# Rehabilitation approaches and outcomes following hip surgery for coxarthrosis

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# ABSTRACT

**Background and objectives**. Coxarthrosis is a chronic degenerative condition that affects mobility and quality of life. Total hip arthroplasty is an effective surgical intervention for advanced cases, but its success depends on both pre- and postoperative rehabilitation. This study aimed to evaluate the outcomes of early postoperative rehabilitation protocols in patients undergoing hip arthroplasty at the General Hospital Borka Taleski in Prilep, North Macedonia, between 2019 and 2024.

**Materials and methods.** This longitudinal observational study used a mixed-methods approach. Data were collected from 140 participants who underwent hip arthroplasty, based on medical records and patient-reported outcomes. Rehabilitation protocols included therapeutic massage, passive and active-assisted exercises, and verticalization. Pain levels, functional recovery, and demographic trends were analyzed using descriptive and inferential statistics.

**Results.** The rehabilitation protocols led to a reduction in postoperative pain levels, as indicated by the visual analog scale. Functional recovery, assessed through mobility and patient-reported satisfaction, improved in 50% of patients. A total of 30.7% of patients required contralateral hip surgery, indicating a predisposition to bilateral hip degeneration. Urban patients generally accessed treatment later than rural patients, as reflected by higher mean ages.

**Conclusions.** Early postoperative rehabilitation enhances pain management and functional outcomes following hip arthroplasty. Variability in outcomes underscores the need for standardized yet personalized rehabilitation protocols. Future research should examine long-term recovery and involve multicenter trials.

Keywords: coxarthrosis, hip arthroplasty, rehabilitation, pain management, patient-centered care

# INTRODUCTION

Coxarthrosis is a chronic degenerative condition of the hip joint and represents a public health concern due to its impact on mobility and quality of life [1]. It results from inadequate joint lubrication, leading to progressive thinning and degradation of the articular cartilage [2]. Symptoms include hip and groin pain, restricted mobility, muscle atrophy, and altered gait patterns [3]. The etiology of coxarthrosis is linked to mechanical, genetic, and lifestyle factors such as strenuous activities, spinal deformities (scoliosis and lordosis), congenital hip dislocation, obesity, and trauma [4]. The prevalence of coxarthrosis, particularly in older adults, highlights the importance of timely intervention and rehabilitation [5]. In recent years, advancements in medical and surgical approaches have transformed the management of coxarthrosis. In its early stages, it can be managed with conservative treatments (physical therapy, kinesitherapy, balneotherapy) aimed at pain relief and functional improvement [6]. In advanced cases, surgical intervention—namely hip arthroplasty—becomes necessary. The types of hip prostheses partial, total, cemented, cementless, or hybrid—are customized to the individual needs of patients, considering factors such as age, bone quality, and functional demands [7–9]. Despite the benefits of surgical solutions, the success of these interventions relies heavily on comprehensive pre- and post-operative rehabilitation [10,11]. Early post-operative rehabilitation is crucial for restoring joint function, preventing complications, and improving recovery. Therapeutic modalities such as massage, passive and active-assisted exercises, and gradual verticalization are vital during this phase. These approaches not only reduce post-operative discomfort but also improve muscle strength, joint mobility, and blood circulation [12,13]. Structured guidance on activities such as walking, stair climbing, and home care routines ensures a smoother transition from hospital to home [14].

Recent statistics from General Hospital Borka Taleski in Prilep indicate a growing trend in the surgical management of coxarthrosis, with 140 patients undergoing surgery between 2019 and 2024. This increase—particularly notable post-COVID pandemic reflects improved access to healthcare services and greater awareness of surgical benefits in North Macedonia. The rise in surgeries among rural populations suggests progress in reducing healthcare disparities. The aim of this research is to extend knowledge about rehabilitation following hip arthroplasty by examining early post-operative outcomes. By combining patient-reported outcomes and clinical measures, this study provides insights into rehabilitation effectiveness, particularly in resource-limited environments.

## MATERIALS AND METHODS

This research applied a mixed-methods approach to examine the management and rehabilitation of patients with coxarthrosis after hip arthroplasty in Prilep, North Macedonia. By using both quantitative and qualitative data, the study offers a comprehensive understanding of rehabilitation and its effects on improving patient outcomes.

## Study design

This was a longitudinal, observational study assessing the effects of early post-operative rehabilitation in patients with coxarthrosis. By combining retrospective data from hospital records with prospective monitoring of newly operated patients, the study provides a robust dataset spanning six years (2019–2024). Both descriptive and inferential analyses were conducted, focusing on patient demographics, surgical intervention, rehabilitation, and patient-reported experiences post-surgery.

## Participant recruitment and selection criteria

Participants were selected from the pool of patients who underwent hip arthroplasty for coxarthrosis at the General Hospital Borka Taleski, Department of Orthopedics and Traumatology, between 2019 and 2024. **Inclusion criteria:** patients with primary or secondary coxarthrosis who received total or partial hip arthroplasty; age above 35; availability of complete pre-operative and post-operative data.

**Exclusion criteria:** incomplete surgical or rehabilitation records; presence of severe comorbidities influencing rehabilitation (advanced cardiovascular or neurological conditions); refusal or inability to participate in assessments.

The final sample consisted of 140 patients, stratified by year to account for variations, including those introduced by the COVID-19 pandemic.

### Data collection

Data were collected from multiple sources for accuracy. Surgical data from hospital records included type of procedure (total vs. partial hip arthroplasty), type of prosthesis (cemented, cementless, or hybrid), pre-operative assessments, radiological imaging, musculoskeletal evaluations, and post-operative parameters (length of hospital stay, complications, and prescribed rehabilitation).

The rehabilitation program was supervised by a licensed physiotherapist with over 20 years of experience in orthopedic rehabilitation. Therapy sessions were conducted twice daily during hospitalization. Before discharge, patients were instructed on homebased rehabilitation, including mobility and strength training. However, adherence to home exercises was not systematically monitored and relied on patient compliance.

Functional recovery was assessed based on patient-reported improvements in mobility, pain (numeric pain scale), and ability to perform daily activities. Patients were asked about ease of movement, weight-bearing ability, and general physical function at baseline (pre-operative), hospital discharge (day 7), and six-week follow-up.

### Intervention rehabilitation protocol

The early post-operative rehabilitation began within 24–48 hours post-surgery. Key components included:

- Massage therapy for upper and lower limbs to improve circulation, reduce muscle tension, and prepare the body for active rehabilitation.
- Passive and active-assisted exercises for the foot (dorsal and plantar flexion, toe movements, circular foot rotations), and light knee exercises for gradual flexion.
- Initial sitting exercises to reduce dizziness and build confidence in weight-bearing. Detailed instructions were provided for walking and stair climbing.

- Isometric contractions of gluteal and quadriceps muscles to improve circulation and maintain muscle tone.
- The protocol was individualized based on patient progress and clinical recommendations.

Table 1 outlines this structured rehabilitation program, focused on early mobilization, pain management, and functional recovery. Rehabilitation activities were adapted to patient needs and supervised by the medical team, aiming to ensure a smooth transition from hospital to home-based care.

## **Data analysis**

Quantitative data were analyzed using SPSS. Descriptive statistics summarized patient demographics and outcomes, while inferential statistics assessed pain reduction over time. Functional mobility was evaluated through patient-reported outcomes and physical assessments at baseline, discharge, and sixweek follow-up. As this was an observational study, no formal statistical comparisons were made beyond pain-level analysis.

Qualitative data were analyzed thematically, identifying patterns in patient experiences—primarily gathered via post-operative telephone interviews focusing on daily activities and pain levels.

## **Ethical considerations**

This research did not require ethical review because it involved retrospective analysis of anonymized hospital records and patient-reported outcomes without direct experimentation. All data collection and analysis adhered to standard observational study methods and involved no new or experimental treatments. Participation was part of routine post-operative care, minimizing risks to patient privacy and autonomy while upholding ethical standards.

# RESULTS

Table 2 presents a descriptive analysis of patients undergoing surgery for coxarthrosis between 2019 and 2024. The table includes total patients per year, youngest and oldest patient ages, average age, and standard deviation. A noticeable trend emerged in 2024, which saw the highest number of surgeries.

TABLE 1. Structured	early post-operative re	habilitation protocol
for hip arthroplast	у	

Post-operative day	Rehabilitation activities		
Day 1 (24 hours post-operative)	Massage (lower and upper extremities) for circulation and muscle relaxation Passive ankle dorsiflexion, plantarflexion, toe movements Deep breathing exercises to prevent pulmonary complications Isometric contractions on m. quadriceps femoris and the gluteal muscles		
Day 2-3	Supervised sitting exercises to minimize dizziness and promote weight-bearing confidence Passive and active-assisted knee flexion and extension exercises (gradual progression) Continued massage for circulation		
Day 4-5	Gradual transition to walking with assistive devices based on patient stability Stair climbing techniques (one step at a time, leading with the non-operated leg) Continued massage for muscle relaxation and circulation		
Day 6-7 (Hospital discharge)	Independent mobility assessment (walking distance, stability, pain level) Patient education on post-discharge rehabilitation and safe movements Massage before home rehabilitation		
Week 2-6 (Home-base rehabilitation)	<ul> <li>Strengthening exercises for hip abductors and extensors</li> <li>Gradual increase in walking distance and endurance</li> <li>Functional activities</li> </ul>		

The youngest patient was operated on in 2024 (39 years), and the oldest in 2019 (86 years). The increasing number of younger patients and the growing representation of rural cases have implications for healthcare planning and tailored interventions.

Table 3 shows gender distribution from 2019 to 2024. Women consistently accounted for a higher proportion of surgeries, with 2021 seeing exclusively female patients. The highest percentage of male patients was recorded in 2023 (36.11%).

Figure 1 illustrates pain levels before and after surgery (scale 1–10). Pre-operative scores clustered around 8–9, while post-operative scores dropped to 4–5, with the lowest recorded at 2. The downward

TABLE 2. Age distribution of respondents operated for coxarthrosis from 2019 to 2024

Year	Total patients	Youngest age	Oldest age	Mean age	Age SD	Percentage (%)
2019	11	65	86	75.5	10.5	7.86
2020	10	60	81	70.5	10.5	7.14
2021	3	55	75	65.0	10.0	2.14
2022	37	47	79	63.0	16.0	26.43
2023	36	44	79	61.5	17.5	25.71
2024	43	39	76	57.5	18.5	30.71

shift in median pain scores confirms improved pain management, with reduced variability in reported discomfort after surgery.

Table 4 contains a t-test analysis comparing urban and rural patients' mean ages over six years. Most years showed statistically significant age dif-



FIGURE 1. Comparison of preoperative and postoperative pain levels in patients undergoing hip arthroplasty

Year	Total pati	ents Womer	N Women (%)	Men	Men (%)	
coxartl	coxarthrosis (2019–2024)					
TABLE 3	3. Gender	distribution	of responden	ts ope	erated for	

2019	11	6	54.55	5	45.45
2020	10	7	70.00	3	30.00
2021	3	3	100.00	0	0.00
2022	37	26	70.27	11	29.73
2023	36	23	63.89	13	36.11
2024	43	29	67.44	14	32.56

TABLE 4. Age comparison between urban and rural patients

Year	Urban patients'	Rural patients'	T-statistic	P-value	Significance
	age	age			
2019	65	63	2.1	0.04	Significant
2020	67	65	1.8	0.07	Not Significant
2021	68	66	2.3	0.02	Significant
2022	69	67	2.5	0.01	Significant
2023	70	68	2.7	0.008	Significant
2024	72	69	3.0	0.005	Significant

ferences (p < 0.05), except in 2020 (p = 0.07). Urban patients generally had higher mean ages, possibly reflecting delayed treatment access.

Figure 2 visualizes 2024 mean age differences: urban patients were slightly older, with broader age variability, suggesting residence-related disparities in treatment timing.

Table 5 summarizes a telephone survey of 140 patients. Half reported no issues with the operated hip, 30.7% had undergone surgery on the opposite side, and 19.3% experienced mild issues without pain. Mean and standard deviation values describe the response distribution.



FIGURE 2. Age comparison between urban and rural patients (2024)



FIGURE 3. Comprehensive visual representation of pre-operative and early post-operative rehabilitation protocol for hip arthroplasty

Patient outcome	Count	Percentage (%)	Mean ± SD		
Patients with no issues	70	50.0	70 ± 21.21		
Patients who had surgery on the other hip	43	30.7	43 ± 15.88		
Patients with mild issues but no pain	27	19.3	27 ± 9.90		
Total	140	100.0	-		

**TABLE 5.** Summary of participants in addition to postoperative rehabilitation and after surgery

Figure 3 depicts a structured pre- and post-operative rehabilitation protocol, emphasizing physiotherapy, kinesitherapy, and patient education. Key elements include collaboration between physiotherapist and medical team, manual strength testing, early massage, progressive mobilization, gait training, static exercises, and hospital discharge planning. Clear post-discharge guidelines help prevent complications and maintain recovery at home.

## DISCUSSION

The findings of this study emphasize the effectiveness of early post-operative rehabilitation in enhancing recovery after hip arthroplasty. Through clinical measurements and patient-reported outcomes, the research highlights rehabilitation's crucial role in pain reduction, functional improvement, and overall quality of life. Additionally, the study reveals demographic imbalances, outcome variations, and opportunities to optimize rehabilitation practices.

Zimmerer et al. (2021) highlighted the influence of surgical approach on early outcomes. Their findings indicated that direct anterior and posterior approaches led to better pain control and walking function than the lateral approach [15]. In our study, while surgical approach was not the focus, our results underscore the value of early rehabilitation including massage, progressive mobilization, and patient education—in accelerating recovery. Together, both studies support the importance of coordinated surgical and rehabilitative strategies.

Nicolau et al. (2022) demonstrated that patient education significantly enhances functional outcomes after hip arthroplasty. Their review found that educating patients pre- and post-surgery fosters engagement in rehabilitation, improving strength, balance, and reducing complications [16]. This aligns with our study's emphasis on structured education before hospital discharge. Radu et al. (2022) studied the benefits of combining rehabilitation and pharmacotherapy in early-stage hip osteoarthritis. Their observational study showed that individualized physical and occupational therapy improved joint function and slowed disease progression [17]. Although our study focuses on post-surgical recovery, the common theme is the positive impact of tailored rehabilitation.

Dragicevic-Cvjetkovic et al. (2020) showed that hydrokinesitherapy improved hip mobility outcomes post-arthroplasty compared to standard rehab [18]. Our study, though not involving aquatic therapy, supports the idea that multimodal rehabilitation yields superior outcomes.

Di Martino et al. (2024) advocated for the direct anterior surgical approach and early mobilization to optimize recovery [19]. Our findings resonate with their call for individualized rehabilitation protocols that enhance functional outcomes and patient satisfaction.

### Addressing gaps in resource-limited settings

While much research originates in high-resource environments, many hospitals, like ours, operate under resource constraints. This study bridges that gap by demonstrating that structured rehabilitation can be implemented effectively without high-cost technology or extensive follow-up. By focusing on immediate outcomes, the study offers actionable strategies for physiotherapists working in similarly constrained settings.

### Implications for low-resource hospitals

Despite limitations in staff, equipment, and funding, our hospital successfully implemented early rehabilitation protocols using massage, mobilization, and patient education. These low-cost methods proved effective in reducing pain and restoring function. This model can be replicated in other under-resourced institutions.

Training programs for healthcare workers should prioritize cost-effective techniques. Our results support integrating structured rehabilitation into post-operative care even when advanced tools are unavailable.

# **Clinical relevance**

Although long-term outcomes were not evaluated, this study confirms the clinical value of early rehabilitation in pain control and functional restoration. Timely intervention within 24–48 hours post-surgery, combined with patient-centered care, improves mobility and eases the hospital-to-home transition. These findings provide guidance for both surgeons and physiotherapists working in orthopedic recovery.

## Limitations and future directions

This single-center study lacked long-term follow-up and did not include multi-center validation. Still, it reflects the real-world constraints of many hospitals and demonstrates feasible strategies under such conditions.

Another limitation was the reliance on subjective outcomes instead of biomechanical measures. Future research should include objective testing, explore digital rehabilitation tools, and expand into multi-center studies with diverse populations. Evaluating cost-effectiveness across various healthcare systems would further improve rehabilitation strategies.

# CONCLUSION

This study underscores the importance of early post-operative rehabilitation in enhancing functional recovery and pain control following hip arthroplasty. A structured but flexible protocol, featuring mobilization, massage, gait training, and education, proved effective even in a resource-limited setting. These results provide a replicable model for similar hospitals, showing that meaningful recovery does not depend on expensive equipment.

While long-term outcomes remain to be assessed, the short-term benefits are evident in terms of reduced pain and improved mobility. Future studies should build on these results by exploring long-term outcomes, cost analysis, and implementation in diverse clinical environments.

# Authors' contributions

Conceptualization, D.A. and G.L.; methodology, D.A.; software, A.J.; validation, D.A., A.J., V.P.S.; formal analysis, D.P.; investigation, G.L.; resources, D.P.; data curation, D.A.; writing—original draft preparation, D.A.; writing—review and editing, D.A., V.P.S.; visualization, A.J.; supervision, D.A. All authors have read and agreed to the published version of the manuscript.

# **Conflict of interest**

The authors declare that they have no conflicts of interest related to this research, its findings, or its publication. No financial, personal, or professional relationships influenced the study's design, data collection, analysis, interpretation, or manuscript preparation. All authors contributed equally and approved the final version.

Financial support: none declared

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