VIA MEDICA

ORIGINAL ARTICLE

Folia Morphol.
Vol. 71, No. 3, pp. 194–197

ISSN 0015–5659
www.fm.viamedica.pl

The incidence of infrapatellar plicae in the elderly Welsh population

A.P. Apostolopoulos[1], B. McConnell[1], A. Manta[1], G. Zafiropoulos[1, 2]

[1]Orthopaedic Department, Cwn Taf Health, Prince Charles Hospital, United Kingdom
[2]University of Glamorgan, United Kingdom

[Received 17 April 2012; Accepted 21 May 2012]

There are several studies reporting the incidence of suprapatellar, medial, and lateral plicae, but there is very limited information regarding the incidence of the infrapatellar plica. The purpose of our study was to record the incidence of infrapatellar plicae in the elderly Welsh population suffering from knee osteoarthritis. A prospective study was performed and 90 knees with severe osteoarthritis of the knee joint (Kellgren-Lawrence type III and IV) were investigated during total knee arthroplasty surgery. Documentation was performed at every total knee replacement surgery for the length of the study. Knee replacement was performed by one senior surgeon. Infrapatellar plica was investigated by a medial parapatellar approach and was classified into five types according to Kim's classification. The overall incidence of infrapatellar plicae was 37.7%. The most common type of plicae was the separate type (23.3%). There was no significant difference found between male and female patients. The fenestra type was the least common (2.22%). The incidence of infrapatellar plicae in the elderly Welsh population suffering from knee osteoarthritis was significantly lower when compared to a study that recorded the incidence of infrapatellar plica in young patients. Possibly, the degenerative changes of the knee joint can cause the resorption of the infrapatellar plica, thus decreasing its incidence in the elderly population. (Folia Morphol 2012; 71, 3: 194–197)

Key words: infrapatellar plicae, incidence, knee osteoarthritis, elderly

INTRODUCTION

The plicae around the knee joint are the embryological remnants of the synovial membranes that separate the knee into three compartments during embryologic development. A medial, lateral, and suprapatellar compartment exists during the development of the knee joint which occurs between the 7th and 10th weeks of gestation. A single cavity forms after the 16th week of gestation, due to the resorption of the synovial membrane. Failure of resorption of the synovial membrane can lead to the formation of the plicae. An infrapatellar plica is formed when there is incomplete regression of the mesenchymal tissue between the medial and lateral compartments of the knee [8].

In our daily clinical practice we do not meet patients with symptomatic infrapatellar plicae. During our previous surgical experience, infrapatellar plica was not a common finding during total knee arthroplasty and knee arthroscopy procedures. We therefore hypothesised that the incidence of infrapatellar plicae is very low in the wide population. However, by the time we started to practice medicine in Wales, an infrapatellar plica was a common finding during total knee arthroplasty procedures. We therefore decided to perform a prospective study and examine

Address for correspondence: A. Apostolopoulos, MsC, PhD, Prince Charles Hospital, Orthopaedic Department, Merthyr Tydfil, CF47 9DT, United Kingdom, e-mail: aalexgr2000@yahoo.com

Table 1. Distribution of plicae type according to gender

Plicae type	Male	Female	Total
Vertical septum	2 (5.40%)	2 (3.17%)	4 (4.44%)
Separate type	8 (21.62%)	13 (20.63%)	21 (23.3%)
Split type	2 (5.40%)	5 (7.93%)	7 (7.77%)
Fenestra type	1 (2.70%)	1 (1.56%)	2 (2.22%)
Absent type	24 (64.86%)	42 (66.66%)	66 (63.7 %)
Total	37	63	90

the incidence of infrapatellar plicae in the elderly Welsh population.

MATERIAL AND METHODS

Between 2009 and 2010 we performed a prospective study in 90 patients who were operated for total knee arthroplasties. Ninety patients (53 women, 37 men) were included in our study and 90 total knee arthroplasties were performed. The mean age was 73.7 years (range 68–81 years). All patients suffered from progressive osteoarthritis of the knee joint (Kellgren Lawrence type III and IV) [9]. Those with previous knee surgeries, patella fractures, or intra-articular knee fractures were excluded from the study as they could alter the anatomy of the knee joint. Patients not from the Welsh population were not included in the study. Demographic data and intraoperative findings were documented. Documentation was performed at every total knee replacement surgery for the length of the study.

Knee replacement was performed by one senior surgeon who specialised in knee surgery. The infrapatellar fat pad was not excised in any of the cases. Infrapatellar plicae were investigated by a medial parapatellar approach and were classified into five types according to Kim's classification [12]. Type A: vertical septum type, when the plica was in continuation with the anterior surface of the anterior cruciate ligament (ACL); type B: separate type, when the plica was completely separated by the ACL; type C: split type, when the plica was completely separated by the ACL and there was a longitudinal split; type D: fenestra type, when the plica was the vertical septum type with a fenestra; and type E: absent type.

RESULTS

Infrapatellar plicae were found in 36 knees, and the overall incidence was 37.7%. There was no significant difference found between male and female patients or between right and left knees (Table 1). The plica was absent in 63.7% of the knees reviewed. The separate type (type B according to Kim's classification) was the most common as the plica was in most cases completely separated by the ACL but no split was present (23.3%). The fenestra type was the least common (2.22%).

The plicae were found to be thickened and sclerotic in 6 cases, possibly as a result of past trauma that caused the fibrotic changes.

DISCUSSION

The plicae were first described by Fullerton [7] and Mayeda [15] in anatomic dissections that they performed in the first decade of the 20th century. Their arthroscopic appearance was first described in 1939 by Lino [14] in cadaveric studies that he performed.

Four types of plicae have been described according to their anatomic morphology: medial, lateral, suprapatellar, and infrapatellar. The suprapatellar plica is the most common and lies between the suprapatellar pouch and the knee. An incidence of 70 to 91% has been reported in various arthroscopic studies [4, 10, 19]. It can have various shapes and Dandy [4] made an arthroscopic classification by describing ten different variations.

The medial plica is also known as the plica synovialis mediopatelaris. It originates on the medial wall of the knee joint and inserts into the synovium surrounding the infrapatellar fat pad. Four different types of medial plicae have been described by Sakakibara et al. [21]. There are various studies in the literature reporting the incidence of medial plica. Sakakibara reported an incidence of less than 55%. In arthroscopic studies, Dandy [4] reported an incidence of 92% and Kim and Choe [10] an incidence of 72%. At the time of writing, the most recent study was performed by Nakaya-

ma et al. [16]. In their study, they investigated the incidence of medial plica during arthroscopic surgery in 3,889 knees in the Japanese population. An anterolateral portal approach was used and a Sakakibara classification was performed. Medial plicae were detected in 3,107 knee joints and the overall incidence was 79.9% [16].

The infrapatellar plica, or ligamentum mucosum, originates from the intercondylar notch and inserts into the synovium around the infrapatellar fat pad or the inferior pole of the patella. Posteriorly the plica may be entirely separated from the anterior cruciate ligament or be either partially or completely attached to it. An arthroscopic classification has been described by Kim et al. [12]. According to Kim's classification, an infrapatellar plica may be one of the following types: absent, separated, split, vertical septum, or fenestra.

A normal plica is usually elastic and soft in structure, and it is usually asymptomatic. Trauma of the knee joint and several inflammatory conditions can cause irritation and fibrotic changes of the plicae. The plica can progressively lose its elastic properties and become thickened. This can lead to snapping of the plica over the femoral condyle causing synovitis, chondral damage, and pain.

The most common type of symptomatic plica is the medial plica. Cases of symptomatic suprapatellar plica have also been reported. The incidence of the lateral plica is very low and there are only four reports of lateral plica syndrome in the literature [6].

The infrapatellar plica was also considered to be asymptomatic. However, in 1996 Kim et al. [12] reported two cases of flexion contracture of the knee that were arthroscopically found to be due to impingement of a pathologic infrapatellar plicae in the intercondylar notch and the trochlea. In 2002 Kim et al. [11] reported another case of a pathologic symptomatic infrapatellar plica. During arthroscopy a fibrotic and sclerotic fenestra pattern plica was described. The plica was impinged at the intercondylar notch and trochlea blocking the extension of the knee joint. Grade 2 softening of the medial femoral condyle was also found [11]. In 2006, Demirag et al. [5] reported a series of 14 patients who had anterior knee pain and had no other pathology apart from a thickened infrapatellar plica that was arthroscopically excised. The presence of an infrapatellar plica may also cause problems during aspiration, arthroscopic visualisation of the anterior cruciate ligament, or retrieval of loose bodies. An intact ligamentum mucosum may be mistaken for an intact anterior cruciate ligament during arthroscopy, until excised. It has also been reported that the vertical septum type may be accompanied by a discoid meniscus [20]. A recent retrospective study reported twelve cases of anterior knee pain, not responding to non-operative treatment, which underwent isolated infrapatellar plica resection without any other noted knee pathology. After one year of follow up the results were, according to the authors, excellent in six cases and good in five cases [1].

Ozcan et al. [18] reviewed 133 abnormal infrapatellar plicae under arthroscopy and evaluated the risk of chondral damage in the knee joint. The abnormal infrapatellar plica originates from the superior aspect of the intercondylar notch and enters the superior aspect of Hoffa's fat pad. An abnormal plica becomes vertical during the extension of the knee and can cause chondral lesions on the superior aspect of the intercondylar notch and on the patellofemoral sulcus. According to this study, the severity of the chondral lesions was not associated with the shape or width of the plica. The anatomic location of the plica was important in the formation of chondral lesions.

There are very few studies in the literature reviewing the incidence of infrapatellar plicae. Kim et al. [11] examined 200 knees arthroscopically and the incidence of the infrapatellar plica was 85.5%. The separate type was the most common (65%) and the fenestra type was the least common (1%). According to Kim et al. [11], the incidence of infrapatellar plicae decreases as the age increases, probably due to absorption of the plicae, which occurs due to chronic injuries and degenerative changes. In Kim's study, knees with degenerative joint disease were excluded. The mean age of patients that were reviewed was 39.9 years. In our study the overall incidence of the infrapatellar plicae was 37.7% and was significantly lower than Kim's published series. This difference could be explained by the fact that the mean age of our patients was 73.7 years and all our patients suffered from severe (Kellgren Lawrence Grade III and IV) knee osteoarthritis. We can therefore agree with Kim's hypotheses that age and degeneration can possibly cause the reabsorption of the infrapatellar plica and the incidence can be expected to be lower in the elderly. Ozcan et al. [18] reviewed 627 patients under arthroscopy. The mean age of the patients was 43 years (range 16 to 84 years). Out of these patients 242 infrapatellar plicae were recorded and the incidence was 38.5%. In Ozcan's study, there is great age variability in the population reviewed.

Ogata and Uhtoff [17] performed an embryologic study on over 116 knees regarding the development of synovial plicae in human knee joints. According to Ogata's results regarding the incidence, the infrapatellar plica was the most frequent (50%). A progressive decrease in its incidence was noticed from 11 to 20 weeks of gestation, indicating, according to the authors, that the development of the joint cavity was still ongoing at the intercondylar notch [17].

The prevalence of the infrapatellar plicae reported in the literature also varies according to the type of imaging studies performed. Brody et al. [2], on double contrast arthrography of 167 knees, reported 10.1% of infrapatellar plicae. According to Dalinka and Garofola [3], there used to be confusion between infrapatellar plica and an intact ACL during arthrography. Kosarek and Helms [13] reviewed retrospectively magnetic resonance images (MRI) of 1060 knee examinations that were performed in their institute in order to identify the incidence of the infrapatellar plicae. All of these patients underwent MRI for conditions and symptoms unrelated to infrapatellar plicae. Of the 1060 MRI examinations only four infrapatellar plicae were detected. The incidence of the infrapatellar plica was 0.4%, which differs from the 65%, 38.5%, and 37.7% noted in the studies by Kim, Ozcan, and ourselves, respectively. This difference is possibly because anatomic studies can detect plicae that are extremely thin and may be beyond the resolution of imaging.

CONCLUSIONS

The clinical significance of the infrapatellar plica was considered to be minimal. Nevertheless, recent studies have proven that a pathologic infrapatellar plica can give rise to symptoms. Additionally, an infrapatellar plica can cause difficulties during arthroscopy to evaluate the ACL, and can interfere when arthroscopically removing a loose body that is located in the intercondylar notch. Very few reports in the literature have recorded its incidence. In our study, the incidence of infrapatellar plicae in the elderly Welsh population suffering from knee osteoarthritis was significantly lower when compared to Kim's study, which recorded the incidence of infrapatellar plicae in younger patients. Possibly, degenerative changes of the knee joint can cause resorption of the infrapatellar plica, decreasing, in this way, its incidence in the elderly population. However, it is not clear if this is caused by abnormal movement of the knee joint, which can cause damage of the plica. Also, the natural terrain of Wales may have an effect on this incidence. Wales has a lot of hills and people have to put a lot of pressure in their knees in order to climb stairs or hills daily. Future studies with a larger number of knee samples and a greater range of age population could give more accurate results and explanations regarding the incidence of the infrapatellar plicae. Also, patients of non-hilly areas need to be examined in case our hypothesis is wrong.

REFERENCES

1. Boyd CR, Eakin C, Matheson GO (2005) Infrapatellar plica as a cause of anterior knee pain. Clin J Sport Med, 15: 98–103.
2. Brody GA, Pavlov H, Warren RF, Ghelman B (1983) Plica synovialis infrapatellaris: arthrographic sign of anterior cruciate ligament disruption. AJR, 170: 1551–1555.
3. Dalinka M, Garofola J (1976) The infrapatellar synovial fold: a cause for confusion in the evaluation of the anterior cruciate ligament. AJR, 127: 586–589.
4. Dandy DJ (1990) Anatomy of the medial suprapatellar plica and the medial synovial shelf. Arthroscopy, 6: 79–85.
5. Demirag B, Ozturk C, Karakayali M (2006) Symptomatic infrapatellar plica. Knee Surg Sports Trauma Arthrosc, 14: 156–160.
6. Dorchak JD, Barrack RL, Kneisl JS, Alexander AH (1991) Arthroscopic treatment of symptomatic synovial plica of the knee. Long term follow up. Am J Sports Med, 19: 503–507.
7. Fullerton A (1916) The surgical anatomy of the synovial membrane of the knee joint. Br J Surg, 4: 191–200.
8. Jouanin T, Dupont JY, Halimi P, Lassau JP (1982) The synovial folds of the knee joint: anatomical study. Anat Clin, 4: 47–53.
9. Kellgren JH, Lawrence JS (1963) Atlas of standard radiographs of arthritis. Oxford Blackwell Scientific.
10. Kim SJ, Choe WS (1997) Arthroscopic findings of the synovial plicae of the knee. Arthroscopy, 13: 33–41.
11. Kim SJ, Kim JY, Lee JW (2002) Pathologic infrapatellar plica. Arthroscopy, 18: E25.
12. Kim SJ, Min BH, Kim HK (1996) Arthroscopic anatomy of the infrapatellar plica. Arthroscopy, 12: 561–564.
13. Kosarek F, Helms C (1999) The MR appearance of the infrapatellar plica. AJR, 172: 481–484.
14. Lino S (1939) Normal arthroscopic findings in the knee joint of adult cadavers. J Jpm Orthop Assoc, 14: 467–523.
15. Mayeda T (1918) Ueber das Strangartige Gebilde in der Knigel-Enkhoele. (Chordi Cavi Articularis Genu) Mitt Med Fak Kaisert Univ Tokio, 21: 507–553.
16. Nakayama A, Sugita T, Aizawa T, Takahashi A, Honma T (2011) Incidence of medial plica in 3.889 knees in the Japanese population. Arthroscopy, 27: 1523–1527.
17. Ogata S, Uhtoff H (1990) The development of synovial plicae in human knee joints: An embryologic study. Arthroscopy, 6: 315–321.
18. Ozcan M, Copuroglou C, Ciftdemir M, Turan F, Calpur OU (2011) Does an abnormal infrapatellar plica of the knee increase the risk of chondral damage in the knee. Knee Sur Sports Traum Arthrosc, 19: 218–221.
19. Patel D (1978) Arthroscopy of the plicae synovial folds and their significance. Am J Sports Med, 6: 217–225.
20. Reider B, Marshall JL, Warren RF (1981) Persistent vertical septum in the human knee joint. JBJS Am, 63: 1185–1187.
21. Sakakibara J. (1976) Arthroscopic study on lino's band-plica synovialis mediopatelaris. J Jpn Ortho Assoc, 50: 513–522.