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Wrist Arthroscopy in South Korea: Utilization, Disparities, and Complications from an 11-Year Nationwide Cohort

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Background: Wrist arthroscopy has evolved significantly as a minimally invasive technique for both diagnostic and therapeutic purposes. However, epidemiologic data on its nationwide use remain scarce, particularly for small joints like the wrist. Given its increasing adoption and technical complexity, understanding population-level trends in wrist arthroscopy is essential to inform clinical practice, policy planning, and surgical education.

Methods: We conducted a retrospective nationwide analysis of wrist arthroscopic procedures performed in South Korea between 2013 and 2023, using National Health Insurance claims data. Procedures were categorized into diagnostic arthroscopy (P1), partial joint debridement or synovectomy (P2), and ligament or tendon reconstruction (P3) based on administrative billing codes. Trends were analyzed by year, age group, sex, income ventile, and region, with incidence rates calculated per 100,000 persons. In addition, postoperative complications such as nerve injury, extensor tendon injury, infection, and complex regional pain syndrome were identified using diagnosis codes within specified postoperative periods.

Results: A total of 48,962 wrist arthroscopic procedures were identified between 2013 and 2023. The incidence increased from 6.43 to 10.98 per 100,000 persons, with a temporary decline during the coronavirus disease 2019 (COVID-19) pandemic. P2 remained most common, but the share of P3 rose markedly. The 50–59-year age group consistently accounted for the highest total number of procedures across the study period. The 30–39-year group showed the most prominent relative increase in P2 and P3 cases. The 20–29-year group recorded the highest rate of P3 procedures in 2023. Women consistently underwent more procedures, though men showed greater growth in P3. Regional variation was observed; however, contrary to expectation, Seoul and the metropolitan areas were not among the highest-incidence regions. No income-based disparity was identified, and complications were uncommon overall.

Conclusions: This nationwide 11-year analysis demonstrates that wrist arthroscopy in South Korea has steadily increased, with a growing trend toward complex reconstructive procedures. Despite regional variation, no income-based disparity was observed, and overall complication rates remained low, although postoperative infection was observed somewhat more frequently than reported after larger-joint arthroscopy, supporting both the accessibility and safety of wrist arthroscopy in routine clinical practice.

Keywords: *Wrist arthroscopy, Nationwide study, Demographics, Triangular fibrocartilage complex, Postoperative complications*

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Wrist arthroscopy was introduced later than arthroscopy for larger joints such as the shoulder or knee, but it has rapidly gained clinical significance with the development of small-diameter arthroscopes and refined surgical techniques.[1,2] It is now widely used for both diagnostic and therapeutic purposes in managing various wrist conditions, including triangular fibrocartilage complex (TFCC) injuries, carpal ligament tears, intra-articular fractures, cartilage damage, and synovitis.[3-7] As a minimally invasive alternative to open procedures, wrist arthroscopy aligns with the global trend toward reducing surgical morbidity. Continuous advancements in arthroscopic equipment and techniques have contributed to its increasing adoption in clinical practice.[1,2]

Unlike large-joint arthroscopy, wrist arthroscopy presents unique diagnostic and technical challenges due to the intricate anatomy of the wrist and limited joint space. These challenges underscore the importance of understanding how the procedure is used in real-world settings. Although nationwide, population-based studies have been conducted in South Korea for shoulder,[8] knee,[9] and hip arthroscopy,[10] no such study has yet focused on wrist arthroscopy. Globally, nationwide analyses of wrist arthroscopy remain scarce, with only a few reports published to date.[11-13]

South Korea's National Health Insurance Service (NHIS), which insures nearly the entire population including beneficiaries of the Medical Aid program, provides a centralized healthcare claims database that offers a unique opportunity to examine nationwide utilization patterns of wrist arthroscopy.[14] This system enables comprehensive analysis of trends, demographic and regional differences, and shifts in surgical practice across more than 50 million residents—an advantage not readily available in countries without universal health coverage.

Accordingly, this study aimed to analyze national trends in wrist arthroscopy from 2013 to 2023 using NHIS claims data, focusing on procedure type, patient demographics, socioeconomic factors, and regional distribution. In addition, we assessed the incidence of major postoperative complications to provide further context on procedural safety.

METHODS

The study was approved by the Institutional Review Board of the National Health Insurance Service Ilsan Hospital (IRB No. 2024-12-035-004), with informed consent waived due to the use of anonymized administrative data.

This retrospective, population-based observational study analyzed nationwide data from 2013 to 2023 to evaluate trends in wrist arthroscopic procedures in South Korea. During this period, the national population remained stable at approximately 52–53 million people, and the NHIS system provided virtually complete capture of insured healthcare utilization. The project began in January 2025 with support from the hospital's research center.

Data Source

The analysis used the NHIS claims database, a government-operated single-payer system that consolidates healthcare claims from all medical institutions nationwide.[15] The database captures more than 99% of inpatient and outpatient encounters, making it a robust resource for population-level research.[14] For this study, we extracted relevant variables from the NHIS dataset, including demographic information (age, sex, and residential district), clinical data (diagnosis codes based on the International Classification of Diseases, 10th Revision [ICD-10]), treatment codes, and financial status categorized by income information (originally collected as 20 ventiles, later aggregated into quartiles for analysis).

Study Participants and Cohort

Patients who underwent wrist arthroscopy between 2013 and 2023 were identified using procedure codes reimbursed by the Korean National Health Insurance, including diagnostic arthroscopy (E7500), partial joint resection (N0703, N0708), and ligament/tendon reconstruction (N0931, N0932). Although the national reimbursement policy has changed over time, the selected study period ensured uniform criteria, with arthroscopic device fees reimbursed at 50%, allowing for consistent case inclusion. By attaching the arthroscopic device prescription code, we were able to exclude open procedures. To address confounding from the 2010 policy shift that halved reim-

bursement for arthroscopic devices, a 3-year washout period (2010–2012) was applied. By starting from 2013, the cohort captures the most recent and stable decade of data under consistent reimbursement criteria.

To exclude elbow or ankle arthroscopies, which shared the same reimbursement protocol in P2 and P3 during the study period, we reviewed up to 5 diagnosis fields per patient (1 primary and 4 secondary) using ICD-10 codes recorded within 2 months before and after the operation. We identified 891 diagnostic codes and categorized them by anatomical region; non-orthopedic-related diagnoses were grouped as "other." Patients were included in the cohort if a wrist joint diagnosis appeared as the primary diagnosis or within 1 of the first 4 secondary diagnosis fields, provided that no other joint diagnoses were concurrently recorded. In cases where diagnoses involving other joints were present, patients were included only if the primary diagnosis was wrist-related. The complete list of wrist-specific diagnostic codes is provided in Supplementary Table 1.

Surgical Classification and Categorization

To analyze the frequency and trends of wrist arthroscopic procedures, all relevant procedures were classified into 3 categories based on the Korean National Health Insurance claim codes and reimbursement standards. (1) Procedure 1 (P1): diagnostic arthroscopy (E7500); (2) Procedure 2 (P2): excision of joint (including synovectomy) (N0703, N0708); (3) Procedure 3 (P3): reconstruction of tendon and ligament (N0931, N0932). These procedure codes were consistently used throughout the study period. The primary outcome was the annual frequency of each procedure type. Categorical variables included year, patient age group, sex, region, and income ventile. Descriptive statistics were computed, and the proportion of each procedure type was calculated annually in detail.

Age and Sex Variables

To assess potential demographic differences in the utilization of wrist arthroscopy, both age and sex were included as key variables. We analyzed how the choice of surgical procedure varied across age groups and between men and women throughout the study period. Age was categorized into 10 groups by decade (e.g., 0–9, 10–19, ..., ≥ 90 years), and sex was classified as men or women based on patient registry data. For each year from 2013 to 2023, the number and proportion of patients undergoing wrist arthroscopy were examined according to age group and sex.

Access Disparity Analysis

To assess socioeconomic disparities in access to wrist arthroscopy, we evaluated procedure frequencies stratified by income level. In the Korean National Health Insurance system, contribution amounts are calculated from an individual's earned income, property holdings, and reported assets, and thus serve as a validated proxy for socioeconomic status.[16] All beneficiaries are categorized into 20 income-based grades (ventiles) according to their contribution level, which we aggregated into 4 quartiles for analysis (first quartile = lowest income group; fourth quartile = highest). For selected years (2014, 2017, 2020, and 2023), we calculated the number of procedures in each quartile for all procedure categories (P1, P2, P3), along with the incidence per 100,000 persons. Population denominators for each quartile were obtained from the NHIS registry for the corresponding years.

For the regional analysis, we revised our approach to evaluate 2 time points (2014 and 2023). For each of these years, we calculated the number of wrist arthroscopy cases per 100,000 population in each administrative province and reported the regional ranking based on incidence. Regional population data were derived from Statistics Korea, and procedure counts were extracted from the NHIS database.

Complications Analysis

To evaluate postoperative complications following wrist arthroscopy, we assessed the occurrence of nerve injury, tendon injury, infection, and complex regional pain syndrome (CRPS) during the follow-up period. All patients who underwent wrist arthroscopy were monitored for the development of new complication-related diagnoses. Nerve injury, extensor tendon injury, and CRPS were defined as newly registered diagnoses within 1 year after surgery. Postoperative infection was defined as any infection-related diagnosis documented within 1 month following the procedure. The specific ICD-10 codes used to identify each complication category are provided in Supplementary Table 2.

Statistical Analysis

Continuous variables were presented as mean ± standard deviation and categorical variables were summarized as annual frequencies and incidence rates per 100,000 population in Korea. Annual distributions of procedures were analyzed using chi-square tests, while sex trends were evaluated using Cochran-Armitage trend tests. All analyses were performed with a significance level of 0.05 using SAS 9.4 software (SAS Institute).

RESULTS

Table 1 summarizes the annual number of wrist arthroscopy procedures performed in Korea from 2013 to 2023, along with the corresponding population and incidence rates per 100,000 population. The total number of procedures during the study period was 48,962. The annual number of procedures ranged from 3,287 in 2013 to 5,635 in 2023. The total population during the study period remained relatively stable, ranging from approximately 52.1 to 53.1 million. The incidence of wrist arthroscopy per 100,000 population increased from 6.71 in 2013 to 11.51 in 2023. From 2013 to 2019, both the absolute number and the incidence of procedures showed a gradual increasing trend. A decrease was observed between 2020 and 2022, followed by a slight increase in 2023.

Trends in Surgical Type Distribution

Table 2 presents the annual trends in the composition of wrist arthroscopic procedures from 2013 to 2023. In 2013, P2 (partial joint resection/synovectomy) accounted for the majority of procedures (58.7%), followed by P1 (diagnostic arthroscopy, 29.1%) and P3 (ligament/tendon reconstruction, 12.2%). Over time, a marked shift in distribution was observed. The proportion of P1 gradually declined to 24.9% by 2023, while P2 also decreased moderately to 41.4%. In contrast, P3 demonstrated the most prominent increase, comprising 33.6% in 2023, nearly a threefold rise from its initial proportion ($p < 0.0001$) (Fig. 1).

Age and Sex Variables

Table 3 presents the annual number and incidence (per 100,000 persons) of wrist arthroscopic procedures by age group and procedure type (P1, P2, P3) from 2013 to 2023. The 50–59-year age group consistently accounted for the highest total number of procedures across the study period. The 30–39-year group showed the most prominent relative increase in P2 and P3 cases, reflecting broader adoption of therapeutic arthroscopy in younger, working-age patients. In terms of incidence per 100,000 persons, the 20–29-year group recorded the highest rate of P3 procedures in 2023 (Fig. 2).

Table 4 summarizes the annual number and incidence (per 100,000 persons) of wrist arthroscopic procedures by sex. Although the total number of procedures was consistently higher in women than in men, the gap gradually narrowed over time ($p = 0.0013$). Among the procedure types, P3 showed the most significant growth. While women had a slightly higher proportion of P3 in 2013 (men vs. women; 8.9% vs. 15.4%), this trend reversed, and men accounted for a greater share by 2023 (men vs. women; 37.3% vs. 30.0%) ($p < 0.0001$).

Access Disparity Analysis

Income-based disparity

In the income quartile-based analysis (Table 5), the total number and incidence of wrist arthroscopic procedures varied modestly across income groups and years, but no consistent pattern suggesting income-related disparity

Table 1. Annual Frequency and Incidence of Wrist Arthroscopy per 100,000 Population in Korea

Year	No. of wrist arthroscopy cases	Proportion (%)	Total population*	Incidence per 100,000 population
2013	3,287	6.71	51,141,463	6.43
2014	3,504	7.16	51,327,916	6.83
2015	3,584	7.32	51,529,338	6.96
2016	3,798	7.76	51,696,216	7.35
2017	4,272	8.73	51,778,544	8.25
2018	4,601	9.40	51,826,059	8.88
2019	4,806	9.82	51,849,861	9.27
2020	5,106	10.43	51,829,023	9.85
2021	5,242	10.71	51,638,809	10.15
2022	5,127	10.47	51,439,038	9.97
2023	5,635	11.51	51,325,329	10.98

*Resident registration population statistics by the Ministry of the Interior and Safety.

Table 2. Annual Frequency and Proportion of Each Arthroscopic Procedure Type

Year	Diagnostic arthroscopy (E7500)			Partial joint debridement or synovectomy (N0703, N0708)			Ligament or tendon reconstruction (N0931, N0932)			Total	
	Frequency (n)	Row %	Column %	Frequency (n)	Row %	Column %	Frequency (n)	Row %	Column %	Frequency (n)	Column %
2013	957	29.11	7.13	1,929	58.69	8.41	401	12.20	3.18	3,287	6.71
2014	992	28.31	7.40	2,038	58.16	8.88	474	13.53	3.76	3,504	7.16
2015	1,010	28.18	7.53	2,069	57.73	9.02	505	14.09	4.00	3,584	7.32
2016	1,159	30.52	8.64	2,030	53.45	8.85	609	16.03	4.83	3,798	7.76
2017	1,324	30.99	9.87	2,153	50.40	9.39	795	18.61	6.30	4,272	8.73
2018	1,364	29.65	10.17	2,124	46.16	9.26	1,113	24.19	8.83	4,601	9.40
2019	1,447	30.11	10.79	1,962	40.82	8.55	1,397	29.07	11.08	4,806	9.82
2020	1,249	24.46	9.31	2,155	42.21	9.39	1,702	33.33	13.50	5,106	10.43
2021	1,283	24.48	9.57	2,122	40.48	9.25	1,837	35.04	14.57	5,242	10.71
2022	1,222	23.83	9.11	2,021	39.42	8.81	1,884	36.75	14.94	5,127	10.47
2023	1,406	24.95	10.48	2,335	41.44	10.18	1,894	33.61	15.02	5,635	11.51
Total	13,413		100.0	22,938		100.0	12,611		100.0	48,962	100.0

Column %: for each procedure type, the proportion of cases occurring in each year (summing to 100% across years per type). Row %: for each year, the proportion of each procedure type out of the total cases (summing to 100% across types per year).
The annual distribution of arthroscopic procedure types showed a significant association (chi-square test, $p < 0.01$).

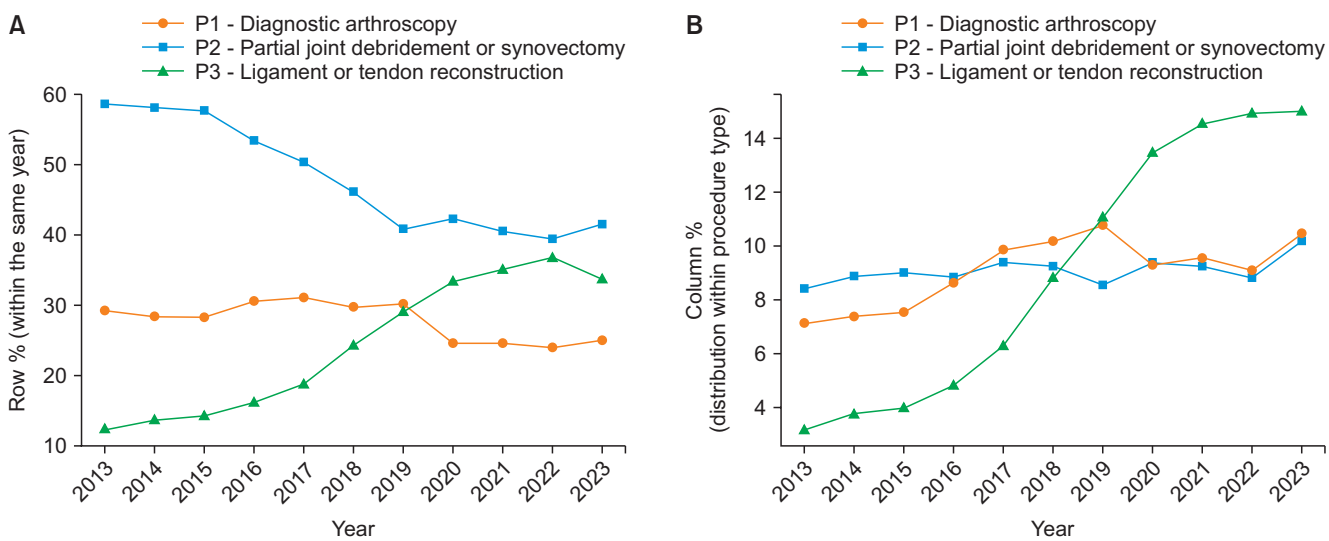

Fig. 1. Trends in the distribution of arthroscopic wrist procedures from 2013 to 2023. (A) Annual procedural composition of wrist arthroscopy. The yearly proportion of each arthroscopic procedure type—diagnostic arthroscopy (P1), partial joint debridement or synovectomy (P2), and ligament or tendon reconstruction (P3)—is shown as a percentage of all arthroscopic wrist procedures performed in the corresponding year. (B) Temporal distribution of each procedure type across the study period. The annual distribution of each procedure type is presented as a percentage of the total number of procedures of that specific type across the entire study period.

Table 3. Annual Number and Incidence of Wrist Arthroscopic Procedures by Age Group and Procedure Type

Age (yr)	Type	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
0–9	Total	2 (0)	1 (0)	1 (0)	16 (0)	10 (0)	11 (0)	4 (0)	6 (0)	1 (0)	1 (0)	4 (0)
	P 1	1 (0)	1 (0)	1 (0)	16 (0)	10 (0)	11 (0)	2 (0)	4 (0)	1 (0)	1 (0)	1 (0)
	P 2	0	0	0	0	0	0	1 (0)	1 (0)	0	0	3 (0)
	P 3	1 (0)	0	0	0	0	0	1 (0)	1 (0)	0	0	0
10–19	Total	125 (2)	143 (2)	165 (3)	153 (3)	155 (3)	179 (3)	168 (3)	164 (3)	156 (3)	178 (4)	179 (4)
	P 1	33 (1)	42 (1)	45 (1)	39 (1)	52 (1)	52 (1)	38 (1)	42 (1)	38 (1)	38 (1)	38 (1)
	P 2	76 (1)	83 (1)	102 (2)	84 (2)	76 (1)	87 (2)	70 (1)	73 (2)	62 (1)	83 (2)	74 (2)
	P 3	16 (0)	18 (0)	18 (0)	30 (1)	27 (1)	40 (1)	60 (1)	49 (1)	56 (1)	57 (1)	67 (1)
20–29	Total	507 (8)	582 (9)	642 (10)	696 (10)	773 (11)	867 (13)	991 (15)	1,043 (15)	1,020 (15)	975 (15)	1,079 (17)
	P 1	106 (2)	122 (2)	153 (2)	151 (2)	173 (3)	193 (3)	196 (3)	138 (2)	154 (2)	148 (2)	186 (3)
	P 2	363 (6)	403 (6)	384 (6)	404 (6)	422 (6)	396 (6)	338 (5)	391 (6)	351 (5)	328 (5)	392 (6)
	P 3	38 (1)	57 (1)	105 (2)	141 (2)	178 (3)	278 (4)	457 (7)	514 (8)	515 (8)	499 (8)	501 (8)
30–39	Total	545 (7)	573 (7)	563 (7)	632 (8)	720 (10)	754 (10)	744 (11)	815 (12)	890 (13)	956 (14)	997 (15)
	P 1	112 (1)	119 (2)	99 (1)	140 (2)	179 (2)	165 (2)	151 (2)	114 (2)	136 (2)	139 (2)	165 (3)
	P 2	390 (5)	390 (5)	381 (5)	370 (5)	397 (5)	386 (5)	301 (4)	339 (5)	312 (5)	335 (5)	403 (6)
	P 3	43 (1)	64 (1)	83 (1)	122 (2)	144 (2)	203 (3)	292 (4)	362 (5)	442 (7)	482 (7)	429 (7)
40–49	Total	711 (8)	729 (8)	702 (8)	728 (8)	865 (10)	815 (10)	892 (11)	897 (11)	995 (12)	942 (12)	1,025 (13)
	P 1	184 (2)	178 (2)	187 (2)	212 (2)	237 (3)	211 (2)	253 (3)	213 (3)	189 (2)	201 (2)	242 (3)
	P 2	439 (5)	467 (5)	430 (5)	413 (5)	463 (5)	393 (5)	394 (5)	396 (5)	433 (5)	402 (5)	450 (6)
	P 3	88 (1)	84 (1)	85 (1)	103 (1)	165 (2)	211 (2)	245 (3)	288 (3)	373 (5)	339 (4)	333 (4)
50–59	Total	899 (11)	925 (11)	963 (12)	989 (12)	1,071 (13)	1,179 (14)	1,115 (13)	1,253 (14)	1,147 (13)	1,093 (13)	1,162 (13)
	P 1	299 (4)	295 (4)	322 (4)	354 (4)	378 (4)	433 (5)	411 (5)	372 (4)	345 (4)	314 (4)	383 (4)
	P 2	458 (6)	469 (6)	498 (6)	496 (6)	499 (6)	512 (6)	488 (6)	560 (6)	519 (6)	459 (5)	481 (6)
	P 3	142 (2)	161 (2)	143 (2)	139 (2)	194 (2)	234 (3)	216 (2)	321 (4)	283 (3)	320 (4)	298 (3)
60–69	Total	347 (8)	384 (8)	400 (8)	436 (8)	513 (9)	593 (10)	665 (11)	718 (11)	797 (11)	726 (10)	864 (11)
	P 1	149 (3)	160 (3)	145 (3)	183 (3)	219 (4)	225 (4)	294 (5)	279 (4)	316 (4)	282 (4)	279 (4)
	P 2	149 (3)	165 (4)	199 (4)	204 (4)	226 (4)	255 (4)	281 (4)	305 (5)	339 (5)	298 (4)	371 (5)
	P 3	49 (1)	59 (1)	56 (1)	49 (1)	68 (1)	113 (2)	90 (1)	134 (2)	142 (2)	146 (2)	214 (3)
70–79	Total	125 (4)	128 (4)	117 (4)	124 (4)	135 (4)	176 (5)	168 (5)	163 (4)	178 (5)	190 (5)	242 (6)
	P 1	62 (2)	61 (2)	46 (1)	57 (2)	64 (2)	61 (2)	79 (2)	69 (2)	84 (2)	75 (2)	86 (2)
	P 2	45 (1)	46 (1)	57 (2)	48 (1)	58 (2)	84 (2)	70 (2)	67 (2)	76 (2)	80 (2)	116 (3)
	P 3	18 (1)	21 (1)	14 (0)	19 (1)	13 (0)	31 (1)	19 (1)	27 (1)	18 (0)	35 (1)	40 (1)

Table 3. Continued

Age (yr)	Type	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
80-89	Total	125 (12)	35 (3)	26 (2)	22 (2)	25 (2)	22 (1)	52 (3)	43 (2)	54 (3)	61 (3)	81 (4)
	P 1	62 (6)	13 (1)	9 (1)	7 (1)	9 (1)	11 (1)	20 (1)	16 (1)	19 (1)	22 (1)	26 (1)
	P 2	45 (4)	12 (1)	16 (1)	10 (1)	10 (1)	9 (1)	16 (1)	21 (1)	27 (1)	34 (2)	44 (2)
	P 3	18 (2)	10 (1)	1 (0)	5 (0)	6 (0)	2 (0)	16 (1)	6 (0)	8 (0)	5 (0)	11 (1)
≥ 90	Total	22 (15)	1 (1)	1 (1)	1 (1)	3 (1)	3 (1)	4 (2)	2 (1)	2 (1)	4 (1)	2 (1)
	P 1	10 (7)	0	0	0	2 (1)	2 (1)	3 (1)	1 (0)	1 (0)	2 (1)	0
	P 2	6 (4)	1 (1)	1 (1)	1 (1)	1 (1)	1 (0)	1 (0)	1 (0)	1 (0)	2 (1)	0
	P 3	6 (4)	0	0	0	0	0	0	0	0	0	2 (1)

Values are presented as number of cases (incidence per 100,000 persons) (%). P1: diagnostic arthroscopy (E7500), P2: partial joint debridement or synovectomy (N0703, N0708), P3: ligament or tendon reconstruction (N0931, N0932).

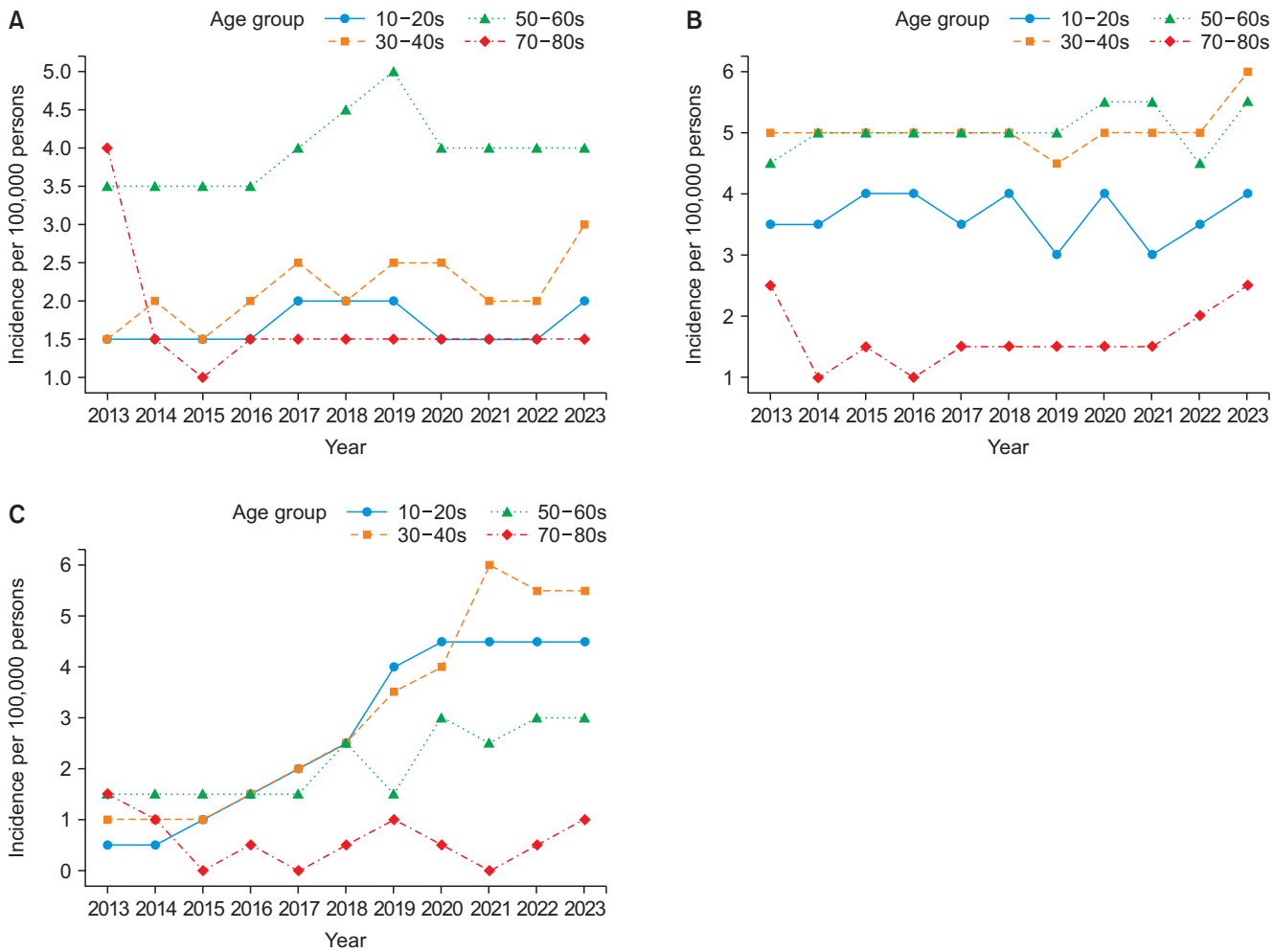

Fig. 2. Annual age-stratified incidence of wrist arthroscopic procedures per 100,000 persons. (A) Diagnostic arthroscopy: annual incidence by age group. (B) Debridement or synovectomy: annual incidence by age group. (C) Ligament or tendon reconstruction: annual incidence by age group.

Table 4. Annual Number and Incidence of Wrist Arthroscopic Procedures by Sex and Procedure Type

Sex	Type	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
Men	Total	1,633 (6)	1,788 (7)	1,879 (7)	2,007 (8)	2,189 (8)	2,433 (9)	2,493 (10)	2,614 (10)	2,594 (10)	2,566 (10)	2,803 (11)
	P1	424 (2)	432 (2)	461 (2)	540 (2)	602 (2)	620 (2)	619 (2)	538 (2)	530 (2)	519 (2)	587 (2)
	P2	1,066 (4)	1,167 (5)	1,179 (5)	1,151 (4)	1,191 (5)	1,216 (5)	1,024 (4)	1,129 (4)	1,029 (4)	1,019 (4)	1,172 (5)
	P3	146 (1)	192 (1)	243 (1)	317 (1)	398 (2)	599 (2)	856 (3)	954 (4)	1,037 (4)	1,029 (4)	1,045 (4)
Women	Total	1,651 (6)	1,713 (7)	1,701 (7)	1,790 (7)	2,081 (8)	2,166 (8)	2,310 (9)	2,490 (10)	2,646 (10)	2,560 (10)	2,831 (11)
	P1	532 (2)	559 (2)	546 (2)	619 (2)	721 (3)	744 (3)	828 (3)	710 (3)	753 (3)	703 (3)	819 (3)
	P2	864 (3)	872 (3)	893 (3)	880 (3)	963 (4)	909 (4)	942 (4)	1,032 (4)	1,093 (4)	1,003 (4)	1,163 (5)
	P3	255 (1)	282 (1)	262 (1)	291 (1)	397 (2)	513 (2)	540 (2)	748 (3)	800 (3)	854 (3)	849 (3)

Values are presented as number of cases (incidence per 100,000 persons) (%). P1: diagnostic arthroscopy (E7500), P2: partial joint debridement or synovectomy (N0703, N0708), P3: ligament or tendon reconstruction (N0931, N0932).
The annual number and incidence of wrist arthroscopic procedures differed significantly by sex (Cochran-Armitage trend test, $p = 0.01$).

Table 5. Wrist Arthroscopy Utilization by Income Quartile in Selected Years (2014, 2017, 2020, and 2023), with Incidence per 100,000 Persons Shown in Parentheses

Quartile	Type	2014	2017	2020	2023
1st	P1	152 (2)	264 (3)	247 (3)	318 (3)
	P2	348 (4)	413 (4)	412 (4)	544 (5)
	P3	93 (1)	180 (2)	330 (3)	412 (4)
	Total	593 (6)	857 (9)	989 (10)	1,274 (12)
2nd	P1	215 (2)	292 (3)	260 (2)	244 (2)
	P2	467 (5)	491 (5)	453 (4)	403 (4)
	P3	111 (1)	191 (2)	403 (4)	359 (4)
	Total	793 (8)	974 (9)	1,116 (11)	1,006 (10)
3rd	P1	246 (2)	333 (3)	326 (3)	361 (3)
	P2	550 (4)	554 (4)	528 (4)	591 (5)
	P3	125 (1)	196 (2)	432 (3)	465 (4)
	Total	921 (7)	1,083 (8)	1,286 (10)	1,417 (11)
4th	P1	303 (2)	365 (2)	344 (2)	399 (2)
	P2	565 (3)	587 (3)	659 (4)	656 (4)
	P3	119 (1)	195 (1)	458 (3)	544 (3)
	Total	987 (6)	1,147 (7)	1,461 (9)	1,599 (10)

Income quartiles are derived from the 20 National Health Insurance Service (NHIS) contribution-based income grades (ventiles), aggregated into 4 groups (1st quartile = lowest income group; 4th quartile = highest). Procedure categories: P1 = diagnostic arthroscopy, P2 = partial joint debridement or synovectomy, P3 = ligament or tendon reconstruction. Procedure counts and population denominators were obtained from the NHIS database and NHIS registry, respectively.

was observed. The lowest income quartile (first) showed relatively higher incidence in certain years, such as 2017 and 2023, whereas the middle and higher income quartiles (second-fourth) demonstrated comparable or greater rates in other years (Fig. 3). Across all quartiles, the relative distribution of procedure types (P1, P2, and P3) remained similar, and the incidence per 100,000 population stayed within a narrow range over the entire study period.

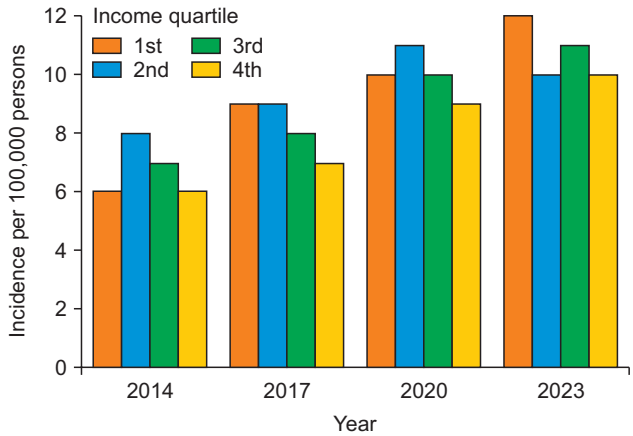

Fig. 3 Incidence of wrist arthroscopy per 100,000 persons across income quartiles in selected years (2014, 2017, 2020, and 2023).

Regional disparity

Table 6 summarizes the regional distribution of wrist arthroscopic procedures in South Korea for 2014 and 2023. In 2014, Jeollabuk-do demonstrated the highest incidence per 100,000 population, followed by Gyeongsangbuk-do and Daegu. By contrast, in 2023, the highest-incidence regions shifted to Chungcheongnam-do, Gwangju, and Incheon. Regions such as Busan and Jeju consistently exhibited relatively low utilization across the 2 time points, while Daegu showed a marked decline in per-capita incidence between 2014 and 2023. Although Seoul and

Table 6. Regional Incidence Comparison of Wrist Arthroscopy (Unit: per 100,000 Population)

Category	Region	2014 (rank)	2023 (rank)	Δ Change
Capital	Seoul	5.8 (11th)	10.7 (8th)	+ 4.9
Metropolitan area	Gyeonggi	6.9 (6th)	10.6 (9th)	+ 3.7
	Incheon	6.4 (9th)	14.9 (3rd)	+ 8.5
Other metropolitan city	Busan	4.9 (16th)	6.2 (17th)	+ 1.3
	Daegu	8.5 (3rd)	6.8 (15th)	– 1.7
	Gwangju	8.2 (4th)	18.0 (2nd)	+ 9.8
	Daejeon	3.6 (17th)	12.2 (4th)	+ 8.6
	Ulsan	5.0 (15th)	11.2 (7th)	+ 6.2
	Sejong	5.7 (12th)	8.4 (13th)	+ 2.7
Province	Gangwon	5.6 (14th)	8.8 (12th)	+ 3.2
	Chungcheongbuk-do	5.6 (13th)	11.5 (5th)	+ 5.9
	Chungcheongnam-do	8.2 (5th)	18.4 (1st)	+ 10.2
	Jeollabuk-do	10.0 (1st)	10.3 (10th)	+ 0.3
	Jeollanam-do	6.6 (8th)	11.4 (6th)	+ 4.8
	Gyeongsangbuk-do	9.6 (2nd)	7.7 (14th)	– 1.9
	Gyeongsangnam-do	6.7 (7th)	9.3 (11th)	+ 2.6
Other	Jeju	6.1 (10th)	6.7 (16th)	+ 0.6

Table 7. Summary of Postoperative Complications

Category	Number (%)
Infection	1,459 (2.98)
Tendon injury	746 (1.52)
Nerve injury	182 (0.37)
Median nerve	28 (0.06)
Ulnar nerve	74 (0.15)
Radial nerve	24 (0.05)
Others	56 (0.11)
CRPS	167 (0.34)

CRPS: complex regional pain syndrome.

Gyeonggi Province recorded the largest absolute number of procedures due to their large populations, they did not rank among the highest in per-capita incidence in either year.

Complication Analysis

Among the total cohort of 48,962 patients who underwent wrist arthroscopy, postoperative complications were identified in a minority of cases (Table 7). The most frequently observed complication was postoperative infection, occurring in 1,459 patients (2.98%), followed by extensor tendon injury in 746 patients (1.52%). Nerve injuries were recorded in 182 cases (0.37%), including ulnar nerve injury in 74 patients (0.15%), median nerve injury in 28 patients (0.06%), radial nerve injury in 24 patients (0.05%), and other or unspecified nerve injuries in 56 patients (0.11%). CRPS was diagnosed in 167 patients (0.34%) within 1 year postoperatively.

DISCUSSION

This nationwide study analyzed trends in wrist arthroscopy in South Korea from 2013 to 2023 using the National Health Insurance Claims Database and identified a total of 48,962 procedures. Our findings can be interpreted across 3 major themes. First, although joint excision or synovectomy (P2) was the most common procedure in the early years of the study period, the proportion of ligament or tendon reconstruction (P3) increased sharply, particularly among younger adult men in their 20s and 30s. This trend likely reflects both the maturation of arthroscopic techniques and the expansion of surgeon expertise, as well as increasing demand from younger patients with sports-related conditions who more often require reconstructive rather than debridement procedures. Second, Korea's comprehensive National Health Insurance system, characterized by a uniform reimbursement structure and minimal variation in patient cost, may explain the limited differences in utilization across income quartiles and geographic regions, suggesting a relatively equitable distribution of arthroscopic care. Finally, the low complication rates observed in this nationwide dataset, which have been suggested in prior literature but rarely confirmed at a national level, indicate that wrist arthroscopy remains a safe procedure with a low incidence of inadvertent events. Taken together, these findings provide a multifaceted explanation for the increasing incidence and evolving procedural patterns observed in this study.

Large-scale nationwide studies on wrist arthroscopy remain scarce worldwide and direct comparison of absolute incidence rates across countries is inherently limited by substantial differences in health care systems, reimbursement policies, and clinical practice patterns, and should not be interpreted as an indicator of health system superiority. The Italian nationwide analysis (2001–2016) demonstrated that procedure volumes peaked between 2006 and 2008 and subsequently declined, with a slightly higher proportion of female patients and the highest frequency among individuals aged 40–49 years.[11] Although this study did not report population-standardized incidence rates, the overall trend showed decreasing utilization over time. Similarly, a Finnish national study covering 1997 to 2016 reported that the incidence of wrist arthroscopy increased until 2014 and then declined by approximately 4% per year thereafter, reaching 20.7 procedures per 100,000 persons in 2016.[12] Over the study period, the average annual incidence in Korea was approximately 8 to 9 procedures per 100,000 persons, which remains lower than that reported in the Finnish population, even when annual differences are considered. This discrepancy may be partly attributable to the higher proportion of diagnostic arthroscopy reported in the Finnish study, in which wrist exploration accounted for 57.8% of all wrist arthroscopic procedures. Our dataset showed the highest proportion of partial joint resection or synovectomy (P2) at baseline and a marked rise in ligament or tendon reconstruction (P3), which accounted for nearly one-third of all wrist arthroscopies by 2023.[12] One important factor contributing to this trend is the growing recognition of TFCC pathology as a major indication for wrist arthroscopy. Since the mid-2010s, improved understanding of TFCC anatomy and the functional significance of foveal lesions has shifted clinical practice toward arthroscopic

repair rather than simple debridement.[2,17,18] As multiple studies[19-24] have reported favorable outcomes after TFCC repair, the demand for reconstructive arthroscopic procedures has increased, which likely contributed to the rapid growth of P3 utilization in Korea. In Korea, wrist arthroscopy appears to be further supported by universal insurance coverage, ready access to arthroscopic equipment, and increasing treatment demand among younger adult patients.[25-30] The rising share of complex procedures suggests that future practice will likely continue to shift toward more technically demanding interventions, potentially accompanied by greater healthcare expenditures.

Despite this progressive shift toward more complex wrist arthroscopy, the proportion of diagnostic arthroscopy (P1) remained relatively high, accounting for 24.9% of all arthroscopic procedures in 2023 (Table 2). Several factors may explain this sustained rate. First, diagnostic arthroscopy is frequently performed in conjunction with other major wrist procedures, such as distal radius fracture fixation or ulnar shortening osteotomy. Second, in real-world reimbursement practice, the Health Insurance Review and Assessment Service may reclassify a surgeon's submitted operative code as diagnostic arthroscopy rather than as a therapeutic arthroscopic procedure, which increases the apparent frequency of P1 coding. Third, the diagnostic arthroscopy code (E7500) is a universal arthroscopy code applied across all joints, whereas P2 and P3 codes are restricted to the wrist, elbow, and ankle because their reimbursement is differentiated (only 50% of the arthroscopy material cost is covered compared with other joints). Consequently, although we excluded non-wrist arthroscopies based on diagnosis codes, the inherent coding structure may still allow a greater likelihood of P1 attribution, with a higher potential for residual inclusion or expansion of diagnostic arthroscopy compared with P2 or P3.

In Korea, nationwide studies on knee,[9] shoulder,[8] and hip[10] arthroscopies have been conducted using the same national database; however, our study is the first large-scale investigation focusing specifically on wrist arthroscopy. In 2017, the national incidence of wrist arthroscopy in Korea was 8.25 per 100,000 persons, which was substantially lower than that of knee (185) and shoulder arthroscopy (116.04) reported in previous nationwide studies, but higher than that of hip arthroscopy (5.17 in 2010). Importantly, the incidence of wrist arthroscopy continued to rise thereafter, reaching 10.98 per 100,000 persons in 2023.

In terms of demographic disparities, these were evident across age and sex. The 50–59-year age group consistently accounted for the greatest absolute number of wrist arthroscopy procedures throughout the study period. However, when adjusted for population size, the 20–29-year group showed the highest incidence in 2023, suggesting more frequent utilization among younger adults. This may be related to greater functional demands, sports participation, and increased awareness of minimally invasive options in this demographic. Age-specific trends also revealed that older patients (particularly those aged ≥ 60 years) were more likely to undergo diagnostic arthroscopy (P1), whereas younger and middle-aged adults demonstrated a rising preference for therapeutic procedures, especially ligament or tendon reconstruction (P3).

Regarding sex, the overall number of wrist arthroscopy procedures was consistently higher in women than in men throughout the study period. However, a distinct pattern was observed in the distribution of P3 procedures. While women initially had a slightly higher proportion of P3 in 2013 (8.9% vs. 15.4%), men demonstrated a steady rise over time and ultimately surpassed women by 2023 (37.3% vs. 30.0%). This shift may reflect the greater involvement of young men in high-impact occupational and recreational activities, which are more often associated with traumatic injuries such as TFCC tears that require complex reconstructive interventions.

Regarding disparities, analysis of income and geographic distribution suggested relatively equitable access to wrist arthroscopy. No consistent association was observed between income level and procedure incidence across the 11-year period. In terms of regional analysis, our initial assumption had been that the capital and metropolitan areas, owing to their high concentration of medical resources, would demonstrate the highest procedure rates. However, this pattern was not observed. On the contrary, the highest-incidence regions were Jeollabuk-do in 2014 and Chungcheongnam-do in 2023, rather than Seoul or Gyeonggi Province. We additionally explored whether regional procedure rates were associated with the local density of hand subspecialists, but this analysis did not reveal a meaningful correlation and therefore was not included in the Results section. Taken together, these findings suggest that regional variation may be influenced more by factors such as local population structure, distribution of orthopedic hospitals, and the generally high accessibility of wrist arthroscopy in community-based settings, rather than by socioeconomic barriers or specialist concentration.

Finally, postoperative complications were uncommon in this nationwide cohort. This finding reaffirms and, importantly, verifies the long-held belief that wrist arthroscopy is a safe procedure in routine clinical practice.[31-34]

Previous reports, including the multicenter survey by Leclercq and Mathoulin[34] and the single-center experience by Beredjiklian et al.,[31] described low complication rates but were limited by selective reporting and concentration among high-volume experts. Similarly, Mac et al. noted that many complications following TFCC arthroscopy are influenced by technical factors and the surgeon's learning curve.[33] In contrast, the present study reflects real-world outcomes across all surgeons and institutions nationwide and therefore provides the most representative assessment to date of complication rates across the full spectrum of clinical practice. The most frequent complications were postoperative infection (2.98%) and tendon injury (1.52%), whereas nerve injury (0.37%) and CRPS (0.34%) were rare. Compared with nationwide studies of other joints, the rates of nerve injury and CRPS were similar.[8-10] The extensor tendon injury rate of 1.52% may also be acceptable considering the proximity of the extensor tendons to the arthroscopic working portals and the relatively thin soft-tissue envelope around the wrist.[35] However, the infection rate remains somewhat higher than that reported for other arthroscopic joints (knee, 0.1–0.5%[9]; hip, 0.6%[10]; shoulder, 0.3–1.0%[8]). This discrepancy may derive from both the anatomical characteristics of the wrist—particularly the minimal soft-tissue coverage. Due to the broad scope of this study and limitations in manuscript length, a more granular analysis incorporating surgeon experience, patient demographics, and procedural characteristics will be addressed in future research.

This study has several limitations. First, it relied on administrative claims data, which lack detailed clinical information such as surgical indications, intraoperative findings, and postoperative outcomes. Second, wrist arthroscopy procedures were categorized using broad procedural codes (P1, P2, and P3), limiting the ability to identify specific interventions, including the exact ligament repaired in reconstructive procedures or the detailed nature of debridement. Third, variability in diagnostic and procedural coding across institutions may have resulted in misclassification despite efforts to minimize coding overlap. Finally, because the analysis was restricted to procedures coded as wrist arthroscopy, arthroscopy-assisted fracture fixation procedures, such as scaphoid fixation or distal radius fracture reduction, were not captured. These procedures represent a growing area of clinical practice and may have led to an underestimation of overall arthroscopy utilization.

Future research should integrate claims data with multicenter clinical registries and patient-reported outcomes to validate complication rates and assess functional efficacy. Comparative international studies are also warranted to contextualize Korea's experience in the global evolution of wrist arthroscopy. This nationwide 11-year analysis demonstrates that wrist arthroscopy in South Korea has steadily increased, with a growing trend toward complex reconstructive procedures. Despite regional variation, no income-based disparity was observed, and overall complication rates remained low, although postoperative infection was observed somewhat more frequently than reported after larger-joint arthroscopy, supporting both the accessibility and safety of wrist arthroscopy in routine clinical practice.

CONFLICT OF INTEREST

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

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SUPPLEMENTARY MATERIAL

Supplementary material is available in the electronic version of this paper at the CiOS website, www.ecios.org.

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