Journal of Hip Preservation Surgery, 2024, **11**, 8–12
DOI: https://doi.org/10.1093/jhps/hnad022
Advance access publication date: 26 July 2023
Research article

Trends in hip preservation surgery in Japan from 2014 to 2019 with a focus on hip arthroscopic surgery

Kensuke Fukushima[1*], Yuka Ogata[1], Yoshihisa Ohashi[1], Tomohisa Koyama[1], Katsufumi Uchiyama[2], Naonobu Takahira[3] and Masashi Takaso[1]

[1]Department of Orthopaedic Surgery, School of Medicine, Kitasato University, 1-15-1, Kitasato, Minami-Ku, Sagamihara City, Kanagawa 252-0374, Japan, [2]Department of Patient Safety and Healthcare Administration, School of Medicine, Kitasato University, 1-15-1, Kitasato, Minami-ku, Sagamihara city, Kanagawa 252-0374, Japan and [3]Department of Rehabilitation, School of Allied Health Sciences, Kitasato University, 1-15-1 Kitasato, Minami-ku, Sagamihara, Kanagawa 252-0374, Japan.

*Correspondence to: K. Fukushima. E-mail: kenfu@r4.dion.ne.jp

ABSTRACT

Secondary hip osteoarthritis due to hip dysplasia is common among Japanese populations. This study aimed to investigate the number of hip preservation surgeries performed in Japan and assess trends, by age and sex, from 2014 to 2019, focusing on hip arthroscopic surgery, based on the National Database of Health Insurance Claims and Specific Health Checkups of Japan (NDB). We downloaded the files 'Number of calculations by division, sex, and age group' under 'operation (code K)' from 2014 to 2019 from the NDB Open Data Japan database. Data on hip preservation surgeries were extracted, including the number for each surgical procedure and its incidence per year, calculated as the number of surgeries performed for each 10-year age group and by sex, regarding hip arthroscopic surgery. Overall, 14 891 hip preservation surgeries were performed in Japan over the study period, with pelvic osteotomy being the most common procedure. Although the incidence of hip preservation surgeries decreased from 2014 to 2019, there was a specific 1.54-fold higher incidence in hip arthroscopic procedures in 2019 compared to 2014. Hip arthroscopic labral repair was performed more frequently than synovectomy. The highest incidence of hip arthroscopic surgery was in the 40- to 49-years age group, with no difference in incidence between sexes ($P = 0.951$). In Japan, pelvic osteotomy was performed more often as a hip preservation surgery than hip arthroscopic surgery. Although hip arthroscopic surgery was developed in Japan, its use has not increased from 2017 to 2019.

INTRODUCTION

Hip arthroscopy has become a common technique for diagnosing and treating painful hips [1–3]. In particular, since the concept of femoroacetabular impingement (FAI) was accepted, advances in arthroscopic techniques and technologies as well as increasing interest in minimally invasive surgery have resulted in a substantial increase and utilisation of these methods [4, 5]. Accordingly, hip arthroscopy has become one of the fastest-growing orthopaedic procedures in the United States over the past decade [6–9]. However, secondary hip osteoarthritis (OA) due to hip dysplasia is more common among Japanese populations. A nationwide multi-institutional epidemiological study in Japan identified hip dysplasia in 81% (390/485) of the patients treated for hip OA [10]. Because of the unique characteristics of Japanese patients, hip osteotomy for developmental dysplasia of the hip (DDH) has been a common hip preservation surgery in Japan. However, no studies have investigated the incidence and trends of hip preservation surgeries, including hip arthroscopic surgery, in Japan over time.

Japan has a universal healthcare system, and all citizens are covered by some form of certificated medical insurance, in principle. The National Database of Health Insurance Claims and Specific Health Checkups of Japan (NDB) is one of the most exhaustive healthcare databases on a national level worldwide. The NDB is managed by the Ministry of Health, Labour and Welfare in Japan. The NDB is partially open and is free for the general public to use. The NDB Open Data Japan provides statistics on the Japanese healthcare system, including individuals' health conditions, and is intended to be comprehensible by the general public. The statistics are based on claims for both outpatients and inpatients and include diagnosis–procedure combinations, prescriptions, dental treatments and specific health checkups. Currently, the NDB Open Data Japan provides statistics from 2014 to 2019. In this study, we aimed to investigate the number of hip preservation surgeries performed in Japan and assess the trends in these surgeries. Furthermore, a detailed analysis of hip arthroscopic surgery was performed.

Submitted 25 September 2022; Revised 28 May 2023; revised version accepted 1 July 2023

Table I. ***Code Ks for the surgical procedures***

055-2	Rotational osteotomy of the femoral head
055-3	Femoral osteotomy
066-2	Hip arthroscopic synovectomy
066-4	Hip arthroscopic removal of the synovial membrane
080-6	Hip arthroscopic labral repair
140	Pelvic osteotomy
141	Shelf operation
141-2	Peri-acetabular osteotomy

MATERIALS AND METHODS

Ethics statements

This study was considered exempt from institutional review board approval as only data available to the public were used. There was no direct involvement of human participants or interventions.

Analysis of hip preservation surgery

We accessed the NDB Open Data Japan site (https://www.mhlw.go.jp/stf/seisakunitsuite/bunya/0000177182.html) and downloaded the Excel files 'Number of calculations by division, sex, and age group' under the 'operation (code K)' from 2014 to 2019. From the downloaded data, we extracted data on hip arthroscopic surgery (codes K066-2 and K066-4), femoral osteotomy (codes K055-2 and K055-3) and pelvic osteotomy (codes K140, K141 and K141-2); which were generally recognised as hip preservation surgeries. We excluded open reduction of the hip joint (K062) and soft tissue release around the hip joint (K026) because these are performed mainly for infants or in specific cases. Detailed code numbers and corresponding surgical procedures are shown in Table I. Until 2016, both labral repair and synovectomy or labral debridement were claimed as arthroscopic synovectomy (codes K066-2 and K066-4), with arthroscopic labral repair (code K080-6) established as an independent procedure in 2017. The number of surgical procedures performed per year and incidence for each surgical procedure, calculated as the number performed per 100 000 population per year, were evaluated. The population data were obtained from the official website of the Statistics Bureau of Japan (www.stat.go.jp).

Analysis of hip arthroscopic surgery

From the extracted data for arthroscopic synovectomy (codes K066-2 and K066-4) and arthroscopic labral repair (code K080-6), we investigated the change in trend in the number of both these procedures from 2014 to 2019 for each 10-year age group and by sex.

Statistical analyses

Descriptive analyses were used for the incidence of hip preservation surgeries in Japan for the 2014–19 study period. For trend analysis, the chi-square test was used to analyse contingency tables of arthroscopic synovectomy and arthroscopic labral repair was performed according to the 10-year age groups and by sex for the whole dataset. Statistical analyses were performed using SPSS for Windows (version 28.0; IBM Corp., Armonk, NY, USA). Statistical significance was set at $P < 0.05$.

RESULTS

Number and incidence of hip preservation surgeries

The number and incidence of each surgical procedure are shown in Table II. During the study period (2014–19), 14 891 hip preservation surgeries were performed in Japan, with approximately 2500 hip preservation surgeries performed annually. The incidence of hip preservation surgery slightly decreased over the study period, from 2.09 cases per 100 000 population in 2014 to 1.97 cases per 100 000 population in 2019.

The most common procedure for hip preservation surgery was pelvic osteotomy including shelf operation and periacetabular osteotomy, with ∼1400 procedures performed annually. The incidence decreased slightly from 1.21 cases per 100 000 population in 2014 to 1.03 cases per 100 000 population in 2019.

Specific incidence for hip arthroscopic surgery

In total, arthroscopic synovectomy, including labral repair, was performed in 498 cases in 2014 and 768 cases in 2019. In 2019, the incidence of arthroscopic labral repair (0.45 cases per 100 000 population) was three-fold higher than that of arthroscopic synovectomy (0.15 cases per 100 000 population). Approximately 590 cases of arthroscopic labral repair were performed annually. Compared to 2014, the total number of hip arthroscopic surgeries in 2019 increased by 1.54-fold. Of note, however, the cases of hip arthroscopic surgeries dramatically increased in 2017, the first year when arthroscopic labral repair was established as an independent procedure as an insurance claim. The number of arthroscopic labral repair cases remained relatively stable over the 3-year period, from 2017 to 2019, whereas the number of arthroscopic synovectomy cases decreased from 2017 (318 cases) to 2019 (195 cases).

To analyse trends in the age of patients undergoing arthroscopic synovectomy and arthroscopic labral repair, the patients were categorised into 10-year age groups, and the number of surgeries was calculated for each age group. As shown in Fig. 1, the number of arthroscopic synovectomies and arthroscopic labral repairs performed followed a unimodal distribution, with the highest number of these procedures performed in the 40- to 49-years age group. A significant relationship was found between the arthroscopic surgical procedure (synovectomy or labral repair) and patient age ($P < 0.001$).

When analysing sex-related trends in patients undergoing hip arthroscopic surgery, no significant difference was noted in the number of surgeries over the study period ($P = 0.951$).

DISCUSSION

This study revealed that approximately 2500 hip preservation surgeries, including hip arthroscopic surgery, were performed in Japan per year, from 2014 to 2019, with pelvic osteotomy being the most common procedure performed. The incidence of total hip preservation surgeries slightly decreased over the study period. For hip arthroscopy, 768 procedures were performed in 2019, with the proportion of hip arthroscopic procedures of the total hip preservation surgeries performed increasing from 18.9% (498/2636) in 2014 to 30.8% (768/2491) in 2019. These findings might reflect the recent development of hip arthroscopic procedures as hip preservation surgery in Japan.

Table II. ***Number and incidence of hip preservation surgeries from 2014 to 2019***

Surgical procedure	*2014*	*2015*	*2016*	*2017*	*2018*	*2019*	*Average*
Arthroscopic synovectomy	498 (0.39)	445 (0.35)	233 (0.18)	318 (0.25)	236 (0.19)	195 (0.15)	320.8 (0.25)
Arthroscopic labral repair	—	—	—	586 (0.46)	612 (0.48)	573 (0.45)	590.3 (0.47)
Total number of arthroscopic synovectomy and labral repair procedures	498 (0.39)	445 (0.35)	233 (0.18)	904 (0.71)	848 (0.67)	768 (0.61)	616 (0.49)
Femoral osteotomy	613 (0.48)	562 (0.44)	491 (0.39)	461 (0.36)	481 (0.38)	427 (0.34)	505.8 (0.40)
Pelvic osteotomy	1525(1.20)	1500 (1.18)	1317 (1.04)	1301 (1.03)	1221 (0.97)	1296 (1.03)	1360 (1.07)
Total	2636 (2.07)	2507 (1.97)	2041 (1.61)	2666 (2.10)	2550 (2.02)	2491 (1.97)	2481.8 (1.96)
Population (×100 000)	1272.4	1271.0	1269.3	1267.1	1264.4	1261.7	1267.6

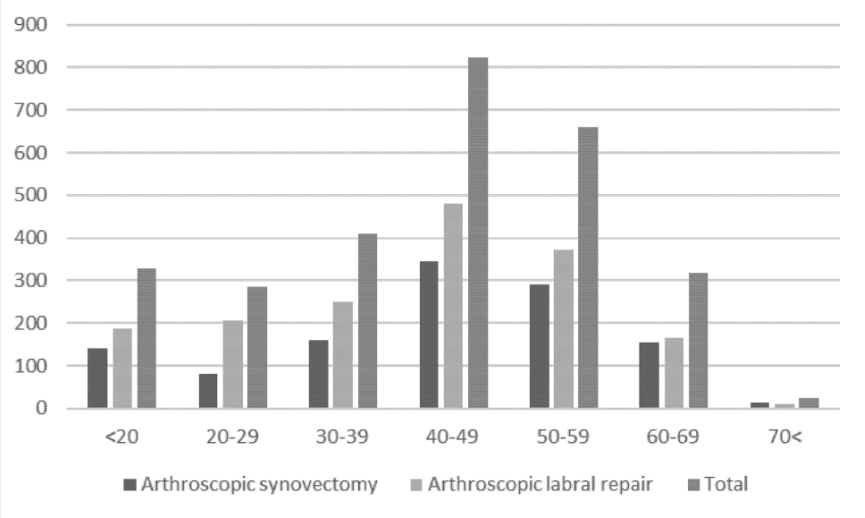

Fig. 1. Comparison by age. Distribution of the number of arthroscopic synovectomies, arthroscopic labral repairs and both procedures combined by age.

In the United States, studies of large databases have reported an increase in the incidence of hip arthroscopic surgery annually [6–8, 11]. Bonazza *et al.* reported a total of 62 782 hip arthroscopic surgeries performed in 27 997 patients from 2008 to 2013 [6]. The number of procedures per the number of patients in the database increased annually from 3762 total procedures (incidence: 0.91 cases per 100 000 population) in 2008 to 15 031 total procedures (incidence: 3.4 cases per 100 000 population) in 2013. Despite the different research durations in the US study compared to that in ours, our study found that the incidence of hip arthroscopic surgeries in Japan was relatively fewer than that in the United States. In a recent analysis of the Swedish National Patient Register, the number of hip arthroscopic surgeries remarkably increased from 15 cases in 2006 to 884 cases in 2014, with a subsequent steady decline to 469 cases in 2018 [12]. Although the population in Japan (125.8 million) is >10 times that of Sweden (10.35 million), the number and trends of hip arthroscopic surgeries in Sweden were comparable to those reported in our study. In Korea (population, 51.78 million), located in East Asia similar to Japan, Lee *et al.* reported 1262 cases of hip arthroscopy performed in 2010, with a more than two-fold increase over the study period from 2007 to 2010 [13]. However, no studies have clearly described the current state of hip arthroscopic surgery in East Asia, such as China and Korea. Hence, further research is needed.

Montgomery *et al.* described several factors attributed to the increased rate of hip arthroscopic surgery [14]. First, technological advances have made hip arthroscopy easier to perform. Second, diagnostic techniques for identifying hip pathology, such as magnetic resonance arthrography, have improved. Third, indications for hip arthroscopic surgery, such as FAI, have been broadened to include pathology previously treated with only open procedures. Fourth, the emphasis on hip arthroscopy and fellowship training programmes has been increasing. Specifically, increased awareness of the concept and treatment of FAI has influenced the development of hip arthroscopic surgery [15]. However, several papers have reported postoperative subluxations or even dislocations of the hip after arthroscopy in patients who showed hip instability, such as DDH [16–18].

Japanese patients have a unique hip morphology, with DDH being common [10]. Therefore, pelvic osteotomies, such as periacetabular osteotomy, have historically been a hallmark of hip joint treatment in Japan. Although several studies have reported on the prevalence of FAI among Japanese patients, the prevalence of hip instability due to DDH is still much higher than that of FAI in Japan [19–21]. Our results confirm this finding, with pelvic osteotomy identified as the most common hip

preservation surgery between 2014 and 2019 in Japan. Using the National Non-Arthroplasty Hip Registry in the United Kingdom, Holleyman *et al.* reported 558 cases of periacetabular osteotomy for DDH between 2012 and 2019 [22]. Although our data included surgeries for paediatric and adolescent patients, ∼1400 pelvic osteotomies were performed per year in Japan; this incidence is higher than that in other countries.

It is important not to underestimate the presence of microinstability due to subtle dysplasia and pay attention to the background of pathology with underlying hip instability, even in patients showing findings related to FAI [23]. Initially, after introducing the FAI concept, hip arthroscopic surgery has been performed even for patients with potential hip instability in Japan. As a result, some patients who experienced worsening clinical results after hip arthroscopy were reported [24]. To address this issue, the Japanese Hip Society proposed a strict diagnostic criterion for primary FAI in 2015 (Table III) [25]. Consequently, the diagnosis and treatment of FAI have been performed more carefully in Japan, which may have led to a reduction in the number and incidence of hip arthroscopic surgeries in Japan compared to those in other countries. As a result, the incidence of hip arthroscopic surgery decreased remarkably in 2016. However, it is possible that with an increased understanding of the clinical indications for hip arthroscopy and fellowship training programmes, the incidence of hip arthroscopy in Japan may increase in the future.

This study has some limitations. First, the study was conducted over a short duration, which limited a comprehensive trend analysis. Second, the diseases for which the surgeries were performed could not be assessed. For example, in the absence of a specific code for FAI surgery in the database (e.g. osteochondroplasty), findings on the number of surgeries performed in Japan for patients with a diagnosis of FAI could not be included. In addition, arthroscopic surgeries for soft tissues (e.g. hamstring or iliopsoas repair) are not included in a specific code. Third, details of the procedures and diagnoses of hip osteotomy could not be determined. Lastly, repeated surgeries and combined surgeries, such as hip osteotomy with arthroscopy, are not identifiable in the NDB Open Data Japan database. It would be significantly biased if multiple simultaneous operations were performed for the same patient as a separate operation. The NDB Open Data Japan database contains exhaustive data, including information on nearly all health insurance claims. In fact, the state of insurance claim information might not reflect the actual clinical status of patients. Since there is no established national registry or another big database for orthopaedic surgeries in Japan yet, no reports have assessed its validation [26]. Despite these limitations, we believe that our study provides relevant and important information on the current status of hip preservation surgery in Japan. Further studies conducted over a longer time period are warranted to assess the trends.

In conclusion, from 2014 to 2019, pelvic osteotomy remained the most common hip preservation surgery in Japan. Although hip arthroscopic surgery has developed in Japan, the incidence of hip arthroscopic surgeries was not increased over the last 3 years. The epidemiology of hip disorders among Japanese patients, with DDH being predominant, and the action of the Japanese Hip Society might have influenced the results presented. However, the incidence of hip arthroscopy in Japan may increase in the future with an increased understanding of the clinical indications for hip arthroscopy and fellowship training programmes.

Table III. ***Japanese Hip Society diagnostic criteria for primary FAI***

Radiographical findings
(i) CE angle >25°
(ii) Indicators for pincer-type impingement
(a) CE angle ≥40°
(b) CE angle ≥30° and an acetabular roof obliquity ≤0°
(c) CE angle ≥25° and positive cross-over sign
(iii) Indicators for cam-type impingement
(iv) Principal indicator: α angle ≥55°
(a) Accessory indicator: head–neck offset ratio <0.14, positive pistol grip deformity or positive herniation pit
(b) [a]Two indicators, including the principal indicator, are necessary as minimum criteria for FAI
Physical findings (reference)
(i) Positive anterior impingement test result
(ii) Positive Patrick's sign
(iii) Decreased angle of hip joint flexion and internal rotation with the hip joint in 90° of flexion (compared to the unaffected side)
Exclusion criteria
(i) *Previous hip disorders*
Inflammatory diseases (e.g. rheumatoid arthritis, ankylosing spondylitis, Reiter's syndrome or lupus), calcium pyrophosphate disease, diffuse idiopathic skeletal hyperostosis, bone tumours, gout, hemochromatosis, osteonecrosis, fractures around the hip, cartilage injury from infection or resulting from penetration of a fixation device into the intra-articular space, OA with obvious narrowing of the joint space, developmental hip disorders or hip deformities acquired during infancy or childhood (e.g. DDH, slipped capital femoral epiphysis, Legg–Calve–Perthes disease and epiphyseal dysplasia).
Previous hip surgery
FAI diagnosis
Primary FAI is strongly suspected in patients with preceding radiographical findings, continuous clinical symptom and referred symptoms on physical examinations.

Abbreviations: CE, centre edge; CT, computed tomography; MRI, magnetic resonance imaging.
[a]Evaluation of accurate radiographic anteroposterior images is required.
[b]False positives readily occur, particularly in terms of the cross-over sign; in such cases, confirmation of the presence of acetabular retroversion, using CT or MRI, is recommended.
[c]Evaluation using plain radiography, CT or MRI is also available.

DATA AVAILABILITY

The datasets supporting the conclusions of this article are included within the article. The raw data can be requested from the corresponding author.

ACKNOWLEDGEMENTS

We would like to thank Editage (www.editage.com) for English language editing.

FUNDING

This research did not receive any specific grant from funding agencies in the public, commercial or not-for-profit sectors.

CONFLICT OF INTEREST STATEMENT

All authors declare that no benefits in any form that are related directly or indirectly to the subject of this manuscript have been or will be received from a commercial party.

REFERENCES

1. Barbera J, Selverian S, Courington R *et al.* The top 50 most influential articles in hip arthroscopy. *Arthroscopy* 2020; **36**: 716–22.
2. Bedi A, Kelly BT, Khanduja V. Arthroscopic hip preservation surgery: current concepts and perspective. *Bone Joint J* 2013; **95-B**: 10–9.
3. de Sa D, Lian J, Sheean AJ *et al.* A systematic summary of systematic reviews on the topic of hip arthroscopic surgery. *Orthop J Sports Med* 2018; **6**: 2325967118796222.
4. Ayeni OR, Wong I, Chien T *et al.* Surgical indications for arthroscopic management of femoroacetabular impingement. *Arthroscopy* 2012; **28**: 1170–9.
5. Fayad TE, Khan MA, Haddad FS. Femoroacetabular impingement: an arthroscopic solution. *Bone Joint J* 2013; **95-B**: 26–30.
6. Bonazza NA, Homcha B, Liu G *et al.* Surgical trends in arthroscopic hip surgery using a large national database. *Arthroscopy* 2018; **34**: 1825–30.
7. Bozic KJ, Chan V, Valone FH III *et al.* Trends in hip arthroscopy utilization in the United States. *J Arthroplasty* 2013; **28**: 140–3.
8. Maradit Kremers H, Schilz SR, Van Houten HK *et al.* Trends in utilization and outcomes of hip arthroscopy in the United States between 2005 and 2013. *J Arthroplasty* 2017; **32**: 750–5.
9. Zhang AL, Feeley BT. Editorial commentary: the rise of hip arthroscopy: temporary trend or here to stay? *Arthroscopy* 2018; **34**: 1831–2.
10. Jingushi S, Ohfuji S, Sofue M *et al.* Multiinstitutional epidemiological study regarding osteoarthritis of the hip in Japan. *J Orthop Sci* 2010; **15**: 626–31.
11. Colvin AC, Harrast J, Harner C. Trends in hip arthroscopy. *J Bone Joint Surg Am* 2012; **94**: e23.
12. Wörner T, Eek F, Kraus-Schmitz J *et al.* Rapid decline of yearly number of hip arthroscopies in Sweden: a retrospective time series of 6,105 hip arthroscopies based on a national patient data register. *Acta Orthop* 2021; **92**: 562–7.
13. Lee YK, Ha YC, Yoon BH *et al.* National trends of hip arthroscopy in Korea. *J Korean Med Sci* 2014; **29**: 277–80.
14. Montgomery SR, Ngo SS, Hobson T *et al.* Trends and demographics in hip arthroscopy in the United States. *Arthroscopy* 2013; **29**: 661–5.
15. Zusmanovich M, Haselman W, Serrano B *et al.* The incidence of hip arthroscopy in patients with femoroacetabular impingement syndrome and labral pathology increased by 85% between 2011 and 2018 in the United States. *Arthroscopy* 2022; **38**: 82–7.
16. Murata Y, Fukase N, Dornan G *et al.* Arthroscopic treatment of femoroacetabular impingement in patients with and without borderline developmental dysplasia of the hip: a systematic review and meta-analysis. *Orthop J Sports Med* 2021; **9**: 23259671211015973.
17. Mei-Dan O, McConkey MO, Brick M. Catastrophic failure of hip arthroscopy due to iatrogenic instability: can partial division of the ligamentum teres and iliofemoral ligament cause subluxation? *Arthroscopy* 2012; **28**: 440–5.
18. Parvizi J, Bican O, Bender B *et al.* Arthroscopy for labral tears in patients with developmental dysplasia of the hip: a cautionary note. *J Arthroplasty* 2009; **24**: 110–3.
19. Fukushima K, Uchiyama K, Takahira N *et al.* Prevalence of radiographic findings of femoroacetabular impingement in the Japanese population. *J Orthop Surg Res* 2014; **9**: 25.
20. Mori R, Yasunaga Y, Yamasaki T *et al.* Are cam and pincer deformities as common as dysplasia in Japanese patients with hip pain? *Bone Joint J* 2014; **96-B**: 172–6.
21. Mimura T, Mori K, Itakura S *et al.* Prevalence of pincer, cam, and combined deformities in Japanese hip joints evaluated with the Japanese Hip Society diagnostic guideline for femoroacetabular impingement: a CT-based study. *J Orthop Sci* 2017; **22**: 105–11.
22. Holleyman R, Sohatee MA, Witt J *et al.* Periacetabular osteotomy for developmental dysplasia of the hip and femoroacetabular impingement: a study using the U.K. Non-arthroplasty Hip Registry (NAHR) data set. *J Bone Joint Surg Am* 2020; **102**: 1312–20.
23. Yamasaki T, Yasunaga Y, Shoji T *et al.* Inclusion and exclusion criteria in the diagnosis of femoroacetabular impingement. *Arthroscopy* 2015; **31**: 1403–10.
24. Uchida S, Utsunomiya H, Mori T *et al.* Clinical and radiographic predictors for worsened clinical outcomes after hip arthroscopic labral preservation and capsular closure in developmental dysplasia of the hip. *Am J Sports Med* 2016; **44**: 28–38.
25. Japanese Hip Society FAI working group. The Japanese Hip Society diagnostic guideline for femoroacetabular impingement. *Hip Joint* 2015; **41**: 1–6.
26. Nakayama T, Imanaka Y, Okuno Y *et al.* Analysis of the evidence-practice gap to facilitate proper medical care for the elderly: investigation, using databases, of utilization measures for National Database of Health Insurance Claims and Specific Health Checkups of Japan (NDB). *Environ Health Prev Med* 2017; **22**: 51.