

Does the use of an acellular dermal graft in abdominal closure after rectus flap harvest impact the occurrence of post-operative hernia?

Masoud Saman¹ · Sameep Kadakia² · Yadranko Ducic^{3,4,5}

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Abstract

Importance Patients with rectus free flap harvest extending below the arcuate line are predisposed to postoperative hernia formation. As such, many authors have advocated the use of closure adjuncts to increase the integrity of the closure and prevent hernia or abdominal wall bulging.

Setting Busy level 1 public trauma center in metropolitan Fort Worth, Texas

Interventions Following harvest of the rectus free flap, 48 patients underwent primary closure; 24 of these patients had defects extending below the arcuate line. Forty patients were closed with an acellular dermal graft; 22 of these patients had defects extending below the arcuate line.

Main outcome measure Postoperative hernia formation and local infection rate were examined in a minimum follow-up period of 1 year.

Results Regardless of closure method, no hernias were observed in the postoperative period. Using an unpaired *t* test and an alpha value of 0.05, there was no statistically significant difference in the infection rate between the two groups.

Conclusion Following rectus abdominis myocutaneous free flap harvest, the use of an acellular dermal graft in abdominal wall closure may not be of any further advantage in the prevention of hernia.

Level of evidence Retrospective (Level III)

Keywords Rectus · Flap · Arcuate · Acellular dermal graft · Hernia

Introduction

The rectus abdominis myocutaneous (RAM) free flap is a versatile tool for the reconstructive surgeon. Although Brown et al. were first to report the use of abdominal cutaneous flaps based on the rectus abdominis perforators in 1975 [1], it was not utilized as a pedicled myocutaneous flap until reported by Drever in 1977 [2]. Since that time, the RAM flap has been used extensively both as a pedicled and free tissue flap for the reconstruction of many defects, notably for the breast and the head and neck.

Despite its ease of harvest and diversity, closure of the donor site has been fraught with challenge for the reconstructive surgeon and concerns remain for potential loss of abdominal wall strength, abdominal bulging, and herniation. For this reason, various closure techniques and the use of closure adjuncts have been advocated.

In regards to donor site closure, the arcuate line is an important anatomic landmark. When the defect is cephalad to the arcuate line, the posterior rectus sheath adequately prevents herniation following harvest of the flap. The weakness of the

✉ Sameep Kadakia
skadakia@nyee.edu

Masoud Saman
msaman309@gmail.com

Yadranko Ducic
yducic@sbcglobal.net

¹ Department of Otolaryngology-Head and Neck Surgery, Otolaryngology and Facial Plastic Surgery Associates, Fort Worth, TX, USA

² Department of Otolaryngology-Head and Neck Surgery, The New York Eye and Ear Infirmary, 310 East 14th ST, 6th Floor, New York, NY 10003, USA

³ Otolaryngology and Facial Plastic Surgery, John Peter Smith Health Network, Fort Worth, TX, USA

⁴ Baylor Neuroscience Skull Base Program, Fort Worth, TX, USA

⁵ Otolaryngology and Facial Plastic Surgery Associates, 923 Pennsylvania ave, suite 100, Fort Worth, TX 76104, USA

posterior sheath caudal to the arcuate line, owing to its composition solely by transversalis fascia, makes defects in this region more likely to lead to herniation and bulging.

Although the incidence of abdominal hernia formation largely depends upon the particular surgeon's experience, flap size, design, and location, and the closure technique used, there is controversy regarding the utility of synthetic biomaterials such as mesh [3–6], autologous dermal grafts [7], and more recently, acellular dermal grafts in closing the abdominal donor site [8].

Primary closure of the abdominal donor site, as advocated by Hartrampf [9], has yielded varying results by different authors. In his retrospective review of 355 patients with primary closure, Hartrampf [10] reported abdominal complication rate of less than 2%. Drever [2] noted abdominal weakness, hernia, or bulging in 43% of his patients following primary closure. Other authors [11] have reported rates of abdominal herniation of up to 20% with primary closure of the donor site.

Various closure techniques have been described to avoid ventral hernia and bulge development. These include external oblique muscle fasciotomy to decrease closure tension [12], rotation flap of the anterior rectus abdominis sheath [13], and bilayered closure of the internal oblique fascia and the anterior rectus sheath [14]. In 1985, Drever and Hodson-Walker [3] reported only a 4% abdominal wall bulging in 155 patients who underwent abdominal donor site repair with the use of synthetic mesh. Since that time, many authors have advocated the use of synthetic mesh to reconstitute the integrity of the abdominal wall following flap harvest [4–6]. Despite its popularity, as with any biosynthetic implant, the surgeon must be aware of the potential adverse effects associated with the use of the mesh such as infections, possible contracture, and capsule formation.

Acellular dermal grafts have been successfully used in the repair of abdominal hernia [15]. Its similarities to native tissue such as observed functional remodeling [16] and rapid revascularization [17], as well as its tolerance to infection [15], and documented incorporation into various tissue types [18–22] makes it an attractive choice for the repair of RAM donor site. More recently, the use of an acellular dermal graft for reconstructing the abdominal wall following pedicle transverse RAM (TRAM) flap was reported by Glasberg and D'Amico [8]. Their retrospective study of 54 patients who underwent abdominal wall donor site reconstruction using an acellular dermal graft did not show development of hernia in any of the patient with an average follow up duration of 18.5 months.

Materials and methods

This was a retrospective study in which 88 patients were examined who underwent RAM free flap harvest for

reconstruction of post-ablative defects, trauma, or CSF leak. An umbilical sparing skin flap was harvested, utilizing perforators 3–5 cm away from the umbilicus on the desired harvest side. All flaps were non-fascial sparing as a skin paddle was harvest in all patients. Although not all, the majority of flaps were extended below the arcuate line. All of the flaps were used for head and neck reconstruction, and varied from a minimum of 10×8 cm to a maximum of 30×15 cm. As this was a retrospective study, patients were not specifically chosen for a particular type of closure; rather, patients treated with and without a closure adjunct were identified in a retrospective fashion for the purposes of comparison. In 48 patients (Group 1), following harvest, the edges of the remnant anterior rectus sheath were reapproximated with a 1-PDS suture in a running fashion. In this group, the harvest was carried below the arcuate line in 24 patients. Six patients in Group 1 required a Jackson-Pratt drain. In another group of 40 patients (Group 2), a thick acellular dermal graft was trimmed to defect size and used to bridge the remnant edges of the anterior rectus sheath using 1-PDS sutures in a running fashion. The acellular dermal graft used in these patients had an average length of 12–16 cm and average width of 3–4 cm. In Group 2, harvest was carried below the arcuate line in 22 patients. In this group, only five patients required a Jackson-Pratt drain. All patients were instructed to use an abdominal binder for 2 weeks following surgery.

Group 1 included 33 males and 15 females, with an age range of 8–89 years, average 60.3 years old. In this group, 41 patients required reconstruction following oncologic ablation, 5 from CSF leak, and 2 from trauma.

Group 2 included 29 males and 11 females, with an age range of 7–86 years, average 59.2 years old. In this group, 32 patients required reconstruction following oncologic ablation, 3 from CSF leak, and 5 from trauma.

Table 1 displays characteristics of both patient groups compared in this study.

Following surgery, patients were followed for a minimum of 12 months and a maximum of 5 years to assess for the presence of a hernia. Thorough examination was performed by a general surgical evaluation to evaluate for the presence of a hernia. General surgery examination was centered around the discovery of postoperative hernia; however, full examination was conducted in order to identify abdominal wall weakness as well as local infection as well. In our study, hernia was not noted; however, if it was found then further diagnosis and treatment would have been conducted by the surgeon.

Results

In this study, the clinical course of 88 patients was followed to note development of an abdominal hernia following harvest of a RAM free flap. 40 patients received abdominal wound

Table 1 Characteristics of both patient groups

Use of acellular dermal graft	Total patients	Below arcuate line	Male/female	Average age (range)	Uses
Primary closure without graft (Group 1)	48	24	33/15	60.3 (8–89)	41-ablative defects 5-CSF leak 2-Trauma
Graft (Group 2)	40	22	29/11	59.2 (7–86)	32-ablative defects 3-CSF leak 5-Trauma

closure with an acellular dermal graft and 48 patients were closed without the use of an acellular dermal graft. The results of our findings are summarized in Table 2.

During the minimum follow up period of 12 months, no hernias were noted in either group. In Group 1, two patients developed localized skin infections, successfully treated with PO antibiotics and wound care. In Group 2, four patients developed localized skin infections, three of which required graft removal. It is also noteworthy to mention that these three patients had Jackson-Pratt drains placed during closure.

Our results showed that there was no difference in hernia development in both groups.

The infection rates in both groups were compared using an unpaired *t*-test and an alpha value of 0.05. The difference in infection rate was not statistically significant ($p=0.5225$) (Table 3).

Discussion

Closure of the abdominal donor site following harvest of the rectus free flap has been fraught with complications such as infection, hernia, and abdominal wall bulging. Although several reports in the literature cite an improved outcome with the use of a closure adjunct, our study of 88 patients has shown that an adjunct may not have a significant impact on the post-operative formation of a hernia. Cephalad to the arcuate line, the posterior sheath has sufficient strength to prevent hernia formation and as such, primary closure of the anterior rectus sheath when possible, is adequate. Caudal to the arcuate line, the posterior rectus sheath is solely composed of the transversalis fascia, predisposing to hernia formation. As such, many authors have proposed the use of augmentation techniques such as mesh or an acellular dermal graft.

In this study, 88 patients underwent rectus free flap harvest for the reconstruction of post-oncologic, traumatic, or CSF leak defects. In 40 of these patients, an acellular dermal graft

was used in the closure of the anterior rectus sheath as a Ultra-thick graft trimmed to fit the corresponding defect. Follow up of minimum 12 months showed that there was no difference in hernia development in patients closed with an acellular dermal graft compared to those closed primarily. In patients closed with an acellular dermal graft, 3 patients were reported to have infections requiring removal of the acellular dermal graft. Of note, these patients all required Jackson-Pratt drains, suggesting the drain as a possible source of infection.

Hernia development in the breast reconstruction literature using the TRAM flap has not been clearly distinguished between defects cephalad and caudal to the arcuate line. However, the focus of this study is closure technique of defects caudal to the arcuate line, given the unlikely nature of herniation cephalad to this landmark. The defect caused by harvest of RAM flap is variable, depending upon the size of the flap, preservation of fascia, and harvest of skin paddle. Meticulous closure of the anterior rectus sheath is imperative, as the risk of incisional hernia formation has been well reported [8]. In the TRAM flap literature, primary closure of the abdominal anterior fascial defect has been shown to have a 12.5 to 20 % rate of hernia development, and a rate of abdominal weakening as high as 44 % [11, 14, 23, 24]. In the majority of these studies, no distinction was made between defect location.

In a study by Glasberg and D’Amico on the use of an acellular dermal graft in closure of the abdominal wall after TRAM flap harvest on 54 patients, none of the patients developed infection or hernia in the follow up period of 18.5 months. It was noted however, that 12 patients developed bulging in the lower abdomen. The technique used by Glasberg et al. involved a 4 cm×12 cm inlay graft of 0.79 mm- 1.78 mm thick acellular dermal graft. Although the study by Glasberg demonstrated favorable outcomes with the use of an acellular dermal graft, other synthetics have been used in the closure of the anterior sheath as well [8]. Kroll et al. have reported a 6 % hernia rate with Marlex mesh

Table 2 Comparison of hernia in patients with and without graft closure

Use of acellular dermal graft	Post-op Hernia	Donor site complications
Primary closure without graft (Group 1)	None	Two localized skin infection (treated with antibiotics and wound care)
Graft (Group 2)	None	Four localized skin infection (three required removal of graft; in patients with JP drain)

Table 3 Statistical analysis of infection rate in Group 1 and Group 2

	Group 1	Group 2
Mean (Infection)	0.04	0.08
Standard deviation	0.20	0.27
N	48	40
Confidence interval	−0.07 to 0.13	
<i>P</i> value	0.5225	

closure of TRAM flap donor sites compared to a 35 % hernia repair with primary closure [14].

Watterson in 1995 studied the use of polypropylene mesh in the reconstruction of TRAM flap donor sites, and noted a four-fold decrease (16 to 4 %) in hernia rate as compared to patients closed primarily [25]. According to a study by Pennington et al., Gore-Tex was suggested to be superior in the closure of abdominal defects compared to primary closure [5].

In 2010, Kheradmand studied the difference in closure of the anterior rectus sheath with prolene mesh compared to dermal autograft. In his study, 34 patients were closed with dermal autograft while 42 were closed with prolene mesh. He reported one patient developed abdominal wall bulging, but no patients developed a true hernia in a mean follow-up period of 27 months. When comparing mesh and dermal autograft, no significant difference was found in infection or abdominal weakness [26].

In our retrospective study of 88 patients, 48 with defects extending caudal to the arcuate line, we found no statistically significant difference in hernia formation between patients closed with an acellular dermal graft and those closed primarily ($p=0.5225$). Our findings suggest that a meticulous primary closure of the anterior rectus sheath in non-fascial sparing defects caudal to the arcuate line may be sufficient to prevent hernia formation in rectus harvest for head and neck reconstruction. Since the flap size is usually smaller than that needed for breast reconstruction, this finding may not apply to the latter. In our study, all anterior rectus sheath defects were able to be reapproximated primarily. Larger defects may not be amenable to primary closure. Our sample size of 88 patients and the retrospective nature of this study could have been limitations to our findings, as only 48 patients had defects caudal to the arcuate line. A prospective randomized controlled trial with a larger sample size of patients with harvest caudal to the arcuate line would increase the power of these findings.

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