Mapping a Danger Zone of the Dorsal Nerve of the Clitoris: Implications in Female Cosmetic Genital Surgery

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Background: The literature regarding the route of the dorsal nerve of the clitoris is sparse and lacks surgical focus. With an increasing number of procedures being performed on the labia, it is important to elucidate the route and note any variation from normal of the nerve.

Methods: Fifty-one cadavers were dissected to yield 97 dorsal nerve of the clitoris samples. Measurements were taken from (1) the dorsal nerve of the clitoris penetration point of the perineal membrane to the urethra, (2) the nerve’s penetration point of the perineal membrane to the pubic bone, (3) the angle of the clitoris to the branch point of the dorsal nerve of the clitoris, and (4) the branch point of the nerve to the distalmost point of the glans clitoris. Any anomalous branching patterns of the dorsal nerve of the clitoris were recorded and classified.

Results: The means and standard deviations of each measurement were used to create a surgical danger zone. The mean of each measurement was (1) 34.63 mm, (2) 5.74 mm, (3) −3.07 mm, and (4) 30.40 mm, respectively. In addition, six distinct branching patterns were observed, organized, and classified based on the location and number of branches observed.

Conclusions: The dorsal nerve of the clitoris has multiple branching patterns and typically travels along the same course in most women. Further investigation of the course and three-dimensional position of the dorsal nerve of the clitoris is warranted to preserve sexual sensation as the frequency of procedures involving the female pudendum increases. (Plast. Reconstr. Surg. 148: 1005, 2021.)

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of dorsal nerve of the clitoris injury during vulvar procedures is not currently known. This study aims to build on previous studies by creating a danger zone for surgical procedures involving the external female perineal area and elucidating any branching patterns of the dorsal nerve of the clitoris that have not been previously reported.

PATIENTS AND METHODS

The population for this study was 51 female cadavers at the University of Nebraska Medical Center, Creighton University, and the anatomy laboratories on both campuses of Kansas City University. The majority of the cadavers provided two samples, leading to a total sample size of 97 dorsal nerves of the clitoris. A shallow vertical incision was made from the pudendal cleft superiorly through the mons pubis. The glans clitoris was located and used as a landmark, as the fascia surrounding the body of the clitoris in the area of the labia minora was carefully dissected. The dorsal nerve of the clitoris was located at the penetration point of the perineal membrane and traced distally to the initial branch point of the dorsal nerve of the clitoris. Further dissection was avoided to preserve the natural position of the dorsal nerve of the clitoris and its relationship to the clitoris and other nearby structures.

Measurements were then made between four specific landmarks using a digital caliper (in millimeters). The measurements that were taken are as follows:

1. From the penetration point of the dorsal nerve of the clitoris through the perineal membrane to the external urethral orifice.
2. From the penetration point of the dorsal nerve of the clitoris through the perineal membrane to the pubic bone.
3. Between the apex of the angle of the clitoris to the initial dorsal nerve of the clitoris branch point (branching proximal to the angle was recorded as a negative value).
4. From the initial dorsal nerve of the clitoris branch point to the prepuce of the clitoris.

Seventy-two of the total population of dorsal nerves of the clitoris were evaluated to observe the terminal branching pattern of the dorsal nerve of the clitoris. This zone depicts where the nerve travels relative to known landmarks and maps areas surgeons should avoid when performing operations in this area. Interrater reliability was fair to good or better according to the Fleiss scale. The interrater reliability findings are depicted in Table 2.

Pictures of the 35 unique branching dorsal nerves of the clitoris were analyzed and organized into types. Branching patterns and type groupings are diagrammed in Figure 2. The type 1 branching pattern was observed in 51.4%

| No. | Mean measurement, mm | Value (SD) |
|-----|----------------------|------------|
| 1   | 34.63 (6.95)         |            |
| 2   | 5.74 (3.04)          |            |
| 3   | −3.07 (11.24)        |            |
| 4   | 30.40 (7.22)         |            |
percent of the specimens. This pattern matches the classic description the dorsal nerve of the clitoris, whereby the nerve splits into two terminal branches. Nerves whose branching patterns deviated from the classic description were initially grouped based on the location of the initial branch point. If the initial branch point was “early” (meaning near, or proximal to the perineal membrane), the pattern was classified as type 2. Types 3 through 6 are classified based on the number of terminal branches produced by the dorsal nerve of the clitoris. The type 3 group possessed three branches, the type 4 group possessed four branches, the type 5 group possessed five branches, and the type 6 group possessed more than five branches. Specific branching patterns included in each category are depicted in Figure 2. Figure 2 also depicts variations within each type. Photographic example of a dissection of type 1 is shown in Figure 3.

### DISCUSSION

This study maps out a danger zone for the dorsal nerve of the clitoris and elucidates branching patterns not previously described in the literature. This work builds on the idea that Vaze et al. put forth regarding the importance of the knowledge about the terminal dorsal nerve of the clitoris so that physicians can avoid it during surgery by creating a surgical danger zone.9 In addition to providing a surgical danger zone, this study expands on the termination of the dorsal nerve of the clitoris that has only previously been described as the nerve fanning out,6 by mapping out the complicated terminal branches of the dorsal nerve of the clitoris.

This study significantly adds to the literature regarding the course of the dorsal nerve of the clitoris. The dorsal nerve of the clitoris innervates the clitoris, which is an integral part of sexual arousal, which suggests that its course is important topography to avoid during any surgical procedure in that area.3,10,11 Di Marino and Lepidi break the nerve into segments: the initial/ischiopubic segment, the first/pubic elbow, the ascending clitoral segment, the second/clitoral elbow, the clitoral descending segment, and the nerve ending.12 This study discusses all but the first segment of the dorsal nerve of the clitoris. We generally found it accurate that Di Marino and Lepidi described that the dorsal nerve of the clitoris

### Table 2. Interrater Reliability Findings

| Measurement | ICC  | Strength According to Fleiss* |
|-------------|------|--------------------------------|
| 1           | 0.50 | Fair to good                   |
| 2           | 0.56 | Fair to good                   |
| 3           | 0.98 | Excellent                      |
| 4           | 0.68 | Fair to good                   |

ICC, intraclass correlation coefficient.

*Fleiss JL. Reliability of measurement. In: The Design and Analysis of Clinical Experiments. New York: Wiley; 1986:1–32.
started at the first/pubic elbow, then traveled superficial to the pubic symphysis on the dorsal portion of the clitoris, where it continued, to meet the crural termination. After that, it matched the angle of the clitoral body as it travels toward the glans, where it becomes the terminal nerve endings. This study also echoed previous studies by finding no nerves at the 12-o’clock position, with nerves running laterally on both sides. Although some of those studies differ on whether the dorsal nerve of the clitoris runs at the 1- and 11-o’clock or 2- and 10-o’clock positions, these findings echo Kelling et al. in the fact that there is simply variation between those positions.

This study also discusses five previously unreported branching patterns, with their respective subtypes described as well. The fact that the nerve branches extensively distally is supported by the fact that the nerves’ width decreased as it continued to travel toward the glans clitoris and by the fact that other studies have noted that the nerve fans out. Elucidating these major patterns is important in the anatomical and surgical fields to help surgeons be aware that anomalous branches

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Fig. 2. Depiction and number of branching pattern types.
may exist when performing surgery so that they can avoid them.

In addition, it is important to consider the course of the dorsal nerve of the clitoris and the branching patterns because of the way that labiaplasties are being performed. When describing one of the most popular techniques for labiaplasty (which has several variations), Alter says that “the mucosa and outer skin are removed while attempting to keep most subcutaneous tissue” and further notes that “enough subcutaneous tissue is excised to produce a good cosmetic result.” The labiaplasty surgical technique described by Alter recommends surgically entering an area where the dorsal nerve of the clitoris could be located in the deep subcutaneous tissue. Alter also describes the incision of the wedge at or posterior to the prepuce of the clitoris to where it converges with the frenula of the clitoris, which is similar in description to clitoral hood reduction, a procedure that often accompanies a labia minora reduction. Hunter further comments on this by stating that the glans clitoris should never be further exposed during a clitoral hood reduction and calls for superficial excision only to maintain clitoral sensation, which is echoed in another study that only looked at outcomes for superficial hood resection and did not attempt ventral hood resections. Another technique that could enter the area where the dorsal nerve of the clitoris runs is the modified central wedge. Giraldo et al. describe this technique as a way to remove the most prominent, ventral portion of the labia minora, with cuts extending from the central portion of the labia minora to the base (on or near the clitoral hood). This is another risk to the dorsal nerve of the clitoris, as it is may expose too much glans clitoris (as Hunter advised against) and possibly injure the nerve where it is running most superficially. From what is known about dorsal nerve of the clitoris anatomy from this study and others, entering too deep into subcutaneous tissue anywhere or too deep during clitoral hood resection could cause devastating effects to the dorsal nerve of the clitoris. Surgeons should be cautious and informed when performing this procedure, which is known to be one of the best to preserve normal anatomy—the goal for any cosmetic procedure.

Even with this knowledge of the possible danger of labia- and clitoral hood–reduction operations, an increasing number of operations are being performed in the perineal area. In addition, the outcomes of these operations are being understudied and underreported and looked at only in optimal circumstances. Study results stem only from accomplished surgeons, and complication rates from other surgeons might be vastly different. Furthermore, labiaplasty is the only nationally tracked operation, meaning we know less about clitoral hood reduction, which may be more dangerous for the operations. These facts mean that the current data are insufficient to truly explore what harm can come from these operations, and it is important to continue to study the dorsal nerve of the clitoris to ensure the best outcomes for patients. Because the dorsal nerve of the clitoris innervates the clitoris and is an intricate part of female sexual pleasure, injury to the nerve during surgery can cause life-altering negative affects to a woman’s physical and mental health, further highlighting the importance of this research. One limitation to the current study may have been that the process of dissection may free up nerve enough to affect the measurements. However, care was taken to ensure the nerve remained on its natural course before measurements were obtained. Furthermore, the nerve was not dissected distally so that attachment would preserve the original pathway. Also, as more patterns (specifically, early branching patterns) were discovered, some of the measurements may have been skewed because of being defined by a specific “initial” branching point that was difficult to determine when there was more than one. In addition, as dissection proceeded, it was noted that some of the measurements could potentially be skewed by body habitus because of the amount of dissection necessary to reach the nerve. Although it is important to note that the nerve will be deeper in women with a larger body habitus, it did skew...
some of the measurements because the spaces were larger and longer because of previously having been filled by adipose tissue. The study population was relatively homogeneous, with most of the cadavers being elderly, Caucasian women and, as such, these findings may differ from the findings of a similar study with a more racially diverse sample population or from women of a younger age. Finally, this project was conducted over more than 1 year, and dissections looking for novel branching patterns occurred only during year 2, which is why the sample size is smaller for that portion of the study.

In the future, studies should be conducted to further map this area into a three-dimensional danger zone. Measurements should be taken with regard to how inferior and medial this nerve runs relative to the total body habitus. Future studies should also measure epithelium-to-dorsal nerve of the clitoris distances at several intervals to help expand on this. Finally, further studies should also be conducted to further elucidate branching patterns.

CONCLUSIONS

The dorsal nerve of the clitoris is an important part of female sexuality and needs to continue to be studied to further elucidate any terminal branching patterns and note any variations so that surgeons can avoid them during procedures such as labiaplasty. The dorsal nerve of the clitoris travels on average 34.63 mm away from the urethra and 5.74 mm away from the pubic bone when it pierces the perineal membrane. It also splits, on average, 3.07 mm before the angle of the clitoris and 5.74 mm away from the pubic bone when it pierces the perineal membrane. Six unique terminal branching patterns were observed and classified based on the proximity of the initial branching and number of branches produced. Further studies should attempt to use a more diverse population and continue to elucidate the dorsal nerve of the clitoris terminal branching patterns and expand on the danger zone that was created.

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