

Hip preservation surgery in Norway: development, demographics and short-term outcomes from the Norwegian paediatric hip register

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Abstract

Hip preservation surgery is increasing both in Norway and internationally. Despite growing interest in the field, there remains considerable variation regarding surgical indications, techniques and implant choices across institutions. To address this and to improve understanding of clinical practice and outcomes, hip preservation procedures in adolescents and young adults were incorporated into the Norwegian Paediatric Hip Register in 2013. This study highlights the development of the registry and reports baseline demographics, perioperative details and patient-reported outcomes, including iHOT-12. Data from 900 patients with 1013 procedures are presented, which includes 273 open and 740 arthroscopic surgeries. The average age was 25.9 years for the open group and 31.9 years for the arthroscopic group. Periacetabular osteotomy (79%) was the most common open procedure, while isolated cam resection accounted for 40% of the arthroscopic procedures. Mean iHOT-12 improved significantly one year postoperatively from 44.1 to 63.7 ($P < .001$) after open surgery and from 45.3 to 64.1 ($P < .001$) after arthroscopy. The implementation of the hip preservation registry enables systematic national evaluation of this field and may help to enhance knowledge and decision-making in hip preservation surgery.

Keywords hip arthroscopy, periacetabular osteotomy, femoroacetabular impingement, developmental dysplasia of the hip

Introduction

Hip preservation surgery can be performed either open or arthroscopically and aims to relieve pain, improve function, and delay or prevent the need for hip replacement surgery. It is suitable for young active adults without signs of

osteoarthritis (OA) [1–5]. Open hip preservation procedures have been performed for decades, with significant contributions by Ganz, who described periacetabular osteotomies (PAO) for hip dysplasia in 1988 [6] and cam resection for femoroacetabular impingement (FAI) in the 1990s [7]. The

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first arthroscopic treatment for FAI syndrome was reported by Sampson *et al.* in 2005, showing favourable early results comparable to open surgeries [8]. Several publications from different centres have confirmed similar findings [9–14]. Hip arthroscopy has become increasingly popular since the 21st century and continues to expand worldwide [15–18], including in Norway [19]. As with any evolving surgical field, various patient selection criteria, surgical techniques, and outcome measures make it challenging to compare results across institutions and studies. This variance may introduce selection bias and impede the possibility of applicable conclusions.

Clinical registries enable large-scale data collection and management, as well as prospective surveillance of clinical outcomes, surgical techniques and implant use. Both the Swedish and Danish hip arthroscopy registries demonstrated that systematic collection of demographic variables and patient-reported outcome measures (PROMs) is feasible and clinically valuable [20, 21]. In recognition of these registries and with the growing interest in this field in Norway, hip preservation procedures among adolescents and young adults were implemented into the Norwegian Paediatric Hip Register in 2013. Equivalent to the Swedish and Danish registries, the Norwegian registry can be used to collect data, monitor, and enhance the health care provided. Unlike the Swedish and Danish hip arthroscopy registries, it contains both open and arthroscopic surgery. To our knowledge, only one comparable registry exists, which is the British Non-Arthroplasty Hip Registry (NAHR) [22]. The aim of this study is to describe the evolution of the registry, its content and preliminary data.

Materials and methods

The hip preservation registry is formally integrated within the Norwegian Paediatric Hip Register, which was initiated in 2010. Patients scheduled for hip preservation surgery complete a preoperative questionnaire and written informed consent at the outpatient clinic, which initiates automatic electronic distribution of preoperative PROMs. Surgeons complete a standardized web-based perioperative form documenting surgical side, type of procedure, and operative findings. Postoperative PROMs are distributed electronically at 1, 2, 5, and 10 years. The hip preservation registry became web-based in 2019, and since 2025, all pre- and postoperative PROMs have been collected electronically.

The PROMs used are iHOT-12, EQ-VAS, and EQ-5D-5L. The Hip Sports Activity Scale (HSAS), a validated tool for mapping the level of sports in patients with FAI, was included in 2025 [23]. iHOT-12 is a hip-specific questionnaire designed for young and active patients with hip disorders and is a validated tool with adequate responsiveness [24]. iHOT-12 has been translated and culturally adapted into Swedish and is considered transferable to a similar Norwegian language and culture [25]. EQ-5D-5L is a generic health status measurement commonly used in international journals [26].

Open hip preservation surgery is only performed at two centres in Norway (Coastal Hospital Hagevik and Oslo University Hospital). In contrast, arthroscopic hip surgery is performed at several hospitals, including private healthcare

facilities. Before 2025, preoperative PROM data were only available at Coastal Hospital Hagevik and Oslo University Hospital, with the latter using iHOT-33. To report preoperative PROM data in this study, relevant questions in the iHOT-12 questionnaire had to be extracted from the preoperative iHOT-33 data. However, with the rollout of electronic preoperative PROM from 2025, iHOT-12 will be used as the primary hip questionnaire, and all institutions reporting to the register are expected to be included.

The aim for a national registry should be to include all relevant procedures in order to reflect high national participation. The registry has performed a coverage and completeness analysis that revealed that ~80% of all hip preservation surgeries performed in 2021 and 2022 were included [19].

Demographic data, perioperative outcomes, and radiographic measurements are outlined in [Tables 1](#) and [4](#). Chondral acetabular lesions are classified according to Beck and Konan [27, 28], and femoral head cartilage lesions are graded by the International Cartilage Repair Society (ICRS) system whenever available. The surgeon is asked to grade any damage to the labrum and cartilage and mark the localization of the injured structure in a figure included in the perioperative report.

The Norwegian Paediatric Hip Register has licences from the Norwegian Data Protection Authority (reference numbers 2011/6449). Ethical approval for this study was obtained from the Regional Committee for Medical and Health Research Ethics (REK), and the project was deemed exempt from formal approval, as included patients had previously consented to participate and to the use of their data in future studies and publications (reference no. 562840).

Statistical methods

Descriptive data are reported as mean or median with standard deviation and range depending on the normal distribution of the data. The independent *t*-test was chosen as the most appropriate statistical test, and statistical analysis was conducted using the International Business Machines Statistical Package for the Social Sciences Statistics (IBM SPSS) software (IBM Corp. Released 2023. IBM SPSS Statistics for Windows, Version 30.0.0.0 Armonk, NY: IBM Corp). Data were deemed significant if the *P*-value was <.05.

Results

Between 2017 and 31 December 2024, 1013 hip preservation surgeries were performed on 900 patients ([Table 1](#)). A total of 273 open surgeries and 740 arthroscopies were registered. The annual incidence for open surgery and hip arthroscopy was 0.82 and 1.48 per 100 000 population, respectively [19]. Mean age was 25.9 years (range 12–45) in the open surgery group and 31.9 years (range 13–72) in the arthroscopy group. Females accounted for 78% of patients undergoing open surgery, whereas males comprised 57% of arthroscopic procedures. Acetabular dysplasia was the main indication for surgery and accounted for 73% of open procedures and 76% had symptomatic FAI morphology as the primary reason for arthroscopy ([Table 2](#)). Nine arthroscopic procedures had femoral dysplasia or malrotation as the main reason

Table 1 Baseline and perioperative data for 900 patients undergoing hip preservation surgery between 2019 and 2024.

Demographics	Open surgery	Arthroscopy	Total
Number of patients	232	668	900
Number of hips	256	716	972
Number of procedures	273	740	1013
Male/female, %	22/78	57/43	48/52
Age, mean (range)	25.9 (12–45)	31.9 (13–72)	30.4 (12–72)
Right/left hip, %	57/43	55/45	55/45
BMI, ^a mean (range)	24.2 (15.6–35.9)	24.9 (15.0–39.9)	24.8 (15.0–39.9)
ASA ^b 1/2/3, <i>n</i>	162/68/2	517/146/5	679/214/7
Operation time minutes, mean (range)	143 (47–319)	101 (19–256)	112 (19–319)
Mean traction time minutes, mean (range)	-	54 (0–140)	-
Surgical dislocation time minutes, ^c mean (range)	53 (20–90)	-	-

^aBMI = Body Mass Index, kg/m² ^bASA = American Society of Anaesthesiologist physical status classification system ^cOpen surgical hip dislocation was performed in 19 cases

for surgery, and 78% underwent cam resection. The most common open procedure was PAO with 217 surgeries (79%), and 293 (40%) isolated cam resection was the most frequent arthroscopic operation (Table 3). Radiographic parameters are presented in Tables 4 and 5. Mean Tönnis and Lateral center-edge (LCE) angles were 18 and 13 degrees, respectively, in patients undergoing isolated PAO or in combination with femoral derotational osteotomy (FDO). Mean alpha angle in patients with cam resection was 79 degrees. Acetabular and femoral cartilage status is reported in Fig. 1, and full-thickness lesions were observed in 12% and 8%, respectively, but the most common finding was debonding in 37%. Labral status is also included in Fig. 1, and detachment was the most common finding (37%). Significant improvement in iHOT-12 scores from 44.1 to 63.7 for open surgery (mean difference 19.6, 95% CI: 11.9–27.4, *P* < .001) and from 45.3 to 64.1 for arthroscopic surgery (mean difference 18.8, 95% CI: 15.0–22.1, *P* < .001) was observed (Fig. 2). The value for minimal clinically important difference (MCID) for iHOT-12 in the literature is 13 and was exceeded by 59% of the patients in both groups at one year postoperatively [29]. Patient acceptable state status (PASS) for iHOT-12 is equal to or above 63, and 18% were above the PASS threshold value preoperatively, and 53% had a PASS value above 63 one year postoperatively [29]. Two centres reported preoperative PROM on 404 patients, yielding a completeness rate of 40%. A total of 153 patients (38%) completed the iHOT-12 both preoperatively and 1 year postoperatively.

Discussion

This study demonstrates that establishing a national hip preservation registry is feasible and capable of acquiring comprehensive baseline, radiological, and PROM data across institutions. In Norway, hip preservation procedures are concentrated within a limited number of centres, particularly with respect to open surgical interventions. Consequently, patient selection and treatment standards may be influenced by a small group of experienced surgeons, with a potential

Table 2 The distribution of different indications for surgeries for both open and arthroscopic procedures are demonstrated.

Indication for surgery	Open surgery	Arthroscopy	Total
Femoroacetabular impingement	34	594	628
Labral damage, unknown aetiology	0	109	109
Acetabular dysplasia	228	54	282
Femoral dysplasia/malrotation	39	9	48
Sequela paediatric hip disease	13	20	33

risk of selection bias. The annual incidence of hip arthroscopy in Norway (4.2 per 100 000 inhabitants) is comparable to that reported in Sweden (4.67 per 100 000), but substantially lower than in Denmark (13 per 100 000) [19, 30, 31]. In contrast, the mean incidence in England is 1.6 per 100 000 for hip arthroscopy and 0.43 per 100 000 for open hip preservation surgery, the latter compared with ~0.82 per 100 000 in Norway [19, 32]. Although absolute procedural volume remains modest, the population-adjusted rates observed in Norway are comparable to, or exceed, those reported in other registries. The registry's ability to prospectively collect large-scale data aligns with experiences from the Scandinavian and British registries and supports its role as an epidemiological and quality-improvement tool. Consistent with international literature, symptomatic FAI morphology was the main indication for hip arthroscopy, while acetabular dysplasia was the primary motive for open surgery [20, 21]. Femoral dysplasia or malrotation was the primary indication for nine arthroscopic procedures. Subanalysis showed that 78% underwent cam resection, and all but one procedure were performed by a single surgeon

Table 3 An overview of type and number (percentage) of open and arthroscopic procedures as reported by the surgeon.

Surgical procedures	Number of procedures (%)
Open surgery (n = 273)	
Periacetabular osteotomy	217 (79)
Femoral derotational osteotomy	20 (7)
PAO & FDO	18 (6)
Isolated cam resection	7 (3)
Isolated acetabular rim resection	5 (2)
Cam and rim-resection	7 (3)
Other	2 (1)
Arthroscopy (n = 740)	
Isolated cam resection	293 (40)
cam resection and labrum suture	58 (8)
Isolated acetabular rim resection	13 (2)
Acetabular rim resection and labrum suture	101 (14)
Cam and acetabular rim resection	35 (5)
Cam and rim resection and labrum suture	146 (20)
Isolated labrum suture	55 (7)
Labral debridement	145 (20)
Labral resection	17 (2)
Labral reconstruction	1 (0)
Cartilage debridement	235 (32)
Cartilage microfracture	4 (1)
Loose bodies removal	39 (5)
Psoas tenotomy	6 (1)

Table 4 Radiographic parameters for patients undergoing PAO or cam resection.

Radiographic parameters	Periacetabular osteotomy	Cam
Lateral center-edge angle	13 (–20–40)	
Tönnis/HTE angle	18 (–5–50)	
Alpha-angle		79 (42–120)

at Coastal Hospital Hagevik. According to the operating surgeon, these patients had concomitant cam morphology and acetabular retroversion and were scheduled for a staged approach, with arthroscopic cam resection preceding PAO to reduce the risk of symptomatic iatrogenic FAI.

Preoperative PROM data indicates significant pain, loss of function, and negative influence on quality of life and are comparable to the Danish, Swedish, and British registries. In this study, average improvement in iHOT-12 exceeded the MCID threshold value following arthroscopic hip preservation surgery, indicating both statistical and clinical significance at the group level. In the open surgery cohort, improvements were statistically significant, but did not consistently reach clinical significance; however, a trend towards

Table 5 Radiographic sign for cartilage degeneration.

Radiographic parameters	Open surgery	Arthroscopy	Total
Minimal joint space width			
<2 mm	0	1	1
2–3 mm	3	28	31
>3 mm	263	681	944
Subchondral cysts yes/no	4/260	65/646	69/906

clinical relevance was observed, possibly influenced by the small sample size. About half of the patients surpassed the PASS threshold 1 year postoperatively compared to 18% who were already above the PASS cutoff preoperatively. Unlike the Swedish and Danish registries, which solely focus on arthroscopic surgery, this registry includes both open and arthroscopic procedures. To our knowledge, only the British registry (NAHR) is equivalent to the Norwegian registry in this regard. They report similar short-term improvements in function and pain relief for both arthroscopic and open hip preservation surgeries [22].

FAI has been postulated to be a factor leading to OA and subsequently hip replacement surgery [28, 33–35]. The most common finding on acetabular cartilage status was debonding according to the Beck classification. Debonding has been identified as a predictor for subsequent hip arthroplasty, underscoring the importance of long-term surveillance of patients with FAI [36]. Clinical registries, such as the Norwegian Paediatric Hip Register and the Norwegian Arthroplasty Register (NAR), are valuable tools for investigating such associations. Furthermore, the registry may play a crucial role in monitoring the course of various paediatric hip disorders in adolescents such as developmental dysplasia of the hip (DDH), which is among the leading causes for secondary OA [37–39]. Acetabular dysplasia was the main indication for open surgery, and the majority underwent PAO. Previous studies have reported long-term survivorship of PAO to be 60% and 30% after 20 years and 30 years, respectively [3, 4]. Similar to the FAI postulate, long-term survivorship of the different PAO can be scoped using both this registry and NAR. Mean LCE angle in the PAO group was 18 degrees; however, the upper range extended to 40 degrees. A subset of PAO procedures was performed to correct acetabular retroversion rather than lateral undercoverage. Such anatomical anomalies highlight the need for caution when interpreting registry-based radiological parameters and emphasize the importance of detailed radiographic phenotyping.

A national registry plays an important role in monitoring the health care provided but relies on accurate feedback from the reporting institutions. To ensure the quality of the data, the registry performed a coverage analysis that demonstrated that 80% of all the hip preservation surgeries performed in 2021 and 2022 were captured, reflecting strong national coverage [19]. Measures to increase participation are

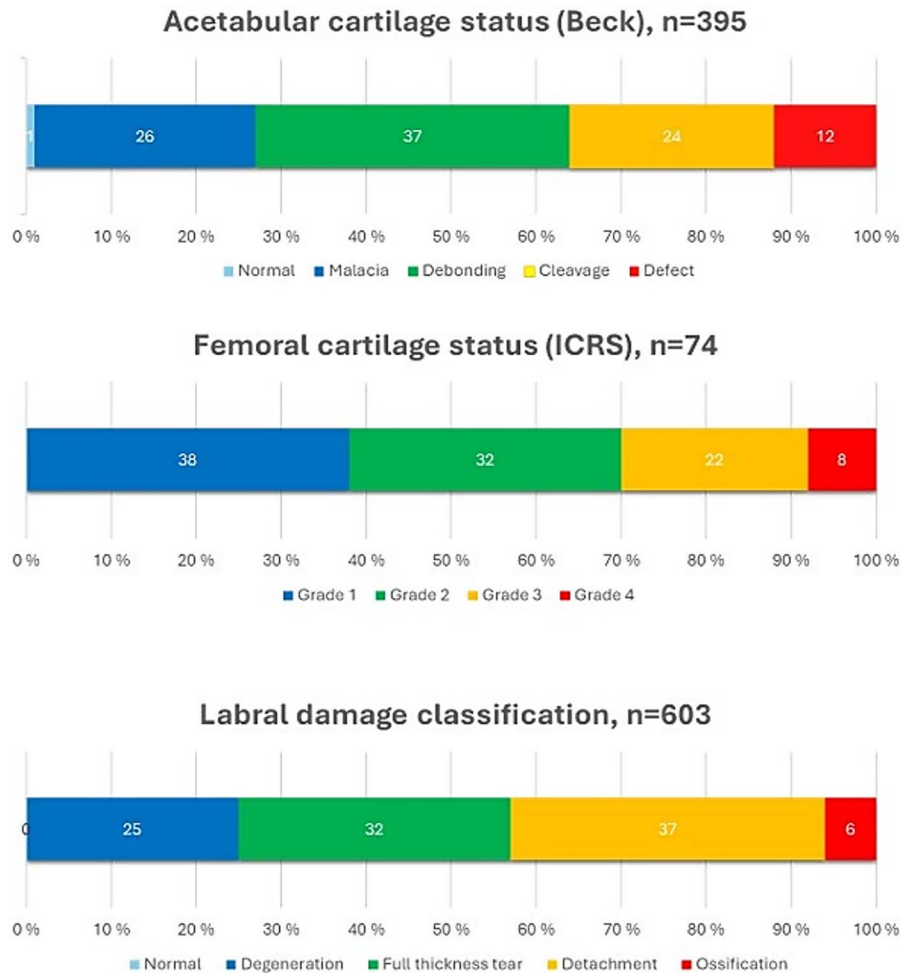


Figure 1 Distribution of reported labral and cartilage damage on both caput femoris (ICRS) and acetabulum (Beck).

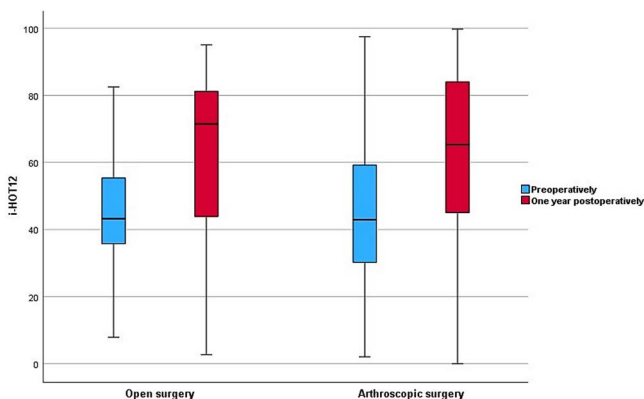


Figure 2 iHOT-12 outcome score preoperatively (blue) and 1 year postoperatively (red) for open and arthroscopic surgery. Mean improvement in iHOT-12 scores from 44.1 to 63.7 for open surgery (mean difference 19.6, 95% CI: 11.9–24.7, $P < .001$) and from 45.3 to 64.1 for arthroscopic surgery was observed (mean difference 18.8, 95% CI: 15.0–22.1, $P < .001$).

important and may be accomplished by written information or initiating meetings with the relevant institutes. However, the majority of patients undergoing hip preservation surgery

were included, which is important for reducing the risk of selection bias and exemplifies in this manner an important advantage of the registry. The transition to a fully electronic registration system is expected to improve coverage and will be continuously monitored within the registry.

Careful planning is important when creating a registry, particularly when it comes to logistical and technological challenges. Selecting appropriate patient-reported outcome tools and perioperative variables is crucial. The latter was especially challenging since this registry involves both open and arthroscopic procedures. iHOT-12, HSAS, and EQ-VAS utilize continuous scales, which often necessitates technical support to incorporate a sliding function onto the electronic chart. Due to the high prevalence of FAI in athletes and that iHOT-12 lacks questions on return to sport, it was decided to implement HSAS, which is a validated instrument for examining level of sport in patients with FAI [40–43]. It also facilitates the registry to compare outcomes for athletes both nationally and internationally. Choosing suitable standardized types of data variables and streamlining registry implementation can be accelerated by initiating early consensus meetings among experts in this field. Likewise, it is also important to create an easy and intuitive postoperatively web-based protocol to prevent missing reports. Various patient outcome measures

are utilized in the literature, such as iHOT-12, iHOT-33, HAGOS, Hip Disability and Osteoarthritis Score (HOOS), and modified Harris Hip Score (mHHS). The latter is the most commonly used PROM [44], but is not in consensus with the Warwick Agreement from 2016, which recommends using iHOT-12 and HAGOS for this young and active patient population [45]. For this reason, iHOT-12 was chosen due to its adequate responsiveness, test-retest reliability and validity. Furthermore, iHOT-12 has comparable sensitivity to its counterpart, the iHOT-33, but is approximately only one third in length [24]. iHOT-12 is therefore a short, precise and dependable outcome measurement tool that may contribute to minimizing the risk for questionnaire fatigue and subsequently loss of data in the follow-up process.

Registry-based research has several limitations. First, data input relies on voluntary and accurate reporting. Register data is thereby sensitive to the bad input—bad outcome principle. Secondly, only two centres contributed preoperative PROMs during the study period, yielding a 40% response rate for baseline PROMs. Furthermore, 38% had completed both preoperative and postoperative PROM and the response rate may have been influenced by the low number of preoperative PROM. However, this is expected to improve with the rollout of electronic preoperative PROM in 2025. Third, register-based studies are also, on a general basis, susceptible to confounding. Register data rarely depicts causality, but rather associations between exposure and outcome. Finally, long-term follow-up is vulnerable to attrition, although electronic PROM distribution implemented in 2025 is expected to improve completeness. Randomized controlled trials are considered the gold standard for clinical evidence, but are challenging to conduct in emerging fields such as hip arthroscopy where consensus on surgical standards and outcome measures is lacking. More recently, registries have started to support registry-based randomized controlled trials. Comparing outcomes using the same validated tools could pave the way for a common scientific language, and this registry may provide an evidence-based platform that could contribute to increased knowledge and improve the quality of care in hip preservation surgery.

Conclusion

The implementation of the Norwegian hip preservation registry enables systematic nationwide collection of demographic, radiological, and PROM data for both open and arthroscopic procedures. Early findings demonstrate clinically meaningful improvement following surgery and confirm the registry's potential as a platform for quality assurance and future research. Continued expansion and improved PROM completeness will further strengthen its value for clinical decision-making.

Conflicts of interest

None declared.

Funding

None declared.

Data availability

The publication of the complete dataset is restricted by regulations from the Norwegian Data Protection Authority and Norwegian data protection legislation. Anonymized dataset may be available upon formal request to the Norwegian Paediatric Hip Register.

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