominoplasty

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**Background:** Persistent postsurgical pain is a well-recognized problem after a number of common surgical procedures, such as amputation, thoracotomy, and inguinal hernia repair. Less is known about persistent pain after cosmetic surgical procedures. We, therefore, decided to study the incidence and characteristics of persistent pain after abdominoplasty, which is one of the most frequent cosmetic surgical procedures.

**Methods:** In September 2014, a link to a web-based questionnaire was mailed to 217 patients who had undergone abdominoplasty between 2006 and 2014 at the Department of Plastic Surgery, Aalborg University Hospital, Denmark. The questionnaire included questions about pain and sensory abnormalities located to the abdominal skin, and physical and psychological function; patient satisfaction with surgery was rated on a 4-point scale.

**Results:** One hundred seventy patients answered the questionnaire. Fourteen patients (8.2%) reported pain within the past 7 days related to the abdominoplasty. Abnormal abdominal skin sensation was common and reported by 138 patients (81%). Sensory hypersensitivity was associated with the presence of persistent pain. Satisfaction with the procedure was reported by 149 (88%) patients. The majority of patients reported improvement on all physical and psychological factors. Patients with pain were more often disappointed with the surgery and unwilling to recommend the surgery.

**Conclusions:** Overall, patients were satisfied with the procedure, although abnormal abdominal skin sensation was common. However, there is a risk of developing persistent neuropathic pain after abdominoplasty, and patients should be informed about this before surgery. (*Plast Reconstr Surg Glob Open* 2015;3:e561; doi: 10.1097/GOX.0000000000000542; Published online 19 November 2015.)

**A**bdominoplasty continues to be one of the most common cosmetic procedures. According to recent statistics of the American Society of Plastic Surgeons, a total of 111,986 abdominoplasties were performed in the United States in 2013. This is an increase of 78% in comparison with 2000.<sup>1</sup> The number of procedures is likely to continue to increase in the future not only

because of the overall increase in the number of esthetic surgical procedures, but also as a consequence of the large number of obese patients achieving massive weight loss after undergoing bariatric surgery.<sup>2</sup> The purpose of abdominoplasty is to remove excessive skin and to tighten the loose abdominal muscles, leaving a natural-looking umbilicus and a minimal amount of visible scars.

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Given the increasing number of abdominoplasties performed, the importance of understanding the possible complications and morbidity associated with the procedure is critical.

Complications can be divided into immediate, early, and late complications. Immediate complications are rare, but life-threatening, with deep vein thrombosis and pulmonary embolism as the most frequent. Common early complications, seen within a month, include hematoma, seroma, local infections, skin or fat necrosis, and wound dehiscence.<sup>3</sup> Late complications include recurrent diastasis, scar hypertrophy, and symptoms related to nerve injury.<sup>4</sup>

Besides these known complications, immediate postoperative pain is also well described.<sup>3</sup> However, only a few studies exist regarding persistent pain after abdominoplasty, that is, pain that persists for at least 3 months after surgery. These studies estimate the risk of persistent pain to be 0.5–4.4%, but they are all based on retrospective medical chart reviews, which may underestimate the prevalence, and they provide no detailed description of the pain and its impact on daily life.<sup>3,5,6</sup>

The purpose of this study was to determine the incidence, impact, and characteristics of persistent pain and sensory abnormalities after abdominoplasty because of weight loss with or without bariatric surgery or because of postpregnancy sequelae. In addition, the study assessed patients' satisfaction with the procedure.

## PATIENTS AND METHODS

Patients who underwent abdominoplasty during a 9-year period from January 2006 to June 2014 at the Department of Plastic Surgery at Aalborg University Hospital, Denmark, were eligible for inclusion in the study.

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The study was a web-based questionnaire survey. A letter containing a link to the survey was mailed to the patients in September 2014; a reminder was sent to nonresponders 2 weeks later. Telephone calls were made to clarify missing answers and for patients who were not able to or did not wish to answer the questionnaire online. The questionnaire not only focused on persistent pain and sensory abnormalities, but also included questions about physical and psychological function before and after abdominoplasty. Details about the surgical procedure were obtained from the patients' medical records.

Approval from the Danish Data Protection Agency (no. 2014-13) was obtained before the data collection, and the patients gave informed consent according to the Helsinki Declaration. Questionnaire studies do not require approval from the Regional or National Committee on Health Research Ethics in Denmark.

### Surgical Procedure

According to the Danish national guidelines, a person is eligible to get abdominoplasty in a public hospital if these criteria are met: a stable physical and mental health, excess loose skin of more than 3 cm, weight loss body mass index greater than or equal to 15 kg/m<sup>2</sup>, no tobacco use at least 6 weeks before surgery, and stable metabolism; in patients who had undergone bariatric surgery, at least 18 months should have passed since surgery. All procedures were performed by 1 of 5 surgeons with little variation in the operative technique. A full abdominoplasty was performed through a transverse suprapubic incision extending bilaterally to the anterior superior iliac spine. Excessive undermining was done over the rectus muscle fascia, reaching the level of the xiphoid. A minimal resection was done to the lateral part of the rectus muscles. If a profound rectus diastasis was found, the diastasis was repaired by fascial duplication. Only the rectus sheath was plicated, leaving the underlying muscle without sutures. The excess flap was resected, and the preserved umbilical stalk pulled through the flap. In case of excess tissue in the flanks, a vertical incision in the midline was done and the medial part of the flap resected (a fleur-de-lis incision). Two surgical drains placed before closure were removed when the output was less than 30–50 mL/24 hours. All patients received low-molecular-weight heparin, 3500–4500 IU, 6 hours after surgery and until full mobilization. Before surgery, lidocaine 1% was injected in the skin. Postoperative analgesic treatment consisted of paracetamol 1 g, 4 times daily, and morphine 10 mg as rescue medication.

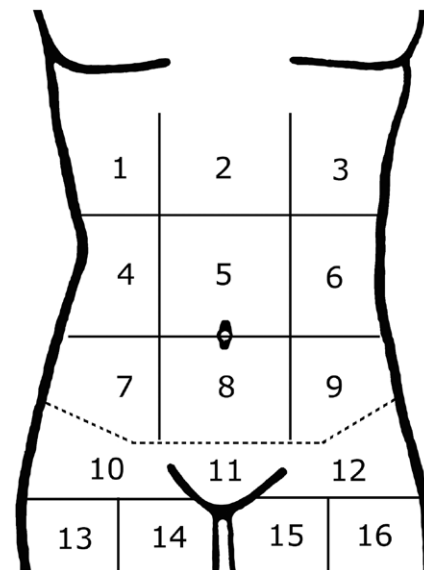
**Questionnaire**

The web-based questionnaire included questions about smoking, preoperative and current weight, and surgical history. The patients were asked to report the primary cause of the abdominoplasty procedure from a list (Table 1). The patients' satisfaction with the procedure was evaluated on a 4-point verbal scale (very satisfied, satisfied, disappointed, and very disappointed) and by asking the patients if they would recommend the procedure to a friend (yes/no).

Nine current physical and psychological factors (ability to work, ability to walk, general physical activity, mood, self-esteem, interpersonal relations, quality of life, sleep, and sex life) were evaluated on a 5-point verbal scale (much better, better, the same, worse, and much worse) compared with before the abdominoplasty. These topics were selected on the basis of the Moorehead–Ardelt Quality of Life Questionnaire, which has been validated as a reliable tool for assessing quality of life in obese patients.<sup>7</sup>

Patients were asked if they had abnormal abdominal skin sensation (hyposensitivity or hypersensitivity), and if they did, they rated how bothered they were by this on an 11-point numeric rating scale (NRS; with 0 being “no bother” and 10 being “worst imaginable bother”). In addition, patients with sensory abnormalities were asked to indicate the specific area(s) using the numbers of a diagram of the abdomen divided into 12 areas (Fig. 1).

Patients were asked if they had experienced pain caused by the abdominoplasty during the past week (yes/no) and also about other pain, including pain caused by previous abdominal surgery, if relevant. Patients with pain during the last week related to abdominoplasty answered questions about onset; duration; location (using the same diagram and numbers as for sensory abnormalities); average and maximal intensity during the past week (on a 0–10 NRS); the impact of pain on daily activities, mood, and sleep (on a 0–10 NRS); and use of analgesic medication. To estimate the likelihood of probable neuropathic pain according to the neuropathic pain grading system,<sup>8</sup> the location of the pain was compared with the location of



**Fig. 1.** Diagram of the abdomen and the upper part of the legs. The dashed line indicates the location of the surgical scar.

sensory abnormalities. In addition, characteristics of pain were described using the 7-item neuropathic pain diagnostic questionnaire (DN4) translated into Danish.<sup>8</sup> The selection of at least 3 of the 7 pain descriptors (burning, painful cold, electric shocks, tingling, pins and needles, numbness, and itching) is suggestive of neuropathic pain with a sensitivity of 81.6% and a specificity of 85.7%. Finally, the patients were asked if they had pain caused by light touching of the skin, eg, by clothes (dynamic mechanical allodynia).

**Statistical Analysis**

Quantitative data were described as mean (SD) or median (range) and qualitative variables using frequency and percentages. Normality was checked using histograms and *QQ*-plots. Numerical data were analyzed using unpaired *t* test or Mann–Whitney *U* test and categorical data using  $\chi^2$  or Fisher’s exact tests. There were no missing data. *P* values less than 0.05 were considered statistically significant.

**RESULTS**

**Patients and Satisfaction with Surgery**

During the 9-year period, 217 patients underwent abdominoplasty and 212 received the link to the questionnaire; the postal address was not available for 5 patients. Thirty-five patients did not respond, 2 patients answered that they did not wish to participate, and 1 patient only answered the questionnaire partially, and thus 174 (80.2%) patients

**Table 1. Primary Cause for the Abdominoplasty**

	No. (%)
Gastric bypass	99 (58)
Banding operation	2 (1)
Gastric sleeve operation	1 (0.6)
Pregnancy and diet/exercise	33 (19)
Diet/exercise	26 (15)
Scar correction after previous surgery	6 (4)
Other or unknown	3 (2)

**Table 2. Clinical Characteristics of Patients with and without Persistent Pain after Abdominoplasty**

Patient Characteristics	Total Population	Patients without Pain	Patients with Pain	P Value*
No. of patients (%)	170	156 (91.8)	14 (8.2)	
Sex, male/female	25/145	24/132	1/13	0.70
Age (y), mean (SD)	45.0 (10.3)	45.3 (10.1)	41.0 (12.1)	0.14
Time since surgery (months), median (range) (SD)	25.0 (3–104)	26.0 (3–104)	16.5 (4–104)	0.33
Fleur-de-lis incision, n (%) (n = 168)	15 (9)	13 (8)	1 (7)	1.0
Repaired rectus diastasis, n (%) (n = 168)	15 (9)	13 (8)	1 (7)	1.0
Weight loss surgery, n (%)	102 (60)	96 (62)	6 (43)	0.25
Pain > 3 months after weight loss surgery, n (%)	15/99(15)	15/93(16)	0/6 (0)	0.59
Smoking				
Current, n (%)	41 (24)	35 (22)	6 (43)	0.23
Previous, n (%)	54 (32)	51 (33)	3 (21)	
Never, n (%)	75 (44)	70 (45)	5 (36)	
Current body mass index, mean (SD)	26.4 (4.4)	26.5 (4.4)	25.8 (3.4)	0.54
Current weight (kg), mean (SD)	75.8 (16.1)	75.8 (16.1)	73.2 (10.8)	0.55
Preoperative weight (kg), mean (SD) (n = 138)	73.9 (15.4)	73.9 (15.4)	71.2 (10.0)	0.57
Chronic pain unrelated to abdominoplasty, n (%)	59 (35)	53 (34)	6 (43)	0.50
Sensory abnormalities, n (%)	138 (81)	124 (79)	14 (100)	0.075
Hyposensitivity, n (%)	126 (74)	114 (73)	12 (86)	0.52
Hypersensitivity, n (%)	39 (23)	30 (19)	9 (64)	<b>0.001</b>
“Squares” with change, n, mean (SD)†	3.3 (1.7)	3.3 (1.7)	4.3 (1.9)	<b>0.035</b>

\*Patients with pain compared with patients without pain. Bold indicates statistically significant values.

†Refers to Figure 1.

responded to the questionnaire. Four patients had surgery within 3 months from receiving the questionnaire and were excluded, so the results are based on 170 patients.

Surgery included fleur-de-lis incision in 15 of 170 and rectus diastasis repaired with a fascial duplication in 15 of 170 (2 patients had both). The median time interval from the surgical procedure to completion of the questionnaire was 25.0 (range, 3–104) months. Table 2 describes baseline data in the study population. Mean age was 45.0 years (SD = 10.3 years); 85.3% were women.

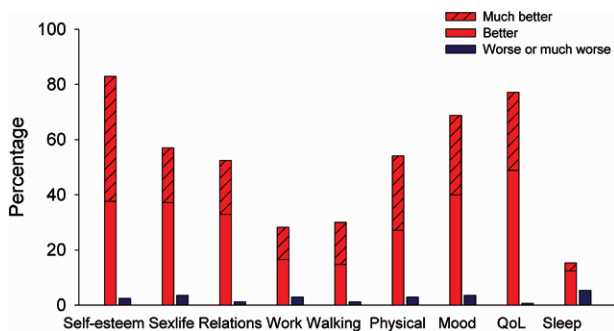
One hundred two patients (60%) had undergone bariatric surgery before the abdominoplasty. Gastric bypass was the most common procedures, performed for 58% (n = 99) (Table 1). Other main reasons were diet/exercise and weight loss after pregnancy

(Table 1). Both men and women reported an increase in body weight at the time of completing the questionnaire compared with the weight before the abdominoplasty. Men reported a weight gain of 3.6kg and women 2.3kg (Table 2).

The majority of patients were satisfied with the procedure: 93 (54.7%) were very satisfied and 56 (32.9%) were satisfied, 14 (8.2%) were disappointed, and 7 (4.1%) were very disappointed. In line with this, 158 (92.9%) patients reported that they would recommend the procedure to a friend in the same situation. Patients reported improvement on self-esteem, mood, and quality of life (Fig. 2).

**Sensory Changes and Pain After Abdominoplasty**

Abnormal abdominal skin sensation was common and reported by 138 patients [81%, 95 confidence interval (CI), 75–87%]. Hyposensitivity was reported by 126 (74%) patients and hypersensitivity by 39 (23%) patients; 16% reported both hyposensitivity and hypersensitivity (Table 2). Many patients were not (44/138, 32%) or only minimally (NRS = 1–3) (61/138, 44%) affected by sensory abnormalities, but 33 of 138 (24%) were at least moderately bothered (NRS ≥ 4), of which 10 were bothered a lot (NRS ≥ 7). Patients with hypersensitivity (either alone or in combination with hyposensitivity) were more bothered by the changes in sensation (median, 3.0; range, 0–9) than those with hyposensitivity alone (median, 1.0; range, 0–10) (P < 0.001; Mann–



**Fig. 2.** Percentage of patients who reported changes after the procedure in various physical and psychological factors.

**Table 3. Area of Sensory Changes and Pain**

Location	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Sensory abnormality	0	0	0	4	28	5	78	108	78	43	55	42	6	6	6	5
Pain	0	0	0	0	3	0	8	8	7	6	4	5	0	0	0	0

Numbers refer to numbers in Figure 1.

Whitney *U* test). Sensory abnormalities were most often reported in area “a8,” just below the umbilicus (Fig. 1), followed by areas “a7” and “a9” (Table 3).

Pain within the past 7 days related to the abdominoplasty was reported by 14 patients (8.2%) (95% CI, 5–12%).

Median time after surgery for patients with pain was 16.5 months, which tended to be less for patients without pain (26.0 months) (Table 2), but 13 of 14 patients reported pain at least 6 months after surgery (Table 4; Fig. 3). Six patients reported at least moderate pain (NRS ≥ 4), and 7 patients reported at least moderate impact of pain on general activities (NRS ≥ 4). Other pain characteristics are reported in Table 4. Nine patients reported pain upon touching the skin (dynamic mechanical allodynia). Five patients took analgesics for the pain caused by abdominoplasty: all 5 took paracetamol, 2 also nonsteroidal anti-inflammatory drugs, and 1 also opioids. The sensory abnormalities and pain had a distribution compatible with nerve injury after abdominoplasty (Table 3), and all patients thus have probable neuropathic pain according to the

neuropathic grading system, although the sensory examination was done by the patient.<sup>8</sup> The descriptors chosen on the DN4 questionnaire were pins and needles (n = 11), burning (n = 8), numbness (n = 8), electric shocks (n = 7), itching (n = 5), and tingling (n = 4). Eleven patients had a score of at least 3, suggesting the presence of neuropathic pain based on the DN4.<sup>9</sup>

Sensory hypersensitivity [OR, 7.6 (2.4–24.2)] was more common in patients with than in patients without pain, and the extent (number of “squares” of sensory abnormalities) was larger in patients with pain [*t* (136) = -2.1, *P* = 0.035], although this is an arbitrary measure, whereas other pain conditions were not more common in patients with pain after abdominoplasty (Table 2). Fleur-de-lis incision and rectus diastasis were not more common in patients with than in patients without pain (Table 2).

Patients with pain were more often unsatisfied with the surgery [5/14 vs 16/156, OR = 4.9 (1.5–16.3), *P* = 0.017] and also more often unwilling to recommend the surgery [5/146 vs 7/156, OR = 11.8 (3.1–44.7), *P* < 0.001].

**Table 4. Pain Characteristics at Time of Follow-up in 14 Patients Reporting Pain after Abdominoplasty**

Pain Characteristics	Time since Surgery	
	3–5 months	≥6 months
No. of patients, n	1	13
Days with pain within the past 7 days		
7	0	5
3–6	0	5
1–2	1	3
Duration of pain		
Continuous	0	2
Hours	0	1
Minutes	1	2
Seconds	0	5
Unknown	0	3
Average pain intensity, NRS 0–10, mean (SD)	4	4.0 (2.7)
Patients with NRS ≥ 4, n	1	5
Pain upon touching the skin (allodynia), n	1	8
Intensity of allodynia, NRS 0–10, mean (SD)	4	4.9 (2.9)
Impact on daily activities, NRS 0–10, mean (SD)	4	3.5 (2.8)
Impact on mood, NRS 0–10, mean (SD)	1	2.2 (2.5)
Impact on sleep, NRS 0–10, mean (SD)	0	1.5 (2.9)

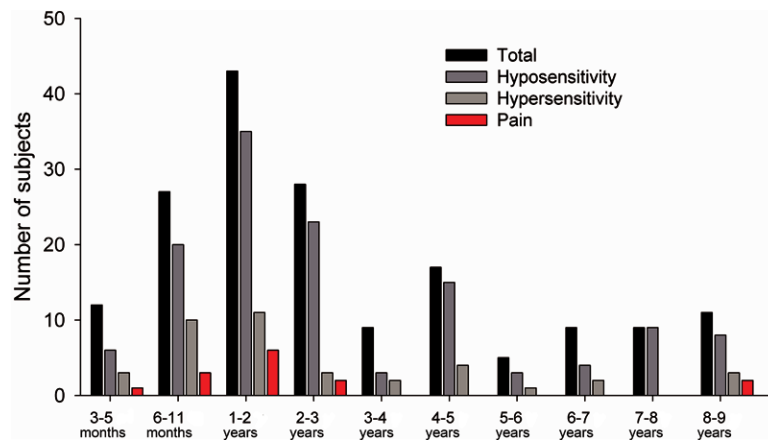
**Responder Analysis**

A comparison of the patients who completed the questionnaire after receiving the first letter (n = 130) and those responding to the reminder (n = 44) showed that they were similar in terms of age (*P* = 0.27; Mann–Whitney *U* test), sex (*P* = 0.40;  $\chi^2$  test), and time since surgery (*P* = 0.27; Mann–Whitney *U* test), and there was no difference in the number of patients reporting pain (11/130 vs 5/44, *P* = 0.57;  $\chi^2$  test) suggesting that responders to the questionnaire are representative of the total population.

**DISCUSSION**

In summary, 14 patients (8.2%) reported pain within the past 7 days related to the abdominoplasty and 138 patients (81%) reported abnormal abdominal skin sensation. Satisfaction with the procedure was high and reported by 149 (88%) patients, and the majority of patients reported improvement of physical and psychological factors.

The strength of this study is the relatively high response rate (80.2%). Only 1 previous study by Bragg et al<sup>9</sup> has reported a similar response rate (78%).



**Fig. 3.** Total number of subjects who had surgery depending on time since surgery and the number of subjects with hyposensitivity, hypersensitivity, and pain at time of follow-up.

Other studies on patient satisfaction with the procedure are few, and all suffer from low response rates 25–46%.<sup>6,10,11</sup> These studies report satisfaction rates of 86–90%<sup>6,11</sup> and recommendation rates of 76–86%.<sup>6,11,12</sup> This is in line with the large number of patients in our study reporting to be satisfied with the procedure (88%) and the large number of patients (93%) wanting to recommend the procedure to a friend. We cannot exclude that recall bias had an impact on some of the questions such as time of onset and change in weight from before surgery, but our main purpose was to examine the prevalence and impact of chronic sensory abnormalities and pain evaluating symptoms within the past 7 days. Based on our results, a prospective study would be relevant to perform. Another limitation is the lack of a control group.

Despite the high frequency of satisfied patients, we found that sensory abnormalities and pain caused by nerve injury were more common at the long-term follow-up after abdominoplasty than previously thought,<sup>4</sup> and that persistent pain was strongly associated with dissatisfaction with the surgery. Sensory abnormalities were reported by 81% patients, and 24% were at least moderately bothered by this. A recent study by Aherra et al,<sup>13</sup> including only 30 patients, found that 17 of 30 patients (56.7%) had sensory abnormalities after the procedure, with sensory changes resolving over time especially beyond the 18-month postoperative period. This study did not separate sensory hyposensitivity and hypersensitivity and did not evaluate pain.

Pain within the past week because of abdominoplasty was reported by 8.2% of the patients and moderate pain by 3.5% at a median follow-up time of 25 months. These figures are similar to results from inguinal hernia repair studies.<sup>12</sup> However, using similar questions, we found higher prevalence rates of persis-

tent pain after other plastic surgery procedures, with persistent pain present in 28% and moderate pain in 7% after breast reduction surgery<sup>14</sup> and in 44% and 10%, respectively, after breast augmentation.<sup>15</sup> Time since surgery tended to be shorter for patients with pain than for patients without, suggesting that pain may resolve over time.

Patients with pain had probable neuropathic pain according to the neuropathic pain grading system,<sup>8</sup> which is higher than in other procedures,<sup>16</sup> probably because there are few other risk factors for pain associated with the underlying condition and surgery than nerve injury. Nine patients reported touch-evoked pain, with many patients reporting that the pain, when present, lasted only seconds. We found a statistically significant association between sensory hypersensitivity and persistent pain consistent with other studies of persistent postsurgical pain.<sup>17</sup> Age and sex were not predictors of persistent pain.

The mechanisms of nerve injury include direct injury such as injury caused by a scalpel or suture and indirect injury such as nerve entrapment in scar tissue. Nerves within the surgical field include the iliohypogastric nerve with its lateral and anterior cutaneous branches, the intercostal nerves with its anterior and lateral cutaneous branches, the lateral femoral cutaneous nerve, and the ilioinguinal nerve. Based on the location of the pain, the main reason for pain in our sample is likely to be a lesion of the anterior cutaneous branches of the iliohypogastric, intercostal, and subcostal nerves, whereas a few patients also had sensory abnormalities suggestive of a lesion of the lateral femoral cutaneous nerve or the ilioinguinal nerve. Other factors may have been responsible for sensory abnormalities and pain. Patients who

have undergone bariatric surgery may have had secondary fibrosis and hernia, which were corrected during the abdominoplasty. In addition, massive weight loss may have caused extreme skin expansion. Further studies are needed to evaluate these factors.

Despite the suggestion that neuropathic pain was the main reason for pain, none of the patients were treated with drugs recommended for treatment of neuropathic pain, which include tricyclic antidepressants, serotonin noradrenaline reuptake inhibitors, gabapentin, and pregabalin as first-line drugs and lidocaine patches, capsaicin 8% patches, and tramadol as second-line drugs.<sup>18</sup>

Also, aggressive early pain relief has been proposed as a method for reducing the risk of developing chronic neuropathic pain.<sup>14</sup> However, despite the fact that 5 patients reported onset of pain immediately after surgery and another 2 patients within the first month, none of these patients were treated accordingly. The value of a correct and early aggressive pain therapy after abdominoplasty remains to be investigated further.

### CONCLUSIONS

This study found that 8.2% reported pain within the past week between 3 months and 9 years after abdominoplasty, most often located under the umbilicus in the same location as the incision line, suggesting direct nerve injury in this area as the primary cause. Pain was compatible with neuropathic pain, but none of the patients with pain were treated according to the recommended guidelines for neuropathic pain. Abnormal abdominal skin sensation was very common, and hypersensitivity, reported by 23%, was more common in patients with persistent pain compared with those without.

In conclusion, despite an overall high satisfaction among patients who had undergone abdominoplasty, there is a risk of developing persistent neuropathic pain, which may need specific treatment, and the patients need to be informed about this before surgery.

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