

To spare or not to spare rib: A survey on internal mammary vessel preparation in microsurgical breast reconstruction

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The use of the internal mammary artery and vein (IMA/IMV) has supplanted the use of the thoracodorsal artery and vein for recipient vessels in microvascular breast reconstruction (Arnez et al., 1995; Dupin et al., 1996; Ninković et al., 1995; Quaba et al., 2005; Saint-Cyr et al., 2007). Advantages of the IMA/IMV include improved flow dynamics, constant location, and improved flap positioning

(Nahabedian, 2012). Access to the IMA/IMV is often performed with the removal of rib cartilage (Haddock & Teotia, 2017), which can lead to contour irregularity and pain (Ahdoot et al., 2013; Mickute et al., 2010). A rib-sparing approach to the IMA/IMV has been evaluated as an efficient and safe approach for recipient vessels (Darcy et al., 2011; Sacks & Chang, 2009). The purpose of this study was to

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Approach to Ribs in DIEP Flaps

Thank you for agreeing to complete this survey. It will take you less than two minutes to complete.

Thank you!

How many years have you been in practice?

Approximately, how many DIEP flaps do you perform per month? (Count bilateral cases as 2)

What is your approach for recipient vessels?

- I always attempt to spare the ribs for my approach to the IMA
- I always remove a rib for my approach to the IMA
- I usually remove a rib but will spare the rib if the interspace is large enough
- I do not use the IMA for my recipient vessels

Which statement do you agree with?

- I do not believe removing a rib can introduce a morbidity
- I believe removing a rib can introduce morbidity

After having a DIEP flap, have you had patients complain about rib removal postoperatively (i.e. deformity, pain, etc)?

- Yes
- No

Comments

FIGURE 1 Survey sent to academic microsurgeons in the United States

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survey microsurgeons in the United States to learn practice patterns with regards to rib cartilage removal in microsurgical breast reconstruction.

This survey study was approved by the Institutional Review Board at the University of Chicago. An anonymous survey (Figure 1) was sent to 207 microsurgeons at academic plastic surgery programs across the United States. The response rate for the survey was 42.5% (88 surveys returned). The average microsurgeon experience was 10.4 years in practice (range 1–30 years, STD 6.8) and 8 abdominal-based breast-free flaps per month (range 1–30 flaps, STD 4.8).

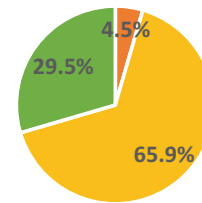
The majority (65.9%, $n = 58$) of microsurgeons responded that they always remove rib cartilage for IMA/IMV exposure while 29.5% ($n = 26$) answered that they would spare rib cartilage if the interspace was large enough. Only 4.5% ($n = 4$) always attempt a rib cartilage-sparing approach. (Figure 2). The majority of microsurgeons (53.4%, $n = 47$) answered that they believe removing rib cartilage can introduce a morbidity. However, only 43.2% ($n = 38$) had patients complain about rib cartilage removal due to symptoms such as pain or chest wall irregularity (Figure 2).

Most microsurgeons surveyed in our study always remove rib cartilage during IMA/IMV dissection for microsurgical breast reconstruction. Many survey respondents commented on their reasoning for removing rib cartilage, which included having space for microsurgery for resident teaching, no personal history of patient complaints of pain, and contour issues being minor from their experience. Interestingly, despite the common practice of always removing rib cartilage, more than half of respondents believe that removing rib cartilage can introduce morbidity. However, less than half of survey respondents had patients complain of rib cartilage removal with the likely reasoning being the benefits of better exposure for microsurgery outweigh the risks of rib cartilage removal.

There have been multiple published studies on the safety and outcomes of the rib-sparing approach (Hamilton et al., 2022; Kim et al., 2013; Parrett et al., 2008; Rosich-Medina et al., 2015; Sacks & Chang, 2009; Sasaki et al., 2019; Wilson et al., 2016). Parrett et al reviewed 74 rib-sparing flaps and found comparable rates of anastomotic revision, hematoma, fat necrosis, and flap loss between the rib-sacrificing and rib-sparing approach (Parrett et al., 2008). Sacks and Chang reviewed 66 rib-sparing flaps with no intraoperative complications and no reports of chest wall deformity or pain on postoperative follow-up (Sacks & Chang, 2009). Kim et al. and Rosich-Medina et al also had similar results with no reports of chest wall deformity in 79 and 310 flaps (Kim et al., 2013; Rosich-Medina et al., 2015). Wilson et al studied 192 rib-sparing flaps compared to 355 rib-sacrificing flaps and found a higher incidence of fat necrosis requiring excision in the rib-sparing group (Wilson et al., 2016). However, rates of breast revision and fat grafting were similar between the two groups. A recent study with Hamilton et al found more complications in the rib-sacrificing group including re-anastomosis and return to the operating room in a review of 620 rib-sparing flaps compared with 66 rib-sacrificing flaps (Hamilton et al., 2022). A summary of studies examining the rib-sparing approach can be found in Table 1.

What is your approach for IMA/IMV in microsurgical breast reconstruction?

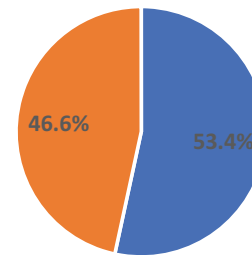
(a)



■ Always spares rib cartilage ■ Always removes rib cartilage
■ Sometimes spares rib cartilage

Do you believe removing a rib can cause morbidity?

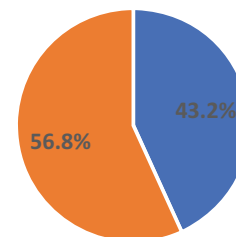
(b)



■ Yes ■ No

Have you had patients complain about rib removal?

(c)



■ Yes ■ No

FIGURE 2 Survey responses on (a) approach to internal mammary artery and internal mammary vein (IMA/IMV) in microsurgical breast reconstruction (b) microsurgeon belief on whether rib cartilage removal can lead to morbidity (c) microsurgeon experience having patients complain about rib cartilage removal

The rib-sparing approach to the IMA/IMV is a safe approach in microsurgical breast reconstruction, and flap outcomes have been shown to be comparable to the rib-sacrificing approach with one study showing superiority to the rib-sparing approach (Hamilton et al., 2022). With these previous studies in mind and our findings that the majority of microsurgeons sacrificing rib, further education and promotion of the rib-sparing approach to the IMA/IMV is needed.

Rib preservation for IMA/IMV dissection is not always possible. Patient anatomy will most often help dictate whether the rib-sparing approach is possible. Narrow intercostal spaces will necessitate at least partial rib removal. Sasaki et al. examined the “ideal intercostal space,” examining rib spaces in 246 patients and found that the second intercostal space was found to be significantly wider than the

TABLE 1 Summary of previously published studies on the rib-sparing approach to IMA/IMV in microsurgical breast reconstruction

Author	Year	Location	Number of flaps	Flap loss	Intraoperative complication	Return to OR	Chest wall deformity	Chest pain
Lee	2008	Boston, MA	74	1.4%	0%	3%	NR	NR
Chang	2009	Houston, TX	66	3%	0%	5%	0%	0%
Mun	2013	Seoul, Korea	79	0%	0%	1.3%	0%	0%
Thanik	2016	New York, NY	192	0.3%	0%	2.5%	NR	NR
Malata	2019	Cambridge, UK	310	0.3%	NR	4.2%	0% ^a	0% ^a
Spiegel	2022	Houston, TX	620	0.3%	0%	0.3%	NR	NR
Total			1341	0.6%	0%	1.9%	0%	0%

^aPreviously reported 0% chest wall deformity/chest pain rate in 178 rib-sparing flaps.

third intercostal space (20.6 vs. 14.0 mm) (Sasaki et al., 2019). Microsurgeons may be hesitant to routinely use the second intercostal space due to the inability to use a more proximal part of artery if there are any potential issues with the IMA/IMV. Additionally, using the second intercostal space may lead to the flap sitting higher on the chest. Other scenarios may also necessitate rib removal including stacked flaps and multi-flap breast reconstruction.

With these considerations in mind, there is no one size fits all for the approach to IMA/IMV in microsurgical breast reconstruction. Our group's approach is to routinely spare rib during the IMA/IMV dissection and to remove partial rib when necessary. However, our study demonstrated that the majority of microsurgeons prefer to remove rib routinely. Our review of the published data on the rib-sparing method shows the safety of the approach as well as equivalence in outcomes. Rib cartilage preservation has potential benefits that should be considered by all those performing microsurgical breast reconstruction. While rib cartilage removal is low-risk, there are potential complications that can lead to decreased satisfaction with breast reconstruction. Given the findings of our study, further education and investigation of rib cartilage sparing techniques are needed in order to promote this technique and its potential application.

CONFLICT OF INTEREST

The authors declare no conflicts of interest.

REFERENCES

- Ahdoot, M. A., Echo, A., Otake, L. R., Son, J., Zeidler, K. R., Saadian, I., & Lee, G. K. (2013). The matrix rib plating system: Improving aesthetic outcomes in microvascular breast reconstruction. *Annals of Plastic Surgery*, 70(4), 384–388.
- Arnez, Z. M., Valdatta, L., Tyler, M. P., & Planinsek, F. (1995). Anatomy of the internal mammary veins and their use in free TRAM flap breast reconstruction. *British Journal of Plastic Surgery*, 48(8), 540–545.
- Darcy, C. M., Smit, J. M., Audolfsson, T., & Acosta, R. (2011). Surgical technique: The intercostal space approach to the internal mammary vessels in 463 microvascular breast reconstructions. *Journal of Plastic, Reconstructive & Aesthetic Surgery*, 64(1), 58–62.
- Dupin, C. L., Allen, R. J., Glass, C. A., & Bunch, R. (1996). The internal mammary artery and vein as a recipient site for free-flap breast reconstruction: A report of 110 consecutive cases. *Plastic and Reconstructive Surgery*, 98(4), 685–689 discussion 690–682.
- Haddock, N. T., & Teotia, S. S. (2017). Five steps to internal mammary vessel preparation in less than 15 minutes. *Plastic and Reconstructive Surgery*, 140(5), 884–886.
- Hamilton, K., Zavlin, D., Doval, A. F., & Spiegel, A. J. (2022). Refining the rib-sparing approach in microsurgical breast reconstruction: Keys to success. *Journal of Reconstructive Microsurgery*, 38(4), 263–269.
- Kim, H., Lim, S. Y., Pyon, J. K., Bang, S. I., Oh, K. S., Lee, J. E., Nam, S. J., & Mun, G. H. (2013). Rib-sparing and internal mammary artery-preserving microsurgical breast reconstruction with the free DIEP flap. *Plastic and Reconstructive Surgery*, 131(3), 327e–334e.
- Mickute, Z., Di Candia, M., Moses, M., Bailey, A. R., & Malata, C. M. (2010). Analgesia requirements in patients undergoing DIEP flap breast reconstructions: Rib preservation versus rib sacrifice. *Journal of Plastic, Reconstructive & Aesthetic Surgery*, 63(12), e837–e839.
- Nahabedian, M. (2012). The internal mammary artery and vein as recipient vessels for microvascular breast reconstruction. *Annals of Plastic Surgery*, 68(5), 537–538.
- Ninković, M., Anderl, H., Hefel, L., Schwabegger, A., & Wechselberger, G. (1995). Internal mammary vessels: A reliable recipient system for free flaps in breast reconstruction. *British Journal of Plastic Surgery*, 48(8), 533–539.
- Parrett, B. M., Caterson, S. A., Tobias, A. M., & Lee, B. T. (2008). The rib-sparing technique for internal mammary vessel exposure in microsurgical breast reconstruction. *Annals of Plastic Surgery*, 60(3), 241–243.
- Quaba, O., Brown, A., & Stevenson, H. (2005). Internal mammary vessels, recipient vessels of choice for free tissue breast reconstruction? *British Journal of Plastic Surgery*, 58(6), 881–882.
- Rosich-Medina, A., Bouloumpasis, S., Di Candia, M., & Malata, C. M. (2015). Total 'rib'-preservation technique of internal mammary vessel exposure for free flap breast reconstruction: A 5-year prospective cohort study and instructional video. *Annals of Medicine and Surgery*, 4(3), 293–300.
- Sacks, J. M., & Chang, D. W. (2009). Rib-sparing internal mammary vessel harvest for microvascular breast reconstruction in 100 consecutive cases. *Plastic and Reconstructive Surgery*, 123(5), 1403–1407.
- Saint-Cyr, M., Youssef, A., Bae, H. W., Robb, G. L., & Chang, D. W. (2007). Changing trends in recipient vessel selection for microvascular autologous breast reconstruction: An analysis of 1483 consecutive cases. *Plastic and Reconstructive Surgery*, 119(7), 1993–2000.
- Sasaki, Y., Madada-Nyakauru, R. N., Samaras, S., Oni, G., Di Candia, M., & Malata, C. M. (2019). The ideal intercostal space for internal mammary

vessel exposure during total rib-sparing microvascular breast reconstruction: A critical evaluation. *Journal of Plastic, Reconstructive & Aesthetic Surgery*, 72(6), 1000–1006.

Wilson, S., Weichman, K., Broer, P. N., Ahn, C., Allen, R., Saadeh, P., Karp, N., Choi, M., Levine, J., & Thanik, V. (2016). To resect or not to resect: The effects of rib-sparing harvest of the internal mammary vessels in microsurgical breast reconstruction. *Journal of Reconstructive Microsurgery*, 32(2), 94–100.

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