Free tissue transfer has become a common option for reconstruction of defects after oncologic head and neck ablative surgery. The radial forearm free flap (RFFF) and the fibula free flap (FFF) are frequently utilized for reconstruction in head and neck cancer ablation because of their relatively reliable anatomy and pedicle length. Harvesting of both the RFFF and FFF involves dissection of numerous perforating vessels and a significant amount of soft tissue. Traditional methods of free flap elevation include a combination of electrocautery (EC) with clipping and tying of vessels or use of traditional bipolar EC. However, these methods can be time consuming and labor intensive. Given the current culture of operative efficiency and limited resources in the provision of healthcare, both safety and efficiency in operative techniques and equipment are a priority.

The Harmonic Scalpel (HS) shears (HS; Ethicon Endo-Surgery, Cincinnati, Ohio) represent an alternative to traditional techniques of free flap elevation. The HS vibrates at 55,000 Hz, converting high-frequency ultrasonic energy into mechanical energy. The vibration disrupts hydrogen bonds in human tissue, forming a coagulum. Proposed advantages of the HS compared with conventional cautery include lower temperatures resulting in decreased adjacent tissue damage (80–100°C for HS as compared with 200–300°C for traditional EC) and increased efficiency by allowing concurrent surgical dissection and hemostasis of small-to-medium-sized vessels with a single instrument. The use of ultrasonic dissection was first utilized in gastrointestinal surgery, before the current use in head and neck reconstruction.

Summary: Free tissue transfer has become the mainstay of head and neck cancer (HNC) reconstructive surgery. The objective of the study is to examine the efficacy of the Harmonic Scalpel (HS) Shears on free flap elevation time and complication rates after HNC reconstruction compared with traditional electrocautery. A retrospective review of 215 HNC patients undergoing surgical ablation and free flap reconstruction from January 2010 to April 2013 at the University of Alberta Hospital was undertaken. All patients requiring free flap reconstruction with radial forearm free flap or fibula free flap were included. Overall, there was no significant difference demonstrated between the HS and electrocautery groups for free flap elevation time for RFFFs ($P = 0.563$) or FFFs ($P = 0.087$). No differences were observed in donor-site complications. The HS is a reliable, safe, and alternative method of free flap elevation in HNC reconstructive surgery.

From the *Division of Plastic and Reconstructive Surgery and †Otolaryngology-Head & Neck Surgery, University of Alberta, Edmonton, Alberta, Canada.

Received for publication December 16, 2015; accepted April 1, 2016.

Presented as an academic poster at the Annual Canadian Society of Otolaryngology-Head and Neck Surgery in Banff, Alberta, Canada. Presented June 2013.

Copyright © 2016 The Authors. Published by Wolters Kluwer Health, Inc. on behalf of The American Society of Plastic Surgeons. All rights reserved. This is an open-access article distributed under the terms of the Creative Commons Attribution-Non Commercial-No Derivatives License 4.0 (CCBY-NC-ND), where it is permissible to download and share the work provided it is properly cited. The work cannot be changed in any way or used commercially.

DOI: 10.1097/GOX.0000000000000740

Disclosure: The authors have no financial interest to declare in relation to the content of this article. The Article Processing Charge was paid for by the authors.
expanding to a variety of other surgical fields. In the head and neck region, this has included both thyroid surgery,\textsuperscript{4,5} and head and neck reconstruction.\textsuperscript{6,9} The HS has been shown to be a safe alternative in head and neck reconstruction.\textsuperscript{7,9} Previous studies have also shown reduced operative time with HS.\textsuperscript{6,8}

The primary objective of this study was to assess the efficacy of HS in reducing free flap elevation times in RFFFs and FFFs. A secondary outcome evaluated was a comparison of donor-site morbidity between the 2 methods.

**MATERIALS AND METHODS**

A retrospective review of all head and neck cancer (HNC) patients undergoing surgical ablation and free flap reconstruction from January 2010 to April 2013 was undertaken. Approval was obtained by the Health Research Ethics Board (Pro00025159). All patients requiring free flap reconstruction with RFFF or FFF, performed by 1 of 3 head and neck surgeons at the University of Alberta Hospital, were included. Patients excluded were those for whom primary or secondary outcome data were unavailable.

The primary outcome assessed was free flap elevation time. Tourniquet time, the time between initial inflation of the tourniquet and deflation time in minutes, was used as a surrogate marker for free flap elevation time. The secondary outcome was donor-site morbidity, which included development of a seroma, hematoma, or infection. Free flap elevation time for each flap with the HS was compared with free flap elevation time using EC for both RFFFs and FFFs. Surgical technique utilized (HC or EC) was based on surgeon preference on the day of surgery. Analyses were performed separately for each surgeon and each technique, to account for differences in operative abilities and preferences. Statistical analysis was performed using the Mann-Whitney U test, and \( P = 0.05 \) was set as the threshold for statistical significance.

**RESULTS**

A total of 221 patients underwent reconstruction for ablative head and neck cancer surgery using RFFFs or FFFs at the University of Alberta between January 2010 and April 2013 (Fig. 1). Six patients were excluded because of missing information or

![Fig. 1. Summary diagram depicting the use of the HS compared with electrocautery and the number of each type of free flap performed by 3 surgeons between 2010 and 2013.](image)

**Table 1. Demographic Data for Patients Undergoing RFFF or FFFG Reconstruction for Major Head and Neck Cancer Surgery from 2010 to 2013 at the University of Alberta Hospital**

| Number of patients included | 215 |
|----------------------------|-----|
| HS                         | 97  |
| EC                         | 118 |

| Male/female ratio          | \( P = 0.415 \) |
|----------------------------|------------------|
| HS                         | 68/32            |
| EC                         | 63/37            |

| Average age (y)            | \( P = 0.490 \) |
|----------------------------|------------------|
| HS                         | 58.0             |
| EC                         | 59.9             |
lack of tourniquet use, and therefore the data collected for 215 patients were used in the analysis (Fig. 1). Patients’ age ranged from 15 to 87 years (mean = 58.0 years) in the HS group compared to 18 to 86 years (mean = 59.9 years) in the EC group ($P = 0.490$). Overall, 118 of these free flaps were elevated using traditional methods, compared with 97 performed with the HS (Table 1). For RFFF elevation, the HS group showed average time differences between −8.3% and +12.8% when compared with the EC group. This corresponded to time differences between −6.2 and +7.3 minutes (Table 2). When examining FFF elevation times, the HS group showed average time decreases between 1.2% and 19.1%. This corresponded to time decreases between 1.0 minute and 14.9 minutes (Table 2). When evaluating the use of the HS group compared with the EC group for each surgeon, a statistically significant increase in time was found for 1 surgeon when elevating RFFFs ($P = 0.029$; Table 2). Besides, no statistically significant difference in free flap elevation time was demonstrated when using the HS (Table 2). With regard to donor-site morbidity, no significant difference in complications between the 2 methods was demonstrated (Table 3).

### DISCUSSION

This study demonstrated that using the HS Shears for elevation of RFFFs and FFFs during reconstruction for oncologic ablative head and neck surgery is both safe and reliable, but failed to demonstrate a significant difference in elevation time when compared with traditional EC. However, it should be noted that there was a trend toward increased donor-site seromas in the HS group. Although it did not reach statistical significance ($P = 0.059$), it did approach it. It could, therefore, be inferred that use of the HS may lead to increased donor-site seromas when compared with EC.

### CONCLUSIONS

Overall, use of the HS Shears for free flap elevation resulted in a lack of significant difference in free flap elevation time for radial forearm ($P = 0.563$) or fibula ($P = 0.087$) free flaps. In addition, no significant differences were observed in free flap donor-site morbidity between the HS and EC groups. On the basis of these results, we can conclude that the HS is a reliable, safe, and alternative method of free flap elevation in head and neck cancer reconstructive surgery.

Daniel A. O’Connell, MD, MSc, FRCS
1E4, Walter C. Mackenzie Health Sciences Centre
8440 - 112 Street, Edmonton
Alberta, Canada T6G 2B7
E-mail: Daniel.o’connell@albertahealthservices.ca
REFERENCES

1. Miller CE, Amaral JF. Harmonic scalpel—pros and cons! *Fertil Steril.* 1994;62:1094–1095.
2. Amaral JF. Ultrasonic energy in laparoscopic surgery. *Surg Technol Int.* 1994;3:155–161.
3. Targarona EM, Balague C, Marin J, et al. Energy sources for laparoscopic colectomy: a prospective randomized comparison of conventional electrosurgery, bipolar computer-controlled electrosurgery and ultrasonic dissection. Operative outcome and costs analysis. *Surg Innov.* 2005;12:339–344.
4. Ecker T, Carvalho AL, Choe JH, et al. Hemostasis in thyroid surgery: harmonic scalpel versus other techniques—a meta-analysis. *Otolaryngol Head Neck Surg.* 2010;143:17–25.
5. Siperstein AE, Berber E, Morkoyun E. The use of the harmonic scalpel vs conventional knot tying for vessel ligation in thyroid surgery. *Arch Surg.* 2002;137:137–142.
6. Albert S, Guedon C, Halimi C, et al. The use of harmonic scalpel for free flap dissection in head and neck reconstructive surgery. *Plast Surg Int.* 2012;2012:302921.
7. Burton JN, El-Deiry MW. Use of ultrasonic shears in the harvest of the free osteocutaneous fibula flap. *Ann Otol Rhinol Laryngol.* 2011;120:563–568.
8. Koch CA, Olsen SM, Martin EJ, et al. Ultrasonic shears in free-tissue transfer: increased efficiency and cost savings. *Otolaryngol Head Neck Surg.* 2011;144:201–205.
9. Dean NR, Rosenthal EL, Morgan BA, et al. Harmonic Scalpel versus electrocautery and surgical clips in head and neck free-flap harvesting. *Ear Nose Throat J.* 2014;93:E36–E39.