Hip arthroscopy in France: an epidemiological study of postoperative care and outcomes involving 3,699 patients.

Elio Disegni, Pierre Martinot, Julien Dartus, Henri Migaud, Sophie Putman, Olivier May, Julien Girard, Emmanuel Chazard

Original article

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Elio **Disegni**[a,b*], Pierre **Martinot**[a,b], Julien **Dartus**[a,b], Henri **Migaud**[a,b], Sophie **Putman**[a,b], Olivier **May**[c], Julien **Girard**[a,b], Emmanuel **Chazard**[d,e]

a Univ. Lille, MABLab – Unité Labellisée de Recherche, ULR4490, F-59000 Lille, France

b CHU Lille, Service d'Orthopédie, Hôpital Salengro, Place de Verdun, F-59000 Lille, France

c Clinique Médipôle Garonne, F-31036 Toulouse, France

d Univ. Lille, ULR 2694 Metrics, CERIM, F-59000 Lille, France

e CHU Lille, Pôle de santé publique, F-59000 Lille, France

* Corresponding author: Elio Disegni,

Service d'orthopédie, Hôpital Salengro, CHU de Lille, place de Verdun,

59037 Lille cedex, France

Email: disegnielio@gmail.com

Tel: +33 6 33 49 24 47

Fax: +33 3 20 44 66 07

Abstract

Background:

Hip arthroscopy is a surgical procedure that is becoming more and more prevalent in France. Even though indications are now well-established little is still known about patient outcomes. Therefore, the purpose of our retrospective study was to: 1) describe the circumstances in which hip arthroscopies are being performed, 2) study arthroscopy and arthroplasty reoperation rates, 3) assess the incidence of readmissions for complications.

Hypothesis

Hip arthroscopy in France produced similar results to those observed in other countries.

Materials and Methods:

We conducted a cohort study from January 2008 to December 2014 in the French population using the national hospital discharge database called “Programme de médicalisation des systèmes d’information (PMSI).” We included all admissions that had a hip arthroscopy code and analyzed readmissions for conversion to hip arthroplasty, revision hip arthroscopy and complications (without being able to provide detailed descriptions). Risk factors associated with conversion, revision and readmission for complications were studied after performing a population analysis.

Results:

A total of 3,699 patients were included over a period of seven years. The mean age was 40 years, with women being significantly older (mean age of 43 years) than men (38 years) ($P < 0.05$). The number of procedures increased from 240 in 2008 to 702 in 2014. Synovectomies (67.9%; 2,514/3,699) and surgical bone procedures (acetabuloplasty or femoroplasty) (47.3%; 1,751/3,699) were the main procedures performed during the primary arthroscopy. In total, 410 patients underwent a conversion to arthroplasty, 231 patients had a revision arthroscopy, and 126 patients suffered a complication. Five years after the index procedure, the conversion rate was 16.3%, revision rate was 8.2%, and readmission rate for a postoperative complication was 5%. The main risk factor associated with conversions was (Hazard ratio (HR) and 95% Confidence Index (CI)) an age between 40 and 79 years during

the first arthroscopy (3.04 [2.40; 3.87] compared with the reference class of 25–39 years). Patients between ages 16 to 24 years during the first arthroscopy (0.35 [0.20; 0.61] compared with the reference class of 25–39 years) had a decreased risk of conversion (HR and 95% CI). The main risk factors associated with revisions were: synovectomies (1.90 [1.34; 2.70]) and surgical bone procedures on the femoral neck and/or the acetabulum (1.82 [1.36; 2.43]). The risk factor associated with complication-related readmissions was an age greater than 40 years (2.23 [1.43; 3.49]).

Conclusion:

Unlike the international literature, our study population was largely male. The rates of revision (8.2% after five years) and conversion to arthroplasty (16.3% after five years) were relatively low and comparable to the different international studies. This procedure, which is not widely performed, is growing in popularity, has low morbidity and remains an interesting approach given the revision and conversion rates after five years. The implementation of specific coding for arthroscopic hip procedures and the pathologies to be treated seems warranted.

Level of Evidence: IV; descriptive epidemiological study

Key words: Hip arthroscopy, Femoroacetabular impingement syndrome, Readmission, Complication, Hip arthroplasty

1.Introduction

Hip arthroscopy is a surgical procedure that is becoming more and more prevalent in France [1]. This technique is used to treat intra- or juxta-articular lesions [2–4]. First described in the early 1930s [5], its current indications are [6–17]: femoroacetabular impingement (FAI) [8, 12, 18], labral tears [19–21], synovial pathologies [22], septic arthritis [9, 11], muscle-tendon impingements [16, 23], and other indications [6, 7, 15, 21]. Labral tears are often secondary to FAIs [24] and together account for more than 75% of the indications for hip arthroscopy [15, 20, 25-27]. However, there is no specific coding for therapeutic hip arthroscopy in France. This technique has proven to be effective [6, 8, 28, 29] and superior to a purely medical treatment [30, 31]. Numerous other articular and extra-articular indications have been described [3, 9, 11, 15, 21, 22]. Over the years, advances in hip arthroscopy have led to a marked increase in the number of procedures [21, 26, 32, 33] and scientific publications [6, 34]. In France, the majority of procedures are performed by a limited number of practitioners, given the need for specialized instrumentation [2, 7] and the steep learning curve.

Analysis of the reoperation rate involving a new arthroscopy (revision) following index arthroscopic surgery clearly highlights the difficulties of this technique [35, 36–40]. Although other authors have reported variable rates [41, 42], revision surgery seems to improve clinical outcomes [43]. The study of the rate of revision to arthroplasty (conversion) also seems to be a key factor to better determine the indications for arthroscopy [29, 41, 44].

The data published on patient outcome after hip arthroscopy are relatively limited and mostly come from the US and the UK [14, 21, 36, 41, 42]. Since there was no available data in France, apart from series [45], we felt it was important to learn more about patient outcomes and decided to conduct a retrospective study using the French national hospital discharge database called “Programme de médicalisation des systèmes d’information (PMSI)” to: 1) describe the circumstances in which hip arthroscopies are being performed. 2) study revision and conversion rates. 3) assess the incidence of readmissions for complications. We hypothesized that hip arthroscopy in France gave comparable results to those found in other countries.

2. Patients and methods

2.1 Patients

All patients with at least one diagnostic or therapeutic hip arthroscopy procedure performed in France between 2008 and 2014 were included ("Classification commune des actes médicaux (CCAM)" [Common classification of medical procedures] codes: NEFC001, NEQC001 and NEJC001 (Table 1)). Patients who were younger than 16 years or who were aged 80 years or older, and patients who had another significant surgical procedure (arthroscopy of another joint, hip arthroplasty) at the same time, were excluded. Patients were followed until December 31, 2014.

A total of 3,984 patients with hip arthroscopy were identified. The study sample consisted of 3,699 patients after applying exclusion criteria (Figure 1), of these 1,666 (45.04%) were women and 2,033 (54.96%) were men. The mean age was 40 years (Standard deviation (SD) = 15.9; min 16 max 80; stable during the inclusion period ($P = 0.44$)). Women were significantly older (mean age 42.7 versus 38.3 ($P < 0.05$)) (Figure 2). The number of procedures increased sharply from 287 in 2008 to 702 in 2014 ($P < 0.05$).

Only 240 procedures (6.49%) were performed on an outpatient basis, and 2,563 procedures (69.3%) were performed in for-profit healthcare institutions. Out of a total of 3,699 procedures, the top three private centers were the "Clinique des Maussins" with 672 procedures, "Nouvelle Clinique Nantaise" with 291 procedures and "Clinique Médipôle Garonne" with 288 procedures. The top three main public hospitals were the "Centre Hospitalier Universitaire (CHU) de Lille" with 186 procedures, "Assistance Publique – Hôpitaux de Paris (AP-HP)" with 132 procedures and "Assistance Publique – Hôpitaux de Marseille (AP-HM) with 118 procedures.

Since there is no specific code for FAI in the International Classification of Diseases 10th revision (ICD-10), we grouped all indications into four major categories: infections, extra-articular lesions, intra-articular lesions and other nonspecific hip pathologies. We found that there was a majority of intra-articular lesions, which represented 45% of codes.

The two main procedures performed during an arthroscopy were: synovectomies (2,514 cases, 67.9%) and surgical bone procedures on the femoral neck (femoroplasty) and/or the acetabulum (acetabuloplasty) (1,751 cases, 47.3%).

2.2 Methods

We used existing standardized discharge summaries from all public and private hospital stays in France extracted from the PMSI national database. Diagnoses were coded using ICD-10 and procedures using CCAM. A unique and anonymous patient identifier made it possible to link their different stays, regardless of the institution. In so doing, we were able to recover the ICD-10 and CCAM codes from the first hospitalization of readmitted patients to identify both risk and protective factors. The assessment criteria were the rate of readmissions for hip arthroplasty (conversions), the rate of readmissions for a new arthroscopy (revisions), and the rate of readmissions for complications, and this regardless of the institution.

Factors that may influence the procedure outcomes were studied in all patients (Table 2).

2.3 Statistical analysis

Descriptive statistics were calculated for the variables of interest (mean and SD for symmetrical distributions and median, first and third quartiles for skewed distributions). The 95% confidence intervals (95% CI) were calculated using the central limit theorem. Discrete variables were expressed as rates of incidence and percentages and their 95% CIs were calculated using a binomial distribution. The independence between qualitative variables was assessed using either the Chi-square test or Fisher's exact test. Welch's t-test and the analysis of variance (ANOVA) were used to compare the means. The tests were bilateral, and significant when P was less than 5%. Any P-value less than 10^{-10} was reported as "P = 0."

Readmissions were depicted with the Kaplan-Meier estimator (95% CIs were calculated using normal distribution and reported in square brackets). Risk factors were identified among those already documented during the arthroscopy stay using a Cox model, with an expert iterative filtering method for covariates. The following cofactors were tested: patient characteristics, pathologies at the origin of the first arthroscopy, comorbidities, and patient care pathways. Adjusted hazard ratios (HRs) and their 95% CIs were presented. Data analysis was performed using R [46].

3. Results

Over the seven-year study, 3,699 arthroscopies were performed. Two hundred and thirty-one patients were readmitted for a revision arthroscopy. The survival rate without revision (with 95% CI) was 99% [98.7; 99.3] after 30 days, 95.9% [95.3; 96.6] after 1 year, and 91.8%

[90.7; 92.9] after 5 years. The factors associated with an increased risk of readmission for revision arthroscopy were (HR and 95% CI): synovectomies (1.90 [1.34; 2.70]) and surgical bone procedures on the femoral neck and/or the acetabulum (1.82 [1.36; 2.43]). Patients between ages 40 and 79 years during the index arthroscopy (0.61 [0.45; 0.82] compared with the reference class of 25–39 years) had a reduced risk of readmission for a revision arthroscopy (Figure 3). Four hundred and ten patients were readmitted for an arthroplasty (conversion). The survival rate without conversion was 99.8% [99.7; 99.9] after 30 days, 93.7% [92.9; 94.5] after 1 year, and 83.7% [82.0; 85.3] after 5 years (Figure 4). The factor associated with an increased risk of conversion was (HR and 95% CI) an age between 40 and 79 years during the index arthroscopy (3.04 [2.40; 3.87] compared with the reference class of 25–39 years). Patients between ages 16 and 24 years during the first arthroscopy (0.35 [0.20; 0.61] compared with the reference class of 25–39 years) had a decreased risk of conversion (HR and 95% CI) (Figure 5). One hundred and twenty-six patients were readmitted for one of the complications listed in Table 3. The complication-free survival rate was 99.6% [99.4; 99.8] after 30 days, 98.3% [97.8; 98.7] after 1 year, and 95% [94; 96] after 5 years. The factor associated with an increased risk of complications was (HR and 95% CI) an age between 40 and 79 years (2.23 [1.43; 3.49] compared with the reference age group of 25–39 years) (Figure 6).

4. Discussion

The literature comprises of several studies describing the epidemiology of hip arthroscopy (Table 4), but none of them until now had addressed a large series involving the French population. To our knowledge, ours is the first epidemiological study that focuses on hip arthroscopies in the overall French population. Based on a large number of patients (3,699) and a long follow-up period (up to seven years) it produced interesting results.

According to the literature, women represent 59.6% of the treated population [31], at different ages [26,27,32-34, 41, 47]. This technique is more effective in younger patients [48], but remains effective regardless of age [28, 49, 50]. While some authors have reported that prior hip arthroscopy does not affect the efficacy of subsequent hip resurfacing [51] or arthroplasty [52], others noted that it lowers the clinical benefits of arthroplasty [53]. Sex [54] and obesity [55, 56] do not impact the efficacy of arthroscopy. The complication rates for hip arthroscopies range from 1.2% to 14% [20, 21, 35, 36, 44, 57–59]. Patients who are obese or older than 65 years have a higher risk of deep vein thromboses (DVT) and postoperative pain [58, 59].

We observed that hip arthroscopies were mostly performed in men, and that the mean age was 42.7 years in women and 38.3 years in men (Figure 2). These data were not consistent with the literature [32], which reported a higher mean age in men than in women. This illustrates how care practices (indications, population, context) differ from one country to another and that a French study was needed. Moreover, the lower rate of outpatient hospitalizations compared to the American literature can be explained by various factors. For instance, hospitalization alternatives are being implemented in the US because the price is so much higher than in France.

On the other hand, we observed a cumulative risk of revision arthroscopy of 4.1% after 1 year and 8.2% after 5 years, which was consistent with the literature, which reported 5.31% after 6 months, 6.87% after 1 year, and 8.92% after 5 years [35, 41, 42]. This risk was even higher if the subject initially underwent a synovectomy or a surgical bone procedure. We cannot speak of a risk factor per se, because the CCAM code associated with synovectomy (NEFC001) is used for most hip arthroscopies, because a synovectomy, at least a partial one, is needed to access the peripheral compartment.

The risk of conversion in our study was 6.3% after 1 year, and 16.3% after 5 years, which was higher than the values reported in the literature with 2.85% after 1 year and 4.74% after 5 years [35] and 5.9% after 2 years in another study [41]. We encountered an already documented risk factor for conversion, which was the patient's advanced age [41, 60]. When an index arthroscopy has failed, surgeons tend to prefer arthroplasty over a revision arthroscopy for patients between ages 40 and 79 years, which explains the low risk of revision. Finally, unlike the literature, after appropriate adjustment, we did not find that obesity [41, 56] or the female sex [41, 42] played a role in patient outcomes.

We also found a cumulative risk of readmission for complications of 1.7% after 1 year and 5% after 5 years. These figures were difficult to compare with the literature, which reported incidence rates between 1.2 and 14% including patients who were not rehospitalized [20, 21, 35, 44, 57–59]. We found an increased risk in elderly patients, and subjects who were initially treated for hip infection, which was consistent with the literature [59].

This study had several limitations: 1) The primary limitation stemmed from its use of existing medical and administrative data. It was hampered by the lack of description of patients' initial lesions and pathologies, and the vagueness of ICD-10 codes, especially for complications that could not be detailed. Indeed, the majority of complications were reported under the code "T81" (complication of a diagnostic or therapeutic procedure). We were therefore unable to draw any conclusions. Since CCAM procedures are considered more reliable, they provide an opportunity to explore complications through the performed procedures. For

instance, FAIs can be assessed by examining the proportion of patients who underwent arthroscopic bone procedures because there are no specific codes for arthroscopic acetabuloplasty or labral repair. Similarly, the presence of a joint lesion can be assessed by searching for management of labial tears. It would therefore be interesting to review these codes in order to incorporate these different pathologies and procedures and bring them closer to the current realities of this technique. There is currently no code for FAI or its management, although its existence and the efficacy of its treatment have been proven by Level 1 studies [30, 31]. Furthermore, the lack of specificity of some codes (incomplete codes, code errors) results in a loss of statistical power used in the calculation of hazard ratios and impedes the identification of all risk and protective factors. It is also possible that some of the arthroscopies studied were actually revision procedures. The implementation of more specific codes would help clarify arthroscopic hip procedures. 2) The use of the database made it impossible to account for laterality. For instance, some patients might have undergone hip arthroscopy on one side and arthroplasty on the other. Consequently, the conversion rate was probably overestimated. However, using regional databases such as the New York [41], British [42] or Florida/California [60] databases, leads to underestimated conversion rates because they do not take into account procedures performed in other regions. 3) This study probably underestimated the total number of hip arthroscopy procedures because exclusions and revisions were not taken into account in the descriptive analysis. 4) Follow-up data for the last patients included were abbreviated because data analysis was stopped on December 31, 2014.

5. Conclusion

Unlike the international literature, our study population was largely male. The rates of revision (8.2% after 5 years) and conversion to arthroplasty (16.3% after 5 years) were relatively low and comparable to the different international studies. This procedure, which is not widely performed, is growing in popularity, has low morbidity and remains an interesting approach given the revision and conversion rates after five years. The implementation of specific codes for arthroscopic hip procedures and the pathologies to be treated seems warranted.

Conflicts of Interest: The authors below declare that they have no conflict of interests regarding this manuscript. Outside this study, Henri Migaud declares to be the editor-in-chief of Orthopaedics & Traumatology: Surgery & Research and an educational and research

consultant for Corin, Zimmer-Biomet, MSD and SERF. Sophie Putman declares to be an educational and research consultant for Corin. Julien Girard declares to be an educational and research consultant for Corin, Microport, and Smith and Nephew. Olivier May declares to be an educational and research consultant for Smith and Nephew, and Adler. The other authors declare they have no conflicts of interest regarding this manuscript or outside this study.

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Author contribution: E. Disegni: analysis and interpretation of data, drafting of the manuscript, and final approval of the version to be published. P. Martinot: critical revision of the manuscript and final approval of the version to be published. J. Dartus: critical revision of the manuscript and final approval of the version to be published. H. Migaud: initial study design and final approval of the version to be published. S. Putman: critical revision of the manuscript and final approval of the version to be published. J. Girard: critical revision of the manuscript and final approval of the version to be published. O. May: critical revision of the manuscript and final approval of the version to be published. E. Chazard: initial study design, acquisition, analysis and interpretation of data, drafting of the manuscript, and final approval of the version to be published.

Figure Legends

Figure 1: Flowchart of the study based on the PMSI database.

Figure 2: Age pyramid.

Figure 3: Hazard ratios of readmission factors for revision hip arthroscopy.

Figure 4: Survival curve of readmissions for arthroplasty.

Figure 5: Hazard ratios of readmission factors for arthroplasty.

Figure 6: Hazard ratios of readmission factors for complication.

References

[1] Erivan R, Villatte G, Dartus J, Reina N, Descamps S, Boisgard S. Progression and projection for hip surgery in France, 2008-2070: Epidemiologic study with trend and projection analysis. Orthop Traumatol Surg Res 2019;105:1227–35.

[2] Flecher X, Ollivier M, Parratte S, Argenson JN. Arthroscopie de hanche. EMC -Techniques chirurgicales - Orthopédie-Traumatologie 2018;13(1):1-8.

[3] Guicherd W, Bonin N, Gicquel T, Gedouin JE, Flecher X, Wettstein M, et al. Endoscopic or arthroscopic iliopsoas tenotomy for iliopsoas impingement following total hip replacement. A prospective multicenter 64-case series. Orthop Traumatol Surg Res 2017;103:S207–14.

[4] Mitchell JJ, Chahla J, Vap AR, Menge TJ, Soares E, Frank JM, et al. Endoscopic trochanteric bursectomy and iliotibial band release for persistent trochanteric bursitis. Arthrosc Tech 2016;5:e1185–9.

[5] Burman MS. Arthroscopy or the direct visualization of joints: an experimental cadaver study. 1931. Clin Orthop Relat Res 2001;390:5–9.

[6] De Sa D, Lian J, Sheean AJ, Inman K, Drain N, Ayeni O, et al. A Systematic summary of systematic reviews on the topic of hip arthroscopic surgery. Orthop J Sports Med 2018;6:2325967118796222.

[7] Chiron P. Technique et indications de l'arthroscopie de hanche. Cahiers d'enseignements de la SOFCOT. Conférences d'enseignement de la SOFCOT 2001. 78: p. 33-50.

[8] Fukui K, Trindade C a. C, Briggs KK, Philippon MJ. Arthroscopy of the hip for patients with mild to moderate developmental dysplasia of the hip and femoroacetabular impingement: Outcomes following hip arthroscopy for treatment of chondrolabral damage. Bone Joint J 2015;97:1316–21.

[9] Pohlig F, Mühlhofer HML, Lenze U, Lenze FW, Suren C, Harrasser N, et al. Diagnostic accuracy of arthroscopic biopsy in periprosthetic infections of the hip. Eur J Med Res 2017;22:6. doi: 10.1186/s40001-017-0246-0.

[10] Hwang DS, Noh CK. comprehensive review of advancements in hip arthroscopy. Hip Pelvis 2017;29:15–23.

[11] de SA D, Cargnelli S, Catapano M, Peterson D, Simunovic N, Larson CM, et al. Efficacy of hip arthroscopy for the management of septic arthritis: A systematic review. Arthroscopy 2015;31:1358–70.

[12] Dall'Oca C, Trivellin G, D'Orazio L, Sambugaro E, Mezzari S, Zanetti G, et al. Hip arthroscopy in osteoarthritis consequent to FAI. Acta Biomed 2016;(87 Suppl 1):46–52.

[13] Heaven S, de Sa D, Simunovic N, Williams DS, Naudie D, Ayeni OR. Hip arthroscopy in the setting of hip arthroplasty. Knee Surg Sports Traumatol Arthrosc 2016;24:287–94.

[14] Niroopan G, de Sa D, MacDonald A, Burrow S, Larson CM, Ayeni OR. Hip arthroscopy in trauma: A systematic review of indications, efficacy, and complications. Arthroscopy 2016;32:692-703.e1.

[15] Ross JR, Larson CM, Bedi A. Indications for Hip Arthroscopy. Sports Health 2017;9:402–13.

[16] Nelson IR, Keene JS. Results of labral-level arthroscopic iliopsoas tenotomies for the treatment of labral impingement. Arthroscopy 2014;30:688–94.

[17] Dei Giudici L, Di Muzio F, Bottegoni C, Chillemi C, Gigante A. The role of arthroscopy in articular fracture management: the lower limb. Eur J Orthop Surg Traumatol 2015;25:807–13.

[18] Flecher X, Wettstein M, May O. Limitations of arthroscopy for managing coxa profunda. Orthop Traumatol Surg Res 2019;105 Suppl8:S267–74.

[19] Kalisvaart MM, Safran MR. Hip instability treated with arthroscopic capsular plication. Knee Surg Sports Traumatol Arthrosc 2017;25:24–30.

[20] Weber AE, Harris JD, Nho SJ. Complications in Hip Arthroscopy: A systematic review and strategies for prevention. Sports Med Arthrosc Rev 2015;23:187–93.

[21] Nakano N, Lisenda L, Jones TL, Loveday DT, Khanduja V. Complications following arthroscopic surgery of the hip: a systematic review of 36 761 cases. Bone Joint J 2017;99:1577–83.

[22] Blitzer CM, Scarano KA. Arthroscopic Management of Synovial Osteochondromatosis of the Hip. Orthopedics 2015;38:536-538.

[23] Colomb R, Khelifi A, Bertrand M, Mares O, May O, Marchand P, Kouyoumdjian P. Does endoscopic piriformis tenotomy provide safe and complete tendon release? A cadaver study. Orthop Traumatol Surg Res 2018;104:1193-1197.

[24] May O, Matar WY, Beaulé PE. Treatment of failed arthroscopic acetabular labral debridement by femoral chondro-osteoplasty: a case series of five patients. J Bone Joint Surg Br 2007;89:595–8.

[25] Harris JD, McCormick FM, Abrams GD, Gupta AK, Ellis TJ, Bach BR, et al. Complications and reoperations during and after hip arthroscopy: a systematic review of 92 studies and more than 6,000 patients. Arthroscopy 2013;29:589–95.

[26] Maradit Kremers H, Schilz SR, Van Houten HK, Herrin J, Koenig KM, Bozic KJ, et al. Trends in Utilization and Outcomes of Hip Arthroscopy in the United States Between 2005 and 2013. J Arthroplasty 2017;32:750–5.

[27] Ahmad SS, Hellgemeir M, Anwander H, Beck M. Surgical hip dislocation is more powerful than arthroscopy for achieving high degrees of acetabular correction in pincer type impingement. Orthop Traumatol Surg Res 2019;105:1339-1344

[28] Cvetanovich GL, Weber AE, Kuhns BD, Hannon CP, D'Souza D, Harris J, et al. Clinically meaningful improvements after hip arthroscopy for femoroacetabular impingement in adolescent and young adult patients regardless of gender. J Pediatr Orthop 2018;38:465–70.

[29] Kaldau NC, Brorson S, Hölmich P, Lund B. Good midterm results of hip arthroscopy for femoroacetabular impingement. Dan Med J 2018;65:A5483.

[30] Griffin DR, Dickenson EJ, Wall PDH, Achana F, Donovan JL, Griffin J, et al. Hip arthroscopy versus best conservative care for the treatment of femoroacetabular impingement syndrome (UK FASHIoN): a multicentre randomised controlled trial. Lancet 2018;391:2225–35.

[31] Palmer AJR, Ayyar Gupta V, Fernquest S, Rombach I, Dutton SJ, Mansour R, et al. Arthroscopic hip surgery compared with physiotherapy and activity modification for the treatment of symptomatic femoroacetabular impingement: multicentre randomised controlled trial. BMJ 2019;364:l185. doi: 10.1136/bmj.l185.

[32] Cvetanovich GL, Chalmers PN, Levy DM, Mather RC, Harris JD, Bush-Joseph CA, et al. Hip Arthroscopy Surgical Volume Trends and 30-Day Postoperative Complications. Arthroscopy 2016;32:1286–92.

[33] Pioger C, Harly É, Rattier S, Blancheton A, Loock E, Grob C, et al. Arthroscopy training in France: A resident perception and self-assessment. Orthop Traumatol Surg Res 2019;105 Suppl8:S397–402.

[34] Erivan R, Villatte G, Dartus J, Reina N, Descamps S, Boisgard S. Progression and Projection for Hip Surgery in France, 2008-2070: Epidemiologic Study With Trend and Projection Analysis Orthop Traumatol Surg Res 2019;105:1277-1235.

[35] Truntzer JN, Hoppe DJ, Shapiro LM, Abrams GD, Safran M. Complication rates for hip arthroscopy are underestimated: A population-based study. Arthroscopy 2017;33:1194–201.

[36] Pailhe R, Chiron P, Reina N, Cavaignac E, Lafontan V, Laffosse JM. Pudendal nerve neuralgia after hip arthroscopy: retrospective study and literature review. Orthop Traumatol Surg Res 2013;99:785-90

[37] Sardana V, Philippon MJ, de Sa D, Bedi A, Ye L, Simunovic N, et al. Revision hip arthroscopy indications and outcomes: A systematic review. Arthroscopy 2015;31:2047–55.

[38] Cvetanovich GL, Harris JD, Erickson BJ, Bach BR, Bush-Joseph CA, Nho SJ. Revision hip arthroscopy: A systematic review of diagnoses, operative findings, and outcomes. Arthroscopy 2015;31:1382–90.

[39] Gupta A, Redmond JM, Stake CE, Dunne KF, Hammarstedt JE, Domb BG. Outcomes of revision hip arthroscopy: 2-year clinical follow-up. Arthroscopy 2016;32:788–97.

[40] Newman JT, Briggs KK, McNamara SC, Philippon MJ. Revision hip arthroscopy: A matched-cohort study comparing revision to primary arthroscopy patients. Am J Sports Med 2016;44:2499–504.

[41] Kester BS, Capogna B, Mahure SA, Ryan MK, Mollon B, Youm T. Independent Risk factors for revision surgery or conversion to total hip arthroplasty after hip arthroscopy: A review of a large statewide database from 2011 to 2012. Arthroscopy 2018;34:464–70.

[42] Malviya A, Raza A, Jameson S, James P, Reed MR, Partington PF. Complications and survival analyses of hip arthroscopies performed in the national health service in England: a review of 6,395 cases. Arthroscopy 2015;31:836–42.

[43] Tissot C, Merlini L, Mercier M, Bonin N. Reasons for and functional results of repeated hip arthroscopy: A continuous prospective study of 17 revisions out of 295 primary hip arthroscopies at mean 28months' follow-up. Orthop Traumatol Surg Res 2017;103:645–9.

[44] Seijas R, Ares O, Sallent A, Cuscó X, Álvarez-Díaz P, Tejedor R, et al. Hip arthroscopy complications regarding surgery and early postoperative care: retrospective study and review of literature. Musculoskelet Surg 2017;101:119–31.

[45] Erivan R, Volkova V, Villatte G, Engels E, Descamps S, Boisgard S. Knee arthroscopy prospective observational study of patient information. Orthop Traumatol Surg Res 2019;29:1495–500.

[46] R Development Core Team. a language and environment for statistical computing: reference index. Vienna: R Foundation for Statistical Computing; 2010.

[47] Griffin DW, Kinnard MJ, Formby PM, McCabe MP, Anderson TD. Outcomes of

Hip Arthroscopy in the Older Adult: A Systematic Review of the Literature. Am J Sports Med 2017;45:1928–36.

[48] Bryan AJ, Krych AJ, Pareek A, Reardon PJ, Berardelli R, Levy BA. Are short-term outcomes of hip arthroscopy in patients 55 years and older inferior to those in younger patients? Am J Sports Med 2016;44:2526–30.

[49] Perets I, Gupta A, Chaharbakhshi EO, Ashberg L, Hartigan DE, Close MR, et al. Does bony regrowth occur after arthroscopic femoroplasty in a group of young adolescents? Arthroscopy 2017;33:988-995.

[50] Domb BG, Linder D, Finley Z, Botser IB, Chen A, Williamson J, et al. Outcomes of hip arthroscopy in patients aged 50 years or older compared with a matched-pair control of patients aged 30 years or younger. Arthroscopy 2015;31:231–8.

[51] Nam D, Maher P, Nath T, Su EP. Does a prior hip arthroscopy affect clinical outcomes in metal-on-metal hip resurfacing arthroplasty? Am J Orthop (Belle Mead NJ) 2014;43:E255-260.

[52] Haughom BD, Plummer DR, Hellman MD, Nho SJ, Rosenberg AG, Della Valle CJ. Does hip arthroscopy affect the outcomes of a subsequent total hip arthroplasty? J Arthroplasty 2016;31:1516–8.

[53] Perets I, Mansor Y, Mu BH, Walsh JP, Ortiz-Declet V, Domb BG. Prior arthroscopy leads to inferior outcomes in total hip arthroplasty: a match-controlled study. J Arthroplasty 2017;32:3665–8.

[54] Frank RM, Lee S, Bush-Joseph CA, Salata MJ, Mather RC, Nho SJ. Outcomes for hip arthroscopy according to sex and age: A comparative matched-group analysis. J Bone Joint Surg Am 2016;98:797–804.

[55] Gupta A, Redmond JM, Hammarstedt JE, Lindner D, Stake CE, Domb BG. Does obesity affect outcomes after hip arthroscopy? A cohort analysis. J Bone Joint Surg Am 2015;97:16–23.

[56] Gupta A, Redmond JM, Hammarstedt JE, Stake CE, Domb BG. Does obesity affect outcomes in hip arthroscopy? A matched-pair controlled study with minimum 2-year follow-up. Am J Sports Med 2015;43:965–71.

[57] Minkara AA, Westermann RW, Rosneck J, Lynch TS. Systematic review and meta-analysis of outcomes after hip arthroscopy in femoroacetabular impingement. Am J Sports Med 2019;47:488–500.

[58] Collins JA, Beutel BG, Garofolo G, Youm T. Correlation of obesity with patient-reported outcomes and complications after hip arthroscopy. Arthroscopy 2015;31:57–62.

[59] Anthony CA, Pugely AJ, Gao Y, Westermann RR, Martin CT, Wolf BR, et al. Complications and risk factors for morbidity in elective hip arthroscopy: A review of 1325 Cases. Am J Orthop (Belle Mead NJ) 2017;46:E1–9.

[60] Schairer WW, Nwachukwu BU, McCormick F, Lyman S, Mayman D. Use of Hip Arthroscopy and Risk of Conversion to Total Hip Arthroplasty: A Population-Based Analysis. Arthroscopy 2016;32:587–93.

Table 1: Hip Arthroscopy CCAM Codes

Codes	Procedures
NEFC001	Arthroscopic synovectomy of the hip joint
NEQC001	Arthroscopic exploration of the hip joint
NEJC001	Arthroscopic debridement and lavage of the hip joint

Table 2: Studied covariates

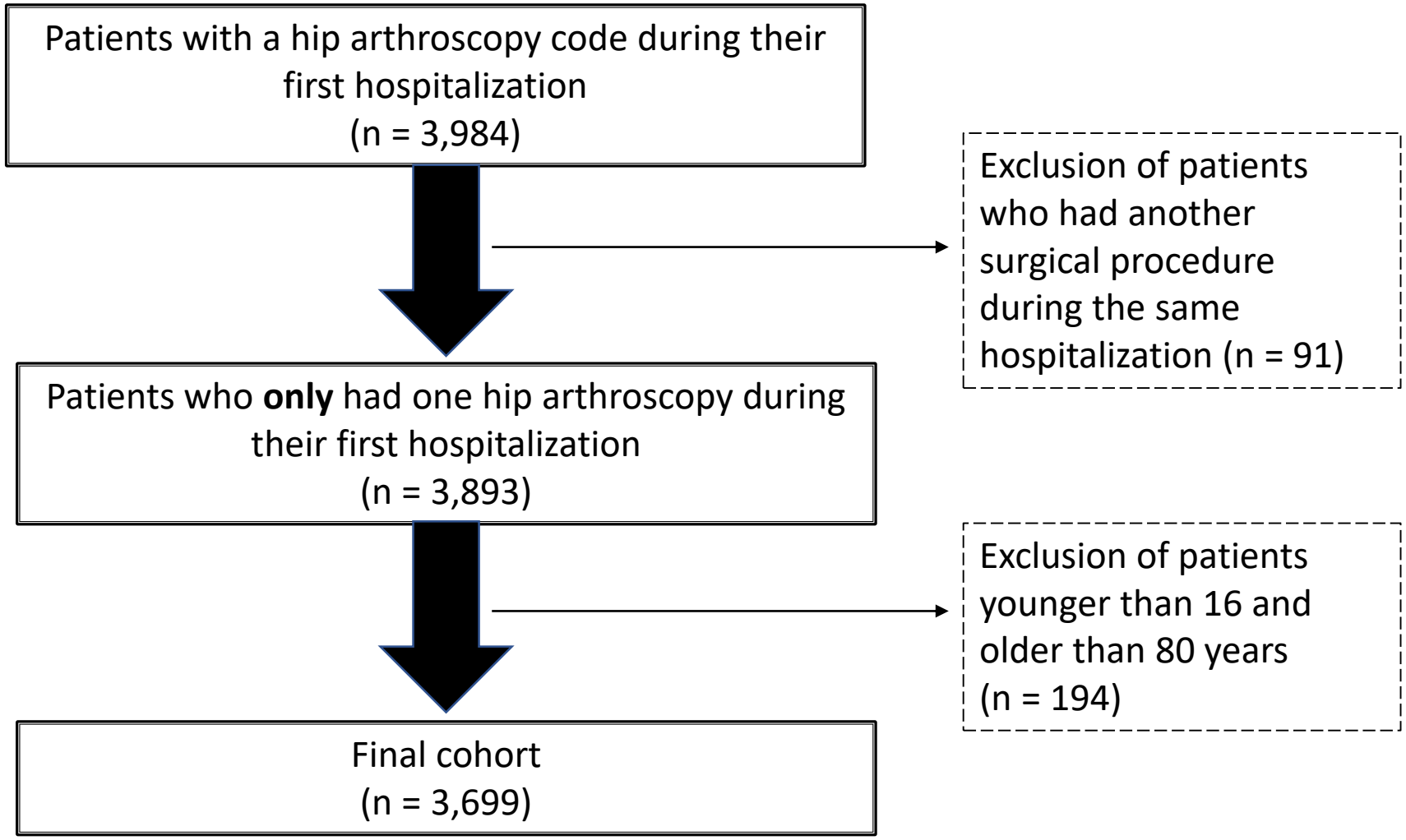
Covariates
Patient characteristics - Sex - Age
Pathologies at the origin of the first arthroscopy - Intra-articular foreign bodies - Native hip [joint] infection - Tenosynovitis of the iliopsoas or gluteus tendons - Synovial pathology - Osteochondrodysplasia - Acetabular protrusio
Comorbidities - Obesity - Diabetes - Cardiac pathologies - Pulmonary pathologies - Psychiatric pathologies - Endocrine pathologies - Urological pathologies - Gastrointestinal pathologies - Oncological pathologies - Hematological pathologies - Pathologies of a joint other than the hip
Emergency department admission
ICU stay
Types of healthcare institutions - Private - Public
Types of stay - Outpatient - Conventional

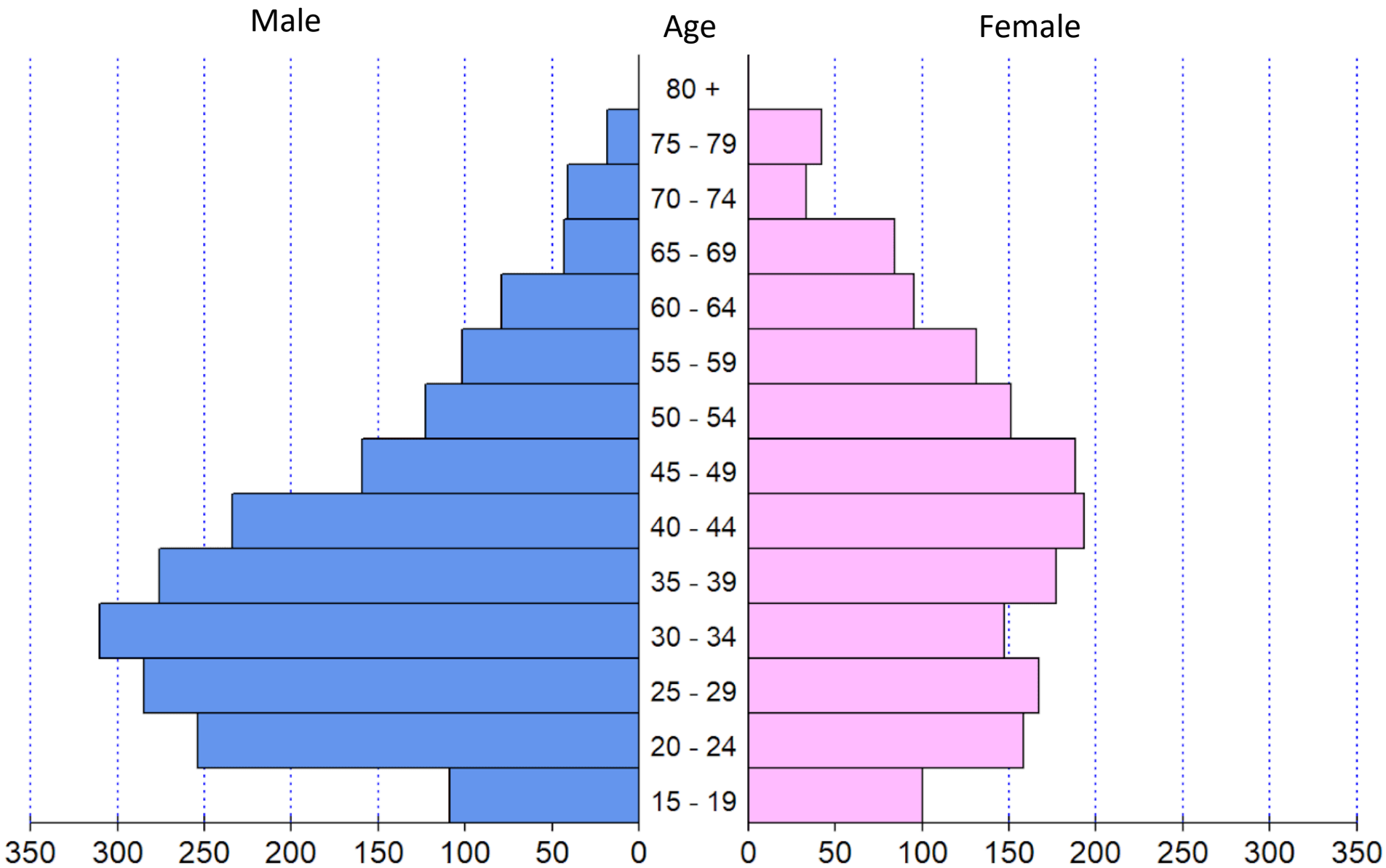
Table 3: Complications and ICD-10 Codes

Complications	Codes
Nerve compression	
- Sciatic nerve	G570
- Pudendal nerve	G588
- Lateral cutaneous nerve of the thigh	G571
Heterotopic ossification	M6125
Arthritis of the native hip joint	M1395
Deep vein thrombosis of the lower extremity	I803
Arthrofibrosis/Stiffness of joint	M2565
Femoral neck fracture	S720
Avascular osteonecrosis of the femoral head	M8795, M8705, M8735
Diagnostic or therapeutic procedure complication	T81

Table 4: Incidence of complications and reoperation and conversion rates from principle series and registries.

Registries/Series	Number of arthroscopies	Complications	Conversions	Reoperations
Weber et al. [20]	8,189	8%		
Nakano et al. [21]	36,761	3.3%		
Cvetanovich et al. [32].	1,338	1.3% *(after 30 days)*		
Truntzer et al. [35].	2,581	5.9%	4.7% *(after 5 years)*	8.9% *(after 5 years)*
(New York registry) Kester et al. [41].	3,957		5.9% *(after 2 years)*	3.7% *(after 2 years)*
(British registry) Malviya et al. [42].	6,395		10.6% *(after 1.4 years)*	4.5% *(after 1.7 years)*
Seijas et al. [44].	258	14%		
Minkara et al. [45].	1,981	1.7%	4.2%	0.7%
Sardana et al. [48].	448		8%	5.6%
(Florida/California registry) Schairer et al. [60].	7,351		11.7% *(after 2 years)*	
Present series	3,699	5% *(after 5 years,*	16.3% *(after 5 years)*	8.2% *(after 5 years)*


Patients with a hip arthroscopy code during their first hospitalization
(n = 3,984)
Exclusion of patients who had another surgical procedure during the same hospitalization (n = 91)
Patients who **only** had one hip arthroscopy during their first hospitalization
(n = 3,893)
Exclusion of patients younger than 16 and older than 80 years
(n = 194)
Final cohort
(n = 3,699)

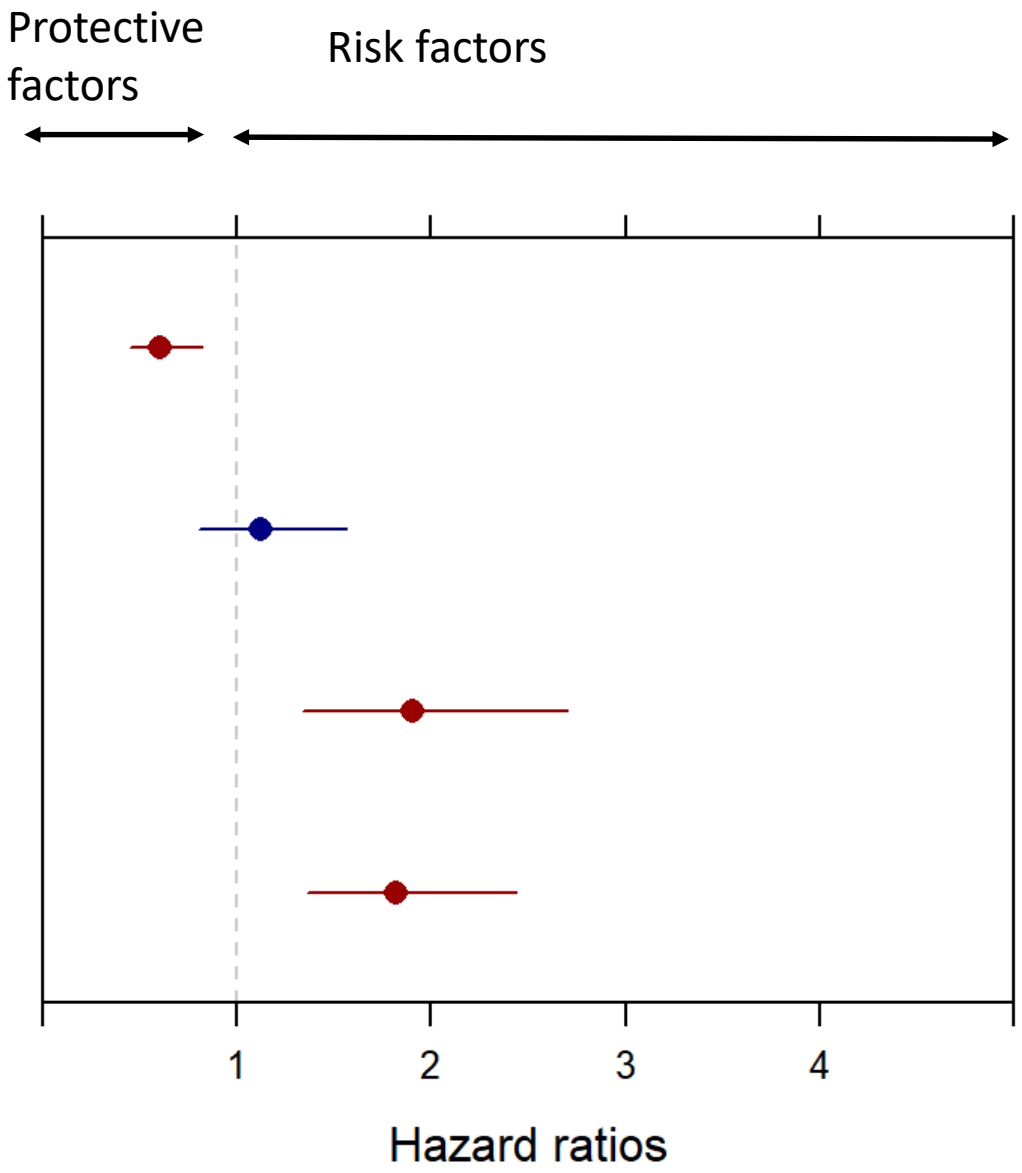

Male
Age
Female
80 +
75 - 79
70 - 74
65 - 69
60 - 64
55 - 59
50 - 54
45 - 49
40 - 44
35 - 39
30 - 34
25 - 29
20 - 24
15 - 19
350
300
250
200
150
100
50
0
0
50
100
150
200
250
300
350

Age (reference 25-39 years)

- 40 to 79 years
- 16 to 24 years

Arthroscopic synovectomy

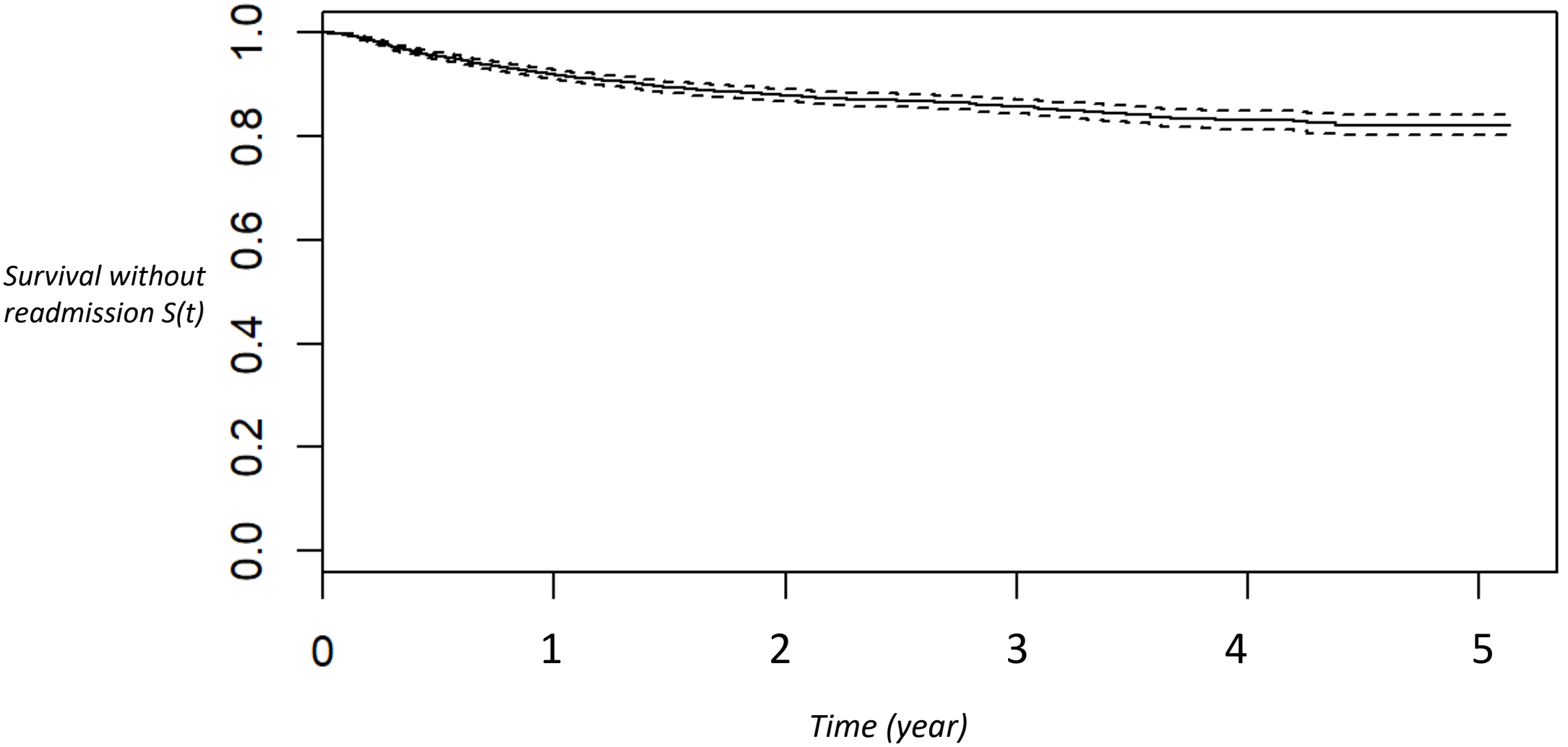
Arthroscopic bone procedure



--: Significant result

--: Nonsignificant result

Readmissions for hip arthroplasty

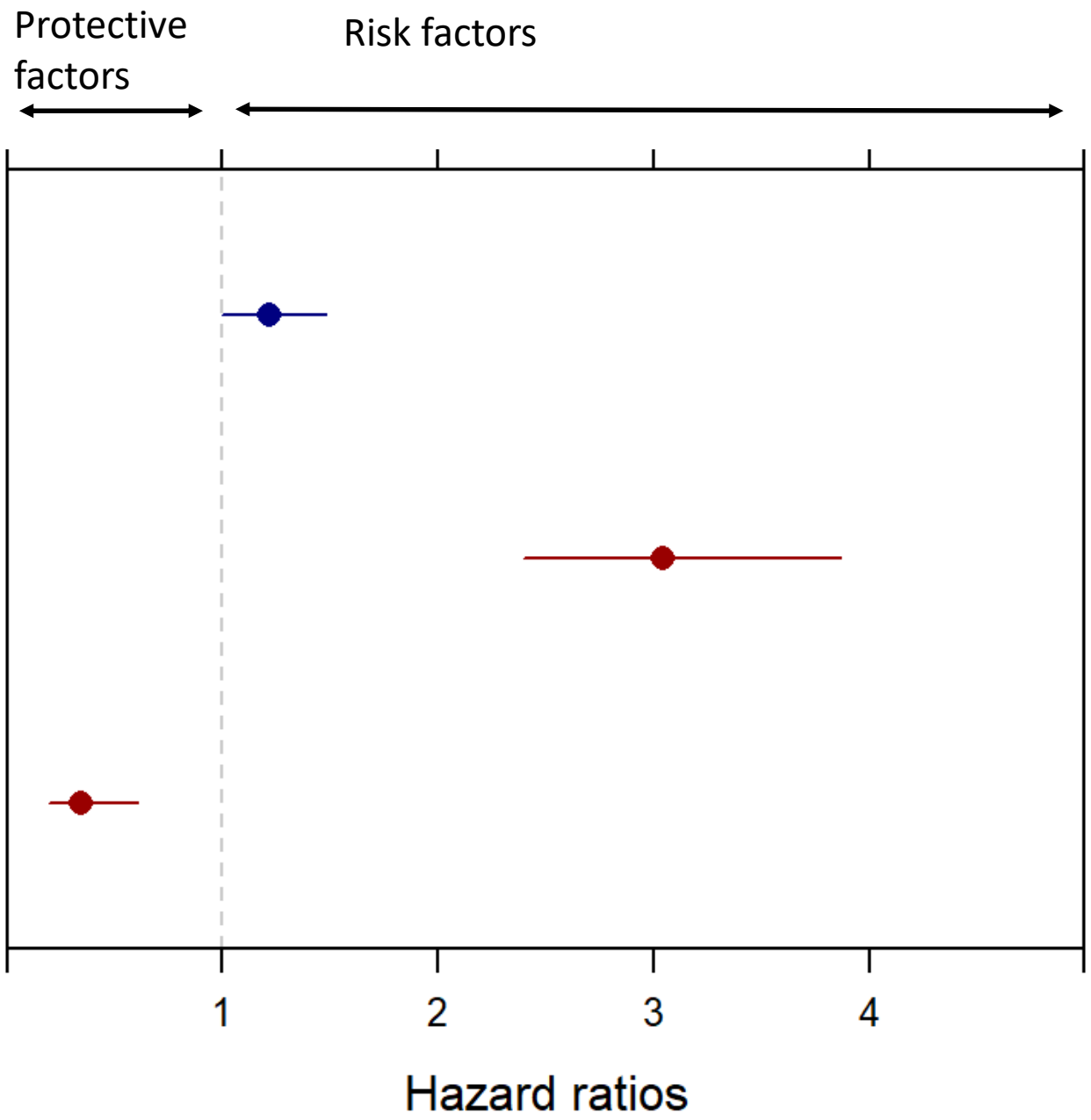


Nonprofit institution

Age (reference 25-39 years)

40 to 79 years

16 to 24 years



--: Significant result

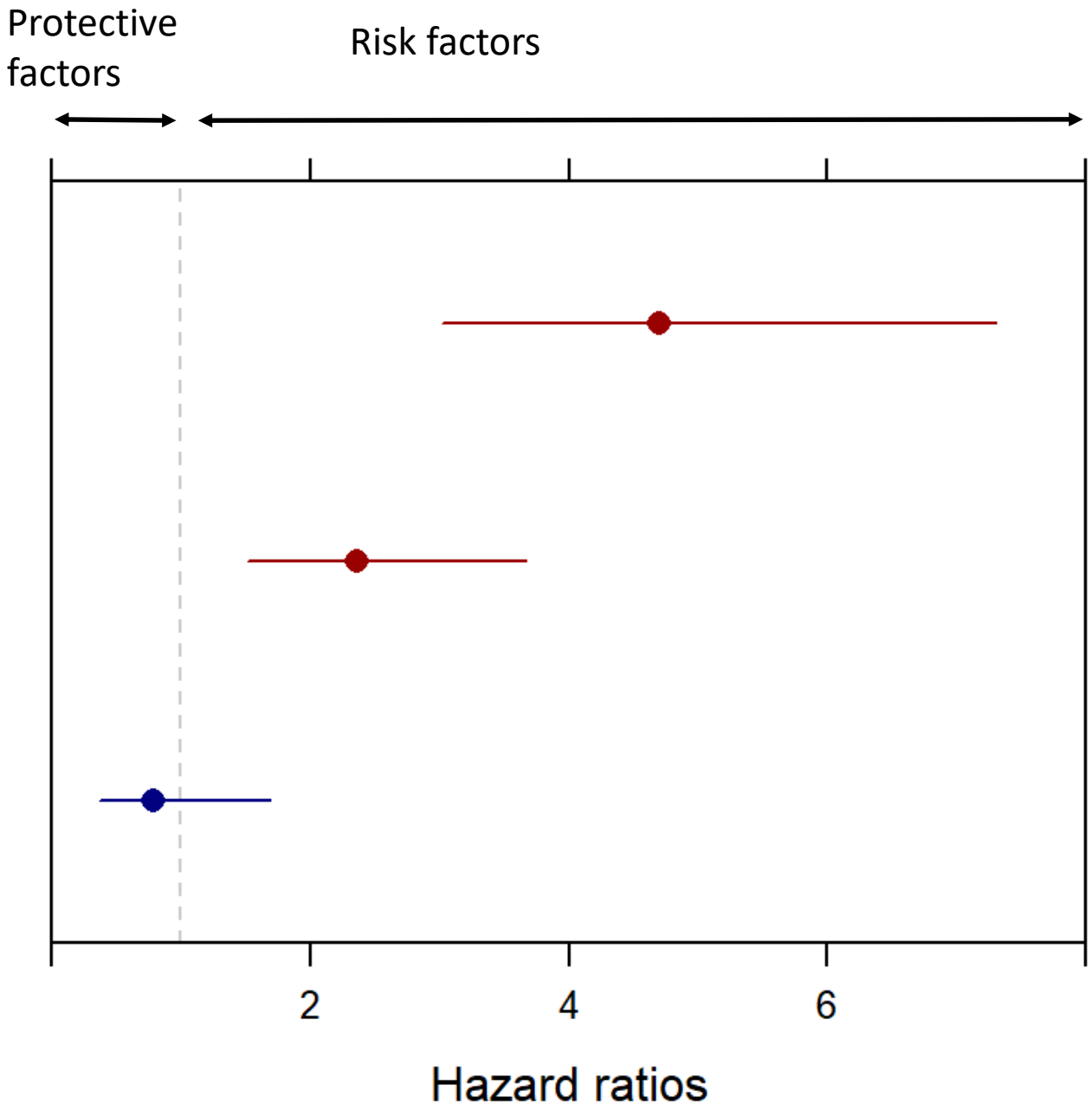
--: Nonsignificant result

Joint infection

Age (reference 25-39 years)

40 to 79 years

16 to 24 years



--: Significant result

--: Nonsignificant result