

# Safety and efficacy of total one-day perioperative completion for inguinal hernia repair during the COVID-19 pandemic: a retrospective cohort study

Sung Ryul Lee

Department of Surgery, Damsoyu Hospital, Seoul, Korea

**Purpose:** During the coronavirus disease 2019 (COVID-19) pandemic, frequent perioperative interactions between patients and medical staff increased the risk of nosocomial infections. Total 1-day perioperative completion (TODPC) involves conducting preoperative evaluations, performing the operation, and facilitating discharge within a single day. This study aimed to evaluate the safety of TODPC in reducing perioperative contact by utilizing online and telephone appointment systems for inguinal hernia (IH) repairs.

**Methods:** In this retrospective cohort study, we analyzed data from patients who underwent IH repairs. The study was divided into 2 periods relative to the COVID-19 pandemic: 18 months pre-pandemic (Group 1, September 2018–February 2020) and 18 months post-pandemic onset (Group 2, March 2020–August 2021). We compared the frequency of TODPC, daycare surgeries (which require hospital visits for preoperative evaluations and admission on the day of surgery), preoperative contacts, hernia types, incarcerations, organ resections, and instances of COVID-19 transmission among medical staff and patients.

**Results:** The study included 5,728 participants, comprising 4,614 pediatric and 1,114 adult patients. The rate of TODPC implementation was higher in Group 2 than in Group 1 (91.0% vs. 75.0%,  $P < 0.001$ ). The incidence of organ resections was low and did not differ significantly between the 2 groups. Throughout the study, there were no reported nosocomial COVID-19 infections among patients, parents, caregivers, or medical staff.

**Conclusion:** TODPC for IH repair was a safe strategy for minimizing the need for organ resections and reducing the risk of mass COVID-19 infections during the pandemic period from March 2020 to August 2021.

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**Key Words:** COVID-19, Inguinal hernia, Perioperative medicine

## INTRODUCTION

On March 11, 2020, the World Health Organization designated coronavirus disease 2019 (COVID-19) as a pandemic, an event that continues to affect global health [1]. In the absence of definitive treatments, vaccination, and social distancing have emerged as primary strategies to mitigate transmission of the virus. These measures have been implemented in many countries. It is crucial to ensure that surgical services, especially

for conditions requiring urgent intervention such as emergency surgeries and treatment for major diseases, including cancer, continue during the pandemic. Although inguinal hernia (IH) is generally a minor condition, delays in elective surgery for this ailment are not advisable indefinitely [2,3] given the increased risk of complications such as incarceration and strangulation [4–6]. Therefore, minimizing perioperative interactions and reducing postoperative hospital stays are vital to decreasing the risk of COVID-19 transmission during IH surgeries [7,8].

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**Corresponding Author: Sung Ryul Lee**

Department of Surgery, Damsoyu Hospital, 234 Hakdong-ro, Gangnam-gu, Seoul 06104, Korea

Tel: +82-2-542-2222, Fax: +82-2-542-0099

E-mail: kingsoss@naver.com

ORCID: <https://orcid.org/0000-0003-0201-0627>

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IH repair, a routine surgical procedure, occasionally necessitates urgent intervention as a result of complications such as incarceration, affecting 3.4% of pediatric and 6.1% of adult patients [4,6]. Surgical management differs from medical treatment as it often requires multiple preoperative stages, including physical examination at an outpatient clinic, diagnostic radiologic evaluations, laboratory tests, and scheduling the surgery. These preliminary stages typically require 3 to 4 patient visits, heightening the potential for virus spread during the pandemic. Additionally, pediatric patients often need a guardian to accompany them, further increasing interpersonal contact and the associated infection risks [9].

The development of the internet appointment system has significantly reduced hospital visits by providing patients with preoperative information about diagnosis and treatment [10]. Hospital systems integrating remote appointment capabilities can potentially eliminate the need for 3 to 4 preoperative stages [11]. The provision of internet information has become a crucial issue for both hospitals and patients. Most hospitals now offer extensive information on their websites, including details about medical staff, disease treatment procedures, and surgical techniques [12]. Since 2012, we have been operating a remote appointment system using the hospital website with internet access and have implemented a total 1-day perioperative completion (TODPC). This system allows patients and caregivers to schedule an online appointment for a TODPC that encompasses diagnosis, preoperative tests, surgery, and discharge. Each pediatric patient stays in a single ward with a parent. Routine postoperative outpatient follow-ups are not performed. This TODPC differs from daycare surgery, which includes preoperative contact for diagnosis and various tests, followed by surgery and discharge on the same day [13]. In contrast, the TODPC involves a single preoperative contact, consolidating all preoperative stages, surgery, and discharge into 1 day. While previous studies have reported the use of daycare surgery for IH treatment [14], studies on the implementation of TODPC are lacking. The application of telemedicine remains a subject of debate. It is important to note that this study was not focused on telemedicine but rather on minimizing perioperative contact using the internet appointment system for the 1-day process.

IH is a benign but highly prevalent condition. This study aims to demonstrate that it is feasible to reduce perioperative contact in IH repair using an online system during the COVID-19 pandemic and to evaluate the safety and efficacy of this approach.

## METHODS

### Ethics statements

The study was approved by the Institutional Review Board

of Damsuyu Hospital (No. DSY-2021-006). All procedures were performed in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki Declaration and its later amendments or comparable ethical standards. Written informed consent was obtained from the patients for publication of this study and any accompanying images.

### Safety and efficacy

To evaluate the safety and efficacy of a TODPC for IH repair, we assessed the number of infections among patients undergoing this procedure before and after the onset of the COVID-19 pandemic. We also analyzed patient visits, convenience, and medical costs for those who received TODPC for IH repair at our institution compared with those receiving their first IH repair at other institutions.

### Study design

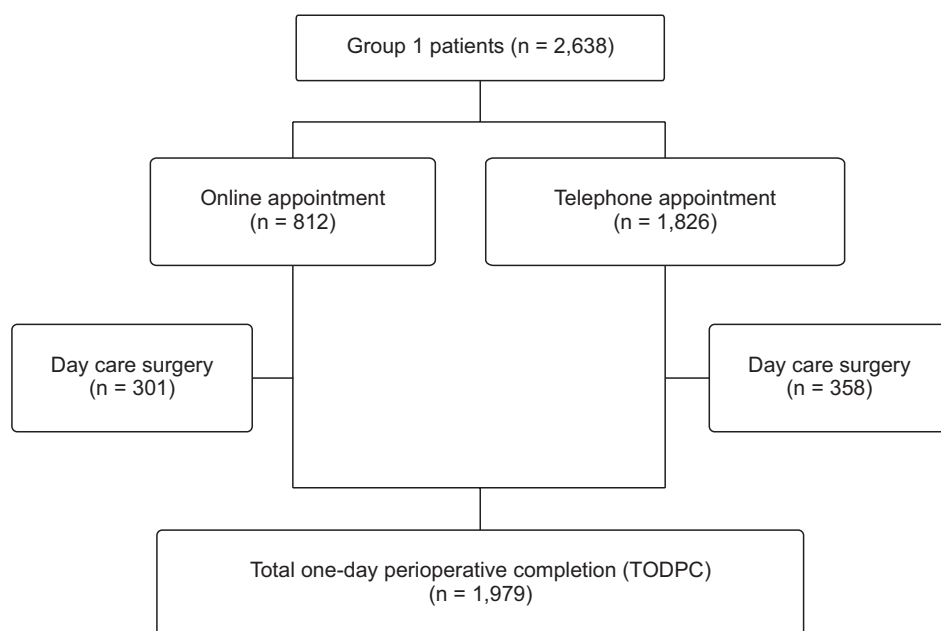
This retrospective study involved 5,728 patients who underwent IH repair between September 2018 and August 2021. The cohort comprised 4,614 pediatric patients (mean age,  $2.7 \pm 2.8$  years) and 1,114 adult patients (mean age,  $47.7 \pm 15.3$  years). The study period was categorized according to the start of the COVID-19 pandemic: Group 1 included patients treated in the 18 months before the start of the pandemic (September 2018 to February 2020, Fig. 1), and Group 2 comprised those treated in the 18 months following the pandemic's onset (March 2020 to August 2021, Fig. 2). Additionally, 194 patients who returned for reoperation at our facility after primary IH repair at external hospitals were closely studied to assess preoperative and postoperative interactions at those facilities.

### Online and telephone appointment system

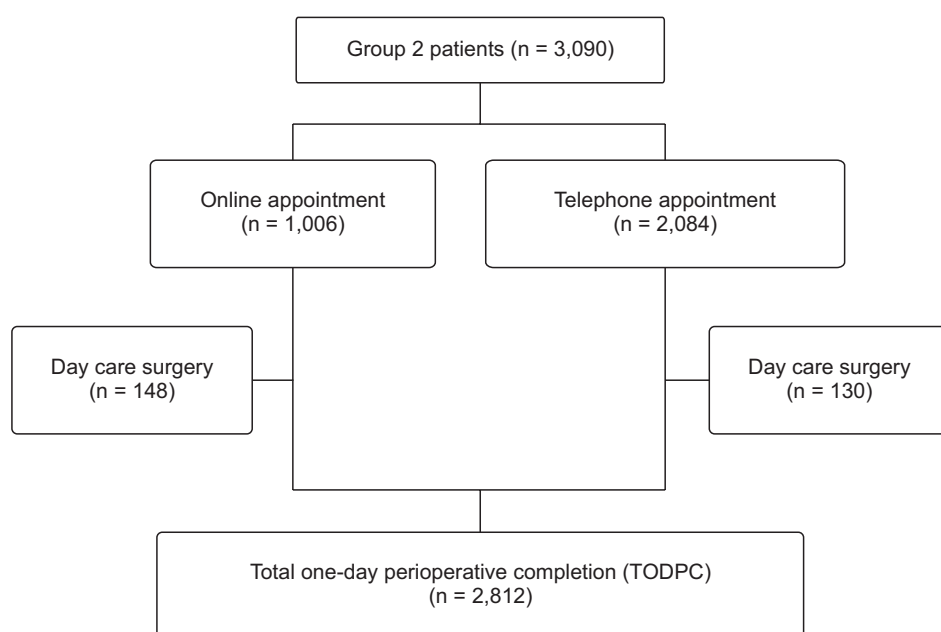
For TODPC, we have been providing an online and telephone scheduling system since 2012 where patients or guardians can schedule appointments through our website. If a patient or guardian schedules a TODPC, the entire process—from diagnosis to discharge, including preoperative laboratory tests, chest X-rays, electrocardiograms, and surgery—is completed on the same day. The day before their visit, all patients and guardians are contacted by a nurse who provides detailed instructions regarding necessary precautions, such as fasting and managing existing medications.

### Total 1-day perioperative completion

TODPC process is a system that our institution has been implementing since 2012. In this study, the patient's admission was contingent on a negative real-time reverse transcription polymerase chain reaction test result for COVID-19, as surgery under general anesthesia poses heightened risks for COVID-19-positive individuals, including complications such



**Fig. 1.** Flowchart of Group 1 patients, September 2018 to February 2020.



**Fig. 2.** Flowchart of Group 2 patients, March 2020 to August 2021.

as pneumonia, potentially increasing the mortality rate [15]. Throughout the COVID-19 pandemic, all patients with IH and their guardians adhered to face mask protocols. Diagnoses were made via physical examination or ultrasonography. Each pediatric patient and their parent occupied a dedicated single ward. Suspected IH patients and their caregivers were required to arrive at the hospital by 8:30 a.m. Following normal findings from chest X-ray and electrocardiogram evaluations, patients were transferred to a ward where blood samples were taken for laboratory tests during intravenous therapy. Provided there were no abnormalities in the test results, surgery was scheduled

to commence at approximately 10 a.m. All procedures were performed under general anesthesia in the supine position, and laparoscopic repairs were performed using a 3-port technique. Wound closure was achieved with 2-octyl cyanoacrylate glue instead of sutures. Additionally, we compared the medical costs incurred by patients undergoing the 1-day process with those undergoing daycare surgery.

### Follow-up protocol

The TODPC has been implemented as part of the basic protocol for all IH patients, which includes a specific follow-

up regimen. Patients were allowed to consume liquids 2 hours after the procedure. The discharge criteria required patients to remain stable and comfortable with daily activities, such as walking, eating, and voiding. Unlike other protocols, there was no routine follow-up before or after the COVID-19 pandemic began. A nurse conducted a telephone assessment of the patient's status the day following the operation. Patients were instructed to visit an outpatient clinic if complications or other problems occurred. Furthermore, patients and caregivers engaged in a telephone consultation to discuss postsurgical conditions and could submit photographs if issues were

encountered [16].

## Procedure for identifying COVID-19 infection

### Symptom monitoring

During each follow-up, patients were queried in detail about COVID-19 symptoms, including fever, cough, shortness of breath, and loss of taste or smell. Patients reporting any symptoms were advised to undergo COVID-19 testing and report results to the hospital.

**Table 1.** Patients' characteristics

Characteristic	Group 1	Group 2	P-value <sup>a)</sup>
No. of patients	2,638	3,090	
Age (yr)			0.066
<18	2,097 (79.5)	2,517 (81.5)	
>19	541 (20.5)	573 (18.5)	
Sex			0.075
Male	2,073 (78.6)	2,488 (80.5)	
Female	565 (21.4)	602 (19.5)	
Laterality of hernia			0.193
Right	1,388 (52.6)	1,647 (53.3)	
Left	1,010 (38.3)	1,203 (38.9)	
Bilateral	240 (9.1)	240 (7.8)	
Hospital visit			<0.001
TODPC after the online appointment system	1,979 (75.0)	2,812 (91.0)	
Daycare surgery after outpatient clinic consultation	659 (25.0)	278 (9.0)	
Hernia type			0.548
Indirect	2,551 (96.7)	2,978 (96.4)	
Direct	87 (3.3)	112 (3.6)	
Number of preoperative contacts			<0.001
0	1,979 (75.0)	2,812 (91.0)	
1	458 (17.4)	191 (6.2)	
2	201 (7.6)	87 (2.8)	
Operative finding			0.832
Incarceration	97 (3.7)	118 (3.8)	
Reducible hernia	2,541 (96.3)	2,972 (96.2)	
Organ resection	4 (0.2)	6 (0.2)	0.947
Postoperative outpatient follow-up	14 (0.5)	18 (0.6)	0.993
Hematoma	6	7	
Seroma	2	2	
Ileus	2	3	
Pain	4	6	
Reoperation	5 (0.2)	6 (0.2)	0.989
Recurrence	1	1	
Metachronous contralateral hernia	4	5	
COVID-19 infection		0 (0)	NA
Patients or parents		0	
Medical staff		0	

Values are presented as number only or number (%).

TODPC, total 1-day perioperative completion.

Group 1, pre-pandemic group; Group 2, post-pandemic group.

<sup>a)</sup>Most P-values represent comparisons of categorical variables, which were tested using the chi-square test. Continuous variables were tested using the t-test.

*Testing and reporting*

Patients were encouraged to undergo COVID-19 testing if symptomatic or concerned about infection. Test results were tracked to promptly identify and manage potential nosocomial infections.

*Testing of hospital staff*

All hospital staff underwent PCR testing at government-run institutions, with no infections detected among staff.

*Data collection and analysis*

Data from follow-up assessments were systematically collected and analyzed. No COVID-19 symptoms or positive test results were reported among patients during the follow-up period.

**Statistical analysis**

All statistical analyses were performed using R software ver. 4.1.2 (The R Foundation; <http://www.R-project.org>). Continuous variables are presented as means and ranges, while categorical variables are shown as frequencies and percentages. The independent t-test was applied to continuous variables, and the chi-square test was used for categorical variables. We set a significance threshold at a P-value of 0.05, considering a P-value of <0.05 in univariate analyses to indicate statistical significance.

**RESULTS**

Table 1 presents the characteristics of the patients. The cohort included 4,614 pediatric patients ( $\leq 18$  years old) and 1,114 adult patients ( $\geq 19$  years old). A higher proportion of patients in Group 2 underwent the TODPC compared with Group 1 (91.0% vs. 75.0%, respectively;  $P < 0.001$ ). Throughout the study period, there were no recorded cases of nosocomial COVID-19 infections among patients, parents, caregivers, or medical staff in both

the TODPC and daycare surgery settings. Table 2 details the perioperative interactions for patients undergoing secondary repairs when the primary surgery occurred in other hospitals. Of the 194 patients who sought care at our hospital for recurrence after initial surgery at an outside hospital, most (61.8%) had 3 perioperative interactions at the original hospital, with an average of 2.6 interactions. Additionally, most patients (87.6%) attended 1 follow-up after surgery, with an average of 1 follow-up.

**DISCUSSION**

IH repair surgeries have continued throughout the COVID-19 pandemic. To mitigate the risk of nosocomial infections, hospitals are adopting measures to minimize patient contact [17,18]. The use of single-patient wards significantly reduces the likelihood of patient-to-patient contact transmission compared with shared wards. Additionally, conducting minor surgeries in specialized surgical hospitals, rather than general hospitals with multiple departments, could further decrease the risk of exposure. Given that tertiary hospitals are primarily responsible for managing severe diseases and COVID-19 cases, minor surgeries, including IH repairs, are recommended to be performed at specialist surgical centers during the pandemic. At our institution, which specializes in IH repair, there has been an increase in the number of procedures performed during the pandemic compared with the period before. Patients generally prefer not to undergo lengthy perioperative processes for benign conditions and are likely to opt for more efficient and quicker surgical options when available.

During the COVID-19 pandemic, minimizing patient-to-patient contact has been a critical focus for medical systems globally [19]. This is especially important in surgeries for serious conditions such as cancer, which require extensive diagnostic procedures and advanced scheduling. Conversely, surgeries for benign conditions such as IH are less complex, allowing for a streamlined preoperative process and reduced hospital stays. The entire preoperative process for IH repair can often be completed in a single day, once initial steps such as diagnosis, laboratory testing, and radiologic examinations are finalized. Recently, there has been a significant increase in the use of the internet to access health-related information. Specifically, during the COVID-19 pandemic, the internet and telehealth have become prevalent tools for surgical consultations [20-23]. Since 2012, TODPC for IH surgery has been performed successfully without significant obstacles at our institution. According to a 2013 Pew survey, 81% of American adults use the internet, with 72% reporting that they have sought health-related information online [24]. Similarly, there is considerable interest in health and disease information in Korea, with a growing reliance on the internet for such information [25,26].

There are several advantages associated with reducing

**Table 2.** Perioperative contacts of secondary repair patients when primary surgery was performed outside our hospital

Variable	Data (n = 194)
No. of preoperative contacts	2.6 $\pm$ 0.7
0	3 (1.5)
1	11 (5.7)
2	56 (28.9)
3	120 (61.8)
4	4 (2.1)
No. of postoperative outpatient follow-ups	1.0 $\pm$ 0.4
0	9 (4.7)
1	170 (87.6)
2	15 (7.7)

Values are presented as mean  $\pm$  standard deviation or number (%).

preoperative contact and adopting a TODPC model for IH repair. First, this approach potentially lowers the risk of infection transmission. Second, it can reduce preoperative costs. Third, it enhances convenience for patients and caregivers by allowing the surgery date to be flexible, accommodating the patient's schedule. However, potential disadvantages include a decrease in hospital revenue and the need for additional medical staff. In Korea, IH repair is billed under a diagnosis-related group billing system which excludes charges for preoperative laboratory tests, chest X-rays, or electrocardiograms under the TODPC. The TODPC costs were found to be US \$90 compared with daycare surgery.

Delayed treatment of IH increases the risks of organ resection due to incarceration and strangulation [4-6]. Consequently, timely intervention remains critical, even during the COVID-19 pandemic. In this study, 114 patients—77 pediatric and 37 adult—with incarcerated IH underwent the TODPC. There were no organ resections in the pediatric group; however, 6 occurred in the adult group. A previous study reported that omental resection was necessary in 30.0% (6 of 20) and bowel resection in 35.5% (39 of 110) of cases with incarcerated IH [27,28]. In contrast, our findings show a lower incidence, with 4.1% (4 of 97) in Group 1 and 5.1% (6 of 118) in Group 2 requiring organ resection. This reduced rate may be attributed to the ability of the TODPC to facilitate timely interventions, even if incarceration occurs at dawn, by using an online appointment system.

Surgeons generally perform outpatient follow-ups for 1 to 2 weeks after discharge to assess the patient's postoperative status [29]. The primary objectives of these follow-ups are to inspect wounds, remove sutures, and evaluate any postoperative pain. The development of minimally invasive surgery has substantially reduced the size of surgical incisions, and innovations in surgical dressings now permit skin closure without the need for sutures. In this study, all patients underwent laparoscopic IH repair and received skin closure with 2-octyl cyanoacrylate glue, eliminating the need for sutures and postsurgical dressings. Consequently, most patients reported minimal pain and resumed normal activities the day following surgery, negating the need for routine postoperative outpatient follow-ups. The TODPC allows for the immediate monitoring of a patient's condition and the identification of any complications through telephone consultations after surgery, rendering routine follow-ups unnecessary.

It is difficult to ascertain the number of perioperative contacts in other studies because of the scarcity of data in this field. In this study, we investigated the perioperative contacts at another hospital for IH patients who were readmitted to our facility for a reoperation as a result of a recurrence or metachronous contralateral IH following an initial surgery at an external hospital. We found that the average number of preoperative contacts was 2.6, while the postoperative

contacts averaged 1.0. Notably, not all initial surgeries were performed during the COVID-19 pandemic; however, it was observed that most patients visited the hospital 3 to 4 times for their IH repairs. An important finding from our study is the feasibility of performing IH repairs with significantly reduced perioperative contacts—75% and 91% of patients in Groups 1 and 2, respectively, required no perioperative visits.

This study has several limitations. The TODPC for IH repair can be implemented in hospitals specializing in benign surgery, but its application is limited in tertiary hospitals treating severe conditions such as cancer. There may be asymptomatic COVID-19 infections. In this study, information regarding the patient's underlying conditions was not collected. Furthermore, developed countries with well-established internet services are able to use online reservation systems, whereas developing countries may encounter challenges in doing so.

In conclusion, the TODPC for IH treatment was safe, potentially reducing organ resections and the risk of COVID-19 nosocomial mass infection during the pandemic. Our analysis comparing the safety of a TODPC IH repair before and after the onset of the COVID-19 pandemic revealed consistent preoperative and postoperative outcomes. The absence of COVID-19 mass infection among patients affirms that minimizing perioperative contact during the pandemic was a safe practice. Additionally, maintaining an online and telephone appointment system could be beneficial even after the conclusion of the COVID-19 pandemic.

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## Conflict of Interest

No potential conflict of interest relevant to this article was reported.

## ORCID iD

Sung Ryul Lee: <https://orcid.org/0000-0003-0201-0627>

## Author Contribution

All work was done by SRL.

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