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Original article

Analysis of the trends in arthroscopic meniscectomy and meniscus repair procedures in France from 2005 to 2017

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ABSTRACT

Introduction: In 2008, the French National Authority for Health (HAS) recommended that "conservative" treatments be adopted for meniscal lesions. This recommendation and the lack of superiority of meniscectomy over non-operative treatment for meniscus degeneration have modified the treatment pathway. However, the impact of these findings on French clinical practice is not known. The objective of this study was to evaluate the change over time in the number of alternative surgical procedures (meniscectomy and meniscus repair) and regional variation in France using data from the French agency for information on hospital care (ATIH).
Hypothesis: We hypothesized that the number of meniscectomy procedures will decrease, and the number of repair procedures will increase over time at various healthcare facilities.
Patients and methods: Between 2005 and 2017, the number of hospitalizations in the Medicine-Surgery-Obstetrics wards for meniscectomy (NFFC003 and NFCC004) or meniscus repair (NFEC001 and NFEC002) was evaluated overall and then based on whether the stay occurred in public or private sector hospitals in France. Data were extracted from the ATIH database and the findings were (1) related to French demographics during the period in question; (2) separated into public or private sector hospitals; (3) distributed into various regions in France and; (4) stratified by patient age.
Results: Between 2005 and 2017, 1,564,461 meniscectomy and 63,142 meniscus repair procedures were done in France. Over this period in the entire country, the meniscectomy rate gradually decreased from 19.80/10,000 inhabitants in 2005 to 15.77/10,000 inhabitants in 2017 (21.4% reduction) ($p < 0.0001$) while the meniscus repair rate increased from 0.42/10,000 inhabitants in 2005 to 1.36/10,000 inhabitants in 2017 (320% increase) ($p < 0.0001$). The largest meniscectomy reduction effort occurred in private sector hospitals, going from 15.79 to 12.01/10,000 inhabitants in 12 years; the decrease was smaller in public hospitals (going from 4.01 to 3.77/10,000 inhabitants) ($p < 0.0001$ in both cases). The change in the procedure ratio between private and public hospitals was asymmetric, with the meniscus repair/meniscectomy ratio clearly increasing more in public hospitals (4% to 12.6%) between 2005 and 2017 than in private hospitals (1.6% to 6.6%) ($p < 0.0001$). We found large regional differences: regions in Eastern France had higher meniscectomy rates, while regions in Western France had higher meniscus repair rates. When the analysis of procedures between 2008 and 2017 was stratified by age, a similar increase in repair procedures was found in all age brackets. Conversely, the reduction in meniscectomy was most apparent before 40 years of age, and the number of meniscectomy procedures was stable after 60 years of age.
Conclusion: These findings suggest there has been a significant shift in the surgical management of meniscal injuries towards more conservative treatments. But the large variations between regions in France is evidence of a continued disparity in clinical practices.
Level of evidence: IV, retrospective study without control group.

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1. Introduction

The meniscus plays a fundamental role in knee kinematics by intervening in load transmission, shock absorption and knee stability [1–3]. Meniscal lesions can have a congenital, traumatic or degenerative origin. For many years, arthroscopic surgical treatment of these lesions solely consisted of partial or total meniscectomy, before the first conservative meniscus repair techniques were introduced in the 1980s [4,5]. The deleterious effects of meniscectomy on clinical function and the development of osteoarthritis in the medium and long term are now well known [6–9]. Better understanding of the role of the meniscus, pathogenesis and meniscectomy outcomes led to the development of the "meniscus preservation" concept. This concept now rests on three approaches: meniscectomy as partial as possible—always arthroscopic—surgery avoidance (non-surgical treatment) and meniscus repair. Meniscus repair aims to trigger healing of damaged tissues. It assumes that a biological healing process is possible due to its peripheral vascularization network [10].

Recommendations of the French National Authority for Health (HAS) in June 2008 confirm the need to spare or preserve the meniscus tissue. In traumatic lesions, a meniscectomy that is as sparing as possible is reserved for non-repairable lesions [11]. For degenerative lesions, recent recommendations based on scientific proof of the lack of superiority of arthroscopic meniscectomy relative to non-surgical treatment have resulted in meniscectomy being indicated only following failure of non-surgical treatment or in rare instances with obvious mechanical signs [12]. However, the impact of these recommendations on clinical practice in France is unknown. This led us to conduct a systematic analysis of French data available on the website of the Agency for Information on Hospital Care (ATIH) to evaluate (1) the change over time in the number of procedures, and (2) regional variations in the surgical treatment options (meniscectomy vs meniscus repair). We hypothesized that the number of meniscectomy procedures would decrease while the number of repair procedures would increase over time in the various hospital settings.

2. Material and methods

2.1. Data extraction

In the period between 1st January 2005 to 31st December 2017, all hospitalizations in the medicine-surgery-obstetrics wards each year for meniscectomy procedures (NFFC003: lateral or medial meniscectomy of the knee, by arthroscopy and NFCC004: lateral and medial meniscectomies of the knee, by arthroscopy) or meniscus repair procedures (NFEC001: reattachment or repair of two menisci in the knee, by arthroscopy and NFEC002: reattachment or repair of one meniscus in the knee, by arthroscopy) were scanned and separated based on whether they were performed in a private sector or public sector hospital as defined in the quantified national target in France.

After collecting the raw data, the overall numbers were filtered to remove inconsistencies between procedures performed and the associated procedure codes (exclusion when a procedure code associated with that of meniscus surgery was atypical and did not apply to knee arthroscopy). We chose not to include meniscectomy and repair procedures performed by arthrotomy, as these are less common and may induce additional bias. It is important to specify that meniscus procedures combined with procedures on the knee joint (especially anterior cruciate ligament (ACL) reconstruction) were not captured by our analysis given it is theoretically impossible to associate these procedures during coding in ATIH database. Thus, our study pertains to meniscus procedures without associated ligament procedures, whether on a stable knee or lax knee that was or was not reconstructed beforehand. Extraction of anonymous data was done using the open-access ATIH web platform.

2.2. Data evaluation

The resulting data were:

- related to French demographics in the period of interest calculated by the French National Institute of Statistics and Economic Studies (INSEE) and expressed as the number of procedures per 10,000 inhabitants;
- separated into public sector or private sector hospitals;
- separated by regions in France (as defined by the Regional Health Agency in the French regional distribution in 2016);
- broken down by patient age into brackets of < 20 years/20–29 years/30–39 years/40–49 years/50–59 years/60+ years. Within this breakdown, a subgroup analysis was done using patients < 40 years of age and those > 50 years of age. The aim of the latter was to provide a less biased estimate due to the lack of diagnostic coding (separating degenerative and traumatic lesion), since patients < 40 years of age are more likely to suffer traumatic lesions and those > 50 years of age are more likely to suffer degenerative lesions. Patients 40 to 50 years of age were removed from this analysis to simplify this split.

2.3. Statistical analysis

This epidemiology study using the extensive data in the French medicalized information system program (PMSI) did not seek to compare data using mathematical inference methods (analysis of a sample to extrapolate the findings to the broader population). The numerical data are an exhaustive collection (but potentially biased due to the acquisition method) of our daily practice and as such, do not require a statistical model to assess their relevance. Nevertheless, informative calculations with the large-sample Chi-square test were done to provide comparisons of percentages and ratios that are backed up by figures.

3. Results

3.1. Meniscectomy versus meniscus repair

From January 2005 to December 2017, 1,564,461 meniscectomy procedures (20.05/10,000 inhabitants on average per year) and 63,142 meniscus repair procedures (0.81/10,000 inhabitants on average per year) without associated ligament procedures were carried out, all types of hospitals pooled together.

Throughout France, a gradual reduction of the meniscectomy rate was found, going from 19.80/10,000 inhabitants in 2005 to 15.77/10,000 inhabitants in 2017 (21.4% decrease) ($p < 0.0001$). In this same period, the meniscus repair rate went from 0.42/10,000 inhabitants in 2005 to 1.36/10,000 inhabitants in 2017 (320% increase) ($p < 0.0001$) (Table 1).

The repair/meniscectomy ratio (R/M) for all hospitals pooled together increased from 2.1 in 2005 to 8.6 in 2017 ($p < 0.0001$).

3.2. Trends by hospital type

The reduction in the meniscectomy rate was greater in private sector hospitals, going from 15.79/10,000 to 12.01/10,000 inhabitants in 12 years ($p < 0.0001$), than in public hospitals (going from 4.01/10,000 to 3.77/10,000) ($p = 0.3$).

Between 2005 and 2017, the meniscus repair rate went from 0.6/10,000 inhabitants to 0.79/10,000 inhabitants for private sector

Table 1
Number of surgical procedures per 10,000 inhabitants for each year with absolute value in parentheses.

Year	Meniscectomy private hospital	Meniscectomy public hospital	Meniscus repair private hospital	Meniscus repair public hospital
2005	15.79 (99071)	4.01 (25149)	0.26 (1607)	0.16 (1033)
2006	16.00 (101108)	4.30 (27151)	0.26 (1656)	0.14 (857)
2007	15.87 (100918)	4.33 (27526)	0.26 (1629)	0.15 (951)
2008	15.43 (98729)	4.36 (27901)	0.29 (1829)	0.16 (1004)
2009	15.08 (96972)	4.51 (29005)	0.33 (2147)	0.19 (1245)
2010	14.60 (94346)	4.47 (28895)	0.39 (2525)	0.20 (1315)
2011	14.38 (93390)	4.45 (28862)	0.42 (2723)	0.22 (1454)
2012	14.31 (93344)	4.47 (29173)	0.48 (3133)	0.27 (1765)
2013	13.47 (88308)	4.29 (28133)	0.55 (3637)	0.33 (2172)
2014	13.40 (88618)	4.28 (28317)	0.59 (3872)	0.35 (2317)
2015	12.93 (85942)	4.21 (27958)	0.67 (4423)	0.40 (2685)
2016	12.53 (83569)	3.97 (26457)	0.72 (4470)	0.50 (3315)
2017	12.00 (80382)	3.77 (25237)	0.79 (5282)	0.57 (3796)

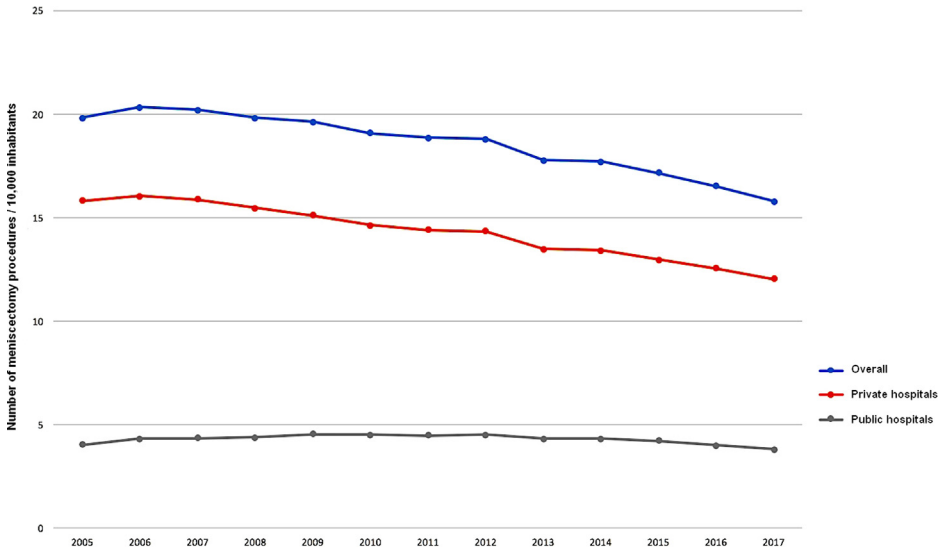

Fig. 1. Trends in meniscectomy procedures in public and private hospitals and overall. The number of procedures is reported per 10,000 inhabitants.

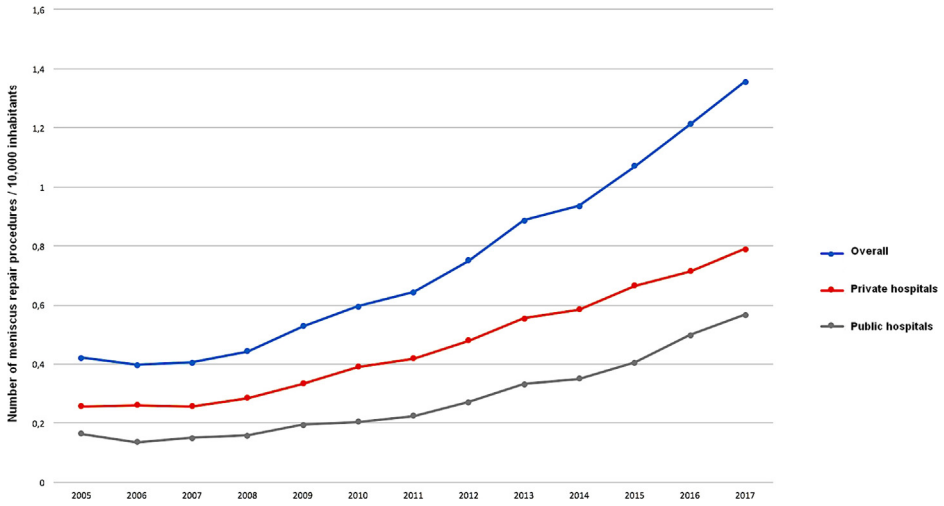

Fig. 2. Trends in meniscus repair procedures in public and private hospitals and overall. The number of procedures is reported per 10,000 inhabitants.

hospitals and from 0.16/10,000 inhabitants to 0.57/10,000 inhabitants for public hospitals ($p < 0.0001$) (Figs. 1 and 2).

The R/M ratio went from 1.64 to 6.6 for private hospitals ($p < 0.0001$) and 4.0 to 12.6 for public hospitals ($p < 0.0001$). The change was unequal between public and private hospitals with the ratio clearly increasing faster in public hospitals ($p < 0.0001$). In 2017, 41.8% of meniscus repair and 23.9% of meniscectomy procedures carried out that year were done at public hospitals.

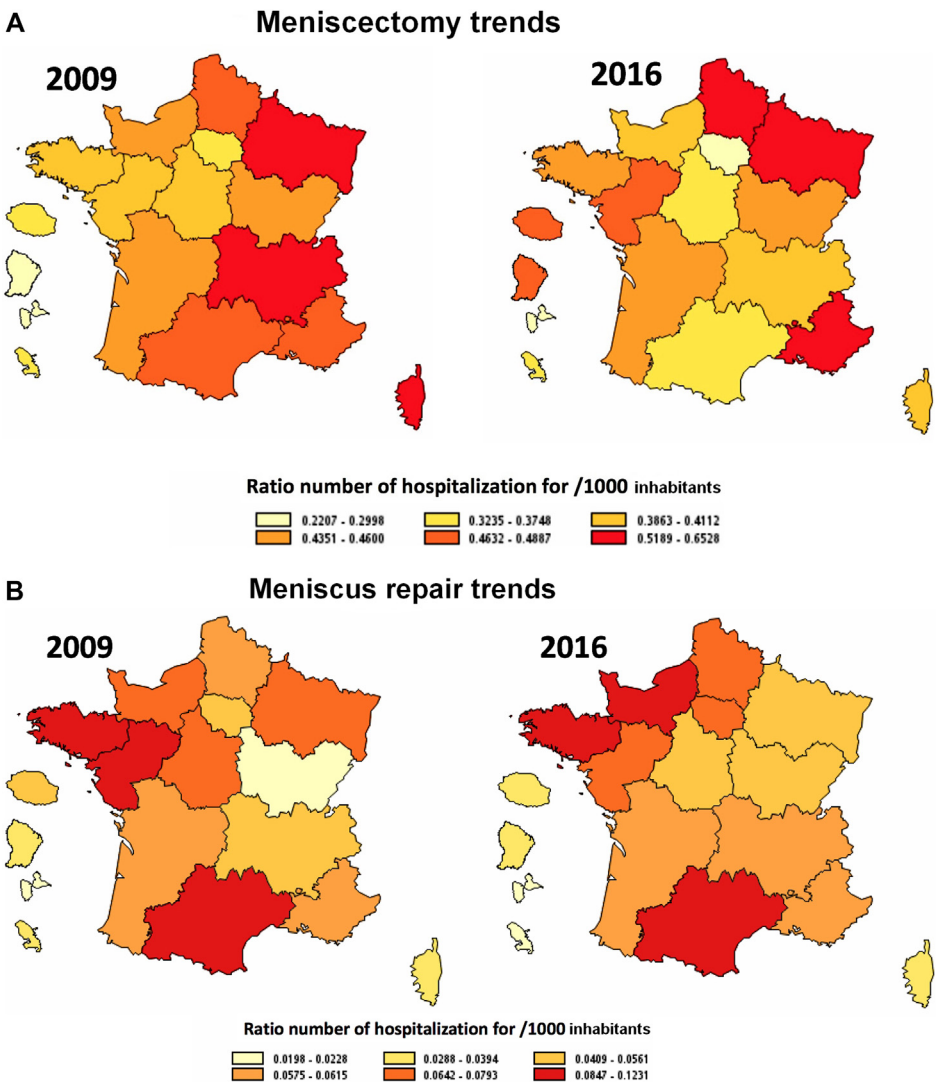

Fig. 3. Map of France showing how the meniscectomy and meniscus repair rates vary by region. The number of procedures is reported per 1000 inhabitants. A. Meniscectomy trends. B. Meniscus repair trends.

3.3. Regional trends

A regional difference was observed. For example, in 2012, there was a split between the Eastern regions where the meniscectomy rate was higher than in the remainder of France (Fig. 3A,B). The highest rates of meniscus repair were found in regions in the Northwest of France and around the Mediterranean.

3.4. Age breakdown

Between 2008 and 2017, there was an even increase in the number of meniscus repair procedures in all age brackets. There was an obvious reduction in the meniscectomy rate for the < 40 years segment, while this rate was relatively stable for the 50–59 years bracket and especially the 60+ years bracket (from 14.24/10,000 inhabitants in 2008 to 12.87/10,000 inhabitants in 2017 for 60+ years) (Figs. 4A,B).

In our analysis of the < 40 and > 50 segments, the reduction in the meniscectomy rate was confirmed in younger patients with a decrease from 55.9/10,000 inhabitants in 2008 to 38.1 in 2017 ($p < 0.0001$). This reduction was less pronounced in patients > 50 years of age with a change from 94.5/10,000 inhabitants in 2008 to 83.7 in 2017 ($p < 0.0001$).

4. Discussion

This study's main finding was the 21.4% reduction in the number of meniscectomy procedures performed between 2005 and 2017 in France and the 320% increase in the number of meniscus repair procedures performed, confirming our hypothesis. However, this change in clinical practices was not homogeneous and depended on the type of hospital (public or private), region in France and patient age. In fact, in private sector hospitals, a greater decrease in the meniscectomy rate was found (20% versus 6% for public hospital over 12 years), with no parallel increase in the number of meniscus repair procedures. In fact, 41.8% of all meniscus repair procedures and 23.9% of all meniscectomy procedures done in 2017 were performed at public hospitals. From a purely mathematical point of view, comparing percentages between different facilities and locations is affected by the mean regression phenomenon: the large difference in the volume of procedures between public and private hospitals "favors" public hospitals in our analysis, for which the changes are more "visible" and "marked" than at the private hospitals, where the modifications are more "compressed" and less obvious.

This difference in how practices have changed can also be seen in the regional distribution of the two procedures. In fact, the regional analysis found a split between Western France where

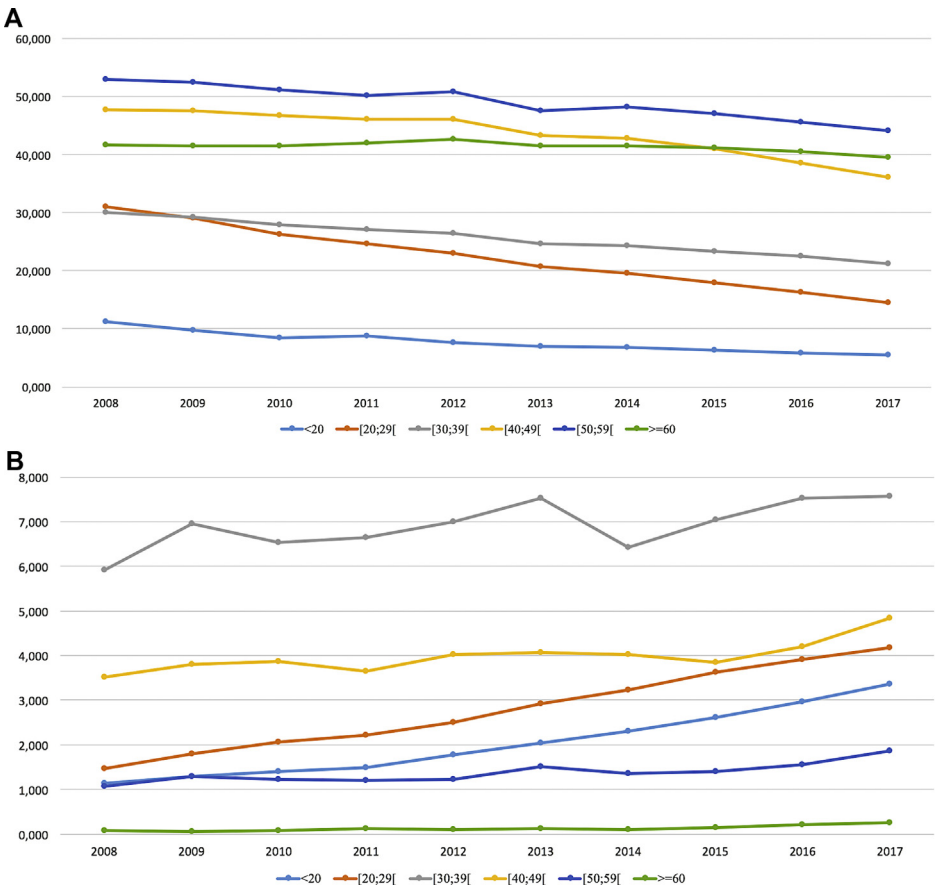

Fig. 4. Curves showing the trend in meniscectomy and meniscus repair rates by patient age. The number of procedures is reported by age bracket. A. Meniscectomy trends. B. Meniscus repair trends.

meniscal repair is performed more often and Eastern France where the meniscectomy rate is higher.

Few studies have looked into the surgical practice used to treated meniscal lesions. In the United States, Abrams et al. [13] reported that an increasing number of isolated meniscal repair procedures were done between 2005 and 2011 (11.4% increase in the total number of repairs in this period), without a concurrent increase in the number of meniscectomy procedures in the same period in patients less than 65 years of age. In the United Kingdom, the meniscectomy rate increased considerably from 1998 to 2013 (going from 5.1/10,000 inhabitants to 14.9) and then decreased slightly up to 2017 (to 12/10,000 inhabitants) [14]; however, this study provided no information on the change in the meniscal repair rate. In Denmark, Thorlund et al. [15] showed the number of meniscus procedures had doubled between 2000 and 2011 (16.1 to 31.2/10,000 inhabitants), with the largest increase seen in patients > 35 and > 55 years old. These findings suggest this increase in procedures mainly impacts patients with degenerative lesions. In another Danish study, Hare et al. [16] reported an increase in the rate of arthroscopic meniscus surgery (repair and meniscectomy) in public and private hospitals between 2000 and 2011. The increase was especially noticeable in the private sector, where the proportion of arthroscopic meniscus surgery went from 1% to 32% during this period. Analyzing data from other countries helps to confirm the recent international trend of less reliance on radial meniscectomy treatment and greater use of conservative meniscus repair, especially in younger patients.

Conversely, it also reveals a delay in diffusion, acceptance and implementation of research findings supporting no surgical treatment for degenerative meniscal lesions [11,12,17]. However, the results of studies from other countries were generated from a different type of database than the PMSI, thus unrelated to surgical procedure coding by the practitioner (Danish Register for Thorlund et al. [15] and Hare et al. [16], Pearl Driver for Abrams et al. [13] and Hospital Episode Statistics for Abram et al. [14]).

These studies are the only information available in the literature to compare our data. Thus, it is difficult to provide a definite explanation for the heterogeneity of the observed results, given the limited data in the ATIH database. Nevertheless, certain hypotheses can be made. The differences between private and public hospitals could be explained by the demographics of the patients treated, age, medical or surgical specialty and continuing medical education of the practitioners involved, combined with a coding and implant reimbursement system used that does not favor repair procedures. The regional differences could be attributed to heterogeneous surgical practices within France or to populations with demographics that differ between regions. As for the relative consistency of the meniscectomy rate in patients above 60 years of age in France, Denmark and the United Kingdom, we believe there is a delay in the consideration of scientific data when managing degenerative lesions, and also aging of the population, which theoretically increase the number of potential patients.

It is important to note that this analysis has significant limitations related to an obvious selection bias in the medical coding system:

- no coding during associated ACL reconstruction procedures, where meniscus repair would logically be more common than in cases of isolated meniscal lesions. In fact, it has been shown that systematic repair of meniscal lesions during ACL reconstruction surgery has a long-term benefit in that it prevents new lesions from developing [18]. No solution was available to identify this

case definition. The decision to not code the meniscus procedure during ACL reconstruction, which was desired by the law to lessen the emphasis on meniscus procedures, negatively affected our ability to analyze surgical practices. To place this in context, during 2017, about 46,000 ACL reconstruction procedures were done (data from the ATIH). While the percentage of associated meniscus procedures is impossible to determine, this figure lets us presume there is a large number of missing data on the number of meniscectomy or repair procedures done in combination with this reconstruction;

- differentiation between degenerative lesions (where meniscectomy largely prevails over meniscus repair) and traumatic lesions (where repairs should be more common), although the age breakdown of the data suggests that the shift from meniscectomy to meniscus repair is especially valid in patients under 40 years of age suffering from more traumatic lesions [12]. Thus, in patients more than 50 years of age for which the meniscal lesions are predominantly degenerative, the number of meniscectomy procedures done in France remained stable;
- data available on the ATIH internet portal did not allow us to quantify the amount of meniscal tissue removed. Hence, while meniscal repair is always preferable, meniscectomy that is as minimal as possible still has indications when repair is not technically feasible. It would have been interesting to determine whether the meniscectomy procedures were become increasingly sparing over the years by determining the percentage of tissue removed;
- we did not have access to the age breakdown within the various regions of France. Thus, it is impossible at this stage to claim the populations within these regions are comparable;
- lastly, since the medical treatment associated with surgical abstention (non-surgical treatment) has taken an important role in treating degenerative meniscal lesions [19], we could not follow how it changed given that this study focused on surgical procedures. A prospective multicenter study would not get around these limitations as it would induce a major selection bias and would not be representative of the general population. Also, it would be difficult to perform this study over a long period of time. Improving the coding system to promote meniscal repair procedures appears to be the only solution to make the PMSI information more exhaustive.

5. Conclusion

While the changes in practice vary based on patient age, between public and private hospitals, and between regions of France, we found a positive trend in surgical management of meniscal lesions in accordance with 2008 HAS and 2016 ESSKA recommendations, evidence of a generalized awareness of the concept of meniscus preservation. Changes to the rules for providing information about meniscus-related surgery are vital to refine this study by capturing every meniscus procedure, including those performed in combination with ACL reconstruction. Thus, awareness campaigns aimed at surgeons treating these lesions could be improved by taking into account evidence-based data on one hand and clinical practices data on the other.

Disclosure of interest

P.B.: occasional educational consultant for Zimmer/Biomet, Smith & Nephew, Editor-in-chief OTSR-RCOT. M.O.: occasional educational consultant for Stryker, Arthrex, Newclip Technics. N.P.: occasional educational consultant for Zimmer/Biomet and Smith & Nephew.

The other authors declare that they have no competing interest.

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Author contributions

P.B., N.P.: helped to design the study; critical review of the manuscript; C.J.: writing and correction of manuscript; M.O.: writing and correction of manuscript; V.P.: exploitation of the database.

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