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Nationwide Claims-Based Trends in Surgical Management of Rectal Prolapse and Rectocele in Korea, 2009–2024

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Article

Keywords:

Posted Date: November 12th, 2026

DOI: https://doi.org/10.21203/rs.3.rs-11003079/v1

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Additional Declarations: No competing interests reported.

Abstract

Rectal prolapse and rectocele are pelvic floor disorders requiring diverse surgical approaches, but long-term nationwide trends remain poorly characterized. We analyzed de-identified Korean Health Insurance Review and Assessment Service claims from 2009 to 2024 for patients with rectal prolapse (K62.3) or rectocele (N81.6) who underwent predefined procedures. Surgical episodes were classified into rectal prolapse-only, rectocele-only, and concurrent-diagnosis cohorts; procedures were grouped as perineal, abdominal, or rectocele repair. Among 47,614 episodes, 19,663 were rectal prolapse-only, 19,431 rectocele-only, and 8,520 concurrent diagnoses. Perineal procedures accounted for 84.9% of rectal prolapse operations, whereas rectocele repair accounted for 97.3% of rectocele procedures. In the rectal prolapse cohort, abdominal procedures increased from 6.1% in 2009–2014 to 20.0% in 2020–2024. Of 4,652 abdominal procedures, 95.5% had claims for laparoscopic instrument materials. Rectocele surgery increasingly shifted toward clinics, whereas abdominal rectal prolapse procedures were concentrated in higher-level hospitals. These nationwide claims data demonstrate divergent patterns in pelvic floor surgery and increasing claims-defined laparoscopic material use among abdominal procedures for rectal prolapse in Korea.

Introduction

Rectal prolapse and rectocele are common pelvic floor disorders that substantially impair quality of life through obstructed defecation, fecal incontinence, pelvic pressure, and the need for manual assistance during evacuation.[1–3] Because these conditions predominantly affect older adults and often respond poorly to conservative treatment, surgical correction remains an important option for durable symptom relief. [2,4,5]

As population aging accelerates, the burden of pelvic floor disorders is expected to increase further, particularly in rapidly aging societies such as South Korea, where adults aged 65 years or older accounted for 19.2% of the total population in 2024.[4, 5] This demographic shift has important implications for the demand for surgery for rectal prolapse and rectocele, which are strongly associated with advanced age and pelvic floor weakness.[1–3]

The surgical management of rectal prolapse has evolved considerably over time.[6, 7] Historically, perineal procedures were widely used, especially in frail or elderly patients, whereas abdominal repair has gained favor because of lower recurrence rates and the wider adoption of minimally invasive techniques.[8, 9] Since the 2000s, laparoscopic ventral rectopexy and related abdominal approaches have become increasingly prevalent, and contemporary guidelines recognize abdominal rectopexy, including minimally invasive techniques, as an important treatment option with acceptable outcomes.[4,8,10] In contrast, operative management of rectocele remains more heterogeneous. Treatment decisions are influenced by symptom severity, concomitant pelvic floor defects, surgeon specialty, and institutional practice patterns, and no single operative technique has emerged as universally preferred.[2,11] Furthermore, few studies have directly compared long-term nationwide trends in procedure type, laparoscopic adoption, and institutional setting for rectal prolapse and rectocele within a single healthcare system. Although several institutional or procedure-specific studies have reported outcomes of individual operations, there is limited population-level evidence comparing long-term changes in surgical volume, operative approach, and provider setting for rectal prolapse and rectocele in the same national healthcare system.[10,12]

Korea's universal National Health Insurance system provides a distinctive setting for examining surgical care across clinics, hospitals, and tertiary centers. Nevertheless, HIRA claims are generated for reimbursement and therefore capture coded healthcare utilization rather than detailed anatomical findings, symptom severity, surgeon specialty, or postoperative outcomes. Using the nationwide claims database of the Korean Health Insurance Review and Assessment Service (HIRA), this study aimed to characterize longitudinal trends in the surgical management of rectal prolapse and rectocele in Korea from 2009 to 2024. Specifically, we evaluated temporal changes in surgical volume, operative approach, laparoscopic adoption, hospital type, and regional distribution at a nationwide level. By analyzing both conditions within the same claims framework, this study further sought to delineate disease-specific patterns of surgical care and identify system-level factors that may drive divergent operative strategies.[13]

Results

Study population and temporal trends

During the 16-year study period from January 2009 to December 2024, a total of 47,614 unique surgical episodes for rectal prolapse or rectocele were identified in the HIRA database. Of these, 28,183 episodes involved a K62.3 (rectal prolapse) diagnosis and 27,951 involved an N81.6 (rectocele) diagnosis, with 8,520 episodes (17.9%) carrying both diagnoses concurrently. After constructing mutually exclusive cohorts, 19,663 cases (41.3%) were classified into the rectal prolapse cohort (rectal prolapse only), 19,431 cases (40.8%) into the rectocele cohort (rectocele only), and 8,520 cases (17.9%) into the concurrent diagnosis cohort (Table 1). Temporal trends and surgical characteristics of the concurrent diagnosis cohort are presented separately in the Supplementary Materials (Supplementary Figs. S1–S3, Supplementary Table S2).

The annual number of surgical episodes increased steadily over the study period, rising from 1,998 cases in 2009 to 4,428 cases in 2024, representing a 121.6% overall increase (Fig. 1A). However, this growth was driven mainly by the increase in the rectocele only cohort, with an additional contribution from the concurrent diagnosis cohort. The annual volume for rectocele surgery increased from 947 episodes in 2009 to 2,090 in 2024 (120.7% increase), whereas rectal prolapse surgery grew more modestly from 801 to 1,423 episodes (77.7% increase). Annual volume in the rectocele cohort exceeded that in the rectal prolapse cohort intermittently in the early period (2009, 2012, and 2013) and again from 2020 onward, with the exception of 2021; the gap was widest in 2024 (2,090 versus 1,423 episodes) (Fig. 1B).

Demographic characteristics

The overall study population was predominantly female (39,042 cases, 82.0%). Male patients were identified exclusively in the rectal prolapse cohort, where they accounted for 8,572 cases (43.6%); the remaining 11,091 cases (56.4%) in the rectal prolapse cohort were female. Both the rectocele cohort and the concurrent diagnosis group consisted entirely of female patients.

The mean age of the entire study population was 59.7 ± 15.2 years. In the rectal prolapse cohort, male patients were younger (56.2 ± 16.4 years) than female patients (67.4 ± 15.2 years), yielding a combined mean age of 62.5 ± 16.7 years. The rectocele cohort was comparatively younger (55.1 ± 13.1 years), with the largest proportion in the 50–60 age group (5,714 cases, 29.4%). Patients with concurrent diagnoses were oldest (63.6 ± 13.2 years), with a peak in the 60–70 age group (2,554 cases, 30.0%).

In the rectal prolapse cohort, the age distribution differed markedly by sex: male patients peaked in the 60–70 age group (1,975 cases, 23.0%), whereas female patients peaked a decade later in the 70–80 age group (3,665 cases, 33.0%) (Table 1, Fig. 2). The mean number of identified surgical episodes per patient was close to one across all cohorts (overall 1.02 ± 0.16), suggesting that repeated coded surgical episodes were infrequent in the available claims records.

Surgical episodes by operative approach

The distribution of surgical approaches differed substantially between the two cohorts. In the rectal prolapse cohort, perineal operations predominated, accounting for 16,689 cases (84.9%), followed by abdominal operations (2,847 cases, 14.5%) and rectocele correction (127 cases, 0.6%). In contrast, rectocele correction was the overwhelming procedure in the rectocele cohort (18,900 cases, 97.3%), with perineal (297 cases, 1.5%) and abdominal (234 cases, 1.2%) operations performed only rarely (Table 1).

Temporal analysis revealed a notable shift in operative approach within the rectal prolapse cohort. The proportion of perineal operations decreased from 93.0% in the early period (2009–2014) to 83.2% in the middle period (2015–2019) and 79.5% in the late period (2020–2024), while abdominal operations increased correspondingly from 6.1% to 16.3% and 20.0% across the three periods (Table 2, Fig. 3A). In the rectocele cohort, the operative approach remained remarkably stable over the entire study period, with rectocele correction consistently accounting for approximately 97% of all episodes (Fig. 3B).

Age-stratified analysis demonstrated that the choice of operative approach varied by age group in the rectal prolapse cohort (Fig. 4). The proportion of abdominal operations was lowest in the 30–40 age group (7.4%) and increased progressively with age, reaching 18.8% in the 70–80 group and 22.1% in patients older than 80 years. In the rectocele cohort, rectocele correction remained the predominant procedure across all age groups, ranging from 100% in the 10–20 group to 94.4% in patients older than 80 years, with a modest increase in perineal (2.2%) and abdominal (2.8%) operations observed in patients aged 60 years or older.

Laparoscopic surgery

Among abdominal procedures, laparoscopic surgery was the dominant approach across all cohorts. Overall, 4,443 of 4,652 abdominal procedures (95.5%) had claims for laparoscopic instrument materials, whereas 209 procedures (4.5%) had no such claims (Table 1).

In the rectal prolapse cohort, the rate of claims for laparoscopic instrument materials increased from 67.4% in 2009 to 96.2% in 2024, with the annual number of procedures with such claims rising from 31 to 279 (Fig. 5). In the rectocele cohort, abdominal procedures were rare (234 cases over 16 years, averaging 14.6 cases per year), precluding meaningful year-by-year trend analysis; nonetheless, claims for laparoscopic instrument materials were present in 90.2% of cases (211 of 234). The corresponding proportion was 98.7% in the concurrent diagnosis group, 94.2% in the rectal prolapse cohort, and 90.2% in the rectocele cohort.

Institutional setting

The distribution of surgical episodes across institution types differed between the two cohorts (Table 3). In the rectal prolapse cohort, hospitals accounted for the largest share (9,462 cases, 48.1%), followed by clinics (4,604 cases, 23.4%), general hospitals (3,053 cases, 15.5%), and tertiary hospitals (2,544 cases, 12.9%). In the rectocele cohort, hospitals similarly handled the largest proportion (8,751 cases, 45.0%), but clinics contributed a substantially larger share (7,433 cases, 38.3%) compared to the rectal prolapse cohort.

Temporal trends revealed divergent patterns in institutional utilization (Fig. 6). In the rectal prolapse cohort, the proportion of cases managed at hospitals increased from 41.3% in the early period (2009–2014) to 52.0% in the late period (2020–2024), while the clinic share declined from 28.5% to 22.7%. In contrast, the rectocele cohort showed a shift toward clinic-based care, with the clinic proportion rising from 32.1% to 45.9%, approaching the hospital share of 46.0% by the late period.

The operative approach also varied by institution type. When the distribution of operative approach was examined within each hospital type (calculated from the counts in Table 3), abdominal operations represented approximately one-third of rectal prolapse procedures in tertiary and general hospitals (31.9% and 31.5%, respectively), whereas at clinics nearly all rectal prolapse cases were managed with perineal operations (98.9%). For rectocele, rectocele correction was the predominant procedure across all institution types, with the highest proportion at clinics (99.1%) and the lowest at general hospitals (93.0%).

Regional distribution and medical costs

Total regional surgical volume was summarized in Table 4, while disease-specific regional distributions for the K62.3-only and N81.6-only cohorts are shown in Fig. 7. Surgical volume was unevenly distributed across 17 administrative regions of South Korea. The three highest-volume regions were Seoul (15,836 cases, 33.3%), Busan (11,725 cases, 24.6%), and Jeonbuk (5,514 cases, 11.6%), which together accounted for 69.5% of nationwide surgical activity. In contrast, several regions including Sejong (22 cases), Jeju (120 cases), and Gyeongbuk (231 cases) contributed fewer than 300 episodes over the entire study period.

The mean cost per surgical episode, expressed in millions of Korean won ($\times 10^6$ KRW), varied considerably by region. Across all cohorts combined, the highest mean costs per case were observed in Gangwon (3.03 $\times 10^6$ KRW), Sejong (3.01 $\times 10^6$KRW), and Daegu (2.53 $\times 10^6$ KRW), while the lowest mean costs were recorded in Jeonbuk (1.34 $\times 10^6$ KRW) and Busan (1.51 $\times 10^6$KRW); the Sejong estimate is based on only 22 episodes. The standard deviations of surgical costs were substantial across all regions and cohorts, frequently exceeding the mean, reflecting a highly right-skewed cost distribution.

Among the three cohorts, the concurrent diagnosis group generally incurred higher per-episode costs than either single-diagnosis cohort. In Seoul, the mean cost per episode was 1.84 $\times 10^6$ KRW for rectal prolapse, 1.49 $\times 10^6$ KRW for rectocele, and 2.23 $\times 10^6$ KRW for patients with both diagnoses. Aggregate reimbursed expenditure across all regions and cohorts was highest in Seoul (28,202 $\times 10^6$ KRW), followed by Busan (17,739 $\times 10^6$ KRW) and Gyeonggi (9,419 $\times 10^6$ KRW), mirroring the regional distribution of surgical volume.

Annual expenditure is summarized in Supplementary Table S3 and Supplementary Fig. S4. In nominal terms, the mean cost per surgical episode rose from 1.22 $\times 10^6$ KRW in 2009 to 2.26 $\times 10^6$ KRW in 2024, an 85.1% increase. After adjustment to constant 2024 Korean won, the increase was 36.1% (1.66 to 2.26 $\times 10^6$ KRW; US$1,220 to US$1,660), indicating that approximately half of the apparent nominal growth reflected general price inflation. Aggregate annual expenditure rose from 3,324 to 10,025 $\times 10^6$ KRW in constant 2024 terms (US$2.44 million to US$7.35 million), a 201.5% increase that outpaced the 121.6% growth in surgical volume over the same period. Inflation-adjusted cost per episode declined slightly through 2013 (1.66 to 1.56), increased steadily thereafter through 2019, and then plateaued, remaining between 2.24 and 2.32 $\times 10^6$ KRW from 2019 to 2024. The trajectory differed by cohort: in constant 2024 Korean won, the mean cost per episode rose by 45.1% in the rectal prolapse cohort and by 97.4% in the concurrent diagnosis cohort, whereas the rectocele cohort showed little change (1.61 to 1.73 $\times 10^6$ KRW, a 7.0% increase). Regional differences also widened over the study period (Supplementary Table S4, Supplementary Fig. S5): the ratio of the highest to the lowest regional mean cost per episode increased from 2.1 in 2009–2014 (Gangwon 2.64 versus Ulsan 1.25 $\times 10^6$ KRW) to 2.6 in 2020–2024 (Daegu 4.20 versus Jeonbuk 1.63 $\times 10^6$ KRW).

Discussion

This nationwide longitudinal analysis demonstrated substantial changes in the surgical management of rectal prolapse and rectocele in Korea between 2009 and 2024.[12] Overall surgical volume increased steadily, and this growth was driven mainly by rectocele surgery, which overtook rectal prolapse surgery from 2020 onward. In the context of rapid population aging in Korea, these findings suggest an increasing national burden of surgically treated pelvic floor disorders. Over the 16-year period, rectocele surgery increased by about 120%, whereas rectal prolapse surgery rose by approximately 78%, and abdominal procedures for rectal prolapse expanded from 6% to 20% of all rectal prolapse operations.[4, 5]

The most important finding was the clear shift in rectal prolapse surgery from perineal to abdominal approaches. Although perineal procedures remained predominant overall, the proportion of abdominal operations increased consistently over time, whereas the operative strategy for rectocele remained remarkably stable, with rectocele repair accounting for almost all procedures. This pattern is consistent with the broader evolution of rectal prolapse surgery toward abdominal rectopexy and minimally invasive techniques, which have gained increasing support in contemporary guidelines and outcome studies.[4, 8-10] In other words, procedural innovation and substitution have been far more pronounced in rectal prolapse surgery than in rectocele surgery in current Korean practice.[11]

Another notable finding was the rapid increase in claims for laparoscopic instrument materials among abdominal procedures in the rectal prolapse cohort. The rate of such claims increased from 67.4% in 2009 to 96.2% in 2024, and they were present in nearly all abdominal procedure claims after 2015. This pattern is consistent with increasing use of minimally invasive approaches for rectal prolapse repair in other settings.[6, 14, 15] However, because the surgical platform was inferred from material claims rather than operative reports, these findings should be interpreted as changes in claims-defined laparoscopic material use rather than confirmation of the operative approach. The increasing rate may reflect maturation of minimally invasive capacity once an abdominal approach was selected, rather than evidence that laparoscopy itself determined the choice of abdominal repair.

The age and sex distribution in the rectal prolapse cohort was also distinctive.[3,5] Male patients showed a peak in the 60–70-year age group, whereas female patients continued to increase with age and peaked in the 70–80-year group, with considerable surgical volume even beyond 80 years. In addition, the proportion of abdominal surgery was lowest in the 30–40-year age group and then increased progressively with advancing age. Although perineal surgery has traditionally been preferred in older or frail patients, these findings may reflect changing patient selection and wider acceptance of minimally invasive abdominal repair in older adults.[4, 9, 10]

This age pattern may reflect evolving patient selection and referral practices, including broader use of minimally invasive abdominal repair in selected older adults. However, frailty, functional status, and referral pathways were not available in the claims data and this interpretation remains speculative.

Institutional practice patterns differed between rectal prolapse and rectocele. In the rectal prolapse cohort, hospitals accounted for an increasing proportion of cases over time, whereas rectocele surgery shifted toward clinic-based care and approached the hospital share in the late period. Procedure choice also varied by hospital type: abdominal surgery was performed in approximately one-third of rectal prolapse cases in tertiary and general hospitals but was rarely performed in clinics, where nearly all rectal prolapse operations were perineal procedures. For rectocele, rectocele repair was the predominant procedure across all institution types, with

the highest proportion observed in clinics. These findings indicate that surgical decision-making is influenced not only by patient and disease characteristics but also by institutional resources, referral patterns, and access to minimally invasive techniques.[10, 14]

The concentration of abdominal rectal prolapse procedures in tertiary and general hospitals, contrasted with predominantly perineal procedures in clinics, is consistent with differences in institutional resources, referral patterns, and case mix. These findings may be relevant to regional referral pathways and training in pelvic floor surgery.

This study has several limitations. First, disease identification and procedure classification were based on administrative diagnosis and reimbursement codes rather than clinical verification. Coding practices may vary among institutions, and Korean reimbursement codes do not distinguish all technical variants of rectopexy. Accordingly, the perineal and abdominal categories should be interpreted as claims-based operative approach groups rather than fully specified procedures. Second, HIRA claims lack important clinical information, including prolapse severity, anatomical findings, symptom burden, frailty, patient preferences, surgeon specialty, recurrence, and functional outcomes. Therefore, this study could not evaluate the appropriateness or comparative effectiveness of individual procedures, and observed temporal changes cannot be linked directly to improved recurrence or patient-reported outcomes.

Third, laparoscopic use was identified using claims for laparoscopic instrument materials rather than operative reports. Robotic-assisted procedures and non-reimbursed device-related expenditures or materials could not be fully identified. Thus, the laparoscopic measure represents claims-defined material use, and the reported costs represent reimbursed episode-level expenditures rather than total healthcare or societal costs. Finally, the unit of analysis was the surgical episode rather than the complete longitudinal course of individual patients. Primary procedures, recurrent disease, and reoperations could not be fully distinguished. In addition, regional analyses were based on treating-institution location rather than patient residence, and CPI adjustment does not account for changes in the National Health Insurance fee schedule, benefit coverage, or institutional billing practices over time.

In conclusion, the surgical management of rectal prolapse and rectocele in Korea changed substantially between 2009 and 2024. Overall surgical volume increased steadily, with particularly marked growth in rectocele surgery. In rectal prolapse, the use of perineal procedures declined, whereas abdominal procedures increased and claims for laparoscopic instrument materials became predominant among abdominal procedure claims. By contrast, rectocele surgery remained procedurally stable, with rectocele repair consistently accounting for nearly all cases. These nationwide claims data highlight persistent differences in recorded operative patterns according to age, sex, hospital type, and region.

These insights may assist clinicians, policymakers, and educators in anticipating future service needs, optimizing resource allocation, and prioritizing training in minimally invasive pelvic floor surgery.

Methods

Ethics statement

This study was exempt from ethics approval by the Institutional Review Board of Eunpyeong St. Mary's Hospital, The Catholic University of Korea (IRB No. PC24ZIDE0157). The need for informed consent was waived by the Institutional Review Board of Eunpyeong St. Mary's Hospital, The Catholic University of Korea because this study involved secondary analysis of de-identified administrative claims data. All methods were performed in accordance with relevant guidelines and regulations.

Data source

We conducted a retrospective observational study using de-identified nationwide health insurance claims data provided by the Health Insurance Review and Assessment Service (HIRA). Korea operates a single-payer National Health Insurance system with near-universal coverage, and claims submitted by healthcare providers for reimbursement are collected and reviewed by HIRA.[16] The dataset contains longitudinal, claim-level information, including patient demographics (e.g., age and sex), dates of healthcare utilization, diagnoses coded according to the Korean Standard Classification of Diseases (KCD; based on ICD-10), procedure and surgery codes, prescription records, healthcare institution information, and reimbursed medical costs.

Study population and cohort construction

We identified all claims filed between January 1, 2009, and December 31, 2024, that contained both (1) a primary or secondary diagnosis of rectal prolapse (KCD code K62.3) or rectocele (KCD code N81.6) and (2) at least one of six predefined surgical procedure codes: Delorme's operation (Q2934), Altemeier's operation (Q2935), other perineal procedures (Q2936), sacral fixation (Q2937), intestinal resection (Q2938), or rectocele correction (Q3020). A surgical episode was defined as a single claim containing both an eligible diagnosis code and at least one eligible procedure code.[17] Under this claim-level definition, each eligible claim was counted as one surgical episode. Patients were counted at their first eligible claim during the study period, and any subsequent claim by the same patient that again met both the diagnosis and procedure criteria was counted as an additional episode[18]. When multiple eligible procedure codes were recorded within the same claim, they were collapsed into a single surgical episode and classified according to the predefined hierarchy (Supplementary Table S1). Because a single surgical episode could carry both K62.3 and N81.6 diagnoses concurrently, three mutually exclusive cohorts were constructed: (1) the rectal prolapse cohort (K62.3 only), (2) the rectocele cohort (N81.6 only), and (3) the concurrent diagnosis cohort (both K62.3 and N81.6). This mutually exclusive design was adopted to avoid double-counting surgical episodes across diagnosis groups and to describe diagnosis-specific surgical patterns separately. The concurrent diagnosis cohort was analyzed separately and is reported in the Supplementary Materials.

Surgical procedure classification

Perineal operations included Delorme's operation (Q2934), Altemeier's operation (Q2935), and other perineal procedures (Q2936). **Abdominal operations** comprised sacral fixation (Q2937) and intestinal resection (Q2938). In addition, patients who underwent **surgical correction for rectocele** were identified using the procedure code Q3020. When multiple procedure codes were recorded within a single claim (e.g., concurrent sacral fixation and rectocele correction), the surgical approach was classified according to a predefined claim-code hierarchy based on clinical representativeness. This hierarchy was applied to avoid double-counting, and the detailed classification rules are provided in Supplementary Table S1. Korean reimbursement codes do not distinguish all technical variants of rectopexy, such as ventral versus posterior fixation or mesh versus suture repair. Accordingly, the perineal and abdominal categories were interpreted as claims-based operative approach groups rather than fully specified procedures.

To further distinguish the surgical technique among abdominal procedures, laparoscopic surgery was operationally defined based on concurrent claims for laparoscopic instrument materials (N0031), following a previously published claims-based approach.[19] Cases with an abdominal procedure code and an N0031 material claim within the same admission were classified as laparoscopic; the remainder were classified as open procedures. Robotic-assisted procedures could not be separately identified; therefore, this measure should be interpreted as claims-defined laparoscopic material use rather than operative-report-confirmed surgical platform. Of note, procedure codes and diagnosis codes were not required to be concordant; thus, a rectocele correction code (Q3020) could be recorded in the absence of an N81.6 diagnosis, likely reflecting concomitant pelvic floor repair or coding variation. Hospital type (tertiary hospital, general hospital, hospital, or clinic) was taken directly from the institution type code recorded in the HIRA claims, which follows the statutory classification of healthcare institutions in the Korean National Health Insurance system. Regional classification was based on the location of the healthcare institution where the surgical episode was claimed, not the patient's residential address.

Statistical analysis

Descriptive statistics were used to summarize patient demographics, clinical characteristics, and surgical procedures for each cohort separately. Continuous variables are presented as means with standard deviations, and categorical variables are expressed as frequencies and percentages. Temporal trends were evaluated descriptively by calendar year. To summarize temporal change beyond year-to-year fluctuation, the 16-year study window was additionally divided into three periods of approximately equal length (2009–2014, 2015–2019, and 2020–2024), and the distribution of operative approach and hospital type within each cohort, as well as regional mean cost per episode, were compared across these periods. No formal hypothesis testing was performed because the study aimed to describe nationwide surgical practice patterns rather than test prespecified comparative hypotheses. All claims data processing and statistical analyses were performed within the HIRA remote analysis environment using RStudio Server (R version 4.5.3); figures were generated in Python (version 3.12).

Medical costs were defined as the total amount reimbursed for each surgical episode, comprising both the National Health Insurance–paid portion and the patient out-of-pocket payment. For temporal comparisons, annual costs were adjusted for inflation and expressed in constant 2024 Korean won using annual consumer price indices from Statistics Korea. Costs were converted to US dollars using the 2024 annual average exchange rate reported by the Bank of Korea Economic Statistics System.[20] These annual

estimates represent aggregate reimbursement for surgical episodes occurring in each calendar year rather than total longitudinal costs incurred over follow-up. Temporal expenditure patterns were examined descriptively; no change-point, segmented-regression, or interrupted time-series analysis was performed, and accordingly no calendar year was treated as a statistically estimated inflection point. Cumulative regional costs are reported in nominal Korean won, whereas all year-by-year comparisons are reported in constant 2024 Korean won.

Declarations

Competing Interests

The authors declare no competing interests.

Author Contribution

Jin Hyeong Park : Conceptualization, Methodology, Investigation, Data curation, Formal analysis, Visualization, Writing – original draftChang Hwan Kim, Dae Hee Pyo, Jong Kyung Park,Nina Yoo : Investigation, Resources, Validation, Writing – review & editingEun Ji Kim , SangMin Lim : Data curation, Formal analysis, VisualizationHyo Jung Kim , Hyung Jin Kim : Supervision, Methodology, Writing – review & editing, Project administration

Acknowledgements

The authors received no specific funding for this work.

Data Availability

The data that support the findings of this study are not publicly available because they comprise pseudonymized individual-level claims data and are subject to legal, ethical, and data-use restrictions imposed by the Health Insurance Review and Assessment Service (HIRA). Access to HIRA data may be requested through the HIRA Healthcare Big Data Hub (https://opendata.hira.or.kr), subject to HIRA approval and compliance with applicable data-use, legal, ethical, and institutional review requirements.

References

1. Steele, S. R. & Mellgren, A. Constipation and obstructed defecation. *Clin. Colon Rectal Surg.* **20**, 110–117 (2007).
2. Mustain, W. C. Functional disorders: rectocele. *Clin. Colon Rectal Surg.* **30**, 63–75 (2017).
3. Zeineddine, J., Bordeianou, L. & Krautkramer, K. A. Rectal prolapse. *Surg. Clin. North. Am.* **106**, 77–91 (2026).
4. Al Zangana, I., Al-Taie, R. H., Al-Badri, S. & Ismail, M. Rectal prolapse surgery: balancing effectiveness and safety in abdominal and perineal approaches. *Cureus* **16**, e69868 (2024).
5. Gerten, K. A., Markland, A. D., Lloyd, L. K. & Richter, H. E. Prolapse and incontinence surgery in older women. *J. Urol.* **179**, 2111–2118 (2008).
6. Madiba, T. E., Baig, M. K. & Wexner, S. D. Surgical management of rectal prolapse. *Arch. Surg.* **140**, 63–73 (2005).
7. Wu, L. et al. Surgical approaches for complete rectal prolapse. *World J. Gastrointest. Surg.* **17**, 102043 (2025).
8. Bordeianou, L. et al. Clinical practice guidelines for the treatment of rectal prolapse. *Dis. Colon Rectum*. **60**, 1121–1131 (2017).
9. Fuschillo, G., Selvaggi, L., Cuellar-Gomez, H. & Pescatori, M. Comparison between perineal and abdominal approaches for the surgical treatment of recurrent external rectal prolapse: a systematic review and meta-analysis. *Int. J. Colorectal Dis.* **40**, 26 (2025).
10. Ng, Y. Y., Tan, E. & Fu, C. W. P. Trends in the surgical management of rectal prolapse: An Asian experience. *Asian J. Endosc Surg.* **15**, 110–120 (2022).

11. Bharucha, A. E. & Knowles, C. H. Rectocele: incidental or important? Observe or operate? Contemporary diagnosis and management in the multidisciplinary era. *Neurogastroenterol Motil.* **34**, e14453 (2022).
12. Feng, L., Wang, M., Li, X. & Yang, Q. A bibliometric analysis of surgical treatment for rectal prolapse. *Med. (Baltim).* **104**, e43763 (2025).
13. Imanova, S. S. Comparative study of surgical treatment with abdominal and perineal approaches in patients with rectal prolapse. *J. Biochem. Technol.* **13**, 35–39 (2022).
14. Williams, B. N. et al. Trends for the surgical management of rectal prolapse in the elderly: a contemporary analysis of the National Quality Improvement Program. *Dis. Colon Rectum*. **68**, 447–456 (2025).
15. Tsunoda, A., Takahashi, T., Matsuda, S., Oka, N. & Kusanagi, H. Midterm functional outcome after laparoscopic ventral rectopexy for external rectal prolapse. *Asian J. Endosc Surg.* **13**, 25–32 (2020).
16. Kim, J. A., Yoon, S., Kim, L. Y. & Kim, D. S. Towards actualizing the value potential of Korea Health Insurance Review and Assessment (HIRA) data as a resource for health research: strengths, limitations, applications, and strategies for optimal use of HIRA data. *J. Korean Med. Sci.* **32**, 718–728 (2017).
17. Kim, L., Kim, J. A. & Kim, S. A guide for the utilization of Health Insurance Review and Assessment Service National Patient Samples. *Epidemiol. Health*. **36**, e2014008 (2014).
18. Park, E. J. et al. Laparoscopic and robotic surgery for colorectal cancer in Korea: a nationwide health insurance database analysis from 2019 to 2023. *J. Minim. Invasive Surg.* **28**, 25–35 (2025).
19. Jeon, J. et al. Trends in medical traveling for radical prostatectomy in the era of robotic surgery: a nationwide cohort study in Korea. *World J. Mens Health*. **44**, 171–181 (2026).
20. Bank of Korea. Economic Statistics System (ECOS). (2024). https://ecos.bok.or.kr

Tables

Table 1. Baseline Demographic and Clinical Characteristics by Disease Type, 2009-2024

	Rectal prolapse (K62.3) N_{pt} = 17,822			Rectocele (N81.6) N_{pt} = 18,953	Both (K62.3 & N81.6) N_{pt} = 7,553	Total N_{pt} = 44,328
Surgical episodes, n (%)	male	female	Subtotal	Female	Female	
	8,572 (43.6)	11,091 (56.4)	19,663 (100)	19,431 (100)	8,520 (100)	47,614 (100)
Annual number of surgeries, n (mean ± SD)						
	535.8 (1.03 **±** 0.19)	693.2 (1.04 ± 0.22)	1,229 (1.03 ± 0.2)	1,214.4 (1.01 ± 0.09)	532.5 (1.03 ± 0.18)	2,976 (1.02 ± 0.16)
Age, mean ± SD	56.2 ± 16.4	67.4 ± 15.2	62.5 ± 16.7	55.1 ± 13.1	63.6 ± 13.2	59.7 ± 15.2
Age group, n (%)						
<20	125 (1.5)	28 (0.3)	153 (0.8)	62 (0.3)	16 (0.2)	231 (0.5)
20-30	609 (7.1)	297 (2.7)	906 (4.6)	847 (4.4)	137 (1.6)	1,890 (4.0)
30-40	912 (10.6)	526 (4.7)	1438 (7.3)	1,616 (8.3)	390 (4.6)	3,444 (7.2)
40-50	1,352 (15.8)	783 (7.1)	2,135 (10.9)	4,340 (22.3)	819 (9.6)	7,294 (15.3)
50–60	1,756 (20.5)	1,335 (12.0)	3,091 (15.7)	5,714 (29.4)	1,722 (20.2)	10,527 (22.1)
60–70	1,975 (23.0)	2,349 (21.2)	4,324 (22.0)	4,454 (22.9)	2,554 (30.0)	11,332 (23.8)
70-80	**1,455** (17.0)	3,665 (33.0)	5,120 (26.0)	2,111 (10.9)	2,238 (26.3)	9,469 (19.9)
≥80	388 (4.5)	2,108 (19.0)	2,496 (12.7)	287 (1.5)	644 (7.6)	3,427 (7.2)
Type of surgical procedure, n (%)						
Perineal operation	7,600 (88.7)	9,089 (81.9)	16,689 (84.87)	297 (1.5)	4,106 (48.2)	21,092 (44.3)
Abdominal operation	937 (10.9)	1,910 (17.2)	2,847 (14.48)	234 (1.2)	1,571 (18.4)	4,652 (9.8)
Rectocele correction	35 (0.4)	92 (0.8)	127 (0.65)	18,900 (97.3)	2,843 (33.4)	21,870 (45.9)
Surgical approach among abdominal procedures, n (%)						
Open	56 (6.0)	110 (5.8)	166 (5.8)	23 (9.8)	20 (1.3)	209 (4.5)
Laparoscopic	881 (94.0)	1,800 (94.2)	2,681 (94.2)	211 (90.2)	1,551 (98.7)	4,443 (95.5)

Both = surgical episodes with concurrent K62.3 and N81.6 diagnosis codes within a single claim; Npt = Number of distinct patients; All other rows use the surgical episode as the unit of analysis

Table 2. Annual Trends in Surgical Procedures by Operative Approach for Rectal Prolapse (K62.3) and Rectocele (N81.6), 2009–2024

Year	Total	Perineal	Abdominal	Rectocele Correction	Total	Perineal	Abdominal	Rectocele Correction
2009	801	748 (93.4)	46 (5.7)	7 (0.9)	947	57 (6.0)	2 (0.2)	888 (93.8)
2010	1,040	995 (95.7)	38 (3.7)	7 (0.7)	959	14 (1.5)	2 (0.2)	943 (98.3)
2011	1,182	1,112 (94.1)	56 (4.7)	14 (1.2)	793	19 (2.4)	0 (0.0)	774 (97.6)
2012	873	807 (92.4)	57 (6.5)	9 (1.0)	903	30 (3.3)	0 (0.0)	873 (96.7)
2013	1,019	940 (92.2)	70 (6.9)	9 (0.9)	1,134	18 (1.6)	2 (0.2)	1,114 (98.2)
2014	1,191	1,075 (90.3)	103 (8.6)	13 (1.1)	1,142	13 (1.1)	6 (0.5)	1,123 (98.3)
2015	1,043	901 (86.4)	132 (12.7)	10 (1.0)	1,012	24 (2.4)	6 (0.6)	982 (97.0)
2016	1,126	956 (84.9)	164 (14.6)	6 (0.5)	1,034	9 (0.9)	9 (0.9)	1,016 (98.3)
2017	1,462	1,217 (83.2)	240 (16.4)	5 (0.3)	1,124	7 (0.6)	15 (1.3)	1,102 (98.0)
2018	1,303	1,077 (82.7)	222 (17.0)	4 (0.3)	1,059	30 (2.8)	16 (1.5)	1,013 (95.7)
2019	1,396	1,114 (79.8)	271 (19.4)	11 (0.8)	1,152	9 (0.8)	25 (2.2)	1,118 (97.0)
2020	1,388	1,129 (81.3)	254 (18.3)	5 (0.4)	1,498	14 (0.9)	26 (1.7)	1,458 (97.3)
2021	1,460	1,177 (80.6)	275 (18.8)	8 (0.5)	1,424	14 (1.0)	33 (2.3)	1,377 (96.7)
2022	1,427	1,126 (78.9)	297 (20.8)	4 (0.3)	1,485	11 (0.7)	30 (2.0)	1,444 (97.2)
2023	1,529	1,189 (77.8)	332 (21.7)	8 (0.5)	1,675	18 (1.1)	26 (1.6)	1,631 (97.4)
2024	1,423	1,126 (79.1)	290 (20.4)	7 (0.5)	2,090	10 (0.5)	36 (1.7)	2,044 (97.8)
Total	**19,663**	**16,689 (84.9)**	**2,847 (14.5)**	**127 (0.6)**	**19,431**	**297 (1.5)**	**234 (1.2)**	**18,900 (97.3)**

Values are presented as n (%).

Table 3. Distribution of Surgical Procedures by Hospital Type for Rectal Prolapse (K62.3) and Rectocele (N81.6), 2009–2024

	Rectal Prolapse (K62.3)				Rectocele (N81.6)			
Hospital Type	**Total**	**Perineal**	**Abdominal**	**Rectocele Correction**	**Total**	**Perineal**	**Abdominal**	**Rectocele Correction**
Tertiary hospital	2,544 (12.9)	1,715 (10.3)	811 (28.5)	18 (14.2)	1,384 (7.1)	35 (11.8)	54 (23.1)	1,295 (6.9)
General hospital	3,053 (15.5)	2,063 (12.4)	961 (33.8)	29 (22.8)	1,863 (9.6)	22 (7.4)	109 (46.6)	1,732 (9.2)
Hospital	9,462 (48.1)	8,358 (50.1)	1,052 (37.0)	52 (40.9)	8,751 (45.0)	204 (68.7)	38 (16.2)	8,509 (45.0)
Clinic	4,604 (23.4)	4,553 (27.3)	23 (0.8)	28 (22.0)	7,433 (38.3)	36 (12.1)	33 (14.1)	7,364 (39.0)
Total	**19,663 (100)**	**16,689 (100)**	**2,847 (100)**	**127 (100)**	**19,431 (100)**	**297 (100)**	**234 (100)**	**18,900 (100)**

Values are presented as n (%). Both cohort (concurrent K62.3 and N81.6 diagnoses) subtracted from each group.

Table 4. Regional Distribution of Surgical Volume and Medical Costs by Disease Type

Region	Rectal Prolapse (K62.3)			Rectocele (N81.6)			Both (K62.3 & N81.6)			Total		
	Cost[a]	**Mean (SD)**[b]	***n***	**Cost**[a]	**Mean (SD)**[b]	***n***	**Cost**[a]	**Mean (SD)**[b]	***n***	**Cost**[a]	**Mean (SD)**[b]	***n***
Seoul	11,681	1.84 (8.57)	6,340	9,340	1.49 (20.72)	6,279	7,181	2.23 (16.94)	3,217	28,202	1.78 (16.06)	15,836
Busan	7,637	1.56 (12.74)	4,890	6,548	1.29 (15.51)	5,060	3,554	2.00 (12.71)	1,775	17,739	1.51 (14.00)	11,725
Incheon	844	2.55 (3.00)	331	489	2.07 (3.20)	237	163	2.67 (2.12)	61	1,496	2.38 (3.01)	629
Daegu	2,127	2.47 (9.80)	861	1,236	1.54 (15.03)	803	2,375	3.95 (31.43)	601	5,738	2.53 (17.55)	2,265
Gwangju	1,505	2.21 (4.42)	682	228	1.60 (2.03)	143	372	2.75 (5.63)	135	2,105	2.19 (4.36)	960
Daejeon	1,220	2.91 (4.60)	420	1,301	2.14 (6.47)	608	159	2.85 (2.08)	56	2,680	2.47 (5.66)	1,084
Ulsan	562	2.25 (3.82)	250	268	0.93 (4.23)	289	76	1.73 (1.36)	44	906	1.55 (3.96)	583
Sejong	40	3.30 (3.09)	12	13	2.51 (1.53)	5	14	2.83 (1.00)	5	66	3.01 (2.40)	22
Gyeonggi	4,792	2.15 (5.42)	2,231	3,885	1.61 (11.99)	2,419	742	2.15 (2.12)	345	9,419	1.89 (9.11)	4,995
Gangwon	652	3.20 (4.35)	204	35	1.66 (1.24)	21	37	2.67 (1.43)	14	724	3.03 (4.07)	239
Chungbuk	429	2.59 (2.26)	166	139	1.65 (2.62)	84	61	2.33 (1.88)	26	629	2.28 (2.37)	276
Chungnam	407	2.27 (3.13)	179	482	2.03 (5.75)	237	78	1.85 (1.25)	42	966	2.11 (4.59)	458
Jeonbuk	2,768	1.37 (10.64)	2,017	2,167	1.44 (21.68)	1,500	2,442	1.22 (12.34)	1,997	7,377	1.34 (14.98)	5,514
Jeonnam	279	1.49 (1.55)	188	798	1.53 (3.66)	521	75	1.53 (1.70)	49	1,153	1.52 (3.16)	758
Gyeongbuk	380	2.43 (2.51)	156	104	2.12 (4.00)	49	71	2.72 (2.31)	26	554	2.40 (2.86)	231
Gyeongnam	1,571	2.83 (3.73)	556	2,188	1.96 (21.65)	1,118	226	2.26 (1.90)	100	3,985	2.25 (17.32)	1,774
Jeju	202	2.11 (2.55)	96	34	2.13 (1.60)	16	19	2.41 (1.33)	8	256	2.13 (2.37)	120
Others	17	0.20 (0.73)	84	17	0.40 (1.14)	42	4	0.21 (0.21)	19	38	0.26 (0.83)	145

[a] Total medical cost, ×10⁶ Korean won (KRW). [b] Mean cost per surgical case (SD), ×10⁶ KRW. Total column: pooled mean and SD across three cohorts. Mean and SD are presented to two decimal places. Costs are presented in nominal Korean won and are cumulative over 2009–2024; inflation-adjusted annual figures are given in Supplementary Table S3. Regions are listed as metropolitan cities followed by provinces. Others = cases where the provider location was not mapped to the standard 17 administrative divisions.

Both = surgical episodes with concurrent K62.3 and N81.6 diagnosis codes within a single claim.

Figures

Fig 1. Annual Trends in Surgical Volume for Rectal Prolapse and Rectocele, 2009–2024

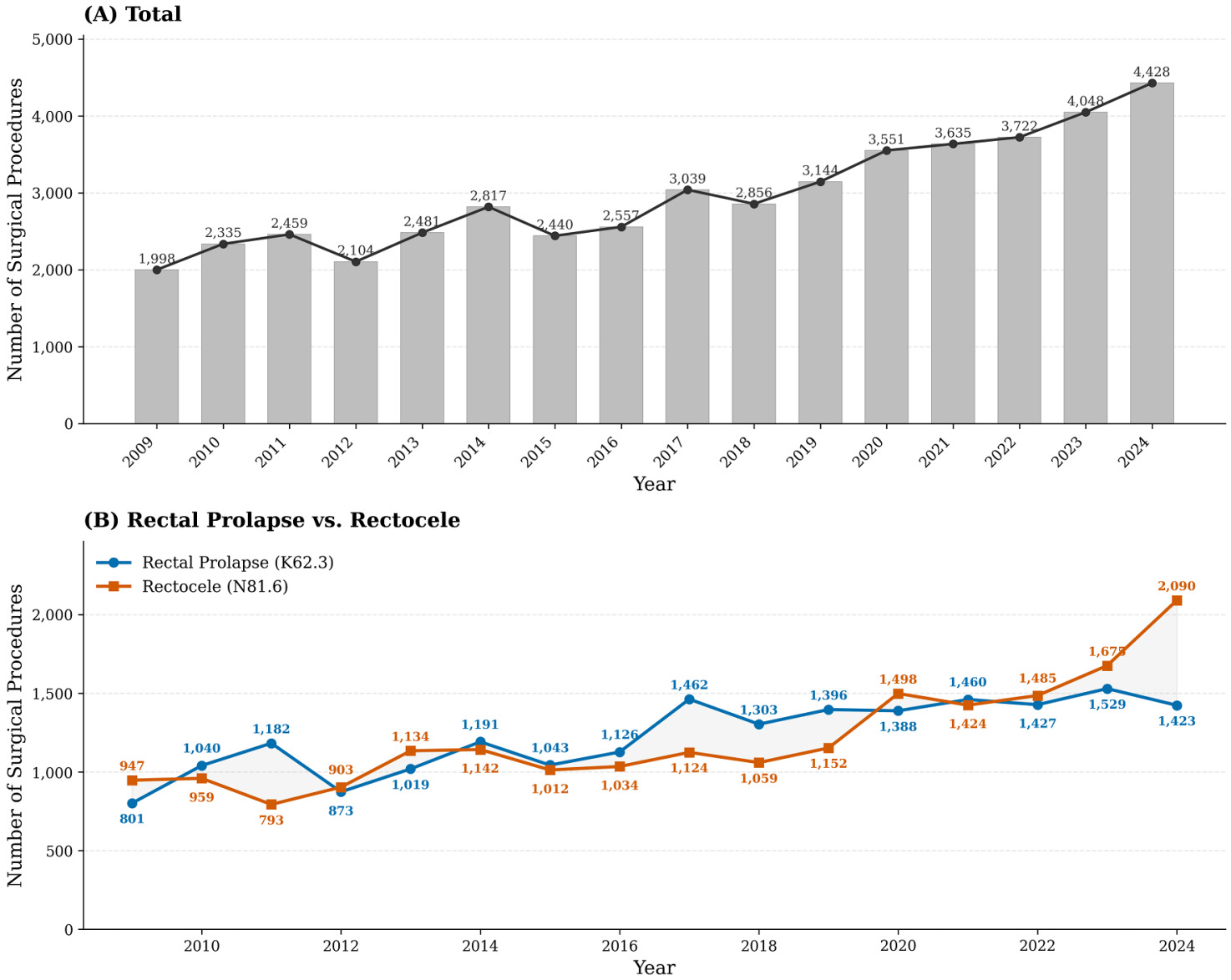


Figure 1

Annual surgical volume for rectal prolapse and rectocele, 2009–2024. (A) Total annual number of surgical episodes, including K62.3-only, N81.6-only, and concurrent diagnosis episodes. (B) Annual surgical volume in the mutually exclusive K62.3-only and N81.6-only cohorts.

Fig 2. Sex and Age Distribution in the Rectal Prolapse Cohort (K62.3)

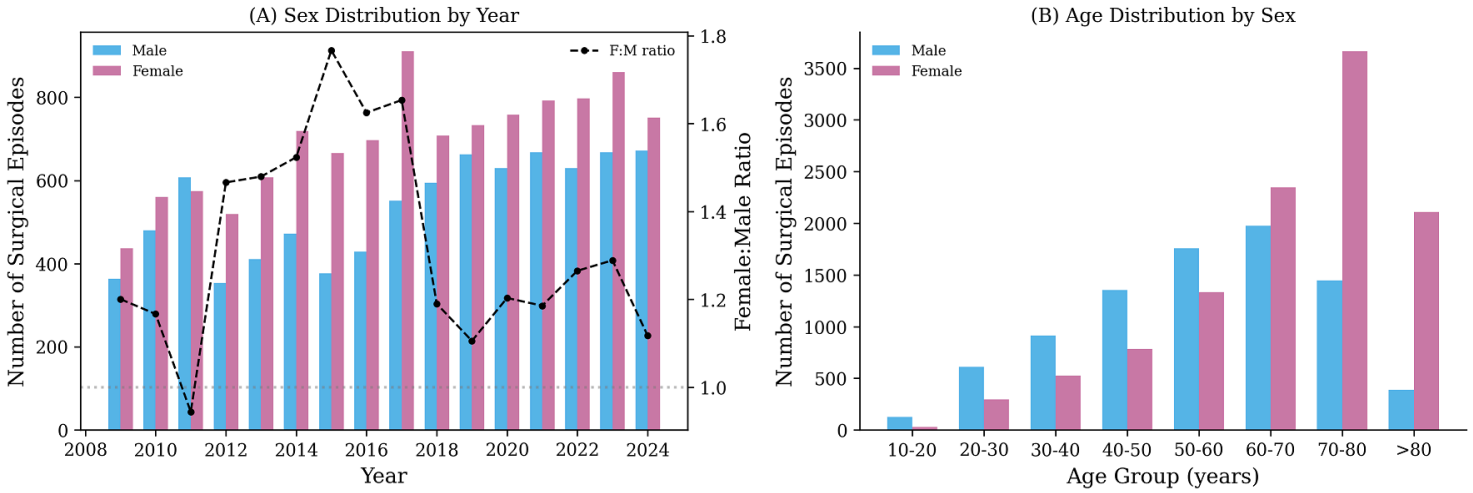


Figure 2

Sex and age distribution of surgical episodes in the rectal prolapse cohort (K62.3). (A) Annual distribution by sex, with the female-to-male ratio shown on the secondary y-axis. (B) Age distribution by sex across the entire study period.

Fig 3. Trends in Surgical Approaches, 2009–2024

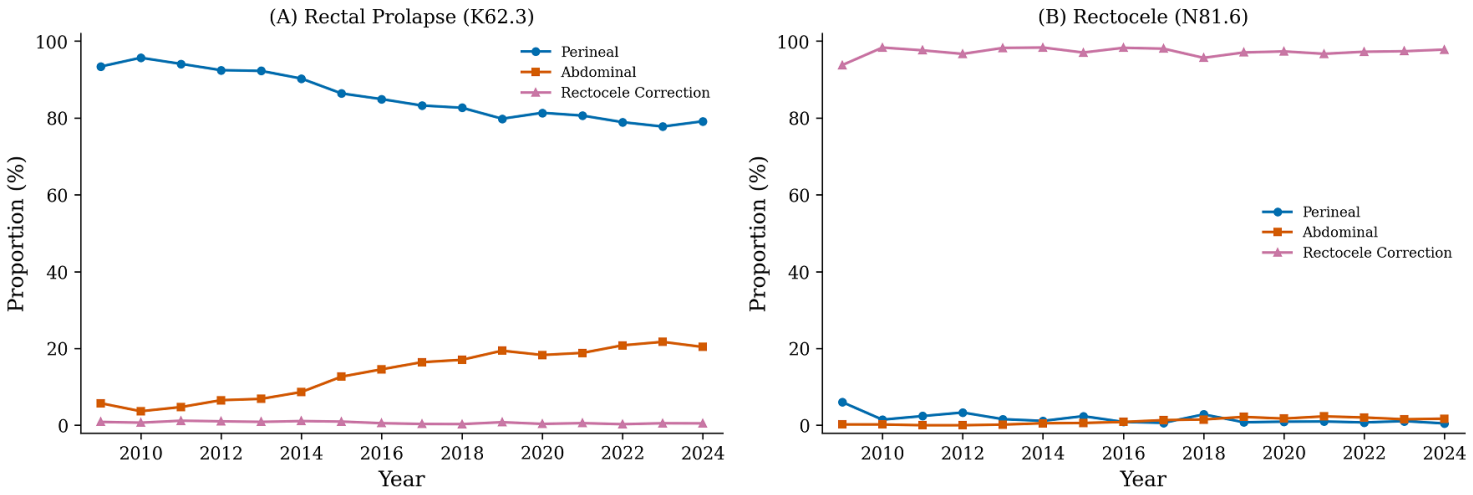


Figure 3

Temporal trends in operative approach, 2009–2024. (A) Rectal prolapse cohort (K62.3-only). (B) Rectocele cohort (N81.6-only). Values represent the annual proportion of surgical episodes classified as perineal operation, abdominal operation, or rectocele correction according to the predefined claim-code hierarchy.

Fig 4. Age Distribution by Operative Approach

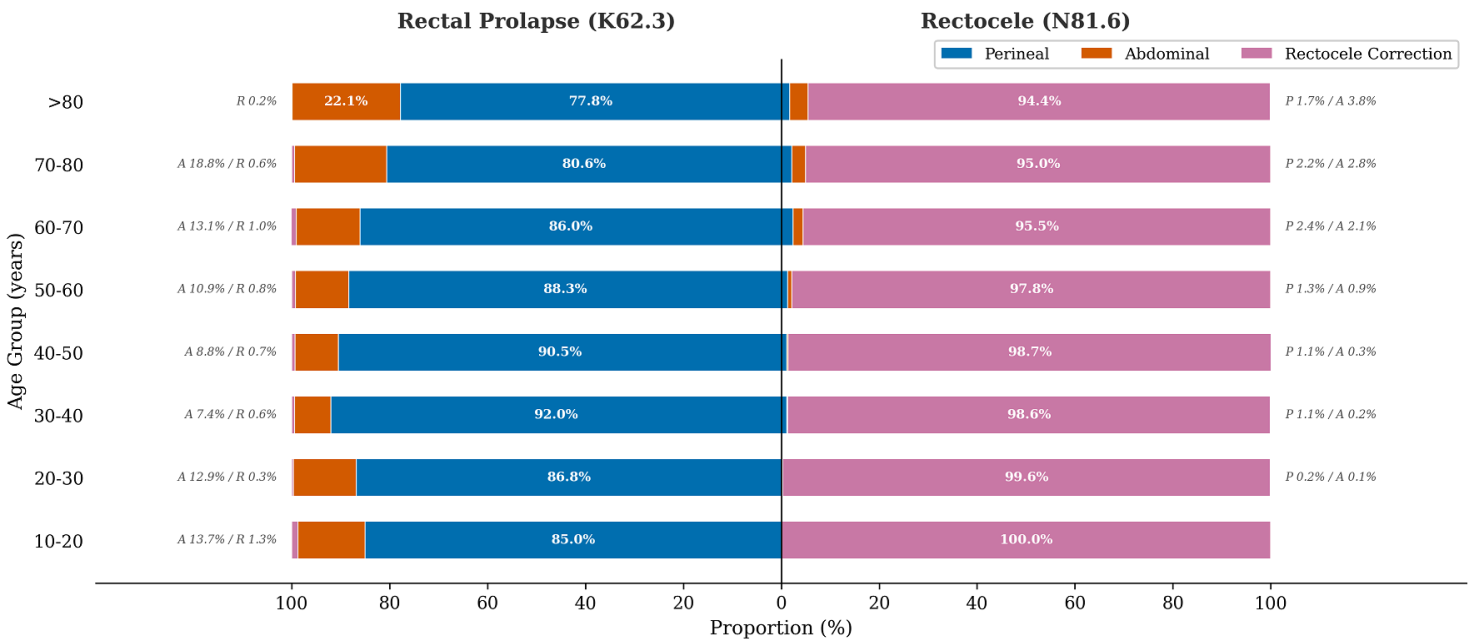


Figure 4

Age distribution by operative approach in rectal prolapse and rectocele. Age-stratified distribution of operative approach in the rectal prolapse cohort (K62.3-only, left) and rectocele cohort (N81.6-only, right). Stacked horizontal bars represent the proportion of each surgical approach within each age group. Percentages annotated outside the bars indicate minor approach proportions. A = abdominal; P = perineal; R = rectocele correction.

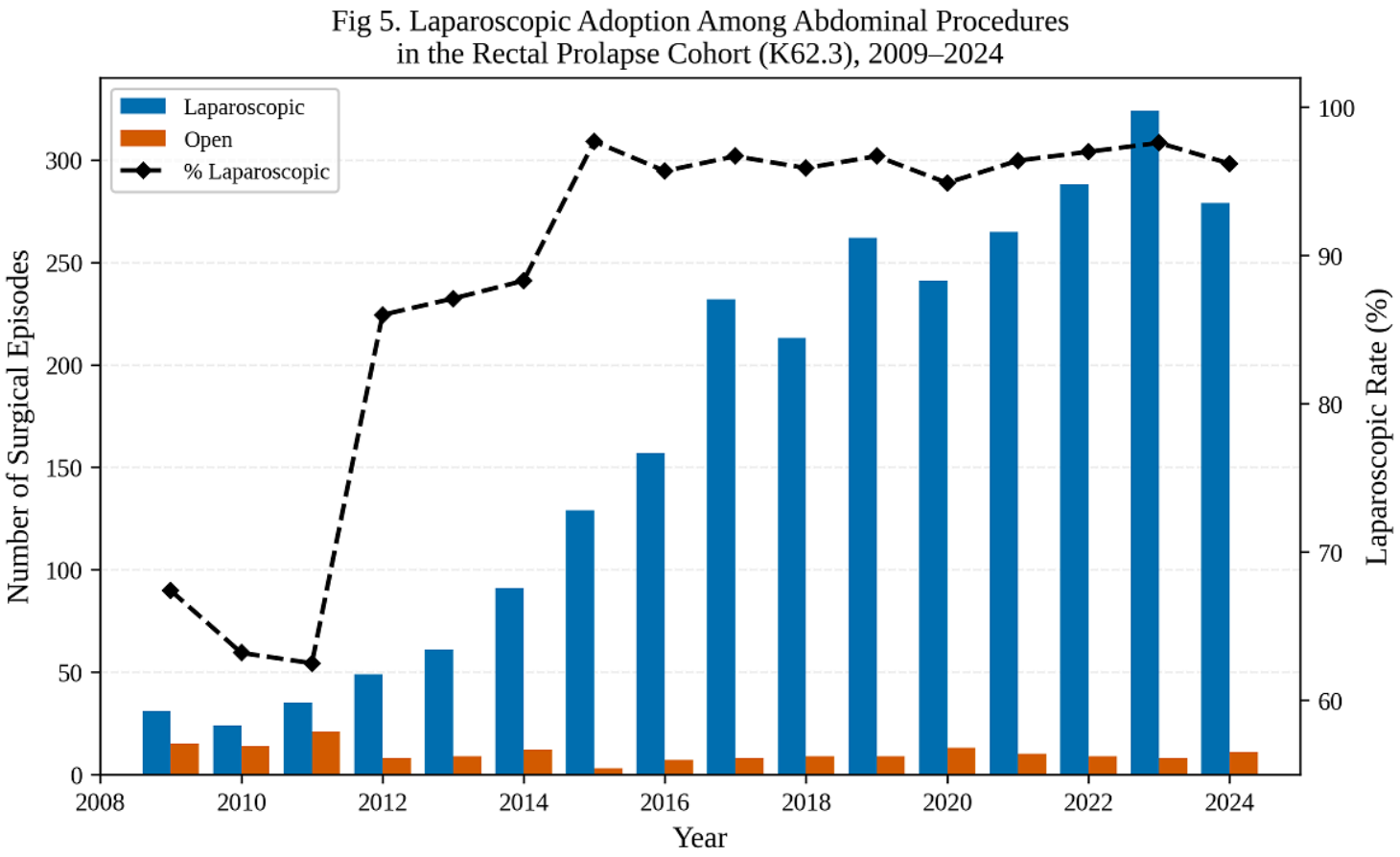


Figure 5

Claims for laparoscopic instrument materials among abdominal procedures in the rectal prolapse cohort (K62.3), 2009–2024. Bars show annual numbers of abdominal procedures with and without claims for laparoscopic instrument materials. The dashed line indicates the annual proportion of procedures with such claims.

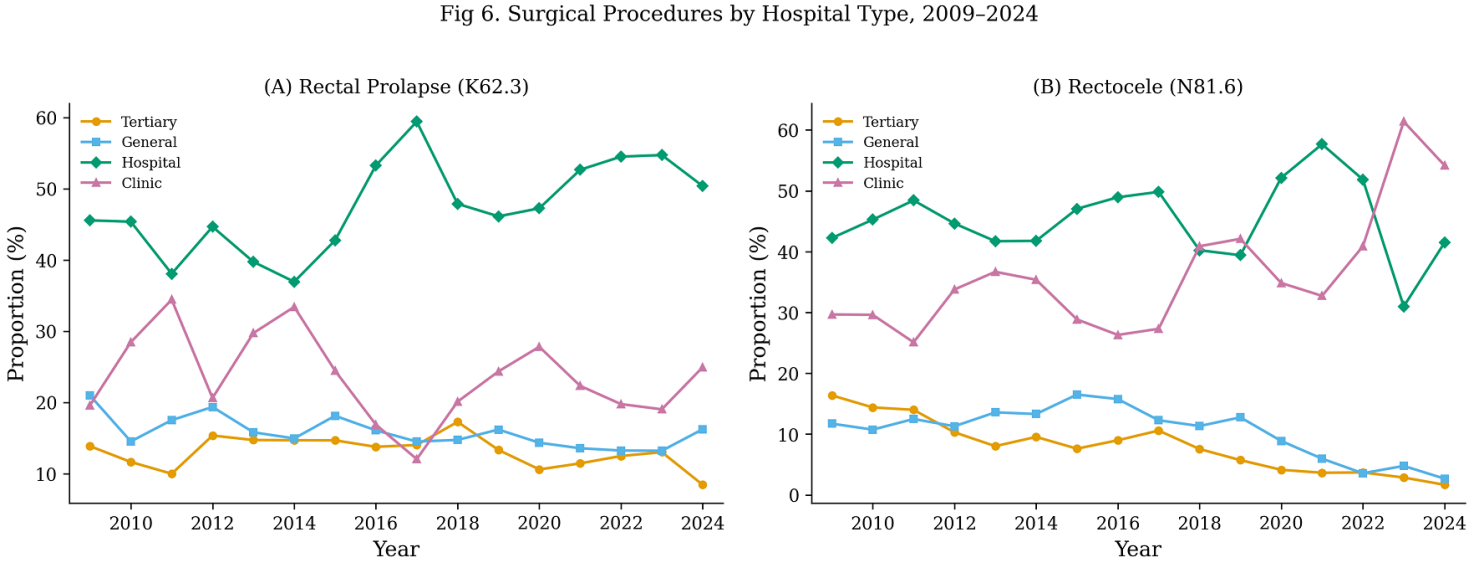


Figure 6

Temporal trends in surgical episodes by hospital type, 2009–2024. (A) Rectal prolapse cohort (K62.3-only). (B) Rectocele cohort (N81.6-only). Values represent the annual proportion of surgical episodes by hospital type.

Figure 7. Regional Distribution of Surgical Episodes by Cohort

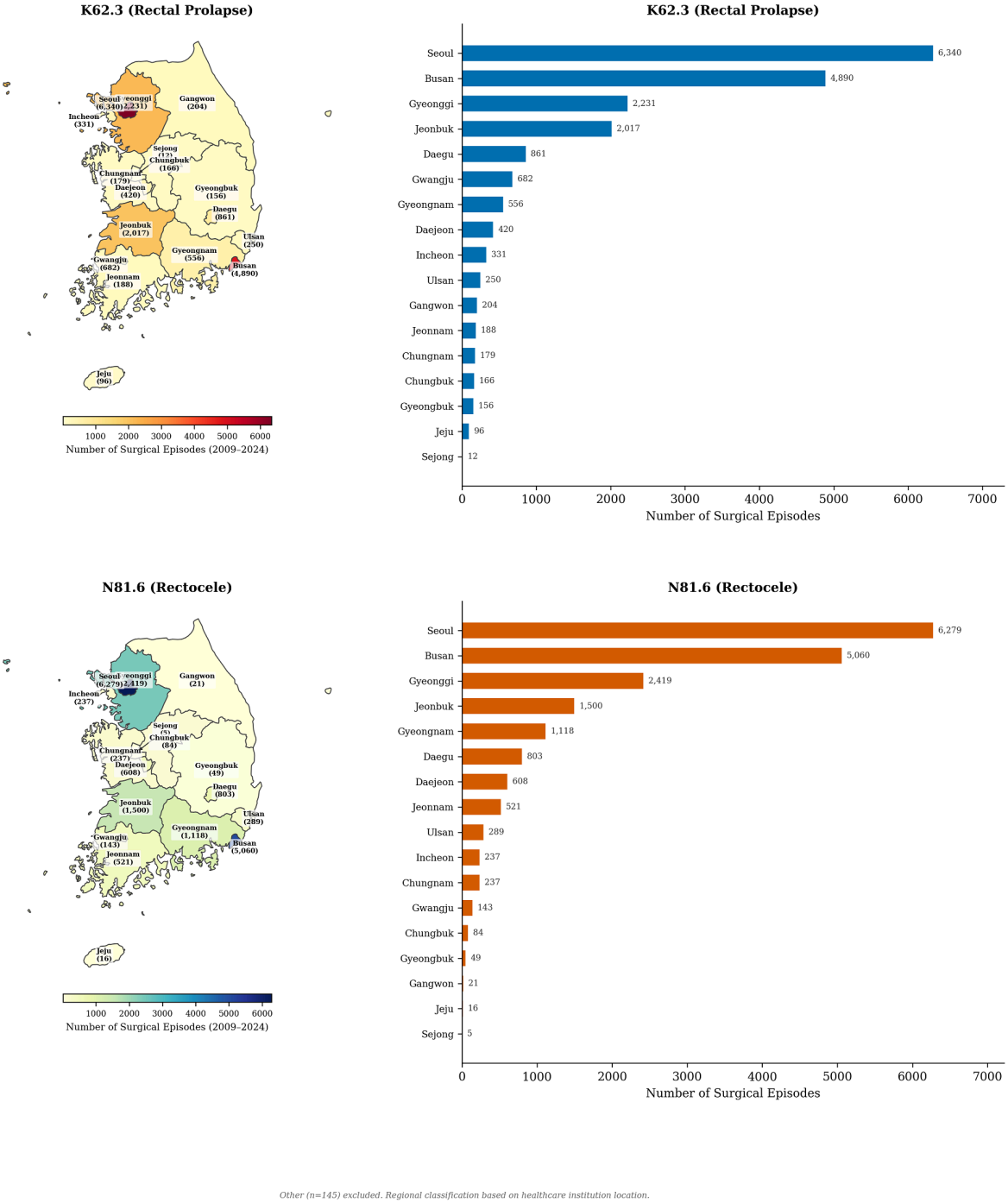


Figure 7

Regional distribution of surgical episodes in the K62.3-only and N81.6-only cohorts. Choropleth maps and horizontal bar charts show cumulative regional surgical volume from 2009 to 2024 for the K62.3-only and N81.6-only cohorts. Regional classification was based on the location of the healthcare institution submitting the claim, not the patient's residential address. Surgical episodes classified as Others because the provider location could not be mapped to the standard 17 administrative regions were excluded from the maps and bar charts. The concurrent diagnosis cohort is summarized separately in the Supplementary Materials.

Supplementary Files

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- SUPPLEMENTARYMATERIALS.docx