



Abdominoplasty and Clitoris Evaluation: A Prospective Study on Sexual Pleasure in Women Undergoing Abdominoplasty

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Abstract

Introduction Being one of the most practiced procedures in plastic surgery, it is important to foster a better understanding of the effect of anatomical changes in the pubic area after abdominoplasty on sexuality in women. Since to date no study has been performed with this purpose, our aim is to evaluate the impact of the abdominoplasty on sexual pleasure and to perform an objective evaluation of changes in clitoral position and prepubic fat area after this procedure.

Materials and Methods A prospective study has been performed in 50 women who expressed a desire to undergo abdominoplasty from January 2021 to December 2021. The primary endpoint was Sexual pleasure assessed by the “Sexuality Assessment Scale” before and 6 months after abdominoplasty in all patients. Furthermore, we evaluated the physical changes of the clitoris (clito-pubic distance, CP distance) and the prepubic fat area on magnetic resonance imaging before and 3 months after abdominoplasty.

Results Patients mean age was of 42 ± 9 years, and mean body mass index of 26 ± 2 kg/m². A significant difference ($P < 0.0001$) between sexual satisfaction before and 6

months after abdominoplasty (mean difference $+7.4 \pm 6.452$) was found. Though there was no significant difference between the clito-pubic distance before and after abdominoplasty (mean difference -3.200 ± 2.499 mm; $p = 0.0832$), a significant difference was found in the size of the prepubic fat area before compared to after abdominoplasty (mean difference -1.714 ± 1.010 cm²; $p = 0.0426$). However, no significant relationship between these anatomical changes and sexual satisfaction was found.

Conclusion Our results show that abdominoplasty is associated with an increase in sexual satisfaction. The changes in the post-operative position of the clitoris were not statistically significant, contrarily to the size of the prepubic fat area, which was significantly modified and could partially explain the improved sexual pleasure. Authors were unable to statistically demonstrate a correlation between those anatomical modifications and sexual pleasure.

Level of Evidence IV This journal requires that authors assign a level of evidence to each article. For a full description of these Evidence-Based Medicine ratings, please refer to the Table of Contents or the online Instructions to Authors www.springer.com/00266.

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Keywords Abdominoplasty · Tummy tuck · Clitoris · Sexual function · Genital surgery

Abbreviations

SAS Sexuality assessment scale
CP distance Clito-pubic distance

Introduction

Sexuality can be expressed through appearance, behaviour, and interpersonal relationships [1–3]. The appearance of the genitals plays an important role in the expression of female sexuality [4] and can affect sexual activity, indicating a relationship between aesthetic and psychosexual issues [2, 5].

Abdominoplasty is a frequently performed cosmetic surgery procedure to improve the body contour after pregnancy or significant weight loss. It is the third most performed cosmetic procedure in the USA, after liposuction and breast augmentation (163,073 in 2020 [6]). It consists of the resection of excess skin and infra-umbilical fat. This surgery treats the aesthetic units of the abdomen, namely the epigastrium, the lower abdomen, the flanks, and the mons pubis [7, 8]. Of these, the mons pubis is the aesthetic unit most commonly associated with sexuality thus seen as the most important area of the abdomen. Changes to this body part as a result of surgery can have a severe psychosexual impact [9].

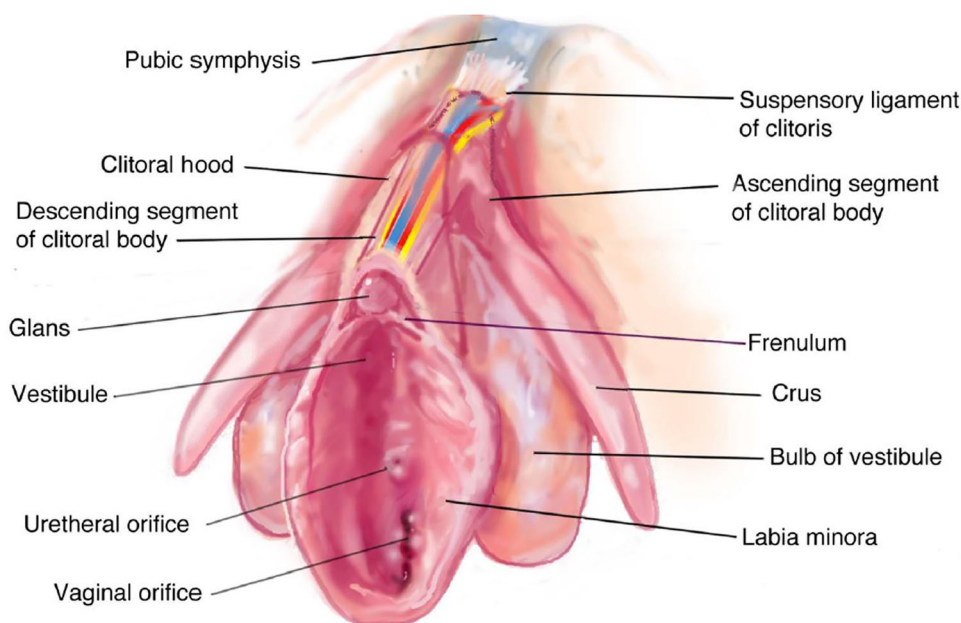
The clitoris has been studied considerably less than the penis. It is often considered to be homologous to the penis [10] when in fact it is a multidimensional erectile tissue located medially below the pubic symphysis and for which the term “clitoral complex” would be more anatomically appropriate [11, 12]. The importance of clitoral stimulation in female orgasm is now recognized in current times [13]. The clitoris can be divided into several anatomical segments (Fig. 1, [14]): the glans, prepuce (cap), body (corpora), bulbs, pillars and suspensory ligament [15, 16]. The internal segment is the part of the clitoris containing the

greatest amount of erectile tissue [16]. The body and pillars of the clitoris are located under the hamstring muscles and fascia superficialis [17]. The body of the clitoris is attached to the pubic symphysis by the clitoral suspensory ligament. The clitoral suspensory ligament is a multidimensional structure that extends from the anterior abdominal wall to the clitoris (Fig. 2 [18]). This structure consists of three anatomically distinct layers [18]. The superficial component is an extension of the fascia superficialis at the mons pubis that inserts onto the clitoral body. The intermediate component originates from the abdominal fascia in the subumbilical area, passes over the anterior side of the pubis, and inserts along the length of the clitoral body. The deep component is the shortest and runs from the pubic symphysis to the knee of the clitoris, descending along the crus of the clitoris [18].

Because of its close relationship with the elements constituting the abdominal wall (the muscular fascia, the fascia superficialis and the skin), the shape and position of the clitoris changes after abdominoplasty [19]. Some studies have shown that sexual satisfaction, particularly clitoral pleasure, increases after abdominoplasty [19] using the sexual assessment scale (SAS) adapted for this purpose [19]. Since this scale consists of subjective questions, this study aims to establish objective criteria that could explain these changes in sexual satisfaction.

Because of the lack of studies on the question of sexuality, it seems important to us to better understand the origin of these sexual changes after abdominoplasty to adapt our surgical practices for the best possible outcomes.

Fig. 1 Anatomy of the clitoris
(Dr J. Kelling et al)



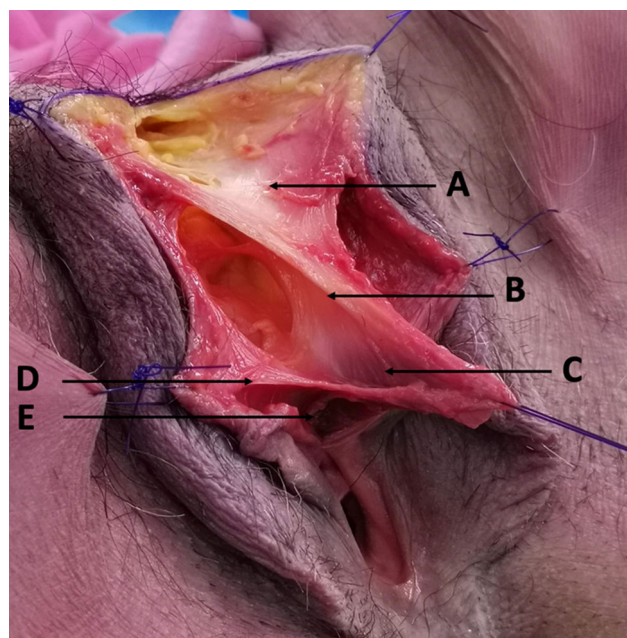


Fig. 2 Anatomy of the suspensory ligament. A: superficial component; B: intermediate component; C: body of the clitoris; D: lateral extension; E: inferior extension. (Dr C.Botter)

Materials and Methods

This study was conducted in accordance with globally accepted standards of Good Clinical Practice (ICH-E6), European Directive 2001/20/EC, and the revised version of the Declaration of Helsinki set out in the European Directive. All patients provided written informed consent to participate. The manuscript also conforms to the Aesthetic Plastic Surgery.

This study took place between January 2021 and December 2021. Patients who presented for a plastic surgery consultation for a request for transverse abdominoplasty with umbilical transposition were included in the study. Inclusion criteria were as follows: age 18–65 years and sexually active, meaning having had at least one sexual intercourse with a partner in the last four weeks [20]. Exclusion criteria were: patients with sexual dysfunction (FSDS-R ≥ 11 ; female sexual disorder scale revised [21]), patients with any abnormality of pelvic anatomy, patients with DSM-5 dysmorphophobia, and illiterate patients.

Once included, for our main outcome, patients completed a preoperative sexuality questionnaire focused on clitoral pleasure: the SAS (sexuality assessment scale) (Fig. 3).

Among the included patients, a pre- and post-operative MRI was performed to assess abdominal wall deformities. These MRIs were retrospectively used to study the position of the clitoris and the prepubic fat. Magnetic Resonance Imaging (MRI), a non-invasive imaging technique,

Please, mark only one answer for each statement.

- The appearance of the genital region affects my sex life.
 - I do not know
 - Disagree
 - Slightly agree
 - Moderately agree
 - Strongly agree
- My level of sexual interest or desire increases after viewing erotic images, sharing a common fantasy with a partner, or when my partner touches or contacts my clitoris.
 - I do not know
 - Disagree
 - Slightly agree
 - Moderately agree
 - Strongly agree
- The clitoris is an erogenous (very sensitive to sexual pleasure) part of my body.
 - I do not know
 - Disagree
 - Slightly agree
 - Moderately agree
 - Strongly agree
- Clitoral stimulation (touching, rubbing) increases my sexual excitement.
 - I do not know
 - Disagree
 - Slightly agree
 - Moderately agree
 - Strongly agree
- The size and temperature of the clitoris change (it becomes slightly engorged, firm, and warmer) when I am sexually excited.
 - I do not know
 - Disagree
 - Slightly agree
 - Moderately agree
 - Strongly agree
- Being sexually aroused (having a wet vagina) improves sexual activity and penetration.
 - I do not know
 - Disagree
 - Slightly agree
 - Moderately agree
 - Strongly agree
- Stimulation of the clitoris during penetration shortens the time to reach orgasm (more intense and faster orgasm).
 - I do not know
 - Disagree
 - Slightly agree
 - Moderately agree
 - Strongly agree
- Considering the last time you had sex, what was the influence of clitoral stimulation on the level of satisfaction with the sexual activity?
 - I did not have a sexual intercourse
 - No influence
 - Slight influence
 - Moderate influence
 - Strong influence

Fig. 3 Sexuality assessment scale (SAS)

currently is the reference procedure for studying the female genitalia [20, 22]. In addition, MRI can be used as preoperative imaging to study the abdominal wall, to look for herniations and diastasis. Injected MRI is a particularly suitable imaging technique which allows for preoperative mapping of the female genitalia [23]. We looked for objective physical criteria that could explain these changes in sexual pleasure after abdominoplasty.

All included patients underwent abdominoplasty using the department's standardized technique (Fig. 4). Under general anaesthesia, we started with a liposuction of the flanks and of the supra-umbilical area. We did not lipoaspirate the pubis. We then made a horizontal supra-pubic incision extending to the anterior superior iliac spines. The abdominal flap was detached from the abdominal wall, preserving the umbilicus. Next, a



Fig. 4 Pictures 2 patients (A and B) before and after abdominoplasty

dermolipectomy on demand was performed. If necessary, a diastasis cure was made. We then performed a supra-umbilical high-tension suture and two peri-umbilical high-tension sutures to lower the abdominal flap. We added three lateral padding stitches between the superficialis fascia of the abdominal flap and the fascia of the rectus and oblique muscles. Finally, we sutured the deep plane with stitches between the superficialis fascia of the abdominal flap and the superficialis fascia of the pubis and then we sutured the abdominal skin edges and then exteriorized the umbilicus (Fig. 5).

During the post-operative follow-up, all patients were seen at 6 months post-operatively to complete the “SAS” questionnaire. The patients who had undergone preoperative MRI were seen again at 3 months for post-operative MRI.

Abdominoplasty is a major surgery, and our experience has shown that most patients need several weeks, even months, to fully recover and enjoy the benefits of the surgery. A 6-month follow-up after abdominoplasty was

considered adequate to evaluate these patients with respect to sexual satisfaction and 3 months with respect to the radiological evaluation of the clitoral position and prepubic fat pad size.

Sexual Pleasure Evaluation—the SAS Score (Fig. 3)

The effect of abdominoplasty on the clitoris and on the sexual satisfaction of the patients was evaluated using the SAS, which was developed specifically for this purpose. The SAS consists of eight items evaluated in five points ranging from 0 to 4, with higher scores indicating a higher level of sexual satisfaction, for a maximum total score of 32.

The SAS was filled out preoperatively and 6 months after abdominoplasty, always in the presence of the same clinician. Patients that did not show up at the 6-month post-operative consultation, answered the questionnaire over the phone.

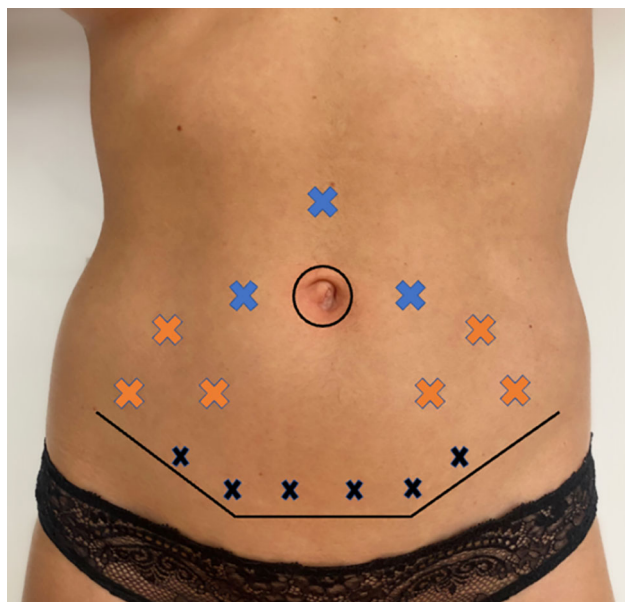


Fig. 5 Typical location and suture type (black lines: incision lines; blue cross: high-tension suture; orange cross: padding suture; black cross: deep plane suture)

This questionnaire evaluates three dimensions of sexuality. First, the appearance of the external genitalia is characterized by genital rejuvenation (item 1). The SAS also assesses sexual function which includes desire, sexual interest, and sexual arousal (items 2, 4, 5, 6 and 7). Finally, this questionnaire studies satisfaction with sexual stimulation (items 3, 4, 5, 7 and 8).

MRI Assessment

The physical change in clitoral position was assessed by using reproducible, fixed bone points that would not be operator-dependent. The distance between the vertical line passing through the anterior pubic boundary and the vertical line passing through the distal end of the clitoris (clito-pubic distance, CP distance) was measured (Fig. 6). The prepubic fat area was assessed by measuring the prepubic fat area contained between the two upper and lower pubic boundaries (Fig. 6). All MRIs included at least 2-dimensional T2-weighted fast spin echo sequences in three orthogonal directions of 4 mm thickness. These measurements were taken before surgery during the pre-operative radiological examination of the abdominal wall and 3 months after surgery. We chose these two measurements because they were reproducible, not operator-dependent, and based on fixed bone points.

Statistical Analysis

All statistical analyses were analysed by Prism 9 (Graph-Pad Software Inc, CA, USA) and Microsoft Office Excel (Microsoft Corp, Redmond, WA, USA). Data were expressed as mean $\pm$ SD. For comparisons of means between different groups, a statistical difference was determined using a paired *T* test; an alpha value of $p < 0.05$ was considered statistically significant. Pearson's correlation coefficient was used to assess the correlation between anatomic changes on MRI and SAS scores.

Results

Our study population consisted of 50 women with a mean age of 42 ± 9 years and a mean body mass index of 26 ± 2 kg/m² (Table 1).

Comparison between pre- and post-operative total SAS scores indicate that patients experienced a significant improvement in sexual satisfaction 6 months after surgery compared with baseline (Table 2; $P < 0.0001$). Overall sexual satisfaction was 19.02 ± 4.605 before the abdominoplasty versus 26.38 ± 4.575 six months after, a difference of 7.4 ± 6.452 for a p value < 0.0001 (Table 2).

The CP distance was 11.85 ± 4.338 mm before the operation and 8.650 ± 2.385 mm after abdominoplasty. This represents a difference of -3.200 ± 2.499 mm for a p value of 0.0832 (Fig. 7).

There was also a significant reduction in the size of the prepubic fat area 3 months after the procedure (mean reduction 1.714 ± 1.010 cm²; $p = 0.0426$). It was 9.435 ± 1.139 cm² before and 7.721 ± 1.616 cm² after the procedure (Fig. 8).

In the four patients who underwent radiological evaluation (Table 3), no significant correlation was found between the difference in CP distance and the differences in total SAS scores ($r = 0.756$; p value = 0.2435) (Table 4). No significant correlation was also found between changes in size of the prepubic fat area and total SAS scores ($r = 0.9242$; p value = 0.0758) (Table 5).

Discussion

In the literature, only one study was found evaluating the effects of physical changes of the pubic area after abdominoplasty on female sexuality [19]. However, no study has investigated the change in clitoral position on magnetic resonance imaging before and after abdominoplasty that could objectively explain these changes in sexual perception. Therefore, in this study an assessment was made of clitoral pleasure using the SAS questionnaire

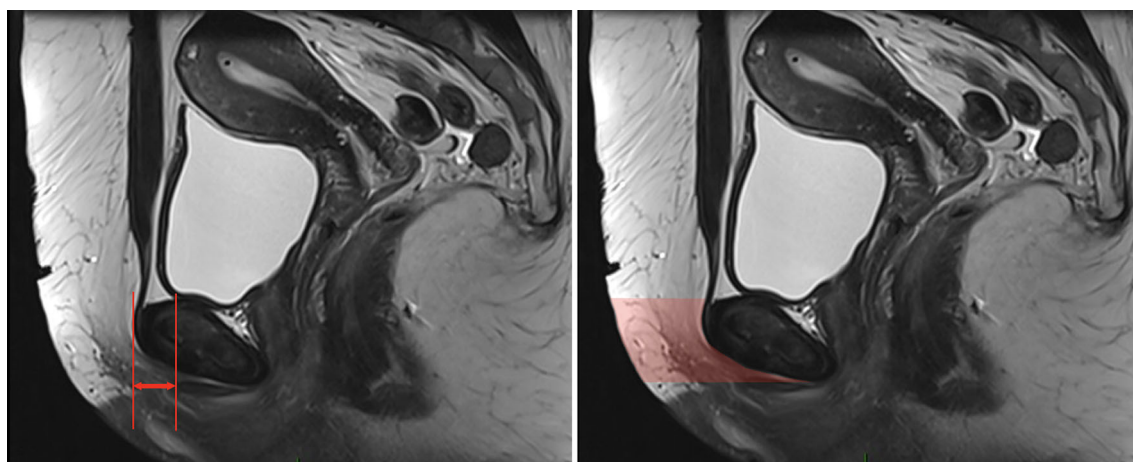


Fig. 6 MRI analysis of the clitoris (CP distance on the left) and the prepubic fat surface (PP surface on the right)

Table 1 Demographic characteristics of the women who underwent abdominoplasty ($N = 50$)

Variables	N (%)
Mean age ($\pm$ SD)	42 (± 9)
BMI ($\pm$ SD)	26 (± 2)
Education	
Less than High school	9 (18%)
High school	24 (48%)
College	12 (24%)
Number of pregnancies	
0	15 (30%)
1	11 (22%)
≥ 2	24 (48%)
Marital status	
Single	9 (18%)
Married/couple	41 (82%)

SD Standard deviation; BMI body mass index

and a comparative study performed on changes in clitoral position and prepubic fat area size on MRI before and after abdominoplasty.

In our study, significant differences were found in post-operative abdominoplasty total SAS scores, indicating greater sexual satisfaction after abdominoplasty. In the study group that underwent radiological evaluation, there was a difference between the position of the clitoris before and after abdominoplasty, although it was not significant. However, there was a significant decrease in the size of the prepubic fatty area after abdominoplasty. No correlation was found between the anatomical changes and the total SAS score.

These anatomical changes can be explained by an elevation of the pubic mons and the consequent increased exposure of the clitoris after abdominoplasty. In fact, the tension applied to the lower edge of the surgical scar pulls all the lower structures upwards, and therefore pulls the prepubic fat and the clitoris upwards.

Abdominoplasty elevates the vulvar commissure, taking with it the clitoris and prepubic fat. We know that the

Table 2 Sexuality assessment scale results for all 50 patients

Variables	Baseline	6 Months	Difference	P Value
Total SAS score	19.02 $\pm$ 4.605	26.38 $\pm$ 4.575	7.400 $\pm$ 6.452	<0.0001
Q1	1.280 $\pm$ 1.144	2.840 $\pm$ 0.8418	1.560 $\pm$ 1.280	<0.0001
Q2	2.500 $\pm$ 0.7626	3.420 $\pm$ 0.9495	0.9200 $\pm$ 1.066	<0.0001
Q3	2.760 $\pm$ 1.001	3.540 $\pm$ 0.5035	0.7800 $\pm$ 1.130	<0.0001
Q4	2.580 $\pm$ 0.6728	3.280 $\pm$ 0.8581	0.7000 $\pm$ 1.074	<0.0001
Q5	2.680 $\pm$ 1.058	3.380 $\pm$ 0.7253	0.7000 $\pm$ 1.111	<0.0001
Q6	2.500 $\pm$ 0.9530	3.240 $\pm$ 0.8221	0.7400 $\pm$ 1.259	<0.0001
Q7	2.400 $\pm$ 0.8330	3.440 $\pm$ 0.7329	1.040 $\pm$ 1.212	<0.0001
Q8	2.320 $\pm$ 0.8908	3.280 $\pm$ 0.7010	0.9600 $\pm$ 0.9467	<0.0001

T test results for paired data at a significance level of $P < 0.05$

SAS sexuality assessment scale, 6 months 6 months follow-up after abdominoplasty; $\pm$ Standard deviation

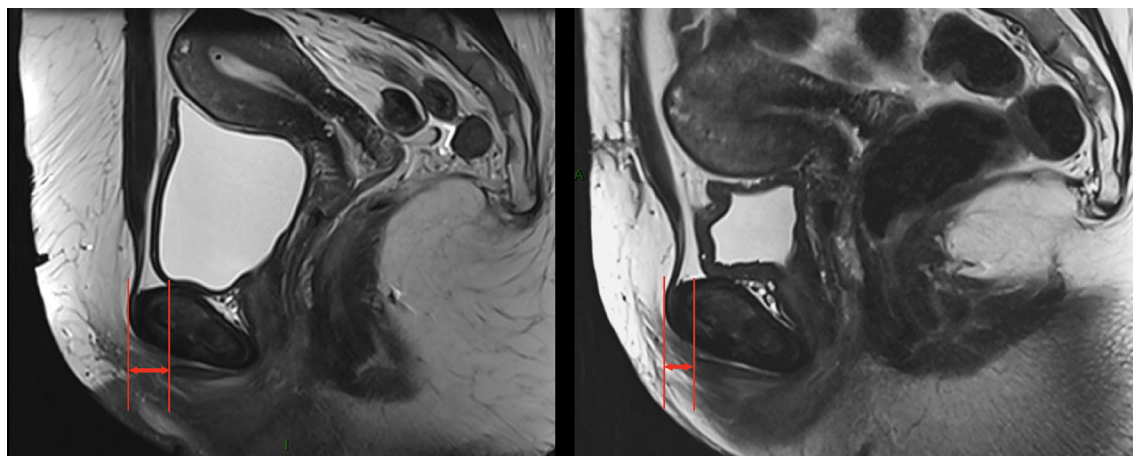


Fig. 7 On the left, the CP distance before abdominoplasty (11.85 ± 4.338 mm.) On the right, the CP distance 3 months after abdominoplasty (8.650 ± 2.385 mm). This means a difference of -3.2 ± 2.499 mm for a p value of 0.0832

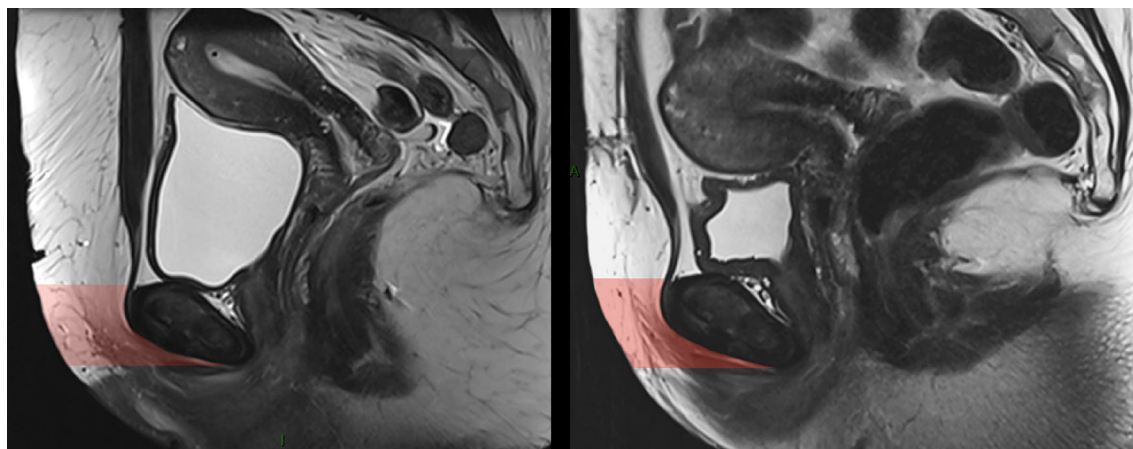


Fig. 8 On the left the prepubic fat area before abdominoplasty (9.435 ± 1.139 cm²). On the right the prepubic fat area 3 months after abdominoplasty (7.721 ± 1.616 cm²). This means a difference of -1.714 ± 1.010 cm² for a p value of 0.0426

Table 3 Sexuality assessment scale and MRI results for 4 patients

Variables	Baseline	6 Months	Difference	P Value
Total SAS score	20.25 ± 4.500	27.50 ± 1.291	7.250 ± 5.377	0.0740
CP Distance (mm)	11.85 ± 4.338	8.650 ± 2.385	-3.200 ± 2.499	0.0832
Prepubic fat area (cm ²).	9.435 ± 1.139	7.721 ± 1.616	-1.714 ± 1.010	0.0426

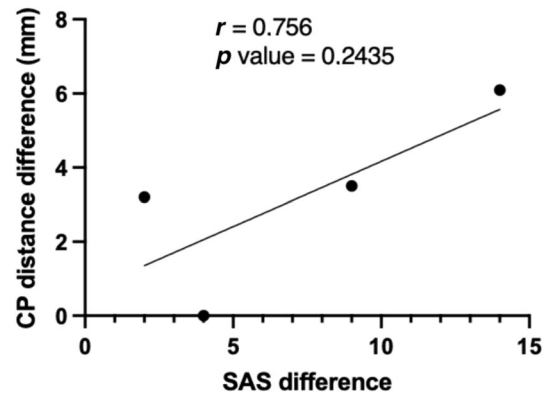
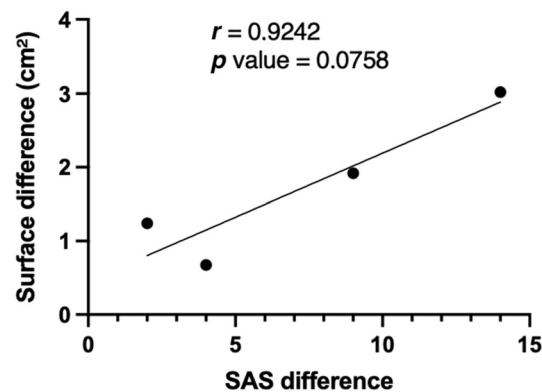
T test results for paired data at a significance level of $p < 0.05$

SAS sexuality assessment scale; 6 months 6 months follow-up after abdominoplasty; CP distance clito-pubis distance; $\pm$ Standard Deviation

clitoris is intimately linked to the elements constituting the abdominal wall thanks to a recent cadaveric study [18]. The clitoral hood is a cutaneous extension, and the suspensory ligament is connected to the fascia superficialis as well as to the abdominal fascia by its various extensions. Thus, the increase in sexual satisfaction, and particularly clitoral satisfaction, could be linked to the positional changes observed on MRI. Superficialization and an

elevation of the clitoral body could be observed. In addition, there was a decrease in prepubic fat, exposing the pubic mons and increasing access to the clitoris. The non-significant difference in CP distance before and after abdominoplasty can be explained by the small sample size.

The biggest limitation of this study is that we cannot rule out the psychological aspect of the intervention on sexuality. We cannot exclude that the increase in sexual

Table 4. Correlation between the CP distance difference and the SAS difference before and after abdominoplasty**Table 5** Correlation between the prepubic fat surface difference and the SAS difference before and after abdominoplasty

satisfaction is due to an increase in self-esteem and body image after abdominoplasty. Indeed, a good self-esteem participates and contributes to sexual functioning and pleasure [3, 24]. The abdomen has a significant effect on body image and affects sexual functioning [9]. Improved body image and self-esteem have a positive effect on sexual desire [1]. Perceived genital attractiveness may also be associated with increased sexual pleasure [5]. Therefore, it cannot be inferred that the elevation of the pubic area and the resulting exposure of the clitoris in the vulvar commissure are the only factors that may have contributed to improved sexuality after abdominoplasty.

The clitoris is considerably less studied than the penis despite the importance of its stimulation in female orgasm. A radiologic assessment with a larger sample size, would be of interest to create a better understanding of the effect of clitoral position on sexuality.

Conclusion

In this study we confirm that sexual satisfaction and particularly clitoral pleasure increase after abdominoplasty. Although it is not the main criterium, the clitoris seems to change position and the prepubic fat area decreases after abdominoplasty. These changes may contribute to increased sexual satisfaction.

Declarations

Conflict of interest The authors declare that they have no conflicts of interest to disclose.

Informed Consent This study was conducted in accordance with globally accepted standards of Good Clinical Practice (ICH-E6), European Directive 2001/20/EC, and the revised version of the Declaration of Helsinki set out in the European Directive. All patients provided written informed consent to participate.

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