OPEN

PRS GLOBAL OPEN

ORIGINAL ARTICLE
Gender-Affirming Surgery

A Relative Value Unit–Based Model for Targeted Nipple–Areola Complex Neurotization in Gender-Affirming Mastectomy

Rishub K. Das, BA*
Katya Remy, MD†
Justin C. McCarty, DO, MPH†
Ian L. Valerio, MD, MS, MBA†
William G. Austen Jr, MD†
Katherine H. Carruthers, MD, MS†

Background: For transmasculine individuals, double-incision mastectomy with free nipple grafts is the most common procedure for gender-affirming chest masculinization. However, patients report decreased sensation postoperatively. Direct coaptation of intercostal nerves to the nipple–areolar complex (NAC) is an experimental technique that may preserve postoperative sensation, yet whether reimbursements and billing codes incentivize hospital systems and surgeons to offer this procedure lacks clarity.

Methods: A retrospective cross-sectional analysis of fiscal year 2023 Medicare physician fee schedule values was performed for neurotization procedures employing Current Procedural Terminology codes specified by prior studies for neurotization of the NAC. Additionally, operative times for gender-affirming mastectomy at a single center were examined to compare efficiency between procedures with and without neurotization included.

Results: A total of 29 encounters were included in the study, with 11 (37.9%) receiving neurotization. The mean operating time was 100.3 minutes (95% CI, 89.2–111.5) without neurotization and 154.2 minutes (95% CI, 139.9–168.4) with neurotization. In 2023, the average work relative value units (wRVUs) for neurotization procedures was 13.38. Efficiency for gender-affirming mastectomy was 0.23 wRVUs per minute without neurotization and 0.24 wRVUs per minute with neurotization, yielding a difference of 0.01 wRVUs per minute.

Conclusions: Neurotization of the NAC during double-incision mastectomy with free nipple grafts is an experimental technique that may improve patient sensation after surgery. Current reimbursement policy appropriately values the additional operative time associated with neurotization relative to gender-affirming mastectomy alone. *(Plast Reconstr Surg Glob Open 2024; 12:e5605; doi: 10.1097/GOX.0000000000005605; Published online 8 February 2024.)*

INTRODUCTION

Since the passage of section 1557 of the Affordable Care Act in 2016, rates of gender-affirming surgery have increased substantially due to greater availability of trained surgeons, insurance coverage, and recognition of the emotional and physical benefits of such procedures.[1–4]

*From *Division of Plastic and Reconstructive Surgery, Vanderbilt University Medical Center, Nashville, Tenn.; and †Division of Plastic and Reconstructive Surgery, Massachusetts General Hospital, Harvard Medical School, Boston, Mass.*

Received for publication November 3, 2023; accepted December 15, 2023.

DOI: 10.1097/GOX.0000000000005605

For transmasculine individuals, the most common procedure is gender-affirming mastectomy, or masculinizing top surgery.[5] This procedure is indicated for adults and adolescents with sustained dysphoria of the chest. Between 2016 and 2019, the rate of gender-affirming mastectomy increased by 143.2% among transgender and/or gender diverse adults and by 389.0% among adolescents.[2,6] Accordingly, education and research in gender-affirming mastectomy is now a core component of plastic surgery training.[3]

Double-incision mastectomy with free nipple grafts is the technique most often used to address dysphoria of the chest, and it has been shown to achieve an acceptable cosmesis, while improving gender congruence as well as body image satisfaction.[7] The dominant sensory innervation to the anterior chest wall and nipple areolar complex (NAC) is from the lateral cutaneous branches of the third through

Disclosure statements are at the end of this article, following the correspondence information.

fifth intercostal nerves.[8,9] These nerves are traditionally transected during gender-affirming mastectomy, resulting in nearly all patients reporting decreased anterior chest wall and nipple sensation at more than 1 year postoperatively. Although most patients report improvements in dysphoria and regret is low after surgery, approximately two-thirds of patients report loss of nipple sensation altogether, and one in five are completely dissatisfied with their lack of nipple sensation.[10–12] These paresthesias can have permanent consequences for patients, including risk of unintentional trauma to the anterior chest wall and decreased chest-related sensuality. A survey of transmasculine patients conducted by Song et al found that nipple sensation was important to 76% of the respondents.[13]

Advances in peripheral nerve surgery have allowed for the pioneering of new strategies to neurotize the chest during gender-affirming mastectomy.[14] Rochlin et al and Gfrerer et al describe techniques that use either direct coaptation or an allograft interposition to reinnervate the NAC with the lateral cutaneous branches of the intercostal nerves preserved during dissection.[15,16] Preliminary results are promising; however, cost and surgeon time are routinely cited as barriers to implementing neurotization techniques during gender-affirming mastectomy across the literature. Moreover, there is a growing concern for barriers to financing and sustaining experimental microsurgery techniques, including neurotization and lymphatic reconstruction.

Work relative value units (wRVUs) represent the technical skill, physical effort, mental effort and judgement, stress related to patient risk, and the amount of labor required to perform a procedure. Using conversion factors, wRVUs can be converted into dollar amounts to estimate reimbursement from payers. It is unknown what effect longer operating times for reinnervation during gender-affirming mastectomy will have on surgeon and healthcare system productivity. In this context, we sought to understand how neurotization procedures are currently valued and the feasibility of targeted NAC reinnervation in gender-affirming mastectomy. We investigated relative value units (RVUs) and efficiency, defined as RVUs per minute, for these procedures.

Takeaways

Question: Is the additional operative time associated with targeted nipple–areola complex neurotization during gender-affirming mastectomy appropriately valued in the current reimbursement landscape?

Findings: Using the Medicare physician fee schedule and operative times from 29 gender-affirming mastectomy encounters, we found that efficiency for gender-affirming mastectomy was 0.23 work relative value units (wRVUs) per minute without neurotization and 0.24 wRVUs per minute with neurotization, yielding a difference of 0.01 wRVUs per minute.

Meaning: The additional operative time associated with targeted nipple–areola complex neurotization during gender-affirming mastectomy is appropriately valued when compared with gender-affirming mastectomy alone.

METHODS

A retrospective, cross-sectional analysis of fiscal year 2023 Medicare physician fee schedule values for mastectomy (19303), breast reduction (19318), and neurotization procedures, using a list of Current Procedural Terminology (CPT) codes specified by prior studies, was performed.[17] The physician fee schedule provided historical monetary pricing for healthcare services, including surgical procedures based on RVUs.[18] Procedures using direct coaptation of nerves as well as allografts were included in the analyses. A total of nine CPT codes for neurotization and gender-affirming mastectomy were included (Table 1). The physician fee schedule was queried to determine RVUs for the CPT codes included. RVUs were averaged to account for differences in billing and coding strategies that may exist based on institution or individual encounters. Bilateral and multiple procedure modifiers were applied, which reduced wRVUs for each additional CPT code after the first by 50%.

We additionally examined operative times at our center for gender-affirming double-incision mastectomy with free nipple grafts to compare efficiency between procedures that included neurotization and those

Table 1. Work RVUs for Breast Neurotization Procedures from the Physician Fee Schedule 2023*

CPT Code	Procedure	2023 wRVUs (Reimbursement, $)
Neurotization		
64901	Nerve graft, each additional nerve, single strand	10.23 (594.38)
64902	Nerve graft, multiple strands	11.81 (688.59)
64905	Nerve pedicle transfer (1st stage)	15.11 (1018.99)
64907	Nerve pedicle transfer (2nd stage)	20.03 (1314.15)
64910	Nerve repair with synthetic conduit or vein allograft	10.52 (771.95)
64911	Nerve repair with autogenous vein graft	14.00 (1038.98)
64912	Nerve repair with allograft first strand	12.00 (907.84)
	Average	13.38 (904.98)
Gender-affirming mastectomy		
19303	Mastectomy	15.00 (971.89)
19318	Breast reduction	16.03 (1108.11)
	Average	15.52 (1040.00)

*Data are extracted from the Centers for Medicare & Medicaid Services' Physician Fee Schedule Lookup Tool (accessed July 29, 2023).

Table 2. Comparison of Efficiency Between Gender-affirming Mastectomy with and without Neurotization

	Bilateral Gender-affirming Mastectomy		
	Without Neurotization (n = 18)	With Neurotization (n = 11)	Difference
Mean operative time (95% CI), min	100.3 (89.2–111.5)	154.2 (139.9–168.4)	53.8 (35.8–71.9)
Total wRUVs	23.28	36.66	13.38
Efficiency (95% CI), wRVUs/min	0.23 (0.21–0.26)	0.24 (0.22–0.26)	0.01 (0.00–0.02)

that did not. A prospective study was conducted over a 12-month period, where patients receiving double-incision mastectomy for gender dysphoria with and without neurotization were enrolled at the time of surgical consultation with one of two providers. Information on the use of neurotization and incision time to procedure end was collected for each encounter. We followed the technique described by Gfrer et al for patients who received immediate neurotization during gender-affirming mastectomy.[19] Briefly, the third, fourth, and/or fifth lateral intercostal nerves were identified and dissected free from the breast parenchyma during dissection of the lateral outer quadrant of the chest. For each preserved nerve, neurorrhaphy was performed to the exposed dermal surface of the deepithelialized recipient site for the free nipple grafts on the superior skin flap. This study was reviewed and approved by an institutional review board (protocol # 2021P002932). Data are reported as mean with a 95% confidence interval. A two-sample *t* test was used to compute significance between cohorts. Significance was defined as a two-sided *P* value less than 0.05. Analyses were computed in Stata version 17 (StataCorp LP, College Station, Tex.).

RESULTS

In 2023, the wRVUs of CPT codes that are commonly used for neurotization procedures had an average of 13.38 and included the following: 64901 (nerve graft, single strand; wRVUs, 10.23), 64902 (nerve graft, multiple strands; wRVUs, 11.81), 64905 (nerve pedicle transfer, first stage; wRVUs, 15.11), 64907 (nerve pedicle transfer, second stage; wRVUs, 20.03), 64910 (nerve repair with synthetic conduit or vein allograft; wRVUs, 10.52), 64911 (nerve repair with autogenous vein graft; wRVUs, 14.00), 64912 (nerve repair with allograft; wRVUs, 12.00).

A total of 29 encounters for gender-affirming double-incision mastectomy with free nipple grafts were included (Table 2). Of these, 11 (37.9%) received neurotization during the procedure with either direct coaptation of intercostal nerves or coaptation using an interpositional allograft nerve. The mean operating time was 100.3 (95% CI, 89.2–111.5) minutes without neurotization and 154.2 (95% CI, 139.9–168.4) minutes with neurotization. The difference in operating time between cohorts was 53.8 (95% CI, 35.8–71.9; $P < 0.001$) minutes.

The wRVUs in 2023 for bilateral gender-affirming mastectomy without neurotization were 15.00 for 19303 (mastectomy) and 16.03 for 19318 (breast reduction) with an average of 15.52. The average total wRVUs for bilateral gender-affirming mastectomy alone was 23.28 using 100% of the allocation for the first side (15.52 wRVUs) and 50% for the contralateral side (7.76 wRVUs). For bilateral masculinizing top surgeries with neurotization, the total wRVUs were estimated at 36.66 by adding the wRVUs for gender-affirming mastectomy alone (23.28 wRVUs) to the average wRVUs for neurotization procedures with the multiple procedures modifier (13.38 wRVUs total, 6.69 wRVUs each side). Efficiency for gender-affirming mastectomy was 0.23 wRVUs per minute without neurotization and 0.24 wRVUs per minute with neurotization, yielding an increase of 0.01 wRVUs per minute (or 4%) for procedures that included neurotization.

DISCUSSION

In this study, we found that billing codes for neurotization of the NAC during gender-affirming mastectomy seemed to appropriately value physician effort. Based on the operating times from this study, efficiency was similar or slightly higher for masculinizing top surgeries with neurotization when compared with those without neurotization. Accordingly, current RVU rates incentivize surgeons to offer neurotization for patients who are interested in preserving nipple and anterior chest wall sensation. From a surgeon's perspective, neurotization during gender-affirming mastectomy may improve patient satisfaction and outcomes while also bolstering productivity metrics, thus making it economically and financially sustainable for the hospital system. These findings contribute to the growing literature that analyzes challenges related to valuation and financing of complex microsurgical techniques.[20]

Evidence supporting the benefits of neurotization of the NAC during gender-affirming mastectomy, either with direct coaptation of intercostal nerves or use of an interpositional nerve allograft, are increasing in number and quality. The study by Rochlin et al of 10 patients undergoing gender-affirming mastectomy with direct coaptation of intercostal nerves to free nipple grafts found that treatment with neurotization was found to significantly improve objective sensation outcomes using monofilament testing when compared with controls.[16] Moreover, there was no significant difference between pre- and postoperative nipple sensation for patients who received neurotization, whereas controls reported significantly decreased postoperative nipple sensation even at one year follow-up. Most masculinizing top surgeries are performed in patients aged 18–25 years.[2] These patients may also uniquely benefit from neurotization, as data for other nerve reconstructive procedures suggest that younger

patients have better nerve recovery after coaptation.[21,22] Previous studies evaluating neurotization in breast reconstruction have demonstrated similar results with nearly all patients reporting the same or improved nipple sensation after surgery.[23–25] Despite these promising results, larger, long-term outcomes evidence is needed to validate neurotization during gender-affirming mastectomy and characterize the technique's safety profile.

Increased operative time and surgeon labor are perceived as barriers to implementation of neurotization strategies in breast surgery. Our analysis found that neurotization added 53.8 minutes to the length of surgery on average. This aligns with previously reported estimates of approximately 40 minutes, or 20 minutes on each side, though no large retrospective analyses have been conducted.[19] Neurotization during gender-affirming mastectomy requires a careful dissection to avoid transecting intercostal nerves and ensure there is substantial nerve length to allow for coaptation. The technique can be challenging at first, but over time surgeons may become adept, reducing the need for an allograft nerve and improving efficiency as well as reducing cost of materials.

Despite the modest increase in operative time associated with isolating the intercostal nerves and coapting them to the dermis of the superior mastectomy flap, there was no difference in wRVUs per minute for masculinizing top surgeries that include neurotization. Described techniques recommend the use of all viable intercostal nerves for neurotization; however, future studies may find that coaptation of one or two nerves are sufficient to preserve nipple sensation. This scenario could reduce postoperative hypersensitivity and further reduce operative time, improving productivity for surgeons.

As the field of plastic surgery grows and our capabilities to improve form and function expand, imbalances in procedural valuation may create barriers in accessing certain procedures for patients and contribute to burnout among the surgeon workforce. Our results show that although the technique demands additional cognitive effort, skill, and resources, the current practice environment favors neurotization of the NAC in gender-affirming mastectomy, especially as surgeons become more experienced with the procedure. Larger prospective studies are needed to evaluate the efficacy and long-term postoperative outcomes after neurotization of the NAC during gender-affirming mastectomy.

Several limitations to this study should be noted. First, this is a cross-sectional study of the Medicare physician fee schedule involving the use of billing codes to identify relevant procedures. The physician fee schedule is updated annually; therefore, the wRVU rates represented in this study may change in the future. Billing practices vary by institution, and the same procedure may be billed using different CPT codes. To address these possible differences, we investigated all billing codes associated with neurotization, based on previous literature, and presented an average of the relevant outcome measures for this study. Some institutions may bill for nipple grafts and reconstruction, but the addition of these billing codes would not affect the conclusions of this analysis. Moreover, mean operative times were acquired from a single center with only two surgeons, which may limit generalizability. Breast reinnervation requires a team-based approach. The presence of intraoperative assistance (including residents and their skill levels) was not analyzed in this study but may influence operative times and efficiency. Similarly, the use of allograft nerves may also increase operative times and the cost associated with procuring the graft and additional coaptations.

Coaptation of the intercostal nerves to the NAC during gender-affirming mastectomy with free nipple grafts increases the complexity and operative time the procedure, but the additional cognitive demands and resources required are appropriately valued by the Medicare physician fee schedule. Although additional prospective studies are needed to evaluate long-term postoperative outcomes in nipple and anterior chest wall sensation, preliminary data suggest that current techniques for neurotization are effective in preserving and, in some cases, increasing sensation.[15,16] Future work should investigate objective and patient-reported outcomes after neurotization and evaluate patient perspectives on nipple preservation. The development of patient-reported outcome measures serves several purposes from enhancing communication between surgeons and patients to providing standardized measures to assess the effectiveness of interventions such as gender-affirming surgery.[26] Several guidelines have been developed in the creation of Patient-reported outcome measures, and it is essential that future studies consider the benefits and limitations of these measures.[27,28] Not all patients undergoing gender-affirming mastectomy have the same gender identity; therefore, data on both the patient's sex assigned at birth and their current gender identity should be collected.[29] Furthermore, refining the surgical technique and reaching consensus on the number of coapted nerves necessary to preserve sensation may improve outcomes and efficiency.

CONCLUSIONS

By analyzing operative times at a single center and wRVUs from the Medicare physician fee schedule, we found that the current practice environment appropriately values the additional operative time and demands required to neurotize the NAC during gender-affirming mastectomy with free nipple grafts. These results suggest that it is economically and professionally sustainable for surgeons to offer patients these procedures, especially as surgeons become more familiar with the procedure and the technique is refined.

Katherine H. Carruthers, MD
Division of Plastic and Reconstructive Surgery
Department of Surgery
Massachusetts General Hospital
Harvard Medical School
55 Fruit St. WACC-435
Boston, MA 02114
E-mail: khcarruthers@mgh.harvard.edu

DISCLOSURES

Dr. Valerio is a consultant for Axogen Inc, Checkpoint Surgical Inc, and Integra Lifesciences. All the other authors have no financial interest to declare in relation to the content of this article.

REFERENCES

1. Das RK, Drolet BC. California's state insurance gender nondiscrimination act and utilization of gender-affirming surgery. *JAMA*. 2023;329:2193.
2. Das RK, Evans AG, Kalmar CL, et al. Nationwide estimates of gender-affirming chest reconstruction in the United States, 2016–2019. *Aesthet Surg J*. 2022;42:sjac193.
3. Das RK, Drolet BC. Training surgery residents in gender-affirming surgery. *JAMA Surg*. 2022;157:651–652.
4. Lane M, Ives GC, Sluiter EC, et al. Trends in gender-affirming surgery in insured patients in the United States. *Plast Reconstr Surg Glob Open*. 2018;6:e1738.
5. Das RK, Al Kassis S, Drolet BC. Payer shifts for gender-affirming chest reconstruction. *JAMA Surg*. 2022;157:1167–1168.
6. Das RK, Perdikis G, Al Kassis S, et al. Gender-affirming chest reconstruction among transgender and gender-diverse adolescents in the US from 2016 to 2019. *JAMA Pediatr*. 2023;177:89–90.
7. Rifkin WJ, Robinson IS, Kloer C, et al. Gender-affirming mastectomy: comparison of periareolar and double incision patterns. *Plast Reconstr Surg Glob Open*. 2022;10:e4356.
8. Smeele HP, Beugels J, Kuijk SMJ van, et al. Learning sensory nerve coaptation in free flap breast reconstruction. *J Reconstr Microsurg*. 2023.
9. Smeele HP, Bijkerk E, van Kuijk SMJ, et al. Innervation of the female breast and nipple: a systematic review and meta-analysis of anatomical dissection studies. *Plast Reconstr Surg*. 2022;150:243–255.
10. Ascha M, Sasson DC, Sood R, et al. Top surgery and chest dysphoria among transmasculine and nonbinary adolescents and young adults. *JAMA Pediatr*. 2022;176:1115–1122.
11. Poudrier G, Nolan IT, Cook TE, et al. Assessing quality of life and patient-reported satisfaction with masculinizing top surgery: a mixed-methods descriptive survey study. *Plast Reconstr Surg*. 2019;143:272–279.
12. Alcon A, Kennedy A, Wang E, et al. Quantifying the psychosocial benefits of masculinizing mastectomy in trans male patients with patient-reported outcomes: the University of California, San Francisco, Gender Quality of Life Survey. *Plast Reconstr Surg*. 2021;147:731e–740e.
13. Song S, Rowen T, Kim E. The impact of gender affirming mastectomy on the sexual health and satisfaction of trans patients. *J Sex Med*. 2023;20(Suppl 2):qdad061-003.
14. Tarriba JET, Alvarez G, Cardenas-Mejia A. Sensory nerve transfers and direct neurotization: the new frontier in peripheral nerve surgery. *Inter Microsurg J*. 2022;6:2.
15. Deptula P, Nguyen D. Neurotization of the nipple–areola complex: superior nipple sensation in gender-affirming mastectomy and autologous breast reconstruction. *Ann Breast Surg*. 2021;5.
16. Rochlin DH, Brazio P, Wapnir I, et al. Immediate targeted nipple–areolar complex reinnervation: improving outcomes in gender-affirming mastectomy. *Plast Reconstr Surg Glob Open*. 2020;8:e2719.
17. Laikhter E, Shiah E, Manstein SM, et al. Trends and characteristics of neurotization during breast reconstruction: perioperative outcomes using the American College of Surgeons National Surgical Quality Improvement Program (ACS-NSQIP). *J Plast Surg Hand Surg*. 2022;56:291–297.
18. Berenson RA, Emanuel EJ. The Medicare physician fee schedule and unethical behavior. *JAMA*. 2023;330:115–116.
19. Gfrerer L, Winograd JM, AustenWG, Jr, et al. Targeted nipple areola complex reinnervation in gender-affirming double incision mastectomy with free nipple grafting. *Plast Reconstr Surg Glob Open*. 2022;10:e4251.
20. Rochlin DH, Coriddi MR, Nelson JA, et al. Immediate lymphatic reconstruction and the current value problem. *Ann Surg*. 2023;277:e1197–e1199.
21. Trehan SK, Model Z, Lee SK. Nerve repair and nerve grafting. *Hand Clin*. 2016;32:119–125.
22. Reddy PG, Arden RL, Mathog RH. Facial nerve rehabilitation after radical parotidectomy. *Laryngoscope*. 1999;109:894–899.
23. Tuinder SMH, Cornelissen AJM, Beugels J, et al. Sifting through the evidence: a comprehensive review and analysis of neurotization in breast reconstruction. *Plast Reconstr Surg*. 2018;142:974e–975e.
24. Beugels J, Cornelissen AJM, Spiegel AJ, et al. Sensory recovery of the breast after innervated and non-innervated autologous breast reconstructions: a systematic review. *J Plast Reconstr Aesthet Surg*. 2017;70:1229–1241.
25. Peled AW, Peled ZM. Nerve preservation and allografting for sensory innervation following immediate implant breast reconstruction. *Plast Reconstr Surg Glob Open*. 2019;7:e2332.
26. Kamran R, Jackman L, Chan C, et al. Implementation of patient-reported outcome measures for gender-affirming care worldwide: a systematic review. *JAMA Netw Open*. 2023;6:e236425–e236425.
27. Santesso N, Barbara AM, Kamran R, et al. Conclusions from surveys may not consider important biases: a systematic survey of surveys. *J Clin Epidemiol*. 2020;122:108–114.
28. Gagnier JJ, Lai J, Mokkink LB, et al. COSMIN reporting guideline for studies on measurement properties of patient-reported outcome measures. *Qual Life Res*. 2021;30:2197–2218.
29. Reisner SL, Biello K, Rosenberger JG, et al. Using a two-step method to measure transgender identity in Latin America/the Caribbean, Portugal, and Spain. *Arch Sex Behav*. 2014;43:1503–1514.