Multidisciplinary Care Coupled With Targeted Muscle Reinnervation May Reduce Pain for Amputees

Although cancer-related limb amputations are not very common (surgeons perform approximately 18,000 of them per year in the United States), a new study in the *Journal of Surgical Oncology* (doi:10.1002/jso.25586) reports that when they are necessary, a multidisciplinary team effort coupled with targeted muscle reinnervation (TMR) at the time of amputation reduces the incidence and severity of chronic pain.

The study is 1 of 3 related studies of TMR performed by researchers at The Ohio State University Wexner Medical Center (hereafter referred to as Wexner) in Columbus, Ohio. The other 2 studies were not limited to cancer survivors and included patients who underwent amputation because of trauma or various diseases. One study published in *Annals of Surgery* (doi:10.1097/SLA.0000000000003088) of patients who had developed a neuroma after amputation concluded that neurectomy and TMR improved pathologic phantom limb pain (PLP) and residual limb pain more completely than conventional neurectomy alone. The second study (*J Am Coll Surg*, 2019;228:217-226. doi:10.1016/j.jamcollsurg.2018.12.015) reported that TMR at the time of limb loss helped to prevent PLP and symptomatic neuroma-related residual limb pain.

According to Ian L. Valerio, MD, MS, MBA, a coauthor of all 3 studies and chief of the division of burn, wound, and trauma in the plastic surgery department at Wexner, patients with cancer who undergo amputation often have comorbidities that may affect their rehabilitation, such as chemotherapy-related fatigue and neuropathy, which can cause increased pain and decreased strength and endurance. Radiation-associated fibrosis also can inhibit rehabilitation and make it more difficult for patients to become acclimated to their new prosthesis.

“Through our work, we’ve identified that patients with cancer who undergo amputation present with unique challenges that often affect their rehabilitation, such as chemotherapy-related fatigue and neuropathy, which can exacerbate pain and decrease strength and endurance,” Dr. Valerio says, and adds that this is why the team conducted the current study with a focus on patients with cancer who undergo amputation.

Wexner’s oncologic amputee program is part of the sarcoma division of The Ohio State University Comprehensive Cancer Center Arthur G. James Cancer Hospital and Richard J. Solove Research Institute. It starts with meeting with the patients before and after their surgeries. Dr. Valerio says a tumor board meets with clinicians from all the medical specialties involved.

**KEY POINTS**

- Patients with cancer who undergo amputation present with unique challenges that often affect their rehabilitation, such as chemotherapy-related fatigue and neuropathy.
- Neuroma symptoms at the amputation site and PLP were found to occur less frequently and were less intense in the cohort of patients treated with TMR compared with a group of patients who underwent amputations without TMR.
in the care of patients, including radiation oncology, medical oncology, surgical oncology, orthopedic oncology, psychology, physical therapy, and plastic surgery. “All of us are tied in with each other and we discuss the comprehensive care of the patient from not only their tumor needs but even through their rehabilitation needs after they undergo amputation,” he says. “We meet face to face to craft the care plan for these patients going forward.” Dr. Valerio says assessments are made at 2-month intervals until the patient meets functional goals, and then are performed annually thereafter.

**Study Details**

Data were collected from patients who underwent major limb amputation at Wexner with concurrent TMR for an oncologic diagnosis between November 2015 and November 2018. A total of 31 patients underwent amputation with concurrent TMR during the study period and 27 patients completed pain surveys. Of those, 15 patients had follow-up of greater than 1 year. Opioid prescriptions were compiled using the Ohio Automated Rx Reporting System.

The TMR cohort was compared with a cross-sectional sample of unselected amputees who did not undergo TMR and were not treated at Wexner. Those patients were recruited into the study from prosthetic clinics, pain clinics, amputee clinics, and other sources from across the United States. The researchers received information from 727 potential participants, of whom 58 eligible patients listed cancer as the reason for their amputation. Demographics and the site of amputation were similar between the TMR and general oncologic amputee cohorts with the exception of the time since amputation, which was found to be longer in the latter group.

**Study Results**

The researchers found that neuroma symptoms, including burning sensations, tingling or crawling sensations, pain with light touch, and sudden pain episodes at the amputation site occurred less frequently and were less intense in the TMR cohort. No differences were observed with regard to hot or cold sensitivity or light pressure causing pain.

Specifically, the mean Patient-Reported Outcomes Measurement Information System (PROMIS) score differences were 5.855 for pain intensity, 5.896 for pain-related behaviors, and 7.435 for PLP interference with relevant aspects of a person’s life, with significantly lower scores found for the TMR cohort. In addition, opioid use by patients in the TMR cohort decreased dramatically during the course of the study: approximately 56% of patients used opioids before their amputation compared to 22% at 1 year after their amputation.

Dr. Valerio says TMR has proven to be so effective in minimizing postamputation pain that it has become routine for oncologic amputees treated at Wexner. He adds that because traditionally greater than 90% of amputees report residual neuroma-related limb pain, PLP, and axial musculoskeletal pain, “…We think that within 5-10 years this will become standard care at most centers that have the ability to operate with appropriate microsurgical support.”

“I find this study interesting, informative, and thought-provoking,” says Kenneth Cardona, MD, associate professor of surgery in the division of surgical oncology at the Winship Cancer Institute at Emory University in Atlanta, Georgia. “The idea of implementing TMR in a preventative fashion at the time of amputation with the goal of minimizing the development of these pain issues while also addressing psychological and other quality-of-life issues is powerful.”

Dr. Cardona does have one caveat. “Because the cancer patients are a small subset of their larger TMR study cohort, and I have looked at all 3 of their recent studies, the question now is with a larger set of cancer patients are these results going to hold?” he says.

Dr. Cardona is chair of the Eastern Cooperative Oncology Group sarcoma committee. Although he does perform sarcoma surgeries, he does not perform amputations routinely. “I would consider this technique. However, as stated in the study, it is just one piece of the puzzle of the more complex program that OSU [Ohio State University] has created. Therefore, I believe this merits discussion within our sarcoma working group as well as with our partners in trauma and vascular, where the bulk of amputees are, to determine whether such a program would have a role at our center. I would not be opposed to referring patients elsewhere, although I’m not sure how many folks outside of OSU have such a program up and running.”

Dr. Valerio notes that even though the cancer cohort is small, the results are consistent with every cohort studied to date. “To me, this shows that the technique is valid since similar results are being reported at other centers. We believe very strongly that this will change prescribing behaviors (surgical planning) in the future.”

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