

## *Topics: Reconstruction of the remnant pancreas after PD*

# Technique of pancreaticojejunostomy reconstruction after pancreaticoduodenectomy

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### Introduction

Pancreaticojejunostomy is one of the three enteric anastomoses performed during pancreaticoduodenectomy, and technically, it is the most challenging. Historically, a number of different anastomotic techniques have been employed. Some favor a pancreatic duct-to-jejunal mucosal anastomosis, some employ a pancreatic duct stent, some even ligate or otherwise obstruct the ductal system. Although almost all surgeons have abandoned duct obstruction as a viable option, an overview of the most popular techniques now used suggests that there is no single approach that is clearly superior to the others. In our view, it is most important to follow sound surgical principles, and over years of practice, to become expert in the particular technique that the surgeon has adopted. What follows is a description of the technique currently practiced by the authors in the Gastrointestinal Surgery Section at UCLA, which has evolved over a number of years of experience with a variety of methods of reconstruction.

### Initial steps in construction of the pancreaticojejunostomy

The jejunal limb that will be used for the anastomosis is closed at its end by a row of staples and reinforced by several 3-0 seromuscular silk sutures and it is usually brought *behind* the superior mesenteric artery and vein in the position occupied formerly by the retroperitoneal duodenum. However, in patients with duodenal cancers involving the third or fourth portion of the duodenum, we bring the jejunum through a hole in the transverse mesocolon instead. This minimizes the possibility of the

jejunum becoming obstructed by recurrent cancer if tumor recurs in the retroperitoneum.

Preparation of the pancreas for the anastomosis requires that it be freed up circumferentially for a distance of about 2 cm from its cut surface. Posteriorly, this usually involves the ligation and division of several tributaries to the splenic vein. On its cranial surface, there may be some branches from the splenic artery that require division. There are usually no significant vessels caudally. Before any sutures are placed, the pancreatic duct is identified and probed to be certain that it is patent out into the body of the gland and that it has not been obstructed by any sutures that were placed earlier (see below). We then place a pediatric feeding tube (5 or 8 F) into the duct, which serves as a stent for the reconstruction that follows.

We perform a two-layer anastomosis using interrupted 3-0 seromuscular silk sutures for the outer layer and two continuous 3-0 absorbable (PDS) sutures for the inner layer. The silk sutures for the posterior row are placed first, beginning at the superior (cranial) margin of the pancreas. They are placed as horizontal mattress sutures (i.e., parallel to the cut surface of the pancreas) about 1–1.5 cm back from the cut edge and 1 cm deep into the pancreatic parenchyma. After the suture is placed into the pancreas, a seromuscular bite is taken in the bowel. This first suture is not tied until the remaining ones that form the posterior row have all been placed. Subsequent sutures are inserted in a similar fashion as horizontal mattress sutures in both the pancreas and bowel, with bites approximately 1 cm deep into the pancreatic tissue that also encompass a cranial-to-caudal distance of about 1 cm (Fig. 1). Thus, most anastomoses require only three or four posterior sutures. After all these sutures have been placed, they are tied snugly, beginning with the one placed first and progressing in order. The first assistant apposes the bowel to the pancreas as the sutures are tied to minimize tension; the sutures are cut on the knot. Any bleeding that

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was provoked by suture placement almost always stops when the sutures are tied. The field is irrigated with saline and the inner row of continuous sutures will be placed next.

The jejunum is opened with electrocautery in a straight line about 1 cm from the posterior row of tied silks and parallel to the posterior cut edge of the pancreas (Fig. 2).

Because the jejunum will stretch during the anastomosis, the length of the jejunal opening should be a centimeter or so less than the long diameter of the pancreas to which it will be attached. Again we begin to place sutures at the cranial margin of the anastomosis. The first of the two 3-0 PDS sutures is placed full thick-

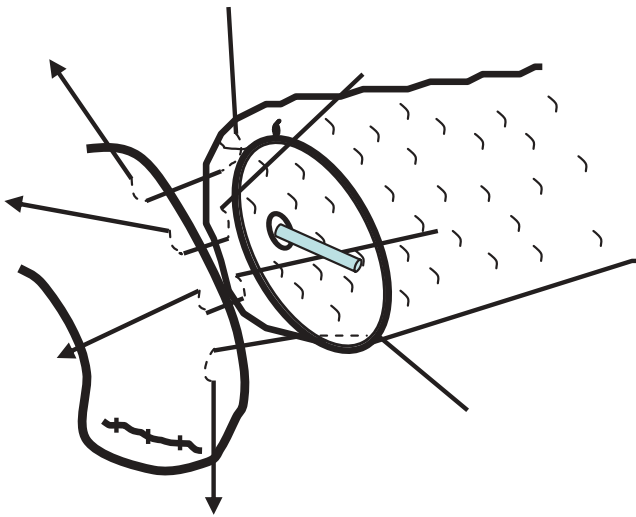
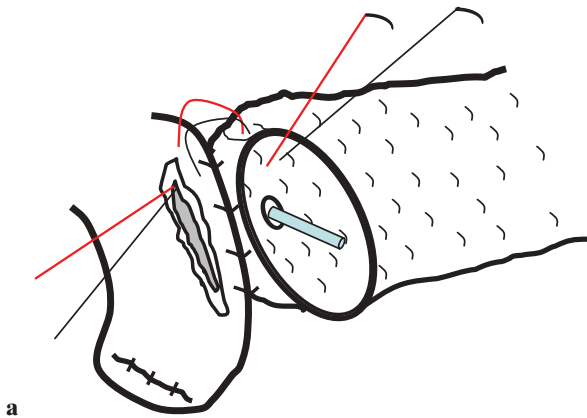


Fig. 1.



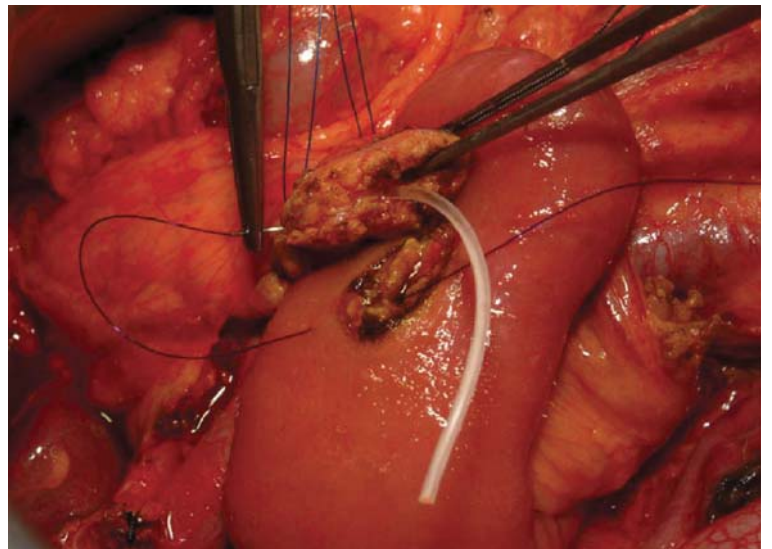
a

**Fig. 2. a** The two inner-row sutures are placed and tied. The *red* suture is placed first and will become the posterior suture line. The *black* suture will become the anterior suture line.

ness from the inside to the outside of the bowel wall, about 3 mm back from the edge. The needle then is driven from the outside of the pancreas about 1 cm back from the cranial margin so that it emerges from the cut surface of the gland at a point about half way along the anteriorposterior diameter of the gland (Fig. 2). This suture is tied and the short end is cut. The second suture is then placed just anterior to the first in a similar fashion, tied, the short end cut, and then the needle is passed through the full thickness of the jejunal wall so that the suture is now on the outside of the bowel lumen. It will be used later for the anterior inner layer of the anastomosis.

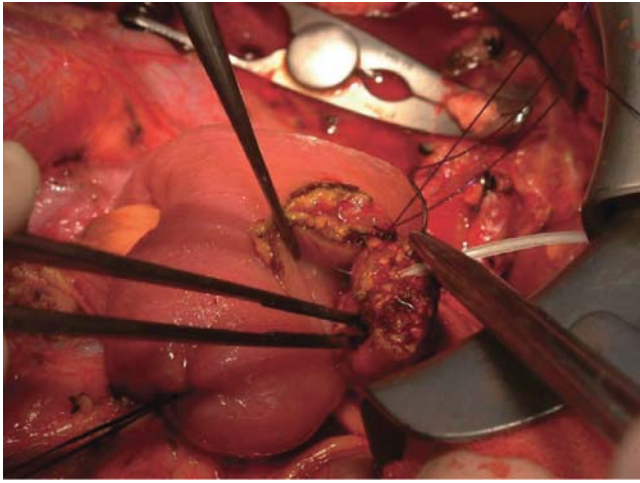
The posterior inner layer of the anastomosis is now performed by placing the first PDS suture in a continuous over-and-over fashion from the pancreas through the full thickness of the bowel wall. Bites into the pancreas should encompass about one half of the diameter of the cut surface and should also be placed into the duct lumen when that structure is encountered (Fig. 3).

On the bowel side, the sutures are placed about 2–3 mm back from the cut edge. The plastic tube that had been placed earlier into the duct lumen aids in its identification during this part of the procedure, but the surgeon must be careful that the sutures placed into the duct do not inadvertently also pass through this stent. Because the diameter of the duct varies, the number of sutures placed into its lumen varies as well. In small ducts (2–4 mm), as few as two sutures may be required; larger ducts may require four or five. Also, because the duct lumen is usually situated more cranially as viewed from the cut pancreatic surface (rather than being centrally located), the lower few bites of the pancreas with this continuous PDS suture usually no longer incorpo-

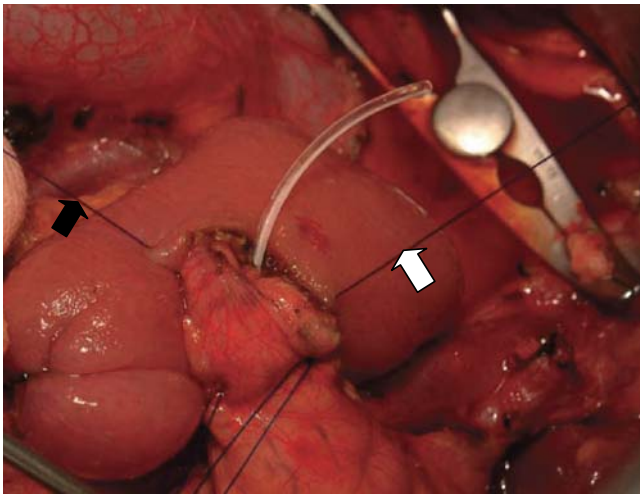


b

**b** The first suture is placed through the bowel and then through the pancreatic tissue



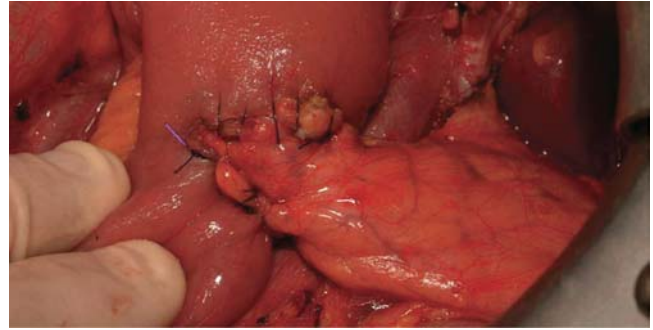
**Fig. 3.** The posterior row of continuous suture is begun. Here the needle is driven through the pancreas and is about to be driven through the jejunal wall. The duct lumen has not been included in this stitch



**Fig. 4.** The posterior-row suture has been completed and is shown (*black arrow*) on the outside of the bowel. The anterior row suture (*white arrow*) is placed next

rate the duct. Instead, as with the first one or two sutures, they are placed only through the pancreatic parenchyma and jejunum. When the entire posterior and inferior pancreatic margin has been closed, the suture is brought from the inside of the bowel lumen to the outside and is held in that position during the placement of the anterior continuous suture (Fig. 4).

The anterior row of continuous suture is placed next in the same way as the posterior row, encompassing the remaining half of the diameter of the cut surface of the pancreas. Exposure of the duct is now more difficult because it is usually closer to the posterior surface of the gland and the posterior sutures already placed between



**Fig. 5.**

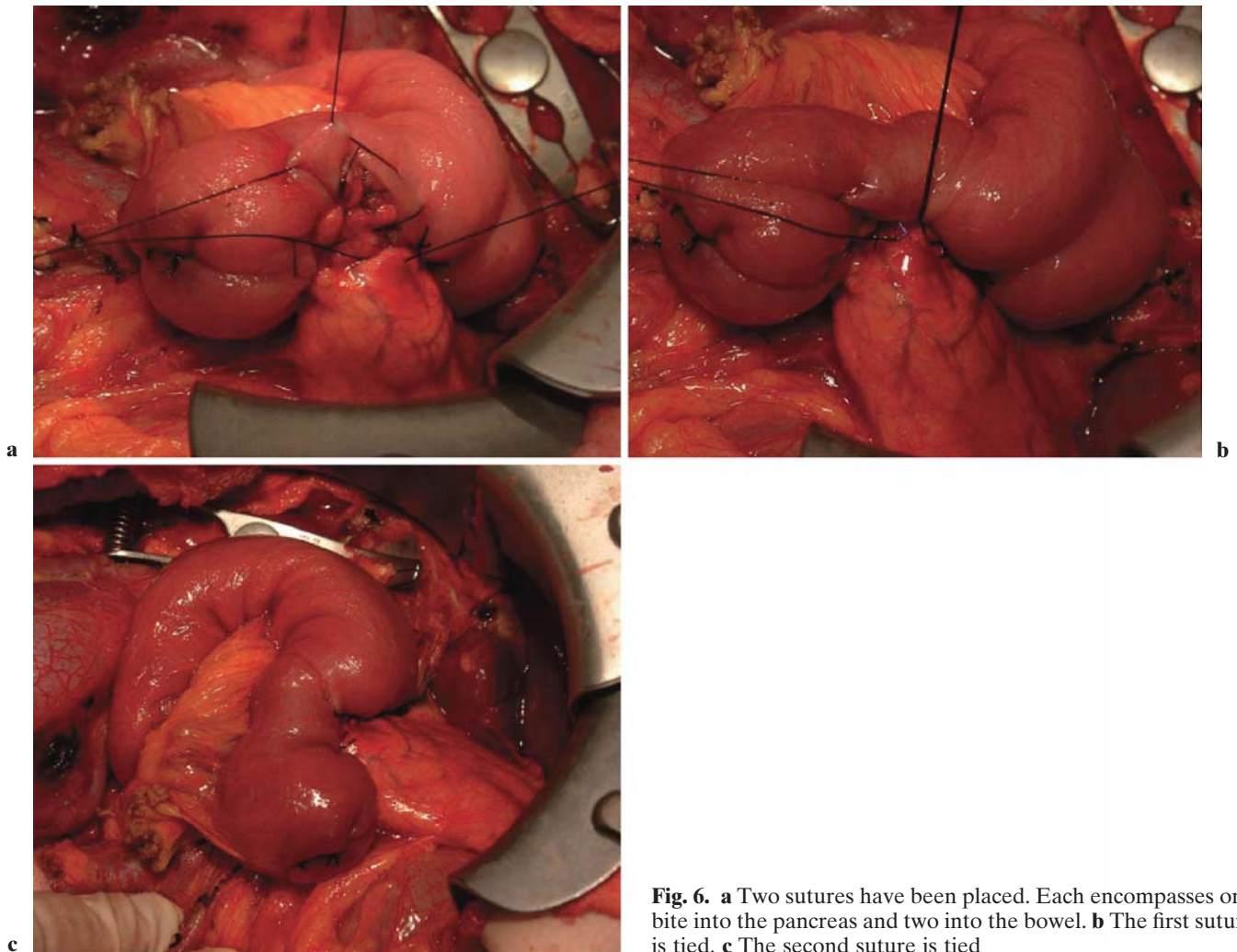
the duct and the jejunum tend to obscure it. Nevertheless, the anterior row of sutures also should incorporate the duct lumen, just as the posterior row did, and the stent is useful to assure accurate placement. We remove the stent when the last suture through the lumen of the duct has been placed and continue with the anterior-row suture until the closure of the pancreas and jejunum is complete. The anterior-row suture is then driven full thickness through the bowel wall, emerging from the pancreas opposite the point where the posterior-row suture ended. The two sutures are tied together and the ends are cut (Fig. 5).

After irrigation of the field, the anterior row of interrupted silk sutures is placed. They too are placed as horizontal mattress sutures about 1–1.5 cm back from the PDS suture line and 1 cm deep into the pancreatic parenchyma. After the suture is placed in the pancreas, seromuscular bites are taken in the bowel. As with the posterior row of silk sutures, we begin at the cranial margin of the pancreas and progress caudally, tying the sutures only after they all have been placed. To minimize the number of sutures that are placed into the pancreas and because there always tends to be an excess of jejunal tissue, we usually place two or even three seromuscular bites into the bowel with each of the silk sutures that have been placed once into the pancreas (Fig. 6a).

When all the sutures are tied, the excess bowel is pulled together (like an accordion) and becomes snugly apposed to the pancreatic surface (Fig. 6b,c). This almost always provides a good seal for the inner layer of the anastomosis, and even with a soft pancreatic parenchyma, the tissue is rarely cut through. Again, as the sutures are tied in the order in which they were placed, the assistant brings the bowel to the pancreas to minimize tension. The sutures are cut, the field is irrigated, and the remaining anastomoses are completed.

At the end of the operation, we place a closed suction drain (Jackson–Pratt #10) through the anterior abdominal wall to the left of the midline, through an opening in the transverse mesocolon behind the stomach and





**Fig. 6.** **a** Two sutures have been placed. Each encompasses one bite into the pancreas and two into the bowel. **b** The first suture is tied. **c** The second suture is tied

between the anterior surface of the anastomosis and the left lobe of the liver.

### Other considerations

We routinely send a cut slice of the pancreas resection margin to the pathologist when the pancreas is transected and before the entire specimen has been removed. This provides sufficient time to assure that the resection margin is free of tumor before we begin the anastomosis.

Although the senior author used pancreatic duct stents earlier in his career, he found no difference in the incidence of fistulas or other complications without them, and so no longer uses them. We have not found it advantageous to use visual magnification for the performance of the anastomosis.

Some years ago, the senior author performed *end-to-end* pancreaticojejunal anastomoses in most cases, re-

serving an *end-to-side* reconstruction for those in which the pancreatic remnant was too large to invaginate into the jejunal lumen. However, more recently, all are done in an end-to-side fashion. This is because the jejunal opening can always be made to be the exact size required, and also because it avoids the occasional problem of bleeding from injury to the vascular arcades in the jejunal mesentery when the mesenteric border of the bowel is sutured to the pancreatic tissue.

Prior to transection of the neck of the pancreas and the removal of the pancreaticoduodenectomy specimen, we routinely place four transfixion sutures of 3-0 Prolene in each of the four corners of the gland, two on each side of the proposed line of transection, to minimize bleeding from the transverse pancreatic vessels. The two sutures that remain in the pancreatic remnant where the pancreaticojejunostomy will be created usually end up about 2 cm back from the cut pancreatic surface at the cranial and caudal margins of the gland. The two external silk sutures that are placed through

the pancreatic parenchyma at those cranial and caudal margins are placed through tissue which is compressed by these Prolene sutures. We believe that they may actually provide additional strength to the pancreatic parenchyma in those areas, which may help to avoid tearing of the pancreas when the silk sutures are tied. The suture in the cranial margin of the pancreas should be placed to avoid obstructing the pancreatic duct. At the time of the anastomosis, insertion of the stent into the duct assures that this has not occurred (see above).

A recent UCLA review of the incidence and management of pancreatic fistulas after pancreaticoduo-

denectomy ( $n = 437$ ) found an overall incidence of 12.6% using the techniques described above. After resection for pancreatic cancer, the fistula incidence was 6.5%.<sup>1</sup>

### Reference

1. Kazanjian KK, Hines OJ, Eibl G, Reber HA. Management of pancreatic fistulas after pancreaticoduodenectomy: results in 437 consecutive patients. *Arch Surg* 2005;140:849-54.