

Genital Sensitivity After Sex Reassignment Surgery in Transsexual Patients

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Background: Tactile and erogenous sensitivity in reconstructed genitals is one of the goals in sex reassignment surgery. Since November 1993 until April 2003, a total of 105 phalloplasties with the radial forearm free flap and 127 vaginoclitoridoplasties with the inverted penoscrotal skin flap and the dorsal glans pedicled flap have been performed at Ghent University Hospital. The specific surgical tricks used to preserve genital and tactile sensitivity are presented.

In phalloplasty, the dorsal hood of the clitoris is incorporated into the neoscrotum; the clitoris is transposed, buried, and fixed directly below the reconstructed phallic shaft; and the medial and lateral antebra- chial nerves are coapted to the inguinal nerve and to one of the 2 dorsal nerves of the clitoris. In vaginoplasty, the clitoris is reconstructed from a part of the glans penis inclusive of a part of the corona, the inner side of the prepuce is used to reconstruct the labia minora, and the penile shaft is inverted to line the vaginal cavity.

Material and Methods: A long-term sensitivity evaluation (performed by the Semmes-Weinstein monofilament and the Vibration tests) of 27 reconstructed phalli and 30 clitorises has been performed.

Results: The average pressure and vibratory thresholds values for the phallus tip were, respectively, 11.1 g/mm² and 3 μm. These values have been compared with the ones of the forearm (donor site). The average pressure and vibratory thresholds values for the clitoris were, respectively, 11.1 g/mm² and 0.5 μm. These values have been compared with the ones of the normal male glans, taken from the literature.

We also asked the examined patients if they experienced orgasm after surgery, during any sexual practice (ie, we considered only patients who attempted to have orgasm): all female-to-male and 85% of the male-to-female patients reported orgasm.

Conclusion: With our techniques, the reconstructed genitalia obtain tactile and erogenous sensitivity. To obtain a good tactile sensitivity in the reconstructed phallus, we believe that the coaptation of the cutaneous nerves of the flap with the ilioinguinalis nerve and with one of the 2 nerves of the clitoris is essential in obtaining this result. To obtain orgasm after phalloplasty, we believe that preservation of the clitoris beneath the reconstructed phallus and some preservation of the clitoris hood are essential. To obtain orgasm after a vagino-

plasty, the reconstruction of the clitoris from the neurovascular pedicled glans flap is essential.

Key Words: transsexualism, phalloplasty, vaginoplasty, sensitivity, gender dysphoria, sex reassignment surgery

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Tactile and erogenous sensitivity in reconstructed genitals is one of the goals in sex reassignment surgery (SRS).^{1–4}

Tactile sensitivity is important to avoid injuries to the genitals^{1–4} and, specifically, to allow the insertion of an erection prosthesis after phalloplasty.

Erogenous sensitivity is the condition to reach orgasm in genital sexual activities, like masturbation and intercourse.

In phalloplasty, microsurgical techniques allow for selection and coaptation of nerves from the donor flap to the recipient nerves in the perineum.⁵ Chang and Hwang⁶ coapted the medial antebra- chial nerve in the forearm flap to the nonerogenous saphenous and femoral nerves in 2 patients. Others used coaptation to the saphenous nerve,⁷ ilioinguinal and iliohypogastric nerves.⁸ Gilbert and associates³ reported coaptation of the pudendal nerve to the sensory nerves of several different free flaps in 12 cases. To obtain orgasm, the preservation of the clitoris seems to be very important.²

To provide erogenous sensitivity in the biologic male affected by gender identity disorder (previously named male-to-female [MTF] transsexualism), Brown^{9,10} described in 1976, the creation of a sensitive clitoris using the reduced glans, which remained attached to its dorsal penile neurovascular bundle.

The high percentages (33%) of necrosis of the clitoris reported by Brown^{9,10} provoked some authors to look for new techniques as a free composite graft of the tip of the penile glans to cover the shortened dorsal neurovascular bundle (Hage et al),¹¹ the glans to form a substitute of the uterine cervix (Malloy et al),¹² a small bud of corpus cavernosum covered by penile skin (Meyer and Kesselring),¹³ the corpus spongiosum as the vascular pedicle of the neoclitoris, preserving the glans (Rubin).¹⁴

Today, most surgeons performing clitoroplasty in transsexual patients use the dorsal portion of the glans penis, with the dorsal neurovascular pedicle,^{15–20} and they report less than the original Brown report.²⁰

The neuroanatomic basis for the protopathic sensibility of the human glans penis has been described.²¹ Normal penile

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sensitivity has been studied.^{5,22,23} Particularly, Gilbert et al⁵ used different methods (static and movement 2-point discrimination, localization, temperature differentiation, and pressure and vibratory thresholds) to evaluate penile sensitivity. Pressure and vibratory thresholds were demonstrated to be the most reliable and informative methods for testing penile sensitivity.

To our knowledge, in literature there are few reports which demonstrate the sensory recovery of innervated radial forearm free flaps.^{1,3,5,24–28} Several authors reported on the return of the erotic sensation to the neophallus and the ability to reach orgasm during sexual activity.^{5,27,28} For vaginoplasty (to our knowledge), sensitivity of the reconstructed clitoris (with the Brown technique) has rarely been tested.^{9,20}

Our center is presently among those with extensive experience in phalloplasty and vaginoplasty (P.H. and S.M.). This gives us the opportunity to focus on several aspects of gender identity disorder, from psychosocial to physical (and functional) well-being of patients, before and after surgery.

In literature, there is a lack of scientific evidence on genital sensitivity following SRS; subsequently, we designed a retrospective study in which a long-term sensitivity evaluation has been performed (by the Semmes-Weinstein monofilament test and the Vibration test) on 27 reconstructed phalli and 30 clitoris. Parallel to this study, sexual and physical health after SRS have been evaluated by our Ghent Gender Team: results of this work are published elsewhere.²⁹

MATERIALS AND METHODS

Since November 1993 until April 2003, 105 phalloplasties with the radial forearm flap (with the “Chinese” modified technique^{6,30}) and 127 vaginoclitoroplasties with the penoscotal inverted skin flap^{31,31a,32} modified^{33–36} and dorsal glans pedicled flap^{9,10,20} have been performed at Ghent University Hospital.

Study Population (see Table 1)

Out of 232 operated transsexuals (French and Dutch speaking), the 107 Dutch-speaking transsexuals (63 female-to-male [FTM] and 44 MTF) who had undergone SRS between 1986 and 2003 and had a minimum follow-up of 1 year were contacted.

Of the 107 persons who were eligible, 30 persons (28%) could not be reached (especially MTF), 15 persons (mainly FTM) refused to cooperate because they did not wish to be confronted with their past. Seven persons wanted to cooperate only if it did not involve coming to the clinic. The 55 others (24 FTM and 31 MTF) were all personally interviewed and examined by a multidisciplinary team (a psychologist or a sexologist, a surgeon, and an endocrinologist) to perform an extended follow-up evaluation of the different aspects of SRS. They were included in the study.

Out of this group of 55 patients, 1 MTF patient did not cooperate for this specific part of the follow up testing (Semmes-Weinstein monofilament and the Vibration tests). Three other FTM French-speaking patients, that could not be included in the psychological and sexological evaluation follow-up, have also been included in this genital sensitivity study. The final number of examined and tested patients was 27 FTM and 30 MTF transsexuals. The mean follow-up of the phalloplasty group was 3 years 6 months (range, 1 year to 8 years 6 months).

The mean follow-up of the vaginoclitoroplasty group was 4 years (range, 1–12 years). None of the researchers had been involved in the initial assessment or treatment of these patients.

Sensitivity Testing

A long-term sensitivity evaluation performed by the Semmes-Weinstein monofilament and the vibration tests of 27 reconstructed phalli and 30 clitorises has been performed. In this group of patients, pressure thresholds were measured with a set of 20 Semmes-Weinstein monofilament. The test was performed in the standard way as it was recommended by the manufacturer’s note (Smith and Nephew Rolyan, Menomane Falls, WI).

The values were converted to a measured stress (g/mm²).³⁷ A biotensiometer (Biomedical Instrument Co, Newbery, OH) was used to measure vibratory thresholds in the same reported way.³⁸ Values were expressed in micrometers.

In the literature, the average pressure and vibratory threshold values reported for the normal male glans are, respectively, 18.5 g/mm² and 0.20 μm.⁵ Values for pressure and vibratory threshold of normal female clitoris have been

TABLE 1. Study Population

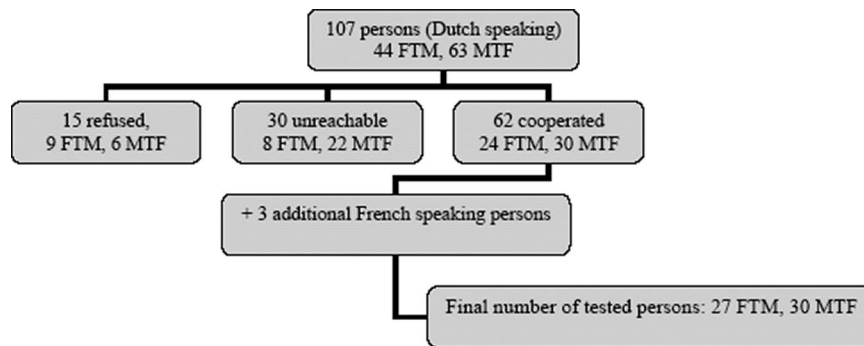




FIGURE 1. Phalloplasty, final result.



FIGURE 2. Vaginoplasty/clitoroplasty, final result.

measured.³⁹ However, the vibration test used in the study of the literature (Horwell Ltd, London, Great Britain) is different from ours, and the amplitude is graded differently, as well. Also, the values for the pressure Semmes-Weinstein test are reported in a different scale in that study³⁹ and are not comparable.

For the phalloplasties group, the tests were done on the tip of the phallus and on the dorsal shaft in the middle of the phallus. In these patients, the same tests were also performed on the distal volar side of the nonoperated forearm (contralaterally to the donor site of the radial forearm flap), on the area overlying the flexor carpi radialis tendon. For the vaginoplasties group, both the tests were performed on the reconstructed clitoris. Results were compared with normal values from the literature, particularly with the measurements of the pressure and vibratory thresholds of the normal glans⁵ and of other sensate radial forearm flap phalloplasties.^{1,5} Furthermore, patients were interviewed on their ability to reach orgasm by genital stimulation and intercourse. Details of these results have been published separately.²⁹

Surgical Technique

In phalloplasty (Fig. 1), the following technical aspects are important for genital sensitivity. (1) The dorsal hood of the clitoris, which has a high erogenous sensitivity,⁴⁰ is incorporated into the neoscrotum. (2) The clitoris is transposed, buried, and fixed directly below the reconstructed phallic shaft²; this new clitoris location will allow for erogenous stimulation, during phallic penetration or masturbation. (3) The medial and lateral antebrachial nerves are coapted to the inguinal nerve and to one of the 2 dorsal nerves of the clitoris.³

In vaginoclitoridoplasty (Fig. 2), the following aspects are important for preservation of genital sensitivity. (1) The clitoris is reconstructed from a part of the glans penis, including a part of the corona (which is erogenous most sensitive).^{9-10,20} (2) The inner side of the prepuce (which has erogenous sensitivity) is used to reconstruct the labia minora. (3) The penile shaft is inverted to line the vaginal cavity.³⁰⁻³⁵

RESULTS

Phalloplasty (Table 2)

The average pressure and vibratory threshold values for the phallus tip were, respectively, 11.1 g/mm² (range: 1.45–439) and 3 μm (range: 0.09, insensitive). The average pressure and vibratory thresholds values for the middle point of the dorsal shaft of the phallus were, respectively, 17.7 g/mm² (range: 2.20–439) and 2 μm (range: 0.64–9). For the forearm donor site (contralaterally to the harvested flap), the average pressure and

TABLE 2. Sensitivity Test in FTM

	Phallus, Dorsal Shaft	Phallus, Tip	Contralateral Nongrafted Forearm
Pressure threshold (g/mm ²)	17.7 (2.20–439)	11.1 (1.45–439)	3.25 (1.45–58)
Vibratory threshold (μm)	2 (0.64–9)	3 (0.09–25.5 insensitive)	0.6 (0.16–2)

TABLE 3. Sensitivity Test in MTF

	Clitoris	Normal Glans Tip
Pressure threshold (g/mm ²)	11.1 (1.45–47.3)	18.5
Vibratory threshold (μm)	0.5 (0.04–9)	0.2

vibratory threshold values were, respectively, 3.25 g/mm² (range: 1.45–58) and 0.6 μm (range: 0.16–2).

Vaginoplasty (Table 3)

The average pressure and vibratory threshold values for the clitoris were, respectively, 11.1 g/mm² and 0.5 μm. One patient had no sensitivity at all, and 1 patient confirmed that her sensitivity was reduced after a cerebrovascular attack.

Orgasm

We also asked the examined patients if they experienced orgasm after surgery, during any sexual practice (ie, we considered only patients who attempted to have orgasm). All FTM and 85% of the MTF patients experienced this; more detailed information has been published separately.²⁹

DISCUSSION

It has been shown in this study that preservation of genital sensitivity is feasible in SRS. To obtain sensitive sexual organs, some technical points are important.

Phalloplasty

As much erogenous tissue from the female genital area is preserved and incorporated in the reconstruction of the phallus as possible: the labia minora to reconstruct the urethra, the dorsal skin of the clitoris to reconstruct the ventral side of the scrotum, and the labia majora to reconstruct the scrotum. Furthermore, the positioning of the clitoris is crucial. Concerning its positioning, we used the technique of Hage and de Graaf,² but other positions have been described. Gilbert et al³ described a technique in which they replaced the clitoris on the dorsum of the phallic shaft near the base. Fang et al²⁷ replaced the clitoris below the shaft but ended up putting it at the junction of the neoscrotum and inner thigh after finding that sexual stimulation was better during sexual intercourse. Finally, the anastomoses of 2 cutaneous nerves of the forearm with an ilioinguinal nerve and one of the 2 dorsal clitoris nerves are important to gain tactile sensitivity and (probably) erogenous sensitivity. The tactile sensitivity is protective after the insertion of an erection prosthesis.

Gilbert et al⁵ performed the Semmes-Weinstein monofilament and the vibration tests on the phallus of 30 normal subjects and on 7 patients who underwent phalloplasty with the coaptation of the major nerve of the donor flap to the pudendal nerve or the dorsal nerve of the clitoris. All patients claimed the return of erogenous sensibility and the ability to masturbate to orgasm.

The flaps used and tested were the radial forearm, the upper lateral arm, and the dorsalis pedis. Comparing different flaps, results demonstrated that pressure and vibratory thresh-

olds were lower in the radial forearm flap compared with the other 2.⁵

Comparing our Semmes-Weinstein and Vibration test results with the results obtained by Gilbert et al⁵ on reconstructed phalli and the normal subjects, no major differences are noted. Pressure threshold values reported in this study (11.1 g/mm²) and in the Gilbert et al⁵ study (18.4 g/mm²) correlate with the normal penile controls over the glans (18.5 g/mm²) and the corona (18.4 g/mm²); considering the dorsal shaft of the phallus, contrary to the results of Gilbert et al,⁵ whose pressure thresholds values (37.6 g/mm²) were grossly insensate,⁵ our results (17.7 g/mm²) were more similar to the values of our reconstructed glans (11.1 g/mm²) and to the control group over the dorsal shaft (19.0 g/mm²).

In comparing vibratory threshold, results of the present study do not differ significantly from the Gilbert et al⁵ results (3 μm and 2 μm, respectively, for the tip and the dorsal shaft in our evaluation, 3.3 μm and 1.8 μm in the Gilbert et al⁵ evaluation). Compared with normal values, both our and the Gilbert et al⁵ results are very high, meaning that sensitivity is low and, if present, very inaccurate (0.20 μm for both glans tip and dorsal shaft of the control group).

We also compared the pressure and vibratory threshold values for the phallus tip (11.1 g/mm² and 3 μm) with values from the forearm donor site (contralaterally to the harvested flap) (3.25 g/mm² and 0.6 μm); a marked decrease was noted. Other works presented in literature, where sensory recovery after innervated radial forearm flap (for other indication than phalloplasty) was studied, used other tests than ours.^{24,25}

In the Gilbert et al⁵ series, the return of erogenous sensibility was present in all 7 patients who received phalloplasty with the coaptation of the major nerve of the donor flap to the pudendal nerve or the dorsal nerve of the penis. They also claimed the ability to masturbate to orgasm.

For Gilbert et al,⁵ the return to the erogenous sensibility might be owing to “dissociated sensibility,” that is, the ability of the brain to interpret other peripheral stimuli as erogenous in nature.

As we perform a nerve anastomosis with the dorsal clitoris nerve, the ability to reach orgasm might be more correlated with the direct erogenous stimulus following the clitoris nerve path.

In the series of Fang et al²⁷ on 22 phalloplasty in FTM transsexuals using free radial forearm flap, all preserved clitoris had erotic sensation; 8 out of 22 patients claimed they had erotic sensation on the neophallus, and one, whose pudendal nerve was anastomosed, could achieve orgasm by masturbation stimulating the neophallus only. In 9 cases that have regular sexual activities, all can achieve orgasm during intercourse, and all were satisfied with the results. In 1993, Hage et al¹ reported using the radial forearm flap for phalloplasty in 6 patients.

In all these cases, the lateral antebrachial nerve was coapted to one of the dorsal nerves of the clitoris: in all patients, tactile sensitivity, measured by pressure stimuli and vibratory sense (it is not specified what kind of means were used), recurred in the neophallus. These findings were in accordance with the results of Gilbert et al.⁵

However, unlike their findings, Hage stated that erogenous sensibility did not occur in any neophallus and that this should not be expected; Hage explained the occurrence of erogenous sensibility in the 3 transsexual patients reported by Gilbert et al,⁵ stressing the importance of the cortical control of the erogenous stimulation.

We disagree with Hage's hypothesis. Indirect proof that coaptation of nerves to the clitoris nerves plays a major role in the recovery of erogenous sensitivity is given by the series of Cheng et al²⁸ on 53 phalloplasties in males. In their procedure, the radial forearm lateral cutaneous nerve was coapted to the remaining part of dorsal penis nerve. Eighty-one percent of the patients reported having erogenous sensibility in their phalli at a follow-up evaluation 20 months postoperatively. Examination of these patients revealed a return of normal vibratory sensation, temperature differentiation, and localization of sensation in three-fourths of the penile skin. One quarter of the penis was insensitive, which was believed to be related to the sensory distribution of the lateral antebrachial cutaneous nerve.²⁸

Concerning orgasm, all FTM transsexual operated patients who attempted to reach orgasm were able to experience it in our series, as well as in other reported series.^{5,27} The quality of orgasm has been studied in our parallel study.²⁹

In our experience with 105 phalloplasties with the radial forearm flap for FTM transsexuals, we believe that, by coapting the nerves of the donor flap with the pudendal and ilioinguinal nerves, tactile sensitivity can be always expect. The presence of a tactile sensitivity can psychologically help to reach orgasm. We believe that orgasm is mainly due to the preservation of the clitoris, buried below the phallus, and to its stimulation, which can happen during masturbation and during sexual intercourse.

Vaginoplasty

In a review article, Hage and Karim²⁰ analyzed the points of the surgical technique used for vaginoclitidoplasty in MTF transsexuals; the glans pedicled flap is overall accepted to be the most important point of the technique to obtain an erogenous sensation. We fully agree with this. However, we also like to remember that erogenous sensation may also be present in the internal part of the reconstructed vagina (coming from the penile shaft), and at the vaginal introitus (coming from the scrotum and the perineal flap). Furthermore, the prostate is reached during vaginal intercourse and, as described in homosexual man having anal intercourse, this can be a source of erogenous sensitivity. In our technique, the internal side of the prepuce is used to reconstruct the labia minora; this also may give erogenous sensation.

Contrary to the opinion of Perovic et al,⁴¹ who believe that engorgement of the bulbar urethra is moderate and does not present a barrier to intercourse, we agree with Karim et al,⁴² preferring to remove this structure to avoid its swelling during sex arousal: this swelling may reduce the diameter of the vagina, making penetration more difficult and painful.

For vaginoplasty, comparing our pressure and vibratory threshold results (11.1 g/mm² and 0.5 μ m, respectively) with the average values reported in literature⁵ for the normal male

glans (18.5 g/mm² and 0.20 μ m respectively), we did not detect major differences.

Sensitivity of the reconstructed clitoris (with the Brown technique) has rarely^{9,20} and not meticulously been tested, and methods used and results obtained were not specified.

The reported percentage of orgasm (85%) in our group of patient does not differ with other reported figures (in the literature, ranges vary between 78% and 90%).^{19,20,42-44} The quality of orgasm has been studied in our parallel study.²⁹

Out of our extensive experience with 127 vaginoclitidoplasties with the penoscrotal and glans pedicled flaps for male gender-dysphoric patients (MTF transsexualism), we believe that the preservation of the male glans, pedicled, reshaped, and replaced to create a clitoris, is fundamental to keep the erogenous sensitivity.

In spite of the presence of an excellent sensitivity in all the MTF-operated patients, the percentage of patients who experienced orgasm was high (85%) but not present in all of them. Possibly, pain during sexual intercourse (due to, for example, an unlubricated reconstructed vagina or to a malpositioning of the erection implant in the reconstructed phallus) could stop the sensation coming from the stimulation of the reconstructed clitoris in MTF transsexuals or from the buried clitoris in FTM transsexuals.

In our parallel study,²⁹ the sexual and physical health after SRS has been evaluated; this demonstrated that, after SRS, transsexual persons' expectations were met at an emotional and social level but less so at the physical and sexual level, even though a large number of transsexuals (80%) reported improvement of their sexuality.

The FTMs masturbated significantly more frequently than MTFs, and a trend to more sexual satisfaction, more sexual excitement, and more easily reaching orgasm was seen in the FTM group. The majority of participants reported a change in orgasmic feeling, toward more powerful and shorter for FTM and more intense, smoother, and longer in MTF.

A significant correlation between general and sexual correlation was also found; when evaluating changes in sex life before and after SRS, 75.5% of participants indicated an improvement and 12.3% a worsening; pain, lack of sensation, and difficulties relaxing were reported in this context. Also, a correlation between the improvement in sex life and the satisfaction with the new primary sex characteristics (scored with the Body Image Scale) was found; differently, a correlation between satisfaction with the secondary or neutral sexual characteristics was not found²⁹; this gives rise to the importance of the SRS and to the sexual functioning (and sensitivity) obtainable with it. More, it has been proved statistically that MTF transsexuals were sexually excited more often than before: the more frequently participants experienced sexual excitement, the more they felt their sexual life had improved.

FTM participants masturbated more frequently after SRS compared with before, regardless of having a partner. FTM sexual activity preoperatively involved their clitoris (more than their vagina), whereas after surgery it involved their penis (and the clitoris buried at its base). MTF sexual activity preoperatively occurred through vaginal and anal

penetration, while postoperatively mostly by vaginal intercourse.

Over two thirds of MTF reported the secretion of a vaginal fluid during sexual excitation (even before orgasm), originating from the Cowper's glands, left in place during surgery.

In FTM with erection prosthesis, sexual expectations were more realized (compared with those without), but pain during intercourse was more often reported.²⁹

The connection of one of the nerves of the radial forearm flap to the ileoinguinalis nerve is very probably giving proprioception to the phallus (the ability to sense the position, location, orientation, and movement of a body part, and probably this proprioceptive sensation is responsible for pain during intercourse; however, it has a protective function against perforation of the prosthesis. Pain may also be explained by an exaggerated pressure of the erection prosthesis on the free forearm flap or by irritation of the pubic bone at the place of fixation.

To conclude, we feel that during the preoperative period more attention should be paid to sexual expectations and to possible sexual changes to help the patients to cope with these new sensations. Indeed, as affirmed many times,⁴⁵ the brain also plays a fundamental role in facilitating or blocking the sensations in both genders.

CONCLUSION

Based on our extensive experience of 105 phalloplasties with the radial forearm free flap and 127 vaginoclitoridoplasties with the penoscrotal inverted and glans pedicled flaps, performed by the Gender Team of the University Hospital of Gent, Belgium, the points of the surgical techniques used are discussed, and the results of the Semmes-Weinstein monofilament and vibratory tests of a smaller group of operated transsexuals are presented.

These last examinations demonstrated the presence of tactile sensitivity. Further study using neuroimaging tests would be useful to demonstrate the presence of the erogenous sensitivity.

To obtain a good tactile sensitivity to the reconstructed phallus, we believe fundamental the coaptation of the cutaneous nerves of the flap with the ilioinguinalis nerve and with one of the 2 nerves of the clitoris. To obtain orgasm after phalloplasty, we believe fundamental preserving of the clitoris beneath the reconstructed phallus (if the brain is not blocking the sensations). To obtain orgasm after vaginoplasties, we confirm the importance of the glans pedicled flap.

Our parallel study on sexual and physical health after SRS demonstrated that transsexuals' expectations were met at an emotional and social level but less so at a physical and sexual level, even though 80% of transsexuals reported an improvement of their sexuality after SRS; a good number of patients had good sensitivity and orgasm.

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