



State of groin hernia repair in Japan: Annual Report of 2022 from the National Clinical Database

Saseem Poudel¹ · Hiroyuki Yamamoto² · Kyosuke Miyazaki¹ · Hitoshi Idani¹ · Masanori Sato¹ · Tsuyoshi Takagi¹ · Itsuro Nagae¹ · Taketo Matsubara¹ · Ken Shirabe³ · Hideki Ueno⁴ · Takehiro Hachisuka¹

Received: 7 October 2024 / Accepted: 16 November 2024
© The Author(s) under exclusive licence to Springer Nature Singapore Pte Ltd. 2024

Abstract

Purpose The National Clinical Database (NCD) in Japan captures over 95% of the surgeries performed by general surgeons. In May 2021, the Japan Hernia Society (JHS) introduced additional categories for groin hernia repair at JHS-registered institutions. This study presents the 2022 data on groin hernia repair from the NCD.

Methods This study included all cases of groin hernia repair registered in the NCD for 2022. The basic data collected included age, sex, type of surgery, day surgery status, emergency status, and anesthesia involvement. For JHS-registered institutions, data on hernia laterality, whether the case was primary or recurrent, surgical details, and groin hernia classifications were also collected.

Results Of the 908 institutions reporting to the NCD, 459 (50.6%) were JHS registered. A total of 118,365 groin hernia repairs were recorded, of which 43,952 (37.1%) were from JHS-registered institutions. Endoscopic repair accounted for 53.3% ($n=63,208$) of the patients. Day surgery was performed in 5.1% ($n=6045$) of the patients. At JHS-registered institutions, 81.6% of bilateral hernias were treated by endoscopic repair; 68.1% were lateral hernias. The most commonly used method was the TAPP method, which was applied in 48.8% of cases.

Conclusions Although endoscopic repair is widely used in Japan, day surgery rates remain low. Improving data collection and increasing NCD participation are crucial for aligning with international standards.

Keywords Groin hernia repair · National registry · Endoscopic repair · Day surgery

Introduction

Real-world data play a pivotal role that extends beyond the controlled environment of clinical trials by accurately reflecting the clinical reality of a population [1]. International guidelines for groin hernia recommend that countries and regions develop and implement registries with high coverage and long-term follow-up for quality control of patients

with groin hernia [2]. In Japan, the National Clinical Database (NCD), a comprehensive database for surgical procedures, was established in 2010 and data collection began in 2011 [3, 4]. It currently covers >95% of the general surgical procedures performed nationwide [4]. The data obtained from this database have provided insights into the surgical procedures performed in various institutions and have been used to report the outcomes of different surgical procedures in Japan [3, 5–7].

However, a significant gap exists in the NCD database concerning the registry of groin hernia repairs in Japan. The existing categories for groin hernia in NCD included only basic surgical information, such as whether the hernia was inguinal or femoral and whether the surgery was open or endoscopic [8]. Crucially, comprehensive data on primary versus recurrent cases, surgical techniques, classifications of groin hernias, and postoperative outcomes are vital for understanding the current status of groin hernia repair.

✉ Kyosuke Miyazaki
kyosukemiyazaki1@me.com

¹ Hernia Registry Committee, The Japanese Hernia Society, Tokyo, Japan

² Department of Healthcare Quality Assessment, Graduate School of Medicine, The University of Tokyo, Tokyo, Japan

³ The Japanese Society of Gastroenterological Surgery, Tokyo, Japan

⁴ Database Committee, The Japanese Society of Gastroenterological Surgery, Tokyo, Japan

To bridge these gaps, the Japan Hernia Society (JHS) formed a registry committee in 2016 and joined the Joint Committee of Gastroenterological Surgery Database. After extensive negotiations with the NCD, four new categories of groin hernia repair were introduced to supplement the pre-existing categories [9]. These data were collected from gastrointestinal surgical institutions that agreed to contribute additional data on groin hernia repair and register with the JHS. Registration using this new system began in May 2021 [9]. The purpose of this paper is to present the state of groin hernia repair in Japan using NCD data for the calendar year of 2022.

Methods

Patients

Patients who underwent groin hernia repair were included in this study based on the data registered in the NCD in the year 2022. The NCD system allows recording of up to 8 surgical procedures per case. In cases in which a patient had two recorded surgical procedures, it was counted as two surgical procedures when counting surgical procedures, but one case when counting cases. Therefore, there was a discrepancy between the number of cases and the number of surgical procedures. Patients with incomplete data were excluded from the analysis.

Basic categories

The pre-existing basic categories included sex, age on the day of surgery, whether the hernia was inguinal or femoral, whether the repair was open or endoscopic, whether the patient arrived by ambulance, whether it was day surgery, if it was an emergency surgery, and whether an anesthesiologist was involved in the surgery.

New categories

For institutes registered as gastrointestinal surgical institutes that chose to join the JHS registry, data from additional categories were collected. Data for patients under 18 years of age who registered under the Japan Pediatric Surgical Society were not included. The new categories in this database are as follows:

1. Hernia laterality: if the hernia is right sided, left sided or bilateral.
2. Hernia recurrence status: primary or recurrent hernia. For recurrent hernia, additional data on the number of recurrences, age at previous and first surgeries, and surgical procedures used were collected.

3. Hernia classification: for NCD registration, the JHS adopted the EHS classification [10]. Lateral, medial, and femoral hernias were denoted as L, M, and F, respectively, and their widths were denoted as 1, 2, and 3 in the EHS classification. Additional information was added: for recurrent cases, an "R" followed by a number indicating the frequency of recurrence (e.g., "R2F1" denotes a femoral hernia with a 1 cm orifice after two recurrences).

- Unclassified type: This is a new category for hernias that cannot be classified as lateral, medial, or femoral, such as interparietal hernias, where the sac passes between abdominal wall layers without reaching the external inguinal ring [11]. The JHS was of the opinion that since these hernias do not pass through the inguinal canal, they cannot be classified as lateral hernias, even though they arise from the internal ring.
- Hernia-like lesion: This is a separate category for lesions mimicking groin hernias (e.g., cord lipoma, hydrocele, Nuck canal cyst, varicocele). If no hernial sac was present, they were classified as hernia-like lesions. If a sac was present, the lesion was classified as L, M, or F, based on the location of the orifice.
- Hernias not arising from groin areas, such as Spigelian hernia, obturator hernia, internal supravesical hernia, and sports hernia, were not covered in this groin hernia classification.

4. Details of the surgical procedure:
5. Surgical procedures were categorized as high ligation, other tissue repair, onlay mesh, plug and patch, underlay mesh, other open repair, laparoscopic percutaneous extraperitoneal closure (LPEC), transabdominal preperitoneal (TAPP) repair, total extraperitoneal (TEP) repair, hybrid repair, and robotic repair. For hybrid repairs, data on open repair techniques were also collected.

In this study, data from open and endoscopic surgeries for the basic categories, which were performed at registered and unregistered institutes. Data on hernia classification and surgical procedures are presented for both the primary and recurrent cases.

Statistical analysis

Categorical data are presented as numbers (percentages) and continuous data are presented as mean \pm standard deviation (SD). Categorical data were compared using the chi-square test, and continuous data were compared using the Welch *t* test. All statistical analyses were conducted using summary data from GraphPad QuickCalcs online [12, 13].

Results

In 2022, 118,365 groin hernia repair cases were registered in the NCD from 908 institutes in Japan. Among these, 43,952 cases (37.1%) were reported by 459 institutes affiliated with JHS. Overall, endoscopic repair was performed in 63,208 patients (53.3%), day surgery was performed in 6,045 patients (5.1%), and emergency surgery was performed in 5,210 patients (4.4%). Anesthesiologists were more frequently involved in open hernia repair at unregistered institutes. Institutes registered with the JHS were more likely to perform day surgery for both open and endoscopic repairs and less likely to perform emergency surgery (Table 1).

Right-sided hernias were more common, and 18.6% of the endoscopically repaired hernias were bilateral. Overall, 81.6% of the bilateral hernias were repaired using an endoscopic approach. Recurrent cases constituted 3.8% of the total registered cases from JHS-affiliated institutes, with 64.7% of these cases being repaired endoscopically (Table 1).

In registered institutes, lateral hernias accounted for 68.1% of all cases, whereas medial hernias were more prevalent in recurrent cases, accounting for 47.6% of these cases (Table 2). There were 137 (0.3%) cases of unclassified hernias (Table 2).

Endoscopic repair was selected for 63.5% of the cases at registered institutes (Table 3). TAPP repair was the most common procedure, performed in 23,194 cases (48.8%), whereas underlay mesh repair was the most frequent open repair method, performed in 6,153 cases (12.9%) (Table 3). Robotic repair was performed in 314 patients (0.7%) (Table 3).

Discussion

To the best of our knowledge, this is the first comprehensive report on groin hernia repair in Japan using NCD data. It details groin hernia repairs conducted in 2022 and reveals that endoscopic repair was performed in more than half of the cases, and that it is more common in institutes registered with the JHS. In addition, endoscopic repair operations in these registered institutes were more frequently performed as day surgery.

Since the first groin hernia registry was started in Sweden in 1992, hernia registry databases have become increasingly common, especially in European countries [1]. Only Swedish and Danish hernia registries have achieved registration rates of > 90% for groin hernias in their countries [1]. Japan has two main health databases: the NCD, where participating hospitals enter data on procedures that are performed, and the National Database of Health Insurance Claims and Specific Health Checkups (NDB), which collects data from insurance claims [4, 14]. In addition, the Japan Society for Endoscopic Surgery (JSES) also retrospectively collects data on various surgical procedures from participating hospitals biannually [15]. The NCD is linked to board certification for various surgical specialties, and encourages participation. However, hospitals must pay membership fees based on the number of registered cases, which might discourage full registration. In contrast, the NDB covers nearly all surgical procedures through health insurance, and participation in the JSES survey is voluntary [14, 15]. In 2022, the NDB recorded 129,217 groin hernia repairs, whereas the NCD registered 118,365 cases (91.8%), and the JSES survey only registered 35,007 groin hernia cases in 2021 [15, 16]. NDB data are publicly accessible, whereas access to

Table 1 Demographic data

	Open				<i>p</i>	Endoscopic			
	All centers	Registered	Unregistered	<i>p</i>		All centers	Registered	Unregistered	<i>p</i>
Number of cases	55,430 (46.7%)	17,123 (38.8%)	38,307 (51.4%)		63,208 (53.3%)	26,968 (61.2%)	36,240 (48.6%)	<0.001	
Male sex	47,816 (86.3%)	14,702 (85.9%)	33,114 (86.4%)	0.06	55,059 (87.1%)	23,470 (87.0%)	31,589 (87.2%)	0.61	
Age	70.5 ± 16.0	69.1 ± 16.5	71.1 ± 15.7	<0.001	66.4 ± 17.0	65.6 ± 17.6	66.9 ± 16.5	<0.001	
Day surgery	3,200 (5.8%)	2,296 (13.4%)	904 (2.4%)	<0.001	2,849 (4.5%)	2,519 (9.3%)	330 (0.9%)	<0.001	
Emergency surgery	4,025 (7.3%)	1,098 (6.4%)	2,927 (7.6%)	<0.001	1,206 (1.9%)	464 (1.7%)	742 (2.0%)	0.003	
Involvement of anesthesiologist	38,865 (70.1%)	11,235 (65.6%)	27,630 (72.1%)	<0.001	59,584 (94.3%)	25,386 (94.1%)	34,198 (94.4%)		
Right sided		9,031 (53.2%)				11,530 (44.9%)			
Bilateral (%total cases)		1,080 (6.4%)				4,778 (18.6%)			
(%bilateral cases)		(18.4%)				(81.6%)			
Recurrent (%total cases)		644 (3.7%)				1,179 (3.9%)			
(%recurrent cases)		(35.3%)				(64.7%)			

Table 2 Hernia classification of registered cases

	All cases (47,537)	Primary cases (45,732)	Recurrent cases (1,805)
Lateral	32,366 (68.1%)	31,654 (69.2%)	712 (39.4%)
L1	5021 (10.6%)	4923 (10.8%)	98 (5.4%)
L2	19,237 (40.5%)	18,838 (41.2%)	399 (22.1%)
L3	8108 (17.1%)	7893 (17.3%)	215 (11.9%)
Medial	10,998 (23.1%)	10,998 (22.2%)	859 (47.6%)
M1	1215 (2.6%)	1076 (2.4%)	139 (7.7%)
M2	6011 (12.6%)	5555 (12.1%)	456 (25.3%)
M3	3772 (7.9%)	3508 (7.7%)	264 (14.6%)
Femoral	1722 (3.6%)	1617 (3.5%)	105 (5.8%)
F1	660 (1.4%)	624 (1.4%)	36 (2.0%)
F2	896 (1.9%)	850 (1.9%)	46 (2.5%)
F3	166 (0.3%)	143 (0.3%)	23 (1.3%)
Combined	1985 (4.2%)	1908 (4.2%)	77 (4.3%)
L + M	1444 (3.0%)	1386 (3.0%)	58 (3.2%)
L + F	299 (0.6%)	288 (0.6%)	11 (0.6%)
M + F	172 (0.4%)	165 (0.4%)	7 (0.4%)
L + M + F	70 (0.1%)	69 (0.2%)	1 (0.1%)
Unclassified	137 (0.3%)	112 (0.2%)	25 (1.4%)
Hernia like lesion	282 (0.6%)	268 (0.6%)	14 (0.8%)
Cord Lipoma	44 (0.1%)	41 (0.1%)	3 (0.2%)
Hydrocele	51 (0.1%)	50 (0.1%)	1 (0.1%)
Nuck canal cyst	146 (0.3%)	141 (0.3%)	5 (0.3%)
Other	41 (0.1%)	36 (0.1%)	5 (0.3%)
No hernia	47 (0.1%)	34 (0.1%)	13 (0.7%)

Table 3 Surgical procedure performed in the registered cases

	All cases (47,537)	Primary cases (45,732)	Recurrent cases (1,805)
Open repair	17,328 (36.5%)	16,641 (36.4%)	687 (38.1%)
High ligation	507 (1.1%)	498 (1.1%)	9 (0.5%)
Other tissue repair	686 (1.4%)	644 (1.4%)	42 (2.3%)
Onlay mesh repair	4273 (9.0%)	4129 (9.0%)	144 (8.0%)
Plug and patch repair	4227 (8.7%)	3975 (8.7%)	252 (14.0%)
Underlay mesh repair	6153 (12.9%)	5987 (12.9%)	166 (9.2%)
Other open repair	1482 (3.1%)	1408 (3.1%)	74 (4.1%)
Endoscopic repair	30,209 (63.5%)	29,091 (63.6%)	1118 (61.9%)
LPEC	1275 (2.7%)	1265 (2.8%)	10 (0.6%)
TAPP	23,194 (48.8%)	22,331 (48.8%)	863 (47.8%)
TEP	5002 (10.5%)	4873 (10.7%)	129 (7.1%)
Hybrid	257 (0.5%)	175 (0.4%)	82 (4.5%)
Robotic	314 (0.7%)	303 (0.7%)	11 (0.6%)
Other	167 (0.4%)	144 (0.3%)	23 (1.3%)

NCD data requires an approved research proposal, and JSES data are freely available to its members. However, the NDB lacks data on procedures not covered by insurance, such as robotic groin hernia repairs, 317 of which were recorded in the NCD by 2022. Despite its comprehensive coverage, the NDB includes only basic demographic and procedural data. The NCD, which was developed for research and quality

improvement, includes additional data, such as ambulance arrivals or emergency surgeries. Compared to these databases, data collected by the JSES are more comprehensive, with detailed data on post-operative complications and recurrences after each surgical procedure [15]. The NCD database can use the JSES survey as a template to develop a more comprehensive database with wider coverage.

Even with these limited categories, we determined the percentage of day and endoscopic surgeries for groin hernia repair in Japan. The international guidelines for groin hernia repair strongly recommend day surgery for most patients [2]. Globally, 95% of 822 hernia surgeons in a consensus survey agreed with this recommendation [17]. The British Association of day surgery advised that 80% of groin hernia repairs be performed as day surgeries, achieving a rate of 77.8% in 2014/15 and up from 67.2% in 2011/12 [18, 19]. The Hernia Commission guide by the Royal College of Surgeons set a benchmark of 70% for groin hernia repairs in a day care setting. The Herniated registry showed that 29.5% of primary elective unilateral groin hernia repairs were performed as day surgeries in 2010, dropping to 14.3% in 2019 owing to the increased use of endoscopic techniques [20]. For open repair, the rate of day surgery was 28.3%. In Spain, this proportion was 54.2% in 2019 [21]. However, in Japan, only approximately 6% of open groin hernia repairs are performed as day surgery. While the data from registered institutes are promising, they still lag behind other developed countries. Studies have shown that day surgery is more cost-effective than inpatient treatment [22]. Reports from Japan have also demonstrated that day surgery is a safe option for uncomplicated groin hernias, even in cases involving endoscopic repair [23]. Japan currently maintains universal health insurance coverage through a social insurance system, which is becoming increasingly expensive for the government each year, primarily because of the rapid growth of the aging population [24]. For inpatient cases, in addition to operation and anesthesia costs, which are similar to those for day surgery cases, Japan's national health insurance system currently reimburses JPY 33,800 (USD 225.3, at an exchange rate of 1 USD = JPY 150) for the first day of admission for groin hernia repair surgery, JPY 18,540 (USD 123.6) per day for days 2–4 of admission, and JPY 18,030 (USD 120.2) per day from days 5 to 30. This amount is multiplied by the hospital coefficient, which depends on various factors such as the patient-to-nurse ratio and hospital functions. According to the Ministry of Health, Labour and Welfare, the average hospitalization period is 4.55 days for groin hernia repair in adults, which is longer than that in other developed countries [25]. If 80% of groin hernia repairs in Japan were to be performed as day surgeries (compared to the current rates of 5.8% for open repairs and 4.5% for endoscopic repairs), even if we disregard the hospital coefficient, patients could receive the same surgeries while collectively saving a minimum of JPY 8.827 billion (USD 58.848 million) annually. Promoting a more cost-effective day surgical approach for groin hernia repairs could significantly reduce costs and ease the burden on Japan's national insurance system. Emphasizing the safety and benefits of this method and encouraging both surgeons and patients to consider that it could lead to positive changes.

Endoscopic repair accounted for more than half of groin hernia repairs in Japan, with TAPP being the most frequently used procedure. The popularity of TAPP or TEP repair for endoscopic repair varies across countries. Similar to Japan, TAPP repair was more popular in Germany, with 60.1% of endoscopic repairs performed using TAPP, whereas in Sweden, TEP repair accounted for 15% of repairs, while only 3% were performed using the TAPP procedure [26, 27]. Even for open repair, although Lichtenstein repair remains the gold standard worldwide, open preperitoneal repair is more common in Japan, followed by Lichtenstein repair. In a recent update to the international guidelines for groin hernia repair, the open preperitoneal mesh technique was weakly recommended as an alternative, provided that expertise and competence were available [28]. The preference for and popularity of a technique in a country or region may be influenced by the preferences and training of early adopters. Endoscopic surgery was used in > 80% of bilateral hernia repairs, consistent with the recommendations of the international guidelines for groin hernia management [2]. Herniated registry data showed that 65.7% of cases registered for elective primary unilateral hernia in 2019 were repaired endoscopically [20]. However, this is not a nationwide database and consists only of data from the participating institutes. The use of endoscopic procedures was similar in the institutes registered with the JHS. Few studies have used nationwide databases, similar to our study, to demonstrate the use of endoscopic surgery. In Denmark, from 2015 to 2019, endoscopic repair was used in 51% of unilateral hernias and 96% of bilateral hernias [29], while in Italy, the rate was around 6% [30]. These data show that the adoption of endoscopic repair in Japan is better than or comparable to that in other developed countries around the world. We should continue to monitor the adoption rate and collect data on operative and postoperative outcomes to provide a better picture of its impact.

This study had several limitations. Only approximately half of the gastrointestinal institutes in Japan are registered, and these institutes account for approximately 37% of all groin hernia cases in the NCD. Although the JHS added four new categories, data collection was still insufficient in comparison to other registries. The NCD lacks information on comorbidities, preoperative risk factors, and postoperative complications. In contrast, the Danish hernia database, linked with a national identity code, allows tracking of follow-up studies [31]. While the NCD records postoperative outcomes for up to 30 days for some procedures, the groin hernia data were not included. The NCD has a more comprehensive data collection for other procedures, which has provided valuable real-world data on their quality and enabled the creation of risk calculators [3]. Efforts will continue to increase the number of registered institutions and enhance the data collection. We will also work with

the NCD to expand the categories and improve the overall quality of registry data.

Conclusion

In 2022, NCD data showed that while endoscopic repair is widely adopted in Japan, the overall rate of day surgery for groin hernia repair remains low in comparison to other developed countries. Enhancing data collection and increasing the number of registered institutions in the NCD are essential for improving outcomes and aligning with international standards.

Declarations

Conflict of interest Hiroyuki Yamamoto is affiliated with the Department of Healthcare Quality Assessment of the University of Tokyo. The department is a social collaboration department supported by grants from the National Clinical Database, Intuitive Surgical Sarl, Johnson and Johnson K.K., and Nipro Co. Kyosuke Miyazaki received Honoria from BD, not related to the manuscript. Hideki Ueno is an editorial board member of Surgery Today. SP, HI, MS, TT, IN, TM, KS, and TH declare no conflicts of interest.

References

- Kyle-Leinhase I, Köckerling F, Jørgensen LN, Montgomery A, Gillion JF, Rodriguez JA, et al. Comparison of hernia registries: the CORE project. *Hernia*. 2018;22:727–35. <https://doi.org/10.1007/s10029-017-1724-6>.
- Simons MP, Śmietański M, Bonjer HJ, Bittner R, Miserez M, Aufenacker TJ, et al. International guidelines for groin hernia management. *Hernia*. 2018;22:1–165. <https://doi.org/10.1007/s10029-017-1668-x>.
- Takeji Y, Yamamoto H, Ueno H, Eguchi S, Endo I, Sasaki A, et al. Development of gastroenterological surgery over the last decade in Japan: analysis of the National Clinical Database. *Surg Today*. 2021;51:187–93. <https://doi.org/10.1007/s00595-020-02075-7>.
- Seto Y, Takeji Y, Miyata H, Iwanaka T. National clinical database (NCD) in Japan for gastroenterological surgery: brief introduction. *Ann Gastroenterol Surg*. 2017;1:80–1. <https://doi.org/10.1002/ags3.12026>.
- Murakami K, Akutsu Y, Miyata H, Toh Y, Toyozumi T, Takeji Y, et al. Essential risk factors for operative mortality in elderly esophageal cancer patients registered in the National Clinical Database of Japan. *Esophagus*. 2023;20:39–47. <https://doi.org/10.1007/s10388-022-00957-y>.
- Matsuyama T, Endo H, Yamamoto H, Takemasa I, Uehara K, Hanai T, et al. Outcomes of robot-assisted versus conventional laparoscopic low anterior resection in patients with rectal cancer: propensity-matched analysis of the National Clinical Database in Japan. *BJS Open*. 2021. <https://doi.org/10.1093/bjsopen/zrab083>.
- Miyawaki Y, Tachimori H, Nakajima Y, Sato H, Fujiwara N, Kawada K, et al. Surgical outcomes of reconstruction using the gastric tube and free jejunum for cervical esophageal cancer: analysis using the National Clinical Database of Japan. *Esophagus*. 2023;20:427–34. <https://doi.org/10.1007/s10388-023-00997-y>.
- Miyazaki K, Inaba T, Uemura Y, Kawarada Y, Shimada G, Suwa K, et al. Annual Report 2011–2017 of Groin Hernia Repair in Japan from National Clinical Database (in Japanese with English abstract). *Jpn Hernia Soc J*. 2019;5:7.
- Miyazaki K, Yamamoto H, Idani H, Sato M, Takagi T, Nagae I, et al. Annual Report 2021 of Groin Hernia Repair in Japan from National Clinical Database (in Japanese with English abstract). *Jpn Hernia Soc J*. 2023;10:10.
- Miserez M, Alexandre JH, Campanelli G, Corcione F, Cuccurullo D, Pascual MH, et al. The European hernia society groin hernia classification: simple and easy to remember. *Hernia*. 2007;11:113–6. <https://doi.org/10.1007/s10029-007-0198-3>.
- Lower WE, Hicken NF. Interparietal Hernias. *Ann Surg*. 1931;94:1070–87. <https://doi.org/10.1097/0000658-193112000-00010>.
- Graphpad Quickcal: 2x2 Contingency Table. Available at: <https://www.graphpad.com/quickcalcs/contingency1/>. Accessed August 9, 2024.
- Graphpad Quickcal: T test calculator. Available at: <https://www.graphpad.com/quickcalcs/ttest1/>. Accessed August 9, 2024.
- Suto M, Iba A, Sugiyama T, Kodama T, Takegami M, Taguchi R, et al. Literature review of studies using the national database of health insurance claims of Japan (NDB): limitations and strategies in using the NDB for research. *JMA J*. 2024;7:10–20. <https://doi.org/10.31662/jmaj.2023-0078>.
- Shiroshita H, Inomata M, Takiguchi S, Akira S, Kanayama H, Yamaguchi S, et al. Update on endoscopic surgery in Japan: results of the 16th national survey of endoscopic surgery by the Japan Society for Endoscopic Surgery. *Asian J Endosc Surg*. 2024. <https://doi.org/10.1111/ases.13285>.
- NDB Open Data. Available at: https://www.mhlw.go.jp/stf/seisa_kunitsuite/bunya/0000177182.html. Accessed August 3, 2024.
- van Veenendaal N, Simons M, Hope W, Tuumavikula S, Bonjer J, Aufenacker TJ, et al. Consensus on international guidelines for the management of groin hernias. *Surg Endosc*. 2020;34:2359–77. <https://doi.org/10.1007/s00464-020-07516-5>.
- Royal College of Surgeons, England. Hernia-commissioning guide. 2013. Available at: <https://www.rcseng.ac.uk/-/media/files/rcs/library-and-publications/non-journal-publications/hernia-guide.pdf>. Accessed August 3, 2024.
- Royal College of Surgeons, England. Commissioning Guide, Groin Hernia, 2016. Available at: <https://www.rcseng.ac.uk/library-and-publications/rcs-publications/docs/commissioning-guide-for-groin-hernia/>. Accessed August 3, 2024.
- Köckerling F, Lorenz R, Reinhold W, Zarras K, Conze J, Kuthe A, et al. What is the reality of outpatient versus inpatient groin hernia repairs? Analysis from the Herniated Registry. *Hernia*. 2022;26:809–21. <https://doi.org/10.1007/s10029-021-02494-6>.
- Guillaumes S, Hidalgo NJ, Bachero I, Juvany M. Outpatient inguinal hernia repair in Spain: a population-based study of 1,163,039 patients—Clinical and socioeconomic factors associated with the choice of day surgery. *Updates Surg*. 2023;75:65–75. <https://doi.org/10.1007/s13304-022-01407-1>.
- Prakongsai P, Chanasopon S, Wongphan T, Pachanee K. Cost-effectiveness analysis of same-day surgery and anesthesia in Thailand. *Value Health*. 2018;21:S87–S87. <https://doi.org/10.1016/j.jval.2018.07.653>.
- Wakasugi M, Hasegawa J, Ikeda Y. Single-incision laparoscopic totally extraperitoneal inguinal hernia repair with tumescent local anesthesia: report of more than 2000 procedures at a day-surgery clinic. *Surg Today*. 2021;51:545–9. <https://doi.org/10.1007/s00595-020-02141-0>.
- Sasaki T, Izawa M, Okada Y. Current trends in health insurance systems: OECD countries vs. Japan. *Neurol Med Chir*. 2015;55:267–75. <https://doi.org/10.2176/nmc.ra.2014-0317>.

25. DPC Hospital Information. Available at: https://www01.prrism.com/dpc/2024/byoinjoho/byoinjoho_koukai06.html. Accessed November 11, 2024.
26. Hemberg A, Landén J, Montgomery A, Holmberg H, Nordin P. Management of groin hernia repair in Sweden: a register-based comparative analysis of public and private healthcare providers. *Scand J Surg*. 2024;113:211–8. <https://doi.org/10.1177/14574969241242312>.
27. Kockerling F, Bittner R, Jacob DA, Seidelmann L, Keller T, Adolf D, et al. TEP versus TAPP: comparison of the perioperative outcome in 17,587 patients with a primary unilateral inguinal hernia. *Surg Endosc*. 2015;29:3750–60. <https://doi.org/10.1007/s00464-015-4150-9>.
28. Stabilini C, van Veenendaal N, Aasvang E, Agresta F, Aufenacker T, Berrevoet F, et al. Update of the international HerniaSurge guidelines for groin hernia management. *BJS Open*. 2023. <https://doi.org/10.1093/bjsopen/zrad080>.
29. Andresen K, Rosenberg J. Decreasing the use of open procedures in elective inguinal hernia surgery. *Laparosc Surg*. 2021;5:17. <https://doi.org/10.21037/lis-20-126>.
30. Ortenzi M, Botteri E, Balla A, Podda M, Guerrieri M, Sartori A. Nationwide analysis of laparoscopic groin hernia repair in Italy from 2015 to 2020. *Updates Surg*. 2023;75:77–84. <https://doi.org/10.1007/s13304-022-01374-7>.
31. Friis-Andersen H, Bisgaard T. Danish Inguinal Hernia Database. *Clin Epidemiol*. 2016;8:521–4. <https://doi.org/10.2147/clep.S99512>.

Publisher's Note Springer Nature remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.

Springer Nature or its licensor (e.g. a society or other partner) holds exclusive rights to this article under a publishing agreement with the author(s) or other rightsholder(s); author self-archiving of the accepted manuscript version of this article is solely governed by the terms of such publishing agreement and applicable law.