

Collaboration between the breast and plastic surgeon in restoring sensation after mastectomy

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Abstract

Breast cancer is the most commonly diagnosed invasive cancer in women worldwide. While hypoesthesia is a known sequela after mastectomy, patients are now inquiring with renewed interest about the degree and timing of sensation after mastectomy. This is a topic that has generated much research interest. However, while there have been advances in the field, there are few, well-done studies that allow for an accurate answer to this question. In this article, relevant breast and donor site anatomy is reviewed for sensate autologous breast reconstruction. Additional donor sites apart from the typically utilized abdomen are analyzed with relevant anatomical discussions. Outcomes are presented; however, due to the heterogeneity of the patient population, surgical approach and postoperative sensory testing, it is difficult to compare results between studies. Future directions and unanswered questions regarding sensate autologous breast reconstruction are highlighted. While great strides have been made in providing sensate autologous breast reconstruction, there are still many unanswered questions. Thus, the collaboration between surgical teams and sharing of outcomes is crucial to allow for optimization of this powerful surgical approach.

KEYWORDS

mastectomy, reconstruction, sensate reconstruction

1 | INTRODUCTION

Breast cancer is the most commonly diagnosed invasive cancer in women worldwide.¹ The diagnosis of breast cancer can have devastating physical and psychological consequences. With improvements in surgical management, increasing amounts of the native breast skin can be spared with oncological safety. This has the potential to improve the breast aesthetics and associated quality of life outcomes, but it does not affect the innervation to the overlying skin. A 2017 New York Times article, "After Mastectomies, an Unexpected Blow: Numb New Breasts," made the idea of hypoesthesia after mastectomy mainstream. While hypoesthesia is a known sequela after mastectomy, patients are now inquiring with renewed interest about the degree and timing of sensation after mastectomy. This is a topic that has generated much research interest. However, while there have

been advances in the field, there are few, well-done studies that allow for an accurate answer to this question.

2 | BREAST ANATOMICAL CONSIDERATIONS

The anatomical basis for innervation of the breast and nipple areola complex (NAC) has been well described, with the dominant innervation originating from the medial and lateral cutaneous branches of the third to fifth intercostal nerves. Due to the dissection plane necessary to adequately remove breast tissue in an oncologically safe and effective way, both of these avenues of sensory innervation are at high risk for injury or loss during the mastectomy.^{2,3} There have been varying degrees of returned sensation described

post-mastectomy⁴⁻¹⁰ and the loss of protective and erogenous sensation has shown to negatively impact quality of life outcomes.¹¹⁻¹⁷

3 | SENSATE AUTOLOGOUS RECONSTRUCTION

The concept of providing sensate autologous breast reconstruction post-mastectomy is not novel and most studies have been performed with abdominally based donor sites.

4 | ABDOMINAL DISSECTION

The majority of research in sensate autologous reconstruction has been performed in deep inferior epigastric perforator (DIEP) or transverse rectus abdominis muscle (TRAM) flaps.^{18,19} The recipient abdominal nerve typically has been the thoracic intercostal nerve at the 10-12th level. This nerve is often in close conjunction with an artery and can potentially be confused for a perforator. Previous anatomic studies have demonstrated complex sensory innervation to abdominal flaps, with both medial and lateral rows of perforators being associated with sensory nerves.²⁰ There has been some controversy as to whether the medial or lateral row of perforators/nerves should be selected for dissection. Some authors suggested that lateral row perforators are more suitable²¹ while others recommended that the posterolateral aspect of the muscle should be avoided to prevent denervation.²² During dissection for the sensory nerve, avoiding damage to the abdominal motor branches is desired to decrease subsequent abdominal wall morbidity. A recent radiologic study suggested avoiding motor nerves by creating a border 3.26 cm from the lateral rectus edges, as the majority of nerves enter the muscle lateral to this border.²³ There has yet to be an anatomic study demonstrating where the sensory nerves exit the abdominal fascia in relation to flap harvest.

5 | BREAST DONOR NERVE

To date, the majority of studies have utilized the 3-7th anterior or lateral intercostal nerves as the breast donor nerve. The lateral intercostal nerve has not been utilized as frequently in recent literature, perhaps due to difficulty locating the nerve. Thus, the anterior intercostal nerve is more commonly utilized, especially as this nerve is typically in the microsurgical field and does not require additional dissection. Our group recently published a cadaveric study characterizing the location of the lateral intercostal nerve at the lateral 4th intercostal space to allow for ease of dissection.²⁴ When utilizing the lateral intercostal nerve, long lengths of the abdominal sensory nerve are required for direct coaptation. However, the introduction of cadaveric nerve grafts and conduits has allowed for the development of new techniques and a resurgence of interest in utilizing this nerve.

6 | OUTCOMES

A systematic review of studies investigating sensory recovery of the breast after innervated and non-innervated reconstructions¹⁹ reported on only three studies which compared sensory recovery in innervated versus non-innervated DIEP flaps.²⁵⁻²⁷ Blondeel was the first to demonstrate that innervated DIEP flaps had better, albeit not statistically significant, sensory recovery as compared to non-innervated flaps.²⁶ However, Speigel found a statistically significant improvement in both the quality and quantity of sensation when innervation was provided, with better results attainable with a nerve conduit versus direct coaptation. This was the only study performed in DIEP reconstruction utilizing a nerve conduit to improve the efficacy of the repair.²⁵ The finding of improved breast sensation post-operatively with innervation has also been demonstrated in TRAM flaps, including one randomized controlled trial.²⁸⁻³³ While studies compared results with and without nerve grafts, only one utilized a nerve conduit.^{25-28,30-38} However, there is significant variability among the studies in regards to surgical protocols, nerves and grafts utilized and postoperative sensory testing, making comparison between studies difficult.^{18,19}

7 | AREAS OF FURTHER RESEARCH IN ABDOMINALLY BASED SENSATE RECONSTRUCTION

Unanswered questions include the optimal length for the donor and sensory nerves, the number of coaptations that should be performed and the impact of utilizing cadaveric nerve grafts and conduits.

8 | ADDITIONAL DONOR SITES

While the argument persists regarding the optimal autologous donor site,³⁹⁻⁴¹ the fact remains that not all patients are candidates for abdominally based autologous breast reconstruction. Our group recently published a review discussing options for sensate reconstruction including flaps that had been utilized as sensate for other recipient sites, and flaps that had yet to be described as sensate. Flaps that have been utilized for sensate breast reconstruction include the latissimus dorsi (LD) flap and the superior and inferior gluteal perforator (SGAP, IGAP) flaps.^{34,42-44} Sensate flaps that have been utilized for non-breast reconstruction include the anterolateral thigh (ALT) flap⁴⁵⁻⁵² and the tensor fascia lata (TFL) flap.^{53,54} Autologous breast reconstruction options that have yet to be utilized for any sensate reconstruction include the lateral thigh flap, the transverse myocutaneous gracilis (TUG) flap, medial circumflex femoral artery perforator (MCFA) flap, posterior medial thigh (PMT) flap, profunda artery perforator (PAP) flap, lumbar artery perforator (LAP) flap and Ruben's fat pad. While these additional flaps have not been widely utilized for reconstruction, a recent study examined the sensation at donor sites for numerous autologous options

including the DIEP, lateral thigh, PAP, transverse musculocutaneous gracilis and SGAP.⁵⁵ Thus, there are numerous options for sensate autologous breast reconstruction requiring consideration and study. To that end, our group has begun to perform cadaveric studies to characterize the location of the cutaneous sensory nerves for these flaps in the context of flap dissection.^{56,57} However, there are still numerous options for autologous reconstruction where the location of the sensory nerve(s) has yet to be characterized.

9 | NIPPLE SPARING MASTECTOMY WITH NERVE IDENTIFICATION

Due to our close relationship with the breast surgery team, we have begun a collaboration that involves identification and preservation of the lateral 4th intercostal nerve at the time of mastectomy. Through careful identification of the nerve at time of mastectomy, a longer length of the breast sensory nerve is retained and ease of coaptation at time of microsurgery is enabled. The identification of the nerve is best performed with the use of loupe magnification during the surgery and careful sharp dissection in the area of the nerve allows for careful identification and dissection of the nerve and avoids possible thermal injury associated with use of electrocautery.

10 | SENSORY RE-EDUCATION

Despite there being reports on the technical approach to provide sensate autologous reconstruction, there have not been any protocols proposed for sensory re-education postoperatively. Studies examining and analyzing sensory re-education have mainly been reported in hand literature after peripheral nerve repair. It has been shown that changes in the cerebral cortex begin within minutes after peripheral nerve injury with overlap in adjacent cortical cortices due to the absence of afferent stimuli.⁵⁸ In order to preserve the original cortical representation, sensory re-education can be performed with alternative stimuli, such as tactile glove or mirror therapy.⁵⁹⁻⁶³ Based on hand literature, we have worked with the physical therapy team to create sensory re-education protocols. It has yet to be determined the efficacy of this intervention and is an active area of research.

11 | FUTURE DIRECTIONS

While great strides have been made in providing sensate autologous breast reconstruction, there are still many unanswered questions. Due to the heterogeneity of the patient population, surgical approach and postoperative sensory testing, it is difficult to compare results between studies. Thus, collaboration between surgical teams and sharing of outcomes is crucial to allow for optimization of this powerful surgical approach.

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