



## BÖLÜM 60

### Minimal İnvaziv Pankreas Cerrahisi

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#### ÖZET

Pankreas cerrahisi, teknik zorluğun yanı sıra fistül, kanama gibi mortal seyredabilen yüksek komplikasyon oranları nedeniyle de tarihsel gelişimi yavaş seyreden bir cerrahidir. Buna paralel olarak da minimal invaziv tekniklerin geliştirilmesi oldukça zaman almıştır. Halen dünya genelinde açık tekniğin yaygın olduğu bu sahada laparoskopik ve robotik tekniğin geliştirilmesi ve yaygınlaştırılması için alınması gereken yollar mevcuttur. Günümüz şartlarında sınırlı olan kanıt düzeyi yüksek çalışmaların sayısının artması ve bu kompleks cerrahi tekniklerin eğitimlerinin organize edilmesi ile ilerleyen yıllarda minimal invaziv pankreas cerrahisinin hem kantitatif hem de kalitatif gelişim göstereceği aşikardır.

#### Tarihçe

Anatomik olarak retroperitoneal yerleşimi ve ana vasküler yapılar ile olan karmaşık ilişkileri nedeni ile pankreas cerrahisinin gelişimi nispeten yavaş kalmıştır. Pankreas rezeksiyonları, cerrahi teknik açıdan zorluğunun yanı sıra fistül, kanama gibi komplikasyon oranlarının yüksek olması da batın içi diğer cerrahilere göre gelişiminin yavaş kalmasında önemli bir nedendir (1). Bunların bir neticesi olarak minimal invaziv tekniklerin gelişimi de yakın geçmişimize dek uzanan yavaş bir süreç içerisinde yer almaktadır. Laparoskopik pankreatikoduode-

nektominin (PD) 1994 yılında (2), laparoskopik distal pankreatektominin (DP) ise 1996 yılında (3) ilk kez tanımlanmasının ardından geçen 20 yıldan fazla sürede, durgun geçen ilk yılların aksine özellikle son dekada oldukça hızlı bir ilerleme kaydedilmiştir. Yine de barındırdığı cerrahi teknik zorlukları ve yüksek volümlü merkezlerde olması gereken uzun süren öğrenme eğrileri nedeni ile halen pankreas cerrahisinde minimal invaziv tekniklerin kullanımının yaygınlaşmamış olması anlaşılabilir.

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rahi eğitimi, birçok cerrahi eğitim programının ilgi odağı haline geldi. Hepatobiliyer cerrahinin robotik gerçekleştirilmesi için sanal gerçeklik ve cansız doku kullanımı sağlayan bir eğitim modeli ABD’de geliştirildi (76). Her ne kadar sanal gerçeklik ve doku modelleri üzerindeki eğitimlerin, gerçek vakaların komplike yönetimlerini garanti edemeyeceği bilinse de bu teknolojinin yaygınlaşması için mantıklı ve eğlenceli bir yol olarak karşımızda durmaktadır.

## Sonuç

Minimal invaziv tekniklerin, teknolojide ve endüstrideki gelişmelere paralel olarak pankreas cerrahisi üzerine olan etkileri, 25 yıl önce ilk kez uygulandığından beri, pankreas adenokarsinomu da dahil olmak üzere birçok klinik senaryoda popüler hale geldi. Şu ana dek elimizdeki oldukça sınırlı randomize kontrollü çalışmalardan oluşan bir yelpazede, geleneksel açık distal pankreatektomiler ve pankreatikoduodenektomilerle karşılaştırıldığında MİDP’nin bazı faydaları (daha düşük kan kaybı, daha kısa kalış süresi ve gelişmiş fonksiyonel iyileşme) ortaya konmuştur. Erken dönemde açık teknikler ve minimal invaziv tekniklerle benzer klinik sonuçlar elde edilse de, bu prosedürlerin uzun vadeli onkolojik etkinliği ile ilgili henüz ortadan kaldırılamamış birçok soru işareti vardır. Öte yandan PD için yürütülen RKÇ’lerin sonuçlarına dayanarak, deneyimli merkezler tarafından umut verici sonuçlar gösterilmiş olmasına rağmen, MİPD’nin APD’ye üstün bir alternatif olarak ilan edilemesi henüz mümkün değildir (77).

Ek olarak, cerrahi açığa dönüşün, cerrah deneyiminin ve hastane hacminin hasta sonuçları üzerindeki potansiyel etkilerini tanımak çok önemlidir. Nihayetinde, yüksek düzeyde kanıtlar elde edildikçe ve MİPC eğitim programları yaygınlaştıkça, pankreasa yönelik güncel yaklaşımların daha hızlı şekilde genişlemesi beklenebilir.

## Kaynaklar

1. Schnelldorfer T, Adams DB, Warshaw AL, et al. Forgotten pioneers of pancreatic surgery: beyond the favorite few. *Ann Surg.* 2008 Jan;247(1):191-202. doi: 10.1097/SLA.0b013e3181559a97. PMID: 18156940.
2. Gagner M, Pomp A. Laparoscopic pylorus-preserving pancreatoduodenectomy. *Surg Endosc.* 1994 May;8(5):408-10. doi: 10.1007/BF00642443. PMID: 7915434.
3. Gagner M, Pomp A, Herrera MF. Early experience with laparoscopic resections of islet cell tumors. *Surgery.* 1996 Dec;120(6):1051-4. doi: 10.1016/s0039-6060(96)80054-7. PMID: 8957494.
4. European Consortium on Minimally Invasive Pancreatic Surgery, 2021. (26.10.2021 tarihinde, <http://www.e-mips.com/> adresi kullanılmıştır).
5. Asbun HJ, Moekotte AL, Vissers FL, et al. International Study Group on Minimally Invasive Pancreas Surgery (I-MIPS). The Miami International Evidence-based Guidelines on Minimally Invasive Pancreas Resection. *Ann Surg.* 2020 Jan;271(1):1-14. doi: 10.1097/SLA.0000000000003590. PMID: 31567509.
6. Schwarz JL, Hogg ME. Current state of minimally invasive pancreatic surgery. *J Surg Oncol.* 2021 May;123(6):1370-1386. doi: 10.1002/jso.26412. Epub 2021 Feb 9. PMID: 33559146.
7. Søreide K, Olsen F, Nymo LS, et al. A nationwide cohort study of resection rates and short-term outcomes in open and laparoscopic distal pancreatectomy. *HPB (Oxford).* 2019 Jun;21(6):669-678. doi: 10.1016/j.hpb.2018.10.006. Epub 2018 Nov 1. PMID: 30391219.
8. Kantor O, Bryan DS, Talamonti MS, et al. Laparoscopic Distal Pancreatectomy for Cancer Provides Oncologic Outcomes and Overall Survival Identical to Open Distal Pancreatectomy. *J Gastrointest Surg.* 2017 Oct;21(10):1620-1625. doi: 10.1007/s11605-017-3506-y. PMID: 28766272.
9. Sibinga Mulder BG, Feshtali S, Fariña Sarasqueta A, et al. A Prospective Clinical Trial to Determine the Effect of Intraoperative Ultrasound on Surgical Strategy and Resection Outcome in Patients with Pancreatic Cancer. *Ultrasound Med Biol.* 2019 Aug;45(8):2019-2026. doi: 10.1016/j.ultrasmedbio. 2019.04.020. Epub 2019 May 24. PMID: 31130412.
10. Strasberg SM, Drebin JA, Linehan D. Radical antegrade modular pancreatosplenectomy. *Surgery.* 2003 May;133(5):521-7. doi: 10.1067/msy.2003.146. PMID: 12773980.
11. Miyasaka Y, Ohtsuka T, Nakamura M. Minimally invasive surgery for pancreatic cancer. *Surg Today.* 2021 Feb;51(2):194-203. doi: 10.1007/s00595-020-02120-5. Epub 2020 Aug 28. PMID: 32857251
12. Tol JA, Gouma DJ, Bassi C et al; International Study Group on Pancreatic Surgery (2014). A consensus statement by the International Study Group on Pancreatic Surgery (ISGPS). *Surgery* doi: 10.1016/j.surg.2014.06.016. Epub 2014 Jul 22. PMID: 25061003
13. Vezakis A, Davides D, Larvin M, et al (1999). Laparoscopic surgery combined with preservation of the spleen for distal pancreatic tumors. *Surg Endosc*

- 1999;Jan;13(1):26-9. doi: 10.1007/s004649900891. PMID: 9869683.
14. Kimura W, Inoue T, Futakawa N, et al. Spleen-preserving distal pancreatectomy with conservation of the splenic artery and vein. *Surgery* 1996 Nov;120(5):885-90. doi: 10.1016/s0039-6060(96)80099-7. PMID: 8909526.
  15. De Rooij T, Van Hilst J, van Santvoort H, et al. Minimally invasive versus open distal pancreatectomy (LEOPARD): a multicenter patient-blinded randomized controlled trial. *Ann Surg*. Jan;269(1):2-9. doi: 10.1097/SLA.0000000000002979. PMID: 30080726.
  16. Van Hilst J, De Rooij T, Klompmaker S, et al. Minimally invasive versus open distal pancreatectomy for ductal adenocarcinoma (DIPLOMA): a Pan-European Propensity Score Matched Study. *Ann Surg*. 2019 Jan;269(1):10-17. doi: 10.1097/SLA.0000000000002561. PMID: 29099399.
  17. Björnsson B, Larsson AL, Hjalmarsson C, et al. Comparison of the duration of hospital stay after laparoscopic or open distal pancreatectomy: randomized controlled trial. *Br J Surg*. 2020; Sep;107(10):1281-1288. doi: 10.1002/bjs.11554. Epub 2020 Apr 7. PMID: 32259297.
  18. Nakamura M, Nakashima H. Laparoscopic distal pancreatectomy and pancreatoduodenectomy: is it worthwhile? A meta-analysis of laparoscopic pancreatectomy. *J Hepatobiliary Pancreat Sci*. 2013; Apr;20(4):421-8. doi: 10.1007/s00534-012-0578-7. PMID: 23224732.
  19. Korrel M, Vissers FL, van Hilst J, et al. Minimally invasive versus open distal pancreatectomy: an individual patient data meta-analysis of two randomized controlled trials. *HPB (Oxford)*. 2021 Mar;23(3):323-330. doi: 10.1016/j.hpb.2020.10.022. Epub 2020 Nov 27. PMID: 33250330.
  20. Ricci C, Casadei R, Taffurelli G, et al. Laparoscopic versus open distal pancreatectomy for ductal adenocarcinoma: a systematic review and meta-analysis. *J Gastrointest Surg*. 2015; Apr;19(4):770-81. doi: 10.1007/s11605-014-2721-z. Epub 2015 Jan 6. PMID: 25560180.
  21. Riviere D, Gurusamy KS, DA K, et al. Laparoscopic versus open distal pancreatectomy for pancreatic cancer. *Cochrane Database Syst Rev*. 2016 Apr 4;4(4):CD011391. doi: 10.1002/14651858.CD011391.pub2. PMID: 27043078; PMCID: PMC7083263.
  22. Korrel M, Lof S, van Hilst J, et al. Predictors for Survival in an International Cohort of Patients Undergoing Distal Pancreatectomy for Pancreatic Ductal Adenocarcinoma. *Ann Surg Oncol*. 2021 Feb;28(2):1079-1087. doi: 10.1245/s10434-020-08658-5. Epub 2020 Jun 25. PMID: 32583198; PMCID: PMC7801299.
  23. Balduzzi A, van Hilst J, Korrel M, et al. Laparoscopic versus open extended radical left pancreatectomy for pancreatic ductal adenocarcinoma: an international propensity-score matched study. *Surg Endosc*. 2021 Jan 4. doi: 10.1007/s00464-020-08206-y. Epub ahead of print. PMID: 33398565
  24. Pecorelli N, Guarneri G, Alagol K, et al. The impact of minimally invasive surgery on hospital readmissions, emergency department visits and functional recovery after distal pancreatectomy. *Surg Endosc*. 2021 Oct;35(10):5740-5751. doi: 10.1007/s00464-020-08051-z. Epub 2020 Oct 6. PMID: 33021692.
  25. Noorani A, Rangelova E, Del Chiaro M, et al. Delayed gastric emptying after pancreatic surgery: analysis of factors determinant for the short-term outcome. *Front Surg*. 2016; Apr 25;3:25. doi: 10.3389/fsurg.2016.00025. PMID: 27200357; PMCID: PMC4843166.
  26. Shin SH, Kim SC, Song KB, et al. A comparative study of laparoscopic vs open distal pancreatectomy for left-sided ductal adenocarcinoma: a propensity score-matched analysis. *J Am Coll Surg*. 2015 Feb;220(2):177-85. doi: 10.1016/j.jamcollsurg.2014.10.014. Epub 2014 Oct 31. PMID: 25529901.
  27. Giulianotti PC, Addeo P, Buchs NC, et al. Robotic extended pancreatectomy with vascular resection for locally advanced pancreatic tumors. *Pancreas*. 2011 Nov;40(8):1264-70. doi: 10.1097/MPA.0b013e-318220e3a4. PMID: 21785385.
  28. Xourafas D, Ashley SW, Clancy TE. Comparison of perioperative outcomes between open, laparoscopic, and robotic distal pancreatectomy: an analysis of 1815 patients from the ACS-NSQIP procedure-targeted pancreatectomy database. *J Gastrointest Surg*. 2017 Sep;21(9):1442-1452. doi: 10.1007/s11605-017-3463-5. Epub 2017 Jun 1. PMID: 28573358.
  29. Beane JD, Pitt HA, Dolejs SC, et al. Assessing the impact of conversion on outcomes of minimally invasive distal pancreatectomy and pancreatoduodenectomy. *HPB*. 2018 Apr;20(4):356-363. doi: 10.1016/j.hpb.2017.10.007. Epub 2017 Nov 27. PMID: 29191691.
  30. van Hilst J, de Rooij T, Abu Hilal M, et al. Worldwide survey on opinions and use of minimally invasive pancreatic resection. *HPB*. 2017 Mar;19(3):190-204. doi: 10.1016/j.hpb.2017.01.011. Epub 2017 Feb 17. PMID: 28215904.
  31. Caba MD, Lambreton F, Arrangoiz MR. Trends in robotic pancreaticoduodenectomy and distal pancreatectomy. *J Laparoendosc Adv Surg Tech*. 2019 Feb;29(2):147-151. doi: 10.1089/lap.2018.0421. Epub 2018 Sep 14. PMID: 30222522.
  32. Niu X, Yu B, Yao L, et al. Comparison of surgical outcomes of robot-assisted laparoscopic distal pancreatectomy versus laparoscopic and open resections: a systematic review and meta-analysis. *Asian J Surg*. 2019 Jan;42(1):32-45. doi: 10.1016/j.asjsur.2018.08.011. Epub 2018 Oct 15. PMID: 30337121.
  33. Zhou J, Lv Z, Zou H, et al. Up-to-date comparison of robotic-assisted versus open distal pancreatectomy: A PRISMA-compliant meta-analysis. *Medicine (Baltimore)*. 2020 Jun 5;99(23):e20435. doi: 10.1097/MD.00000000000020435. PMID: 32501990; PMCID: PMC7306371.
  34. Nakata K, Nakamura M. The current status and future directions of robotic pancreatectomy. *Ann Gastroenterol Surg*. 2021 Mar 4;5(4):467-476. doi: 10.1002/ags3.12446. PMID: 34337295; PMCID: PMC8316739.
  35. Weng Y, Jin J, Huo Z, et al. Robotic-assisted versus open distal pancreatectomy for benign and low-grade malignant pancreatic tumors: a propensity score-matched study. *Surg Endosc*. 2021 May;35(5):2255-2264. doi: 10.1007/s00464-020-07639-9. Epub 2020 Aug 11. PMID: 32458287; PMCID: PMC8057962.
  36. Magge DR, Zenati MS, Hamad A, et al. Comprehen-

- sive comparative analysis of cost-effectiveness and perioperative outcomes between open, laparoscopic, and robotic distal pancreatectomy. *HPB (Oxford)*. 2018 Dec;20(12):1172-1180. doi: 10.1016/j.hpb.2018.05.014. Epub 2018 Jun 30. PMID: 31217087.
37. Chopra A, Nassour I, Zureikat A, et al. Perioperative and oncologic outcomes of open, laparoscopic, and robotic distal pancreatectomy for pancreatic adenocarcinoma. *Updates Surg*. 2021 Jun;73(3):947-953. doi: 10.1007/s13304-020-00927-y. Epub 2021 Jan 4. PMID: 33394353.
  38. Nassour I, Winters SB, Hoehn R, et al. Long-term oncologic outcomes of robotic and open pancreatectomy in a national cohort of pancreatic adenocarcinoma. *J Surg Oncol*. 2020; Aug;122(2):234-242. doi: 10.1002/jso.25958. Epub 2020 Apr 29. PMID: 32350882.
  39. Chen H, Shen Z, Ying X, et al. Robotic distal pancreatectomy reduces pancreatic fistula in patients without visceral obesity as compared to open distal pancreatectomy: A propensity score matching retrospective cohort study. *Int J Surg*. 2021 Jun;90:105960. doi: 10.1016/j.ijso.2021.105960. Epub 2021 May 12. PMID: 33989824.
  40. Lee SY, Allen PJ, Sadot E, et al. Distal pancreatectomy: a single institution's experience in open, laparoscopic, and robotic approaches. *J Am Coll Surg*. 2015; 2015 Jan;220(1):18-27. doi: 10.1016/j.jamcollsurg.2014.10.004. Epub 2014 Oct 15. PMID: 25456783.
  41. Zhao W, Liu C, Li S, Geng D, et al. Safety and efficacy for robot-assisted versus open pancreaticoduodenectomy and distal pancreatectomy: a systematic review and meta-analysis. *Surg Oncol*. 2018; Sep;27(3):468-478. doi: 10.1016/j.suronc.2018.06.001. Epub 2018 Jun 4. PMID: 30217304.
  42. De Pastena M, Esposito A, Paiella S, et al. Cost-effectiveness and quality of life analysis of laparoscopic and robotic distal pancreatectomy: a propensity score-matched study. *Surg Endosc*. 2021 Mar;35(3):1420-1428. doi: 10.1007/s00464-020-07528-1. Epub 2020 Apr 2. PMID: 32240383.
  43. Liu R, Liu Q, Zhao ZM, et al. Robotic versus laparoscopic distal pancreatectomy: a propensity score-matched study. *J Surg Oncol*. 2017; Sep;116(4):461-469. doi: 10.1002/jso.24676. Epub 2017 Jun 19. PMID: 28628713.
  44. Al Abbas AI, Zeh III HJ, Polanco PM. State of the art robotic distal pancreatectomy: a review of the literature. *Updates Surg*. 2021 Jun;73(3):881-891. doi: 10.1007/s13304-021-01070-y. Epub 2021 May 29. PMID: 34050901.
  45. Lof S, van der Heijden N, Abuawwad M, et al. Robotic versus laparoscopic distal pancreatectomy: multicentre analysis. *Br J Surg*. 2021 Mar 12;108(2):188-195. doi: 10.1093/bjs/znaa039. PMID: 33711145.
  46. Braga M, Ridolfi C, Balzano G, et al. Learning curve for laparoscopic distal pancreatectomy in a high-volume hospital. *Updates Surg*. 2012; Sep;64(3):179-83. doi: 10.1007/s13304-012-0163-2. Epub 2012 Jul 5. PMID: 22763577.
  47. Shakir M, Boone BA, Polanco PM, et al. The learning curve for robotic distal pancreatectomy: an analysis of outcomes of the first 100 consecutive cases at a high-volume pancreatic centre. *HPB*. 2015; 2015 Jul;17(7):580-6. doi: 10.1111/hpb.12412. Epub 2015 Apr 23. PMID: 25906690; PMCID: PMC4474504.
  48. Al Abbas AI, Wang C, Hamad AB, et al. Mentorship and formal robotic proficiency skills curriculum improve subsequent generations' learning curve for the robotic distal pancreatectomy. *HPB (Oxford)*. 2021 May 5:S1365-182X(21)00132-5. doi: 10.1016/j.hpb.2021.04.022. Epub ahead of print. PMID: 34059420.
  49. Tran TB, Dua MM, Worhunsy DJ, et al. The first decade of laparoscopic pancreaticoduodenectomy in the United States: costs and outcomes using the nationwide inpatient sample. *Surg Endosc*. 2016; May;30(5):1778-83. doi: 10.1007/s00464-015-4444-y. Epub 2015 Aug 15. PMID: 26275542.
  50. Nassour I, Wang SC, Christie A, et al. Minimally invasive versus open pancreaticoduodenectomy. *Ann Surg*. 2018 Jul;268(1):151-157. doi: 10.1097/SLA.0000000000002259. PMID: 28486387.
  51. Torphy RJ, Friedman C, Halpern A, et al. Comparing short-term and oncologic outcomes of minimally invasive versus open pancreaticoduodenectomy across low and high volume centers. *Ann Surg*. 2019; Dec;270(6):1147-1155. doi: 10.1097/SLA.0000000000002810. PMID: 29771723.
  52. Azagra JS, Arru L, Estévez S, et al. Pure laparoscopic pancreaticoduodenectomy with initial approach to the superior mesenteric artery. *Wideochir Inne Tech Maloinwazyjne*. 2015 Sep;10(3):450-7. doi: 10.5114/wiitm.2015.54040. Epub 2015 Sep 11. PMID: 26649095; PMCID: PMC4653251.
  53. Hallet J, Zih FS, Deobald RG, et al. The impact of pancreaticojejunostomy versus pancreaticogastrostomy reconstruction on pancreatic fistula after pancreaticoduodenectomy: meta-analysis of randomized controlled trials. *HPB (Oxford)*. 2015 Feb;17(2):113-22. doi: 10.1111/hpb.12299. Epub 2014 Jul 7. PMID: 25040921; PMCID: PMC4299385.
  54. Boggi U, Amorese G, Vistoli F, et al. Laparoscopic pancreaticoduodenectomy: a systematic literature review. *Surg Endosc*. 2015 Jan;29(1):9-23. doi: 10.1007/s00464-014-3670-z. Epub 2014 Aug 15. PMID: 25125092.
  55. Palanivelu C, Senthilnathan P, Sabnis SC, et al. Randomized clinical trial of laparoscopic versus open pancreaticoduodenectomy for periampullary tumours. *Br J Surg*. 2017; Oct;104(11):1443-1450. doi: 10.1002/bjs.10662. PMID: 28895142.
  56. Poves I, Burdío F, Morató O, et al. Comparison of perioperative outcomes between laparoscopic and open approach for pancreaticoduodenectomy: the Padulap randomized controlled trial. *Ann Surg*. 2018; Nov;268(5):731-739. doi: 10.1097/SLA.0000000000002893. PMID: 30138162.
  57. van Hilst J, De Rooij T, Bosscha K, et al. Laparoscopic versus open pancreaticoduodenectomy for pancreatic or periampullary tumours (LEOPARD-2): a multicentre, patient-blinded, randomised controlled phase 2/3 trial. *Lancet Gastroenterol Hepatol*. 2019; Mar;4(3):199-207. doi: 10.1016/S2468-1253(19)30004-4. Epub 2019 Jan 24. PMID: 30685489.
  58. Chen K, Liu X, Pan Y, et al. Expanding laparoscopic pancreaticoduodenectomy to pancreatic-head and periampullary malignancy: major findings based on sys-



- tematic review and meta-analysis. *BMC Gastroenterol.* 2018; Jul 3;18(1):102. doi: 10.1186/s12876-018-0830-y. PMID: 29969999; PMCID: PMC6029373.
59. Conrad C, Basso V, Passot G, et al. Comparable long-term oncologic outcomes of laparoscopic versus open pancreaticoduodenectomy for adenocarcinoma: a propensity score weighting analysis. *Surg Endosc.* 2017 Oct;31(10):3970-3978. doi: 10.1007/s00464-017-5430-3. Epub 2017 Feb 15. PMID: 28205031.
  60. Croome KP, Farnell MB, Que FG, et al. Total laparoscopic pancreaticoduodenectomy for pancreatic ductal adenocarcinoma oncologic advantages over open approaches? *Ann Surg.* 2014 Oct;260(4):633-8; discussion 638-40. doi: 10.1097/SLA.0000000000000937. PMID: 25203880..
  61. Kantor O, Talamonti MS, Sharpe S, et al. Laparoscopic pancreaticoduodenectomy for adenocarcinoma provides short-term oncologic outcomes and long-term overall survival rates similar to those for open pancreaticoduodenectomy. *Am J Surg.* 2017 Mar;213(3):512-515. doi: 10.1016/j.amjsurg.2016.10.030. Epub 2016 Dec 28. PMID: 28049562.
  62. Zureikat AH, Postlewait LM, Liu Y, et al. A multi-institutional comparison of perioperative outcomes of robotic and open pancreaticoduodenectomy. *Ann Surg.* 2016 Oct;264(4):640-9. doi: 10.1097/SLA.0000000000001869. PMID: 27433907.
  63. Kornaropoulos M, Moris D, Beal EW, et al. Total robotic pancreaticoduodenectomy: a systematic review of the literature. *Surg Endosc.* 2017; Nov;31(11):4382-4392. doi: 10.1007/s00464-017-5523-z. Epub 2017 Apr 7. PMID: 28389798.
  64. Vining CC, Kuchta K, Schuitevoerder D, et al. Risk factors for complications in patients undergoing pancreaticoduodenectomy: a NSQIP analysis with propensity score matching. *J Surg Oncol.* 2020; Aug;122(2):183-194. doi: 10.1002/jso.25942. Epub 2020 May 23. PMID: 32445612.
  65. Mejia A, Shah J, Vivian E, et al. Analysis of 102 Fully Robotic Pancreaticoduodenectomies: Clinical and Financial Outcomes. *Pancreas.* 2020 May/June;49(5):668-674. doi: 10.1097/MPA.0000000000001545. PMID: 32433405.
  66. Baimas-George M, Watson M, Murphy KJ, et al. Robotic pancreaticoduodenectomy may offer improved oncologic outcomes over open surgery: a propensity-matched single-institution study. *Surg Endosc.* 2020;34(8):3644-3649. doi: 10.1007/s00464-020-07564-x. PMID: 32328825.
  67. Cai J, Ramanathan R, Zenati MS, et al. Robotic pancreaticoduodenectomy is associated with decreased clinically relevant pancreatic fistulas: a propensity-matched analysis. *J Gastrointest Surg.* 2020; May;24(5):1111-1118. doi: 10.1007/s11605-019-04274-1. Epub 2019 Jul 2. PMID: 31267434.
  68. McMillan MT, Zureikat AH, Hogg ME, et al. A propensity score-matched analysis of robotic vs open pancreaticoduodenectomy on incidence of pancreatic fistula. *JAMA Surg.* 2017 Apr 1;152(4):327-335. doi: 10.1001/jamasurg.2016.4755. PMID: 28030724; PMCID: PMC5470429.
  69. Vining CC, Kuchta K, Berger Y, et al. Robotic pancreaticoduodenectomy decreases the risk of clinically relevant post-operative pancreatic fistula: a propensity score matched NSQIP analysis *HPB.* 2021 Mar;23(3):367-378. doi: 10.1016/j.hpb.2020.07.004. Epub 2020 Aug 15. PMID: 32811765.
  70. Girgis MD, Zenati MS, King JC, et al. Oncologic outcomes after robotic pancreatic resections are not inferior to open surgery. *Ann Surg.* 2019. doi: 10.1097/SLA.00000000000003615. PMID: 31663967.
  71. Weng Y, Jiang Y, Fu N, et al. Oncological outcomes of robotic-assisted versus open pancreaticoduodenectomy for pancreatic ductal adenocarcinoma: a propensity score-matched analysis. *Surg Endosc.* 2021 Jul;35(7):3437-3448. doi: 10.1007/s00464-020-07791-2. Epub 2020 Jul 21. PMID: 32696148; PMCID: PMC8195757.
  72. Lof S, Vissers FL, Klompmaker S, et al. Risk of conversion to open surgery during robotic and laparoscopic pancreaticoduodenectomy and effect on outcomes: international propensity score-matched comparison study. *Br J Surg.* 2021 Jan 27;108(1):80-87. doi: 10.1093/bjs/znaa026. PMID: 33640946.
  73. Kamarajah SK, Bundred J, Marc O Saint, et al. Robotic versus conventional laparoscopic pancreaticoduodenectomy a systematic review and meta-analysis. *Eur J Surg Oncol.* 2020 Jan;46(1):6-14. doi: 10.1016/j.ejso.2019.08.007. Epub 2019 Aug 7. PMID: 31409513.
  74. de Rooij T, van Hilst J, Boerma D, et al. Impact of a Nationwide Training Program in Minimally Invasive Distal Pancreatectomy (LAELAPS). *Ann Surg.* 2016 Nov;264(5):754-762. doi: 10.1097/SLA.0000000000001888. PMID: 27741008.
  75. de Rooij T, van Hilst J, Topal B, et al. Outcomes of a multicenter training program in laparoscopic pancreaticoduodenectomy (LAELAPS-2). *Ann Surg.* 2019;269(2):344-350. doi: 10.1097/SLA.0000000000002563. PMID: 29099400.
  76. Hogg ME, Tam V, Zenati M, et al. Mastery-based virtual reality robotic simulation curriculum: the first step toward operative robotic proficiency. *J Surg Educ.* 2017;74(3):477-485. doi: 10.1016/j.jsurg. 2016.10.015. Epub 2016 Nov 21. PMID: 27884677.
  77. van Hilst J, de Graaf N, Abu Hilal M, et al. The Landmark Series: Minimally Invasive Pancreatic Resection. *Ann Surg Oncol.* 2021 Mar;28(3):1447-1456. doi: 10.1245/s10434-020-09335-3. Epub 2020 Dec 19. PMID: 33341916; PMCID: PMC7892688.