Single-Incision Laparoscopic Nissen Fundoplication for Gastroesophageal Reflux Disease Using Conventional Instruments

Gastroözofageal Reflü Hastalığı Tedavisinde Konvansiyonel Aletler ile Tek Kesi Laparoskopik Nissen Fundoplikasyon

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ABSTRACT Objective: Since the early 1990s with the development of minimally invasive techniques, laparoscopic Nissen fundoplication has become the gold standard intervention for the surgical treatment of gastroesophageal reflux disease (GERD), and antireflux surgical treatment of GERD can be performed by the single incision laparoscopic technique. In this study, we aimed to assess the safety and feasibility of single incision laparoscopic Nissen fundoplication (SILNF) with a new liver retraction technique. **Material and Methods:** Ten patients underwent single incision laparoscopic Nissen fundoplication between October 2011 and March 2012. In all patients, upper gastrointestinal endoscopy was performed. Ambulatory 24-h pH impedance monitoring was performed in all patients. The skin, subcutaneous tissue and fascia were incised with a 20 mm vertical midline incision above the umbilicus, and a SILS-Port™ (Covidien Corp, Mansfield, MA, USA) was placed with conventional laparoscopic hand instruments. **Results:** The procedure was successfully performed in all ten patients. The mean Johnson-DeMeester score was 29±7.9. The mean operation time was 93±14.1 minutes. The hiatal area was clearly visible with the new liver retraction technique which was applied in this study. None of the patients required conversion to an open procedure. Two patients required the insertion of an additional port. There were no intraoperative or early postoperative complications. **Conclusion:** SILNF is safe and technically feasible, and it can be performed with conventional laparoscopic instruments.

Key Words: Fundoplication; gastroesophageal reflux; surgical procedures, minimally invasive

ÖZET Amaç: 1990'lı yılların başından itibaren minimal invaziv tekniklerin gelişmesi ile gastroözofageal reflü hastalığının cerrahi tedavisinde antireflü cerrahisinin uygulamasında, laparoskopik Nissen fundoplikasyon ameliyatı altın standart haline gelmiştir. Laparoskopik Nissen fundoplikasyon tek kesi laparoskopik teknik kullanılarak da gerçekleştirilebilir. Bu çalışmada, yeni bir karaciğer retraksiyon tekniği kullanılarak yapılan tek kesi laparoskopik Nissen fundoplikasyon ameliyatının uygulanabilirliğinin ve güvenliğinin değerlendirilmesi amaçlanmıştır. **Gereç ve Yöntemler:** Ekim 2011 ve Mart 2012 tarihleri arasında 10 hastaya tek kesi laparoskopik Nissen fundoplikasyon ameliyatı uygulandı. Operasyon öncesi tüm hastalar üst gastrointestinal sistem endoskopisi ile değerlendirildi ve 24 saatlik pH empedans izlemi yapıldı. Deri, derialtı dokusu ve fasya, göbek üzerinde 20 mm dikey orta hat kesi ile geçildi ve SILS-Port ™ (Covidien Corp, Mansfield, MA, USA) konvansiyonel laparoskopik el aletleri ile yerleştirildi. **Bulgular:** Tek kesi laparoskopik fundoplikasyon 10 hastanın tamamında başarıyla uygulandı. Ortalama Johnson-DeMeester skoru 29±7,9 idi. Ortalama ameliyat süresi 93±14,1 dakika olarak bulundu. Bu çalışmada uygulanan yeni karaciğer retraksiyon tekniği ile hiatal alan rahatlıkla görülebilmiştir. Hastaların hiçbirinde açık cerrahi tekniğe dönülme ihtiyacı olmadı. İki hasta ek port girilmesine gereksinim oldu. İntraoperatif veya erken postoperatif komplikasyonla karşılaşılmadı. **Sonuç:** Tek kesi laparoskopik Nissen fundoplikasyon, güvenli ve uygulanabilir bir tekniktir. Ameliyat konvansiyonel laparoskopik el aletleri kullanılarak gerçekleştirilebilir.

Anahtar Kelimeler: Fundoplikasyon; gastroözofageal reflü; cerrahi işlemler, minimal girişimsel

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Laparoscopic Nissen fundoplication (LNF) has become the gold standard intervention for the surgical treatment of gastroesophageal reflux disease (GERD) since the early 1990s with the development of minimally invasive techniques.[1] Although no exact figures exist for the total the number of LNFs performed annually, it is estimated that approximately 25,000 cases are managed in the United States for GERD.[2]The advantages of laparoscopic surgery are less postoperative pain, a faster return to daily activities, and a better cosmetic outcome. Antireflux surgical treatment of GERD can be performed by the single incision (SI) laparoscopic technique.[3] The demands of the patients for better cosmetic outcomes, and minimally invasive surgeons play a significant role in the increasing popularity of this technique. The potential safety concerns of this technique should not be ignored to achieve improved cosmetic results.

There are few case reports of single incision laparoscopic Nissen fundoplication (SILNF) in the literature.[4,5] Although case reports of SILNF have been published, as far as we know, this is one of the few reports of clinical series of SILNF. This study aimed to assess the safety and the feasibility of the SI approach for LNF of GERD.

MATERIAL AND METHODS

We began performing SILNF in our department in October 2011. Up to March 2012, 10 (3 males and 7 females) patients had undergone SILNF. After receiving the approval of the medical ethics committee of Selcuk University Medical Faculty (no: 2012/69), follow-up data were obtained from hospital charts and office records.

The data included operation time, gender, age, body mass index (BMI), 24-h pH impedance monitoring findings, the length of hospital stay (defined as the time from postanesthesia care until discharge from the hospital), operative complications, and early-term outcomes.

In all patients, upper gastrointestinal endoscopy and ambulatory 24-h pH- impedance monitoring were performed. Esophageal pH-impedance monitoring was performed using a 6-Fr pHTip™ disposable catheter (UNISENSOR AG, Aticon, Switzerland). After calibration, the probe was placed 5 cm above the low esophageal sphincter. The patients were asked to continue their regular activity and meal regimens throughout the 24-h study. They were given personal diaries to note meal times, medication intake, time in recumbent position, and the timing of typical symptoms associated with GER. Data were recorded on a portable Ohmega® ambulatory pH and impedance recorder (Medical Measurement System, Enschede, Netherlands), and analyzed using the MMS® analysis program (Medical Measurement System, Enschede, Netherlands). The accuracy of reflux detection was verified manually by an expert reader. Johnson–DeMeester scores higher than 17 were considered abnormal.[6] None of our patients had undergone any previous abdominal procedures, because midline intra-abdominal adhesions may interfere with the SILNF approach. The same perioperative protocol was implemented in all 10 patients.

SILNF was performed using a surgical technique similar to standard five-port LNF, except that it was conducted through a single incision.

TECHNICAL PROCEDURE

The patient was in a supine position with the head at a 30-degree angle. The surgeon stood between the patient's legs, and the camera assistant stood on the left side of the patient.

The skin, subcutaneous tissue, and fascia were incised with a 20 mm vertical midline incision above the umbilicus, and the SILS-Port® was placed. An integrated rigid 30-degree, 5 mm laparoscope (KARL STORZ® GmbH & Co. KG, Tuttlingen, Germany) and 5 mm conventional laparoscopic instruments were selected for the procedure. The abdomen was then insufflated with continuous carbon dioxide to a pressure of 13 mm Hg. A routine exploration was performed under the guide of the laparoscope.

The Berk technique which was described in our previous study was used for retraction of the left liver lobe.[7] In brief; to mobilize the left lobe of the liver, the fibrous appendix (appendix fibrosa

hepatis) and triangular ligament were separated from the abdominal wall using a harmonic scalpel (Ethicon Endosurgery®, Cincinnati, OH). Fibrous appendix is a fibrous process, that passes through the left triangular ligament to attach to the diaphragm. A prolene suture (1 no) was used for this retraction method. A straight needle with a 1 no prolene suture was passed transabdominally at right subcostal area. Prolene suture was passed through fibrous appendix, and inside out of the abdomen, at its access site. The left liver lobe was folded upon itself by the traction of the prolene suture. Thus hiatal area was plainly visible (Figure 1).

The gastrohepatic omentum and the peritoneum covering the hiatal area were dissected with a harmonic scalpel. The right crus was retracted laterally, and the right side of the esophagus was dissected. The posterior vagus nerve was observed. The left crus was similarly dissected from the esophagus and a "cruro-esophageal window" was created between the crura and the posterior esophageal wall. The fundus was mobilized by dividing the proximal gastrosplenic ligament. At a point beginning 6-8 cm distal from the esophageal junction, short gastric vessels were divided with the harmonic scalpel, and a window was created. To mobilize the proximal stomach, the fundus was separated from the posterior retroperitoneal adhesions. A grasper was passed through the cruro-esophageal window (from the right to the left of the patient). A 32 Fr bougie was placed into the stomach. The crus of the diaphragm was approximated by 2/0 silk sutures before wrapping. The fundus of the stomach was grasped by the grasper, and it was then pulled through the cruro-esophageal window to create a 360-degree wrap. A wrap of about 3–4 cm in length was created with three interrupted 2/0 silk sutures. One of the stitches was inserted in the muscular layer of the esophagus between the two gastric walls to prevent slippage. The sutures were tied using the extracorporeal technique. Finally, the fundoplication was fixed to the right crus of the diaphragm. The esophageal bougie was withdrawn by the anesthesiologist. Control of hemostasis was achieved, and no drainage was left in place. After removing the port and releasing the residual carbon dioxide, the fascial defect was closed with 1 no loop prolene suture. The skin was sutured in an intradermic fashion using rapid vicryl (Figure 2).

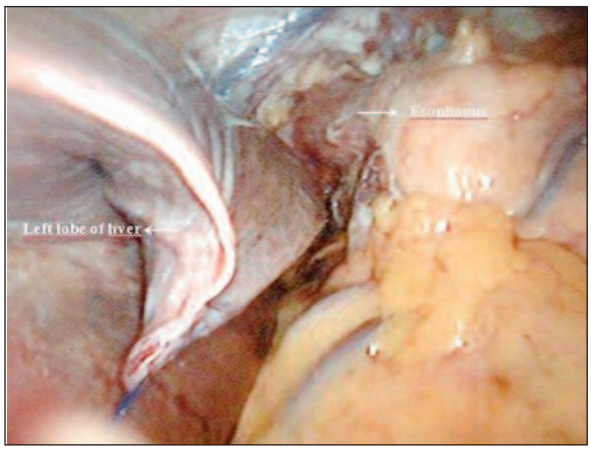

FIGURE 1: The left liver lobe was folded upon itself by traction with a retraction suture.
(See color figure at http://tipbilimleri.turkiyeklinikleri.com/)

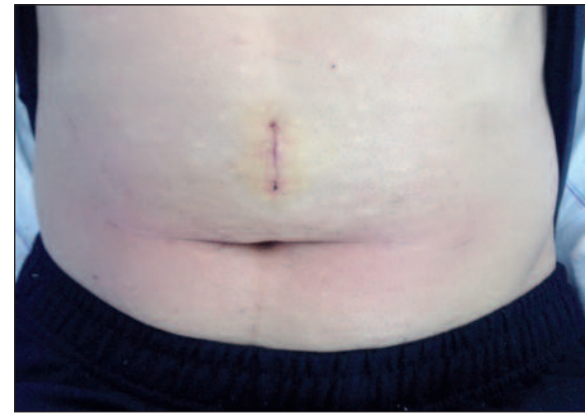

FIGURE 2: Vertical midline incision above the umbilicus.
(See color figure at http://tipbilimleri.turkiyeklinikleri.com/)

Oral liquid nutrition and a soft diet were started 6 hours after surgery. The patients were able to maintain hydration, and pain was managed appropriately with oral analgesics.

Continuous variables were expressed as mean±SD when indicated.

RESULTS

Ten consecutive patients were operated upon by the same surgeon (HY) using the SILNF technique described herein. The patients were seven females

and three males. The mean age was 35±8.5 years, and the mean BMI was 24.67±3 kg/m^2. All the patients had GERD. The mean Johnson–DeMeester score was 29±7.9.

None of the patients required conversion to an open procedure. Two patients required an additional port; due to bleeding from the short gastric vessels in one patient, and difficulty of dissection due to the "cruro esophageal window" in another patient. The mean operating time was 93±14.1 minutes. The mean hospital stay was 2.2 ±0.9days. There were no intraoperative or early postoperative complications. All the patients' clinical outcomes and demographic data are shown in Table 1.

DISCUSSION

One of the goals of surgery is to reduce the invasiveness of the treatment. This has led to the development of new techniques that have been proved to be safe and effective, and they are considered as gold standard treatments today.[8] Laparoscopy has provided surgeons with new and innovative ways to treat various surgical problems. Current LNF techniques involve the use of five laparoscopic port incisions. The advantages of laparoscopic procedures compared with open surgery have encouraged an interest in minimally invasive surgical techniques. This interest facilitated the birth of natural orifice transluminal endoscopic surgery and single-access laparoscopy.[9,11] In our opinion, SI laparoscopic surgery is considered as one of the best examples of a minimally invasive method.

LNF surgery for GERD is a standard method, and it is often performed with five ports. Single-incision laparoscopic surgery (SILS) applications were initiated in order to improve less invasive techniques, however, their use has been rather limited in time. Therefore, SILS technique and Nissen fundoplication (SILNF) have been employed. Herein, we report our experience with SILNF for GERD in 10 patients.

Surgery has been introduced to provide further lower recurrence rates and to maintain the patient with the utmost quality of life, irrespective of the approach to treatment of GERD, as a single incision or conventional laparoscopic.[12] The laparoscopic approach to GERD has clear advantages, including less acute and chronic postoperative pain, a low rate of incisional hernia, shorter convalescence, earlier return to daily activities, and better cosmetic results.

Current LNF techniques involve the use of five laparoscopic small skin incisions, resulting in five surgical scars.[13,14] SILS was developed with the aim of reducing the invasiveness of traditional laparoscopy and improving the cosmetic outcome. However, the main reason for reducing the number of incisions and trocar placements is that each incision is associated with the risk of morbidity due

TABLE 1: Clinical outcomes and demographics of the patients.

Patient No	Age (Years)	Sex	BMI	DeMeester Score	Operation time	Operative complications	Additional port	Length of hospital stay
1	35	Female	24.64	30.25	94	No	-	2
2	56	Female	26.15	29.23	86	No	-	2
3	24	Female	22.36	42.45	110	No	-	1
4	31	Male	28.64	34.26	97	No	-	3
5	29	Female	23.85	28.96	118	No	1	2
6	38	Female	20.56	18.89	80	No	-	1
7	30	Male	22.10	19.26	103	No	-	2
8	37	Female	27.24	23.89	74	No	-	3
9	36	Female	29.28	23.44	80	No	1	4
10	34	Male	21.96	39.37	88	No	-	2

BMI: Body mass index.

to bleeding, incisional hernia, organ damage, and decreased cosmesis.[15] Our surgical technique for LNF is performed entirely through a 20 mm vertical midline incision above the umbilicus. Unlike previous SILNF reports that used specially designed articulating instruments and special tools for the node such as EndoStitch, our technique utilizes conventional 5 mm rigid laparoscopic instruments, a laparoscope, and a laparoscopic knot advancer that are already available in the operating room.[4,5]

The retraction of the left lobe of the liver is the most important factor when performing the SILNF. The new liver retraction method we developed can clearly expose the esophagogastric area. SILNF can be performed safely and easily with Berk technique.

There were no intra- or postoperative complications related to this new approach in our series. Before performing this operation, our surgical team had performed nearly 250 SILS, including sleeve gastrectomies, hemicolectomies, cholecystectomies, splenectomies, appendentomies, and inguinal hernia operations. Certainly, there is a learning curve for SILNF as true for all surgical procedures. In our opinion, surgeons who have previously performed certain numbers of SILS would not find it difficult to perform SILNF.

We recommend the use of epigastric access. This procedure can be done using transumbilical incision[4]. Positioning the single incision within the umbilicus results in better cosmetics results. We choose the vertical midline incision above the umbilicus in order to facilitate the manipulation. The distance between the umbilicus and the operative field might cause manipulation difficulties and inadequate visualization during the surgery.

The limitation of this study is that vertical midline incision above the umbilicus was preferred as a port entrance in order to access to the hiatal area. This is a problem in that it shades the cosmetic advantage of SILS. However, if this study can achieve a suitable retraction of the left lobe of the liver; when longer and angled hand tools are used, transumbilically SILNF can be performed easily.

Studies have shown the single incision laparoscopic surgery to be feasible and safe[16]. Umbilical hernia rate was reported as 2.4% after SI surgery[17]. In our series, the umblical hernia rate was found as 5.8%.[18] The larger fascial incision for a single port laparoscopic device may lead to increased herniation risk.[19] This appears as a disadvantage of the SI surgery.

The other issue that can be debated is that whether this method with its technical limitations is required or not. However, this debate is not within the scope of this study in which we aimed to prove that SILNF can be achieved.

Although the early experience with SILS is promising, experienced laparoscopic skills are essential for a safe and effective completion of the surgery. The use of nonarticulating instrumentation required training and experience. Optimal use of these instruments requires intracorporeal movements such that tissue dissection, traction, and diathermy which are sometimes performed with the contralateral hand compared with conventional laparoscopy. In addition, the occurrence of instrument clashing is a disadvantage of this procedure.

CONCLUSION

In the hands of experienced laparoscopic surgeons, SILNF for GERD is feasible and seems to be safe. SILNF can be done with conventional laparoscopic instruments. However, if conventional hand tools are used, port should be above the umbilicus. This study reveals that SILNF can be performed when the liver is retracted properly. Nevertheless, if angled and longer hand tools are preferred and umbilicus is used as a port entrance, the procedure can reveal more cosmetically acceptable results.

REFERENCES

1. Geagea T. Laparoscopic Nissen's fundoplication: preliminary report on ten cases. Surg Endosc 1991;5(4):170-3.
2. Finks JF, Wei Y, Birkmeyer JD. The rise and fall of antireflux surgery in the United States. Surg Endosc 2006;20(11):1698-701.
3. Hamzaoglu I, Karahasanoglu T, Aytac E, Karatas A, Baca B. Transumbilical totally laparoscopic single-port Nissen fundoplication: a new method of liver retraction: the Istanbul technique. J Gastrointest Surg 2010;14(6): 1035-9.
4. Hawasli A, Holman AK. Single incision laparoscopic Nissen fundoplication: step by step. Surg Laparosc Endosc Percutan Tech 2011;21(2):e78-80.
5. Barbaros U, Demirel T, Sumer A, Deveci U, Tukenmez M, Cansunar MI, et al. Pure SILS Floppy Nissen fundoplication with hiatal repair: A case report. ISRN Gastroenterol 2011; 2011:347487. doi: 10.5402/2011/347487.
6. Johnson LF, DeMeester TR. Development of the 24-hour intraesophageal pH monitoring composite scoring system. J Clin Gastroenterol 1986;8(Suppl 1):52-8.
7. Yilmaz H, Alptekin H. Single-port laparoscopic nissen fundoplication: a new method for retraction of the left lobe of the liver. Surg Laparosc Endosc Percutan Tech 2012;22(5): e265-6.
8. Arezzo A, Morino M. Endoscopic surgery through single-port incision: time for a trial? Surg Endosc 2011;25(6):1709-11.
9. Marks JM, Ponsky JL, Pearl JP, McGee MF. PEG "Rescue": a practical NOTES technique. Surg Endosc 2007;21(5):816-9.
10. Zorron R, Maggioni LC, Pombo L, Oliveira AL, Carvalho GL, Filgueiras M. NOTES transvaginal cholecystectomy: preliminary clinical application. Surg Endosc 2008;22(2):542-7.
11. Iannelli A, Schneck AS, Ioia G, Gugenheim J. Single incision laparoscopic surgery cholecystectomy: a preliminary experience. Surg Laparosc Endosc Percutan Tech 2010;20(3): e89-91.
12. Salminen PT, Hiekkanen HI, Rantala AP, Ovaska JT. Comparison of long-term outcome of laparoscopic and conventional nissen fundoplication: a prospective randomized study with an 11-year follow-up. Ann Surg 2007;246(2):201-6.
13. Zollinger RM, Ellison EC. Plate 43; Fundoplication, Laparoscopic. Zollinger's Atlas of Surgical Operations. 9th ed. New York: McGraw-Hill; 2011. p. 104-7.
14. Türkçapar AG. [Laparoscopic antireflux surgery]. Turkiye Klinikleri J Gastroenterohepatol-Special Topics 2012;5(2):43-52.
15. Roy P, De A. Single-incision laparoscopic TAPP mesh hernioplasty using conventional instruments: an evolving technique. Langenbecks Arch Surg 2010;395(8):1157-60.
16. Erbella J Jr, Bunch GM. Single-incision laparoscopic cholecystectomy: the first 100 outpatients. Surg Endosc 2010;24(8):1958-61.
17. Gunderson CC, Knight J, Ybanez-Morano J, Ritter C, Escobar PF, Ibeanu O, et al. The risk of umbilical hernia and other complications with laparoendoscopic single-site surgery. J Minim Invasive Gynecol 2012;19(1): 40-5.
18. Alptekin H, Yilmaz H, Acar F, Kafali ME, Sahin M. Incisional hernia rate may increase after single-port cholecystectomy. J Laparoendosc Adv Surg Tech A 2012;22(8):731-7.
19. Helgstrand F, Rosenberg J, Bisgaard T. Trocar site hernia after laparoscopic surgery: a qualitative systematic review. Hernia 2011;15 (2):113-21.