

## CASE SERIES

# Two-Stage Pancreatoduodenectomy in Which Pancreatojejunostomy Performed in First Stage for Pancreatic Trauma

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### ABSTRACT

We report 2 cases of two-stage pancreatoduodenectomy for injuries to the pancreatic head, in which the pancreatojejunostomy was performed first. Case #1 was caused by a traffic accident and case #2 by a blow to the abdomen. Both injuries to the pancreatic head were classified as American Association for the Surgery of Trauma Organ Injury Score grade V. In the initial surgeries, all the reconstruction modalities except for cholangiojejunostomy were performed. A modification of Child's method was used for the reconstruction. The pancreatic duct was converted into an incomplete external drainage. A complete drainage tube was inserted into the common hepatic duct via the liver, and the stump was sutured and closed. The bile duct and jejunum were sutured for anastomosis in stage 2. In this stage, only cholangiojejunostomy was performed. Only the anterior half circumferences of the bile duct and jejunum were anastomosed. Both patients survived and experienced no complications.

### INTRODUCTION

Pancreas is anatomically complex and because of its physiological characteristic of generating potent external secretions, the mortality rate due to pancreatic trauma is high at 15.7-54.4% [1, 2, 3]. Moreover, pancreatic trauma is relatively rare; therefore, research has provided little high-level evidence [4]. The severity of pancreatic injuries can be categorized using the American Association for the Surgery of Trauma Organ Injury Score (AAST-OIS) [5]. Pancreatic head injuries that are indicated for PD are pancreatic injuries that are accompanied by an injury to the main pancreatic duct, which are classified as AAST-OIS grade V. However, the Eastern Association for the Surgery of Trauma's "Management of Adult Pancreatic Injuries" states that no data exists that would serve as evidence for recommending PD [6]. Nevertheless, some pancreatic injuries that are accompanied by an injury to the main pancreatic duct exhibit severe damage to the pancreatic parenchyma, which makes non-operative management impossible. If only performing restorative surgery would

be risky, PD may be indicated. Therefore, while only a small number of patients will require PD, they do exist.

The mortality rate of PD for trauma was about 50% until the 1980s [7, 8]. Though this has recently improved to 13-15% [9, 10], it is still considered unacceptable. Often when a patient's overall condition is poor, only damage-control surgery is performed initially, then resection and reconstruction are performed in stage 2 [9, 10, 11]. However, relatively good results have been reported in a small number of cases when resection is performed in the initial surgery [12, 13]. Here, we report 2 cases of two-stage PD for injuries to the pancreatic head in which the pancreatojejunostomy was performed first.

### CASE PRESENTATION

#### Case #1

A Twenty-eighty-year-old man who was injured when the two-wheeled vehicle he was riding was struck by an automobile. When being transported by ambulance, his consciousness was clear, his blood pressure was 164/125 mmHg, and his pulse rate was 70/min. Full-body contrast-enhanced computed tomography (CT) revealed injuries to the pancreatic head and major pancreatic duct, bleeding from the gastroduodenal artery (GDA), and blood congestion in the pancreaticoduodenal region. A diagnosis of AAST-OIS grade V was made (**Figures 1a, 1b, 1c**). No injuries outside the pancreaticoduodenal region were observed. The GDA rupture was close to where it branched from the common hepatic artery. The injuries to the major pancreatic duct and pancreatic head were complex, and the GDA rupture was severe; therefore, emergency surgery was performed. First, the GDA was ligated to stop

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**Abbreviation** AAST-OIS American Association for the Surgery of Trauma Organ Injury Score; CT computed tomography; GDA gastroduodenal artery; PD Pancreaticoduodenectomy

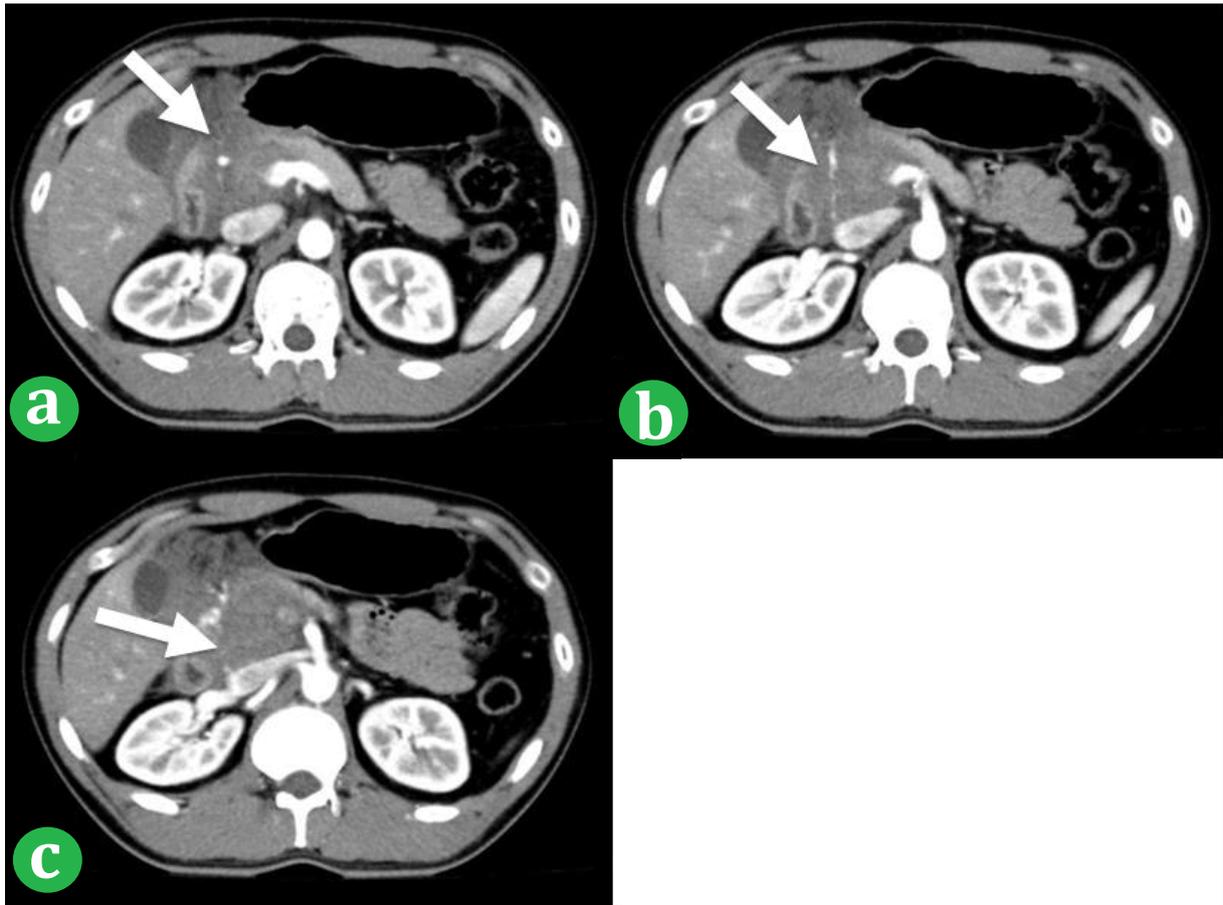
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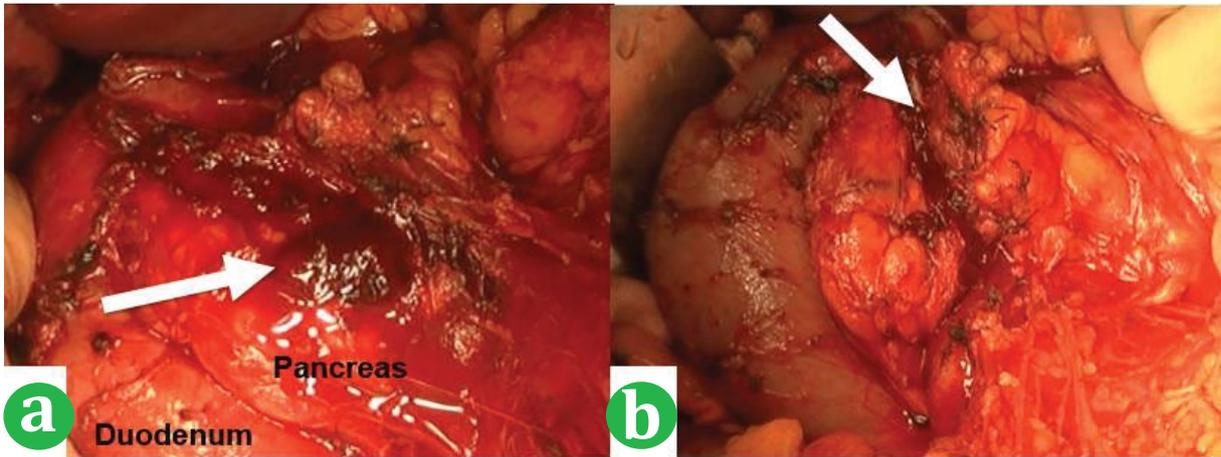


**Figure 1.** (a). Ruptured pancreas at the pancreatic head (arrow). (b). Bleeding from the gastroduodenal artery (arrow). (c). Markedly reduced contrast effect at the pancreatic head (arrow).

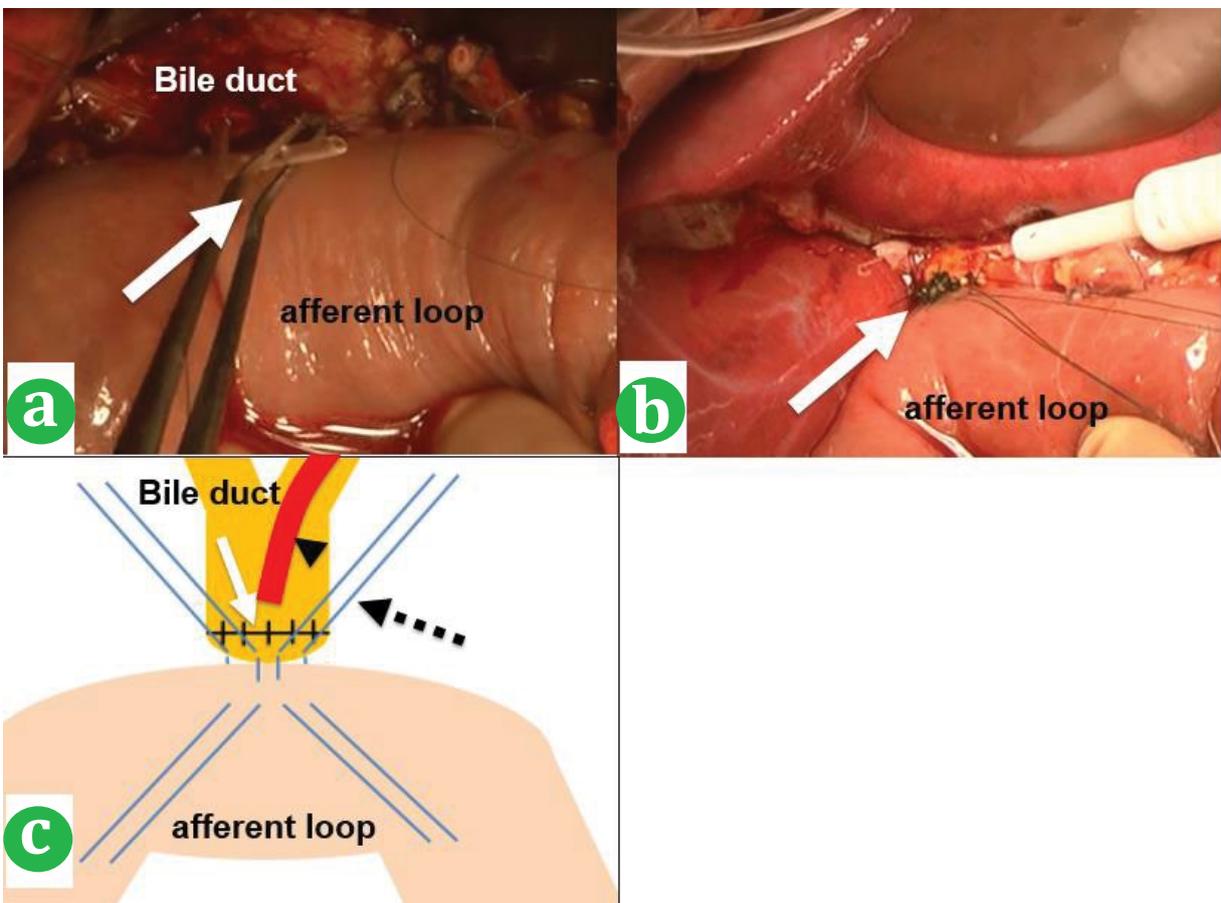
the bleeding. The main pancreatic duct was ruptured at the right margin of the portal vein (**Figures 2a, 2b**). The pancreatic head was severely crushed; thus, a pylorus-preserving PD was planned. The pancreas was resected at the left margin of the portal vein. Reconstruction after the resection was performed using a modification of Child’s method. With side-to-end pancreaticojejunostomy with a modified Blumgart method, the pancreatic duct is converted into an incomplete external drainage, in which the drains outside the body through to the jejunum anastomosed the pancreas. The common hepatic duct was closed, and a 6 Fr complete drainage tube was inserted via the liver. Moreover, the jejunum, proposed as the site of anastomosis in the stage 2 surgery, was sutured to the seromuscular layer of the posterior wall of the common hepatic duct stump (**Figures 3a, 3b, 3c**). Finally, an end-to-side duodenojejunostomy was performed (**Figure 4**). The procedure lasted 5 hours and there was 932 g of bleeding. No postoperative complications were observed and the patient was discharged 25 days later. Two months post-discharge, he was re-hospitalized for the cholangiojejunostomy in stage 2. This surgery was performed via a 10 cm incision in the upper abdomen. The anterior half circumferences of the common hepatic duct (closed stump) and jejunum, which had been fixed in the first surgery, were opened and only the anterior walls were anastomosed (**Figures 5a, 5b**). Stage 2 lasted 2 hours and there was 30 g of bleeding. No complications were observed.

**Case# 2**

A Forty-year-old man whose pancreatic head was injured by a kick to the abdomen in a fight at a drinking establishment. His consciousness was clear but his blood pressure was 50/30 mmHg, his pulse rate was 116/min, and he was in shock. After a transfusion of 1000 ml, the blood pressure improved to 105/72 mmHg; consequently, contrast-enhanced CT was performed. CT revealed bleeding from the pancreatic head and duodenum, and extensive injuries to the main pancreatic duct (**Figures 6a, 6b, 6c**). A diagnosis of AAST-OIS grade V was made and emergency surgery was performed. There were no injuries outside the pancreaticoduodenal region. A large amount of blood was observed in the abdominal cavity but the only source of the bleeding was near the pancreatic head. The pancreas was deeply ruptured to the right of the right margin of the portal vein, and injuries to the main pancreatic duct were also observed (**Figure 7**). Hematoma and extensive congestion from the GDA injury were observed in the area of the pancreatic head. Based on these findings, a pylorus-preserving PD was planned. As in case 1, the pancreatic duct was converted into an incomplete external drainage, and the bile duct was closed, converted into a complete external drainage, and fixed to the jejunum. Up to the duodenojejunostomy was performed in a procedure that lasted 4 hours 7 minutes with 3139 g of bleeding. No complications were observed after the initial surgery. Stage 2 was performed 27 days later. Similar to case 1, only the



**Figure 2. (a).** The main branch of the gastroduodenal artery showing rupture and bleeding at the pancreatic head (arrow). **(b).** The pancreas, including the main pancreatic duct, was ruptured at the right margin of the portal vein (arrow).



**Figure 3. (a).** A 6 Fr complete drainage tube was inserted into the common hepatic duct via the liver (arrow). **(b).** The common hepatic duct stump was sutured and closed, and the posterior wall of the common hepatic duct stump was sutured to the jejunum (arrow). **(c).** Schema. Arrow: sutured bile duct stump. Arrow head: drainage tube (in the bile duct). Dotted-line arrow: fixed bile duct stump and jejunum posterior wall.

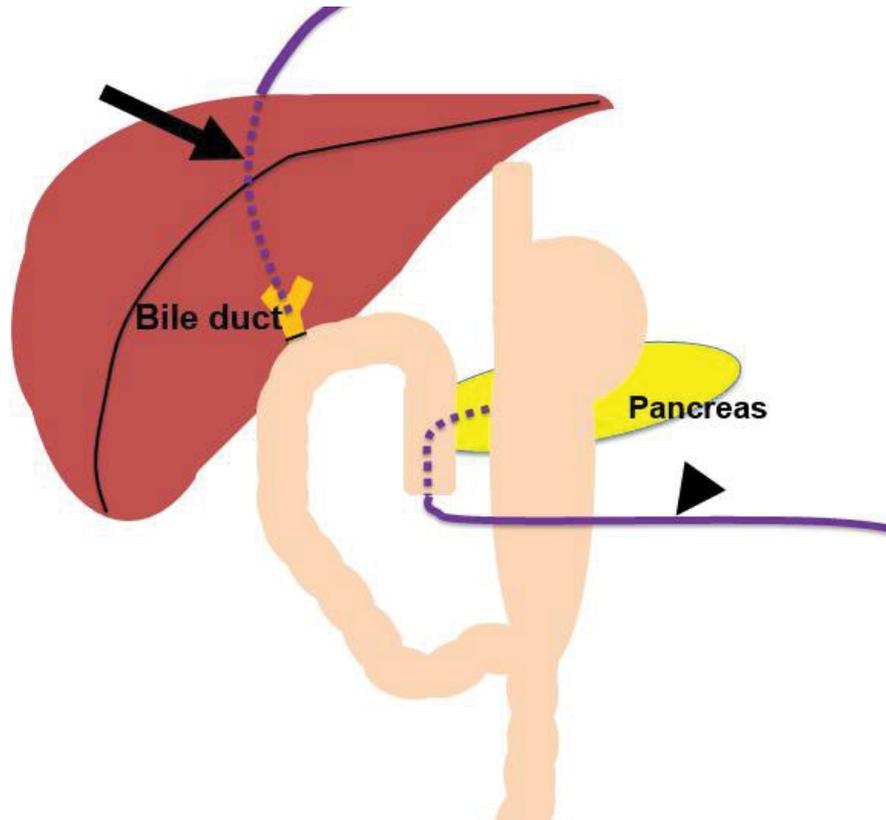
anterior half circumferences of the bile duct and jejunum, which had been fixed in the first surgery, were opened and anastomosed. Stage 2 lasted 2 hours 19 minutes, with 269 g of bleeding. No postoperative complications were observed and the patient was discharged.

**DISCUSSION**

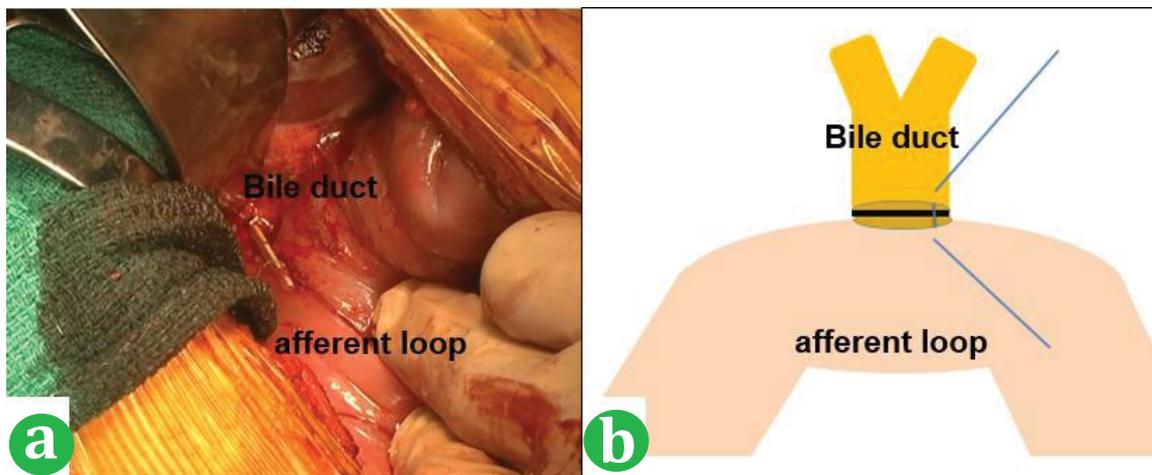
In the 2 cases of PD for injuries to the pancreatic head we experienced, the patients were generally stable and bleeding was promptly controlled after the procedures were started. Because this made adequate time available, resection and reconstruction, apart from

the cholangiojejunostomy, could be performed. In cases without coagulation disorders, hypothermia, or acidosis, it may be possible to perform a two-stage PD, with the pancreatojejunostomy performed first. In this procedure, pancreatojejunostomy and duodenojejunostomy are performed in stage 1, and cholangiojejunostomy is performed in stage 2. The 2 cases we experienced survived without any complications, exhibiting good results.

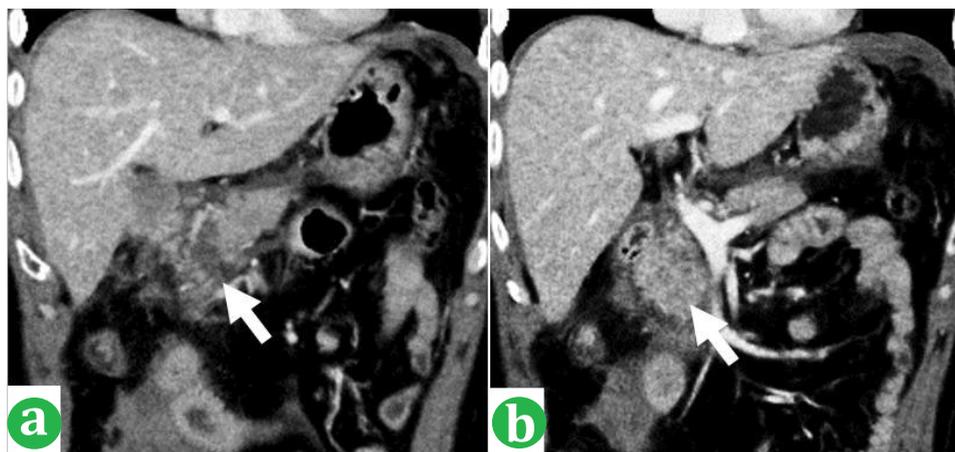
Reports of two-stage PD for trauma in the literature include those in which only gastrointestinal reconstruction is performed in the first surgery [12]



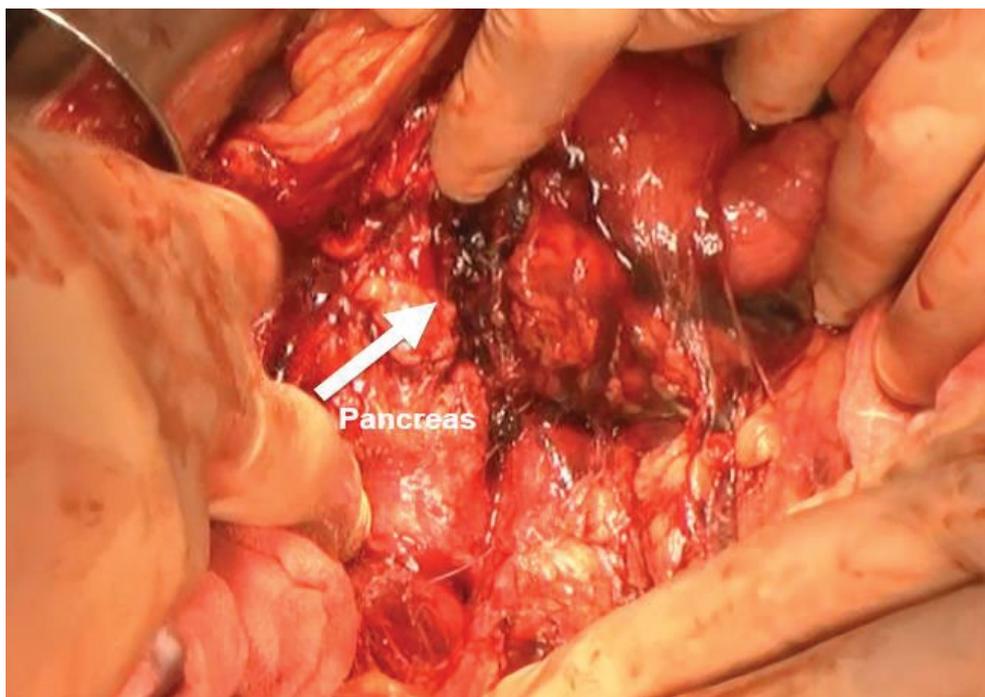
**Figure 4. (a).** Schema at the end of the initial surgery (modified Child's method). The bile duct and jejunum were not reconstructed. Arrow: complete external drainage tube in the bile duct. Arrow head: incomplete drainage tube in the pancreatic duct.



**Figure 5. Stage 2 surgery. (a).** Only the anterior walls of the half circumferences of the common hepatic duct and jejunum, which had been fixed in the first surgery, were opened and anastomosed. **(b).** Schema. Only the anterior walls are anastomosed.



**Figure 6. Contrast-enhanced CT. (a).** The pancreas was ruptured at the pancreatic head. **(b).** Reduced contrast effect at the pancreatic head.



**Figure 7.** A large amount of blood was observed in the abdominal cavity. The pancreas was deeply ruptured to the right of the right margin of the portal vein and injuries to the main pancreatic duct were also observed (arrow).

and those in which only gastrointestinal reconstruction and cholangiojejunostomy are performed in the first surgery, and pancreatic-gastrointestinal reconstruction is performed in the second surgery [14]. However, at our hospital, we performed pancreaticojejunostomy and gastrointestinal reconstruction in the first surgery and cholangiojejunostomy in the second surgery. The most pertinent issue with PD is the pancreatic-gastrointestinal anastomosis [15]. Complications at this site, i.e. pancreatic fistula, can be life-threatening, so we believe it is better to get the “dangerous” pancreatic-gastrointestinal anastomosis over with in the first surgery. Bile mixing with pancreatic fluid is thought to increase the severity of pancreatic fistula; therefore, converting the bile duct into a complete external drainage ensures that in case of a pancreatic fistula formation, it will not become critical. The second surgery can then be performed safely and securely, because it only involves anastomosis of the bile duct and jejunum. In contrast, if pancreatic-gastrointestinal anastomosis is performed in the second surgery, the first surgery involves dissecting the pancreas and converting it into a complete external drainage. Thus, any adhesions that occur from the first surgery need to be detached in the second surgery before the pancreaticojejunostomy can be performed, which can make the procedure more complicated. In fact, Gupta *et al.* reported that in 1 of 5 cases of two-stage PD, in which the pancreaticojejunostomy was not performed first, the stage two pancreaticojejunostomy had to be abandoned [12]. At times, a one-stage PD is possible, but this should only be performed if better results can be obtained than from a two-stage PD. In a trauma patient whose condition has temporarily worsened, if a severe pancreatic fistula occurs because of PD, the patient’s life may not be savable. Therefore, to ensure that a pancreatic fistula would not become critical even if one occurred, we

did not perform cholangiojejunostomy in the first surgery to prevent pancreatic fluid and bile from intermingling at the anastomosis site. Further, the second surgery was not performed in the early stages, when a pancreatic fistula may occur (3-4 weeks after the first surgery). Cholangiojejunostomy was performed once the possibility of a pancreatic fistula formation had completely disappeared (at least 1 month after the first surgery). In case 2, the patient strongly desired the second surgery to be performed as soon as possible, so it was carried out after waiting for 1 month. From the standpoint of ensuring critical complications do not occur due to PD, we believe that in trauma patients, it is better not to complete the PD even if there is ample time.

Surgeries performed by experienced hepatopancreaticobiliary (HPB) specialists, who are trained in pancreatic surgery techniques, have fewer complications and are safer [16, 17, 18]. PD can be performed with relative safety at high-volume centers that are accustomed to dealing with complications, and surgeries for pancreatic trauma should be performed by HPB surgeons [17].

PD is a surgical modality that should be avoided for injuries to the pancreatic head. However, it should be performed if PD is necessary to save a life. In such cases, simple modalities and surgical techniques the surgeon is accustomed to should be chosen, and an HPB surgeon should participate in the procedure.

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### Conflict of Interest

The authors have declared that no competing interests exist.

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