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Laparoscopically Harvested Omental Free Flap to Cover a Large Soft Tissue Defect

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Objective
The omentum has been a very important tool in the armamentarium of the reconstructive surgeon. It has lost much of its value because of the morbidity associated with laparotomy. Laparoscopic surgery has become a popular technique and allows operations to be performed with minimal morbidity. The possibility of harvesting the omental free flap with the laparoscope and its use in reconstructive surgery has been demonstrated.

Summary Background Data
Since the first laparoscopic cholecystectomy was performed, many surgeons have learned the procedure. Other surgical specialties have also benefited from this technique. The omentum provides a large amount of vascularized tissue and excellent wound coverage. It can be transferred as a pedicle flap, or as a free flap, using microvascular technique.

Methods
The procedure was developed and refined in an animal model. One team harvested the omentum with laparoscopic assistance, while the other team prepared the recipient vessels. After completion of the microvascular transfer, the dogs were observed for 14 days. At that time, the omental tissue was examined for gross and histologic changes. A clinical case is also presented.

Results
Gross and microscopic studies documented the viability of this approach. The patient tolerated the procedure well and had an unremarkable postoperative course.

Conclusions
Experimental and clinical evidence shows that the omentum can be successfully harvested as a free flap using laparoscopic assistance. This technique may prove to be of clinical significance and very useful for reconstructive surgery with less morbidity.

Since the first laparoscopic cholecystectomy was performed in France by Dubois[1] and in the U. S. by Reddick and McKernan,[2] many surgeons across the world have learned the procedure, and over the last few years, laparoscopic surgery has become a popular surgical technique. It has opened many new frontiers and allowed standard operations to be performed using laparoscopic approach. Laparoscopic vagotomy, gastrostomy, intestinal resections, hernia repair, and appendectomy are just

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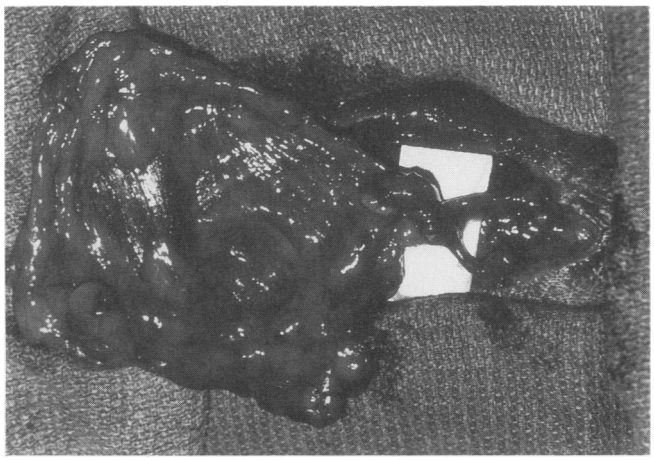

Figure 1. Experimental model showing the completed microvascular anastomosis and the omentum revascularized.

Figure 3. Experimental model examined on the 14th postoperative day showing the viable vascularized omental flap.

some of these applications. Neurosurgery, urology, gynecology, otolaryngology, and other surgical specialties have also benefited from this technique. We describe a laparoscopic approach to reconstructive surgery by harvesting an omental free flap to cover a soft tissue defect.

The omentum has been an important tissue in the armamentarium of the reconstructive surgeon. The omentum has lost much of its value in the reconstructive arena because the laparotomy associated with harvesting can cause significant morbidity such as prolonged ileus and wound infections. We report the first experimental and clinical case in which the omentum was retrieved with the laparoscope and used as a free flap.

METHODS AND RESULTS

Surgical Technique

The technique was developed and refined in an animal model. Initially the pig was used; however, it is not a suitable model because the vessels of the omentum arborize very early and a suitable vascular pedicle is difficult to obtain. In the dog, the right gastro-epiploic vessels

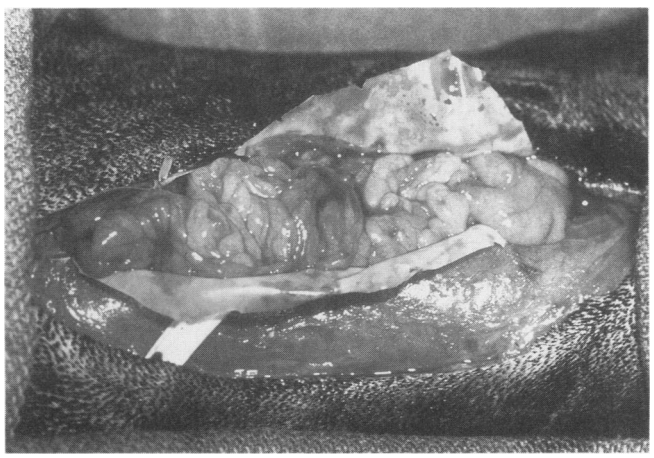

Figure 2. Experimental model showing the omental flap wrapped with latex to prevent other source of revascularization.

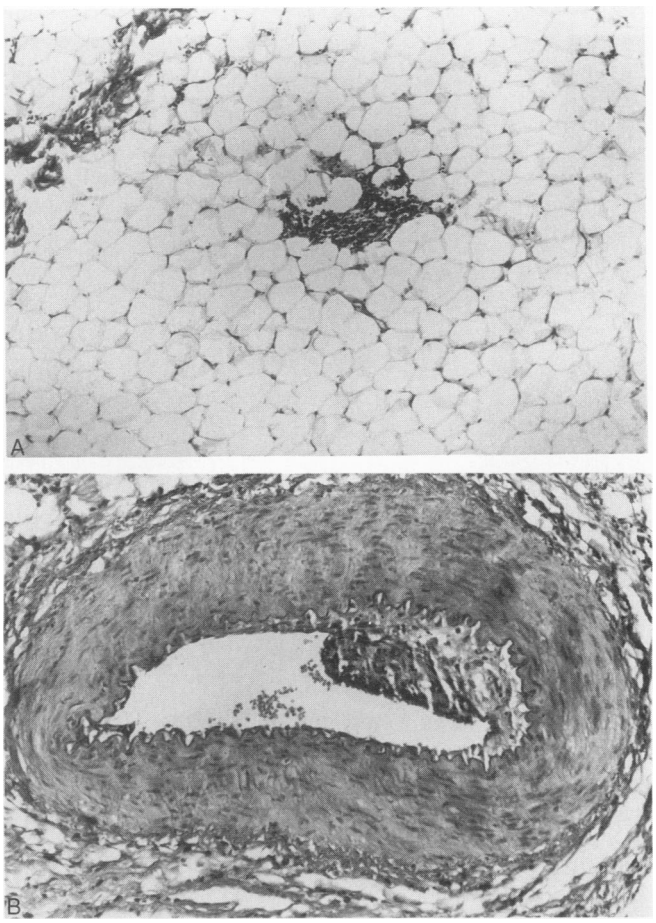

Figure 4. A: Micrograph of the histology of the omental graft on the 14th postoperative day. The fatty adipose tissue is viable. B: Photomicrograph of the histology of the experimental omental flap on the 14th postoperative day showing the patent artery.

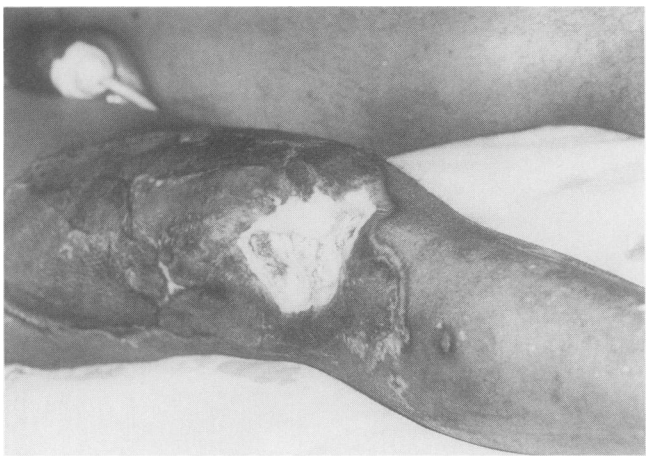

Figure 5. Preoperative condition of the non-healing right knee wound.

are well developed and the distinct branches from the main vessels provide a broad and well-vascularized tissue. After administering general anesthesia and establishing a pneumoperitoneum with carbon dioxide, an

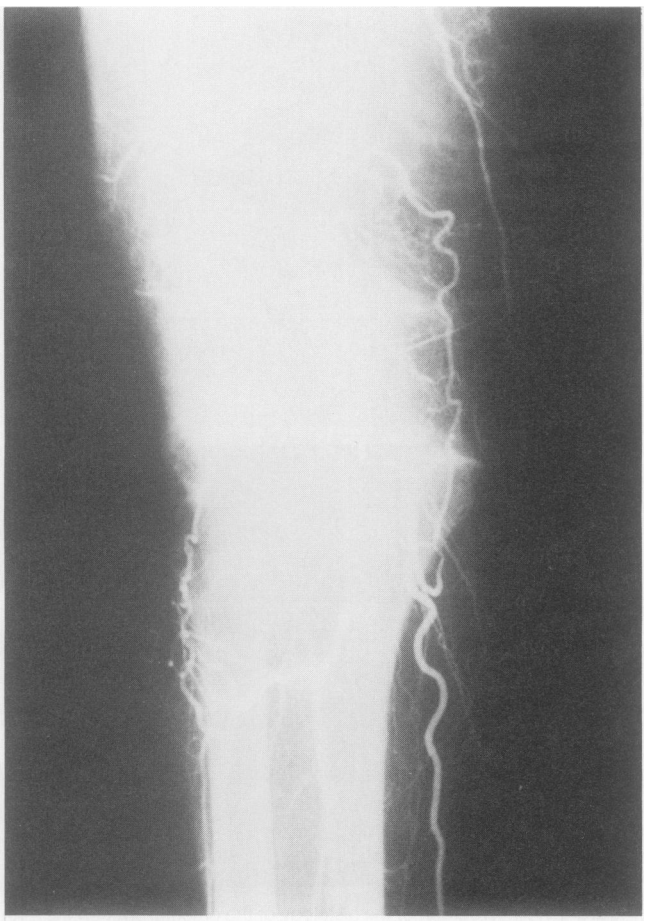

Figure 6. Preoperative arteriogram showing patent popliteal and tibial vessels. The popliteal artery and vein were used as donor vessels for the omental flap.

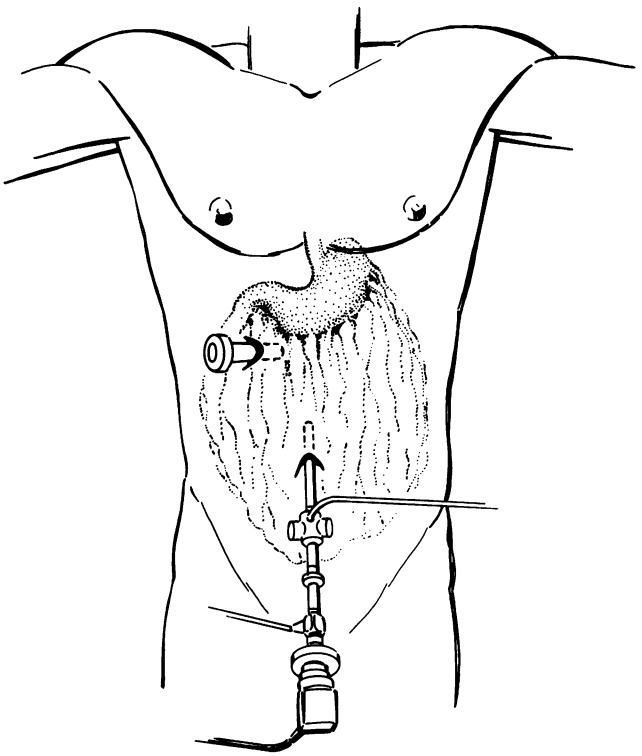

Figure 7. The position of the cannulas and laparoscopic instruments for harvesting the omentum.

umbilical cannula is inserted. Through this cannula, the laparoscope is inserted and used to guide the operation. A specialized 25-mm cannula is introduced in the right

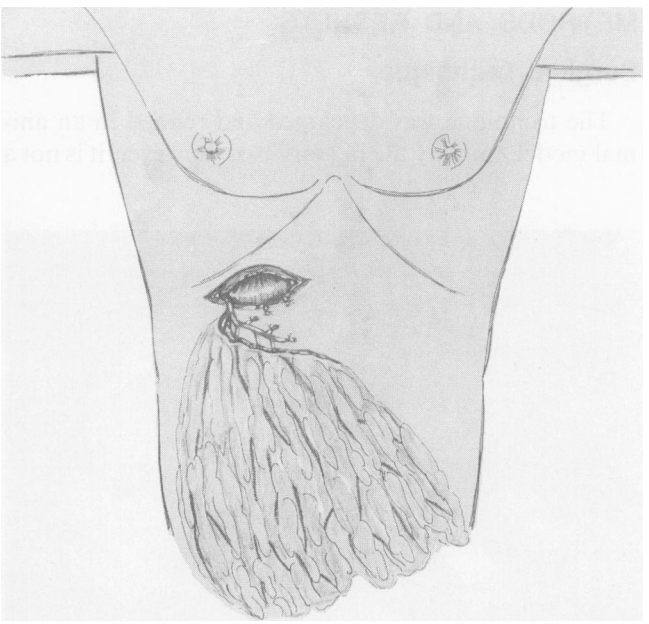

Figure 8. The completed dissection of a segment of omentum based on the right gastro-epiploic artery and vein. The branches between the greater curvature of the stomach and the main epiploic vessels have been ligated and divided.

Figure 9. The omentum revascularized and inset into the wound.

upper quadrant and a grasping instrument is inserted and used to identify and isolate the omentum along the greater curvature of the stomach. Once the desired segment of omentum is identified, the incision is enlarged to approximately 8 cm, and the omentum is exteriorized onto the abdominal wall. The omental branches are ligated and divided outside the abdomen using 5-0 silk, avoiding tears or damage to surrounding tissues. Once this vascular pedicle has been isolated, the amount of omentum required to fill the defect is dissected from the surrounding omentum. The left carotid artery and left jugular vein are isolated through a cervical incision. Using the microscope, the recipient vessels are prepared for microvascular anastomosis.

The omental vessels are divided and the free omental segment is transferred to the recipient site where microvascular anastomosis is completed (Fig. 1). The rest of the omentum is placed back in the abdominal cavity, and the right upper quadrant incision is closed with interrupted 0-Vicryl. The skin is closed with interrupted 4-0 nylon. Once the omental tissue is revascularized, it is wrapped with a layer of latex glove material to isolate it from surrounding tissues and to prevent any other source of revascularization (Fig. 2).

At 2 weeks, the omentum was healthy with a good pulse in the omental artery and a patent omental vein. The latex sheet prevented any surrounding adhesions (Fig. 3). On gross examination, the transplanted omentum was focally hemorrhagic, but retained the yellow color of fatty adipose tissue. There were no areas of fat necrosis or liquefaction. Histologic examination of the omentum showed viable fatty adipose tissue (Fig. 4A) but did display foci of chronic inflammation. Foreign body reaction was focally present. There was no evidence of infiltration of the fat histiocytes as is seen in fat necrosis. The vascular anastomoses were intact and patent. A small organizing fibrin clot was present near the anastomotic site (Fig. 4B).

Clinical Case

A 61-year-old black man, obese and a heavy smoker with a history of hypertension, had severe trauma and third-degree burns to the right lower extremity on November 1991. He underwent a knee fusion with several wound debridements and skin graftings in another institution. He was referred to us due to failure of the graft sites and infection. This resulted in a large wound in the lateral aspect of his right knee with exposed bone and chronic drainage for 7 months (Fig. 5). On examination he had a fully sensate foot but could not ambulate well. He had no previous abdominal surgery and no abdominal scars. A preoperative arteriogram (Fig. 6) revealed a patent but calcified popliteal artery with three patent vessels to the leg and foot. Due to the large size of this wound, we elected to use the omental free flap harvested using a laparoscopic approach.

Two operative teams were used. After induction of general endotracheal anesthesia, the laparoscopic team harvested the omentum using a technique similar to that

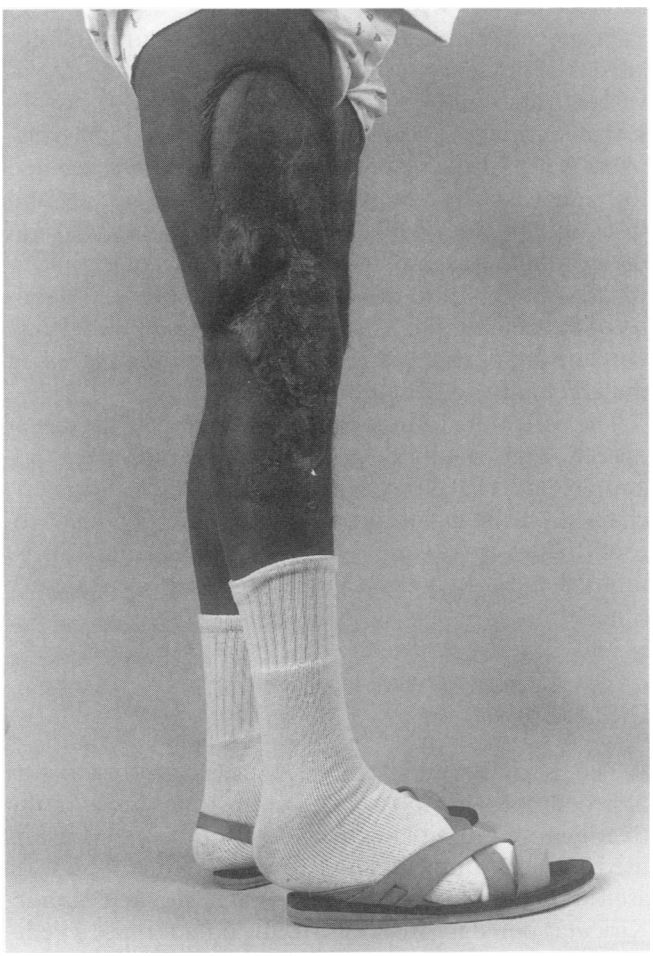

Figure 10. The 10-month follow-up with the wound healed after a skin graft was applied on the third postoperative day. The patient is ambulatory.

described in the experimental section. Figure 7 shows the position of the cannulas and laparoscopic instruments. Using a 25-mm cannula, the omentum was identified and exteriorized by making a 8-cm incision in the right upper quadrant. The omentum was mobilized into the incision and the greater curvature of the stomach identified (Fig. 8). The right gastro-epiploic vessels were identified and four branches between the greater curvature of the stomach and the main vessels were ligated and divided. A large segment of omentum was isolated based on the gastro-epiploic vessels. The omentum was wrapped with warm moist saline pads until the donor site and vessels were ready for transfer. At that time the proximal part of the gastro-epiploic artery and vein were ligated and divided, and the vascularized pedicle of omentum was transferred to the reconstructive team for revascularization. The stomach and omentum were returned to the abdomen and laparoscopically inspected for bleeding. The right upper quadrant incision was closed with a running absorbable suture and the skin closed with staples. The laparoscope was removed and the umbilical incision closed with a single absorbable suture.

The reconstructive team debrided the wound and isolated the popliteal artery and vein. An end-to-side microvascular anastomosis was performed using 9-0 nonabsorbable sutures. The omental arteries had a doppler signal as well as palpable pulses. The omentum was secured to the edges of the defect with absorbable sutures and inset into the wound (Fig. 9). A dressing was applied and the extremity was immobilized with a posterior splint. A window was made in the dressings to monitor the viability of the omentum by visual checks and Doppler signal. On the third postoperative day a skin graft was placed on the granulating omental bed.

The patient had a nasogastric tube removed the day of operation and was on a regular diet on the second postoperative day. The skin graft healed well and he was discharged on the eighth postoperative day. The most recent follow-up was in November, 1992, and at 10 months the area was healed and he was ambulatory (Fig. 10).

DISCUSSION

The use of the omentum in reconstructive surgery was first described by Jobet and Lambell in 1926[3] for the treatment of intestinal wounds. Durmond and Morsion used the omentum as a free graft in the treatment of ascites in 1914,[3] after excising a large thoracic tumor. Kiricuta[3] popularized the use of the omentum as a pedicle flap. The omental free flap was first described by McLean and Buncke,[4] and Harii.[5] Jurkiewicz described the use of omentum for chest wall reconstruction.[6] Since the omentum provides a large amount of vascularized tissue, it has been used not only as a pedicle flap, but also as a free flap in the management of difficult wounds.

This article reports experimental and clinical evidence that the omentum can be successfully harvested as a free flap using laparoscopic assistance. Gross and microscopic studies document the viability of this approach. The abdominal incision required to perform this operation was minimal and the procedure was well-tolerated by the animals and the patient. If the omentum is not needed in its entirety, one can custom design the free flap. The long, large vessels can simplify the microanastomosis in difficult cases and avoid the use of vein grafts.

The use of minimally invasive surgery is gaining large popularity throughout the surgical world. Although more clinical experience and follow-up is needed to reach definitive conclusions, we believe that our technique of harvesting the omental free flap with the laparoscope may prove to be of major clinical significance and very useful for reconstructive surgery with less morbidity.

Acknowledgments

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Discussion

DR. MAURICE J. JURKIEWICZ (Atlanta, Georgia): I would agree with all of the conclusions of Dr. Gadacz, that is, the use of the omentum provides broad coverage and it is a good flap to use. It has a long pedicle and therefore it's easy to use. Vein grafts are not required as an interposition in order to get an appropriate arterial conduit or venous return. Our experience with the omentum dates back to 1973. At the end of 1990 we had accumulated 72 instances of the use of the omentum. We began originally with its use as a transposition flap to cover chest wall defects. Primarily these were osteoradionecrosis following treatment for carcinoma of the breast. We subsequently extended its use to treatment of mediastinal wound infections. The omentum is my first choice for patients with growth dis-