International Orthopaedics
https://doi.org/10.1007/s00264-021-05048-8

ORIGINAL PAPER

Causes of knee pain evaluated by arthroscopy after knee arthroplasty: a case series

Fabricio Roberto Severino[1] · Victor Marques de Oliveira[1] · Ricardo de Paula Leite Cury[1] · Nilson Roberto Severino[1] · Patricia Maria de Moraes Barros Fucs[1]

Received: 15 April 2021 / Accepted: 16 April 2021

Abstract

Background The origin of persistent pain and joint limitation after knee arthroplasty are controversial and difficult to diagnose. Knee arthroscopy is indicated when the results of routine evaluation tests are not clear. The purpose of this study was to determine through arthroscopy the cause of post-knee-arthroplasty pain symptoms in patients without a prior diagnosis of cause of pain.

Methods This prospective case series study described the outcomes of 34 patients (35 knees) with pain and limited function in the arthroplastic joint, who underwent diagnostic and therapeutic arthroscopy. Patients were clinically evaluated using range-of-motion tests and the Lysholm, Hospital for Special Surgery (HSS) and Knee Society Score (KSS) scales.

Results The procedure found cyclops in 17 knees, synovitis in 9 knees, arthrofibrosis in 6 knees, polyethylene wear with debris in two knees, and polyethylene bouncing in one knee with unicompartmental arthroplasty with a mobile polyethylene platform. It was effective for the relief of pain symptoms, with excellent or good outcomes in 80% of cases; there was a poor outcome in 11.43%, which maintained the presentation of pain and underwent revision arthroplasty, and, in 8.57%, did not undergo another surgery despite symptom persistence.

Conclusions Post-arthroplasty knee arthroscopy seems beneficial in patients with pain and without a pre-established diagnosis and who had already undergone conservative treatment unsuccessfully.

Keywords Arthroplasty · Replacement · Knee · Arthroscopy · Pain · Fibrosis

Introduction

The number of patients undergoing total or unicompartmental arthroplasty has increased significantly over the last decades. This procedure is indicated to relieve chronic knee pain and restore joint mobility, physical function, and quality of life [1]. Although knee arthroplasty presents excellent long-term results in 90% of the cases in evaluations ten to 15 years after surgery [2], about 20% of patients continue to experience persistent pain and joint movement limitation after surgery [1, 3, 4].

Post-arthroplasty pain may have a defined cause, such as infection; poor positioning of the prosthetic components; aseptic loosening of one or more components; peri-prosthetic fracture; a free body in the joint; and also, in patients with unicompartmental arthroplasty, a lesion in the preserved meniscus in the non-prosthetic compartment, which are diagnosed through laboratory and radiographic tests or bone scintigraphy, but often are not sufficient to an accurate diagnosis [1, 3, 5–7].

However, a large number of cases with pain and joint motion dysfunction present diagnostic difficulties, requiring evaluation by an experienced orthopaedic surgeon for the patients' clinical and functional improvement [4].

✉ Patricia Maria de Moraes Barros Fucs
patricia@fucs.com.br

Fabricio Roberto Severino
dr.fabricio.severino@gmail.com

Victor Marques de Oliveira
victorknee@hotmail.com

Ricardo de Paula Leite Cury
rcury1@me.com

Nilson Roberto Severino
nrseverino@uol.com.br

[1] Department of Orthopedics and Traumatology, Santa Casa Medical School and Hospitals, R. Dr. Cesário Motta Junior, 112, São Paulo 01221-020, Brazil

Published online: 29 January 2022

If, after the evaluation, any of these complications were found, several procedures have been used to treat pain or stiffness in the arthroplastic knee, including manipulation under anaesthesia, open arthrolysis or arthroscopy. Knee arthroscopy has been indicated for patients with a presentation of pain, limited mobility and synovitis when the results of routine evaluation tests are not clear [4, 5]. However, there is a lack of evidence in which could evaluate the outcomes obtained with this procedure as a diagnostic and therapeutic method. Therefore, the purpose of this study was to determine through arthroscopy the cause of post-knee-arthroplasty pain symptoms in patients without a prior diagnosis of cause of pain.

Patients and methods

This prospective case series study followed the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) recommendations [8]. The study was approved by the institution's Ethics Committee, and the patients signed informed consent forms. Between September 2001 and November 2013, 1123 knee arthroplasties were performed in our institution, 168 were unicompartmental knee arthroplasties (UKA), and 955 were total arthroplasties (TKA). Among all patients undergoing knee arthroplasty, those who remained with symptoms of pain, even after receiving painkillers, non-steroidal anti-inflammatory drugs (NSAIDs) and physical therapy (according to individual prescription), and for whom the cause of pain could not be determined with clinical, laboratory or imaging tests were selected for the study.

Of the 1123 knees operated on, 40 remained painful in the arthroplastic joint without clinical, laboratory or imaging diagnoses confirming the cause for the pain symptomatology. From a total of 39 patients (40 knees), five were excluded, three due to death and two because they missed reassessment. Remaining 34 patients (35 knees) (3%) were thus evaluated, including 29 women (one underwent bilateral arthroscopy) and five men. Of these 35 knees, 11 had undergone UKA (31.4%), and 24 had undergone TKA (68.6%). The main post-arthroplasty complaints and symptoms were as follows: pain in 35 knees (100%); pain and limited flexion–extension in 25 knees (71.4%); and pain with cracking sound and feeling of blockade (2.85%).

The range of motion (ROM) before the knee arthroplasty varied from 20° to 120° for flexion, with a mean of 92° and from − 15° to 0° for extension, with a mean of − 8.5°.

All the patients underwent arthroscopy indicated for pain, and the time between arthroplasty and arthroscopy ranged from four to 36 months, with a mean of 12.6 months. Patient age on the day of arthroscopy varied from 43 to 76 years, with a mean of 65 years. Regarding the symptomatic knee, 19 were on the right, and 16 were on the left.

Patients were clinically evaluated using range-of-motion tests and the Lysholm, Hospital for Special Surgery (HSS) and Knee Society Score (KSS) scales.

Pre-arthroscopy pain was evaluated using the Lysholm scale [9], with results ranging from 0 to 100 points. On this scale, pain improvement is considered poor for scores < 68, normal for a score of 69–76, good for a score of 77–90 and excellent for a score of 91–100. The Hospital for Special Surgery (HSS) [10] and Knee Society Score (KSS) [11] scales were also evaluated preoperatively. The HSS score gives a maximum of 100 points and evaluates the following domains: pain, function, range of motion, muscular strength, deformity and instability. The final score is classified as 'excellent' (> 85 points), 'good' (70–84), 'fair' (60–69), and 'poor' (< 60). The KSS (maximum 100 points) is divided in an objective physician component and a subjective patient component, evaluating pain, function, satisfaction and expectations. A post-operative evaluation was performed with the Lysholm, HSS and KSS scales, with the time after arthroscopy varying from 1 to 11 years, with a mean of five years and eight months.

In the statistical analysis, a significance level of 5% (0.05) was adopted for the application of the statistical tests. The program Statistical Package for Social Sciences (SPSS), version 13.0, was used to obtain the results. Paired-sample *t* tests were applied.

Results

A total of 34 patients (35 knees) were evaluated. Most patients (17 cases) presented cyclops (anterior intra-articular fibrosis) as the arthroscopic diagnosis (Fig. 1); anterior or supra-patellar synovitis was seen in nine patients; anterior, lateral and medial arthrofibrosis was observed in six patients; mobile polyethylene bouncing in the medial fin of the metallic base was found in one patient with unicompartmental arthroplasty; and fixed polyethylene wear, with longitudinal scratches, was visualised in two patients.

All the patients presenting cyclops, synovitis or arthrofibrosis, underwent, during the same arthroscopic procedure, resection and release of the knee joint using a shaver blade tip (Fig. 2).

The three patients presenting changes in polyethylene underwent revision arthroplasty in a later date, and two patients had unicompartmental arthroplasty, while one had total arthroplasty. One patient with arthrofibrosis who did not show improvement and presented with a recurrence of arthrofibrosis subsequently underwent revision arthroplasty. The procedure was effective for the relief of pain symptoms, with excellent or good outcomes for 28 of the operated knees (80%); there was a poor outcome for four knees (11.43%),

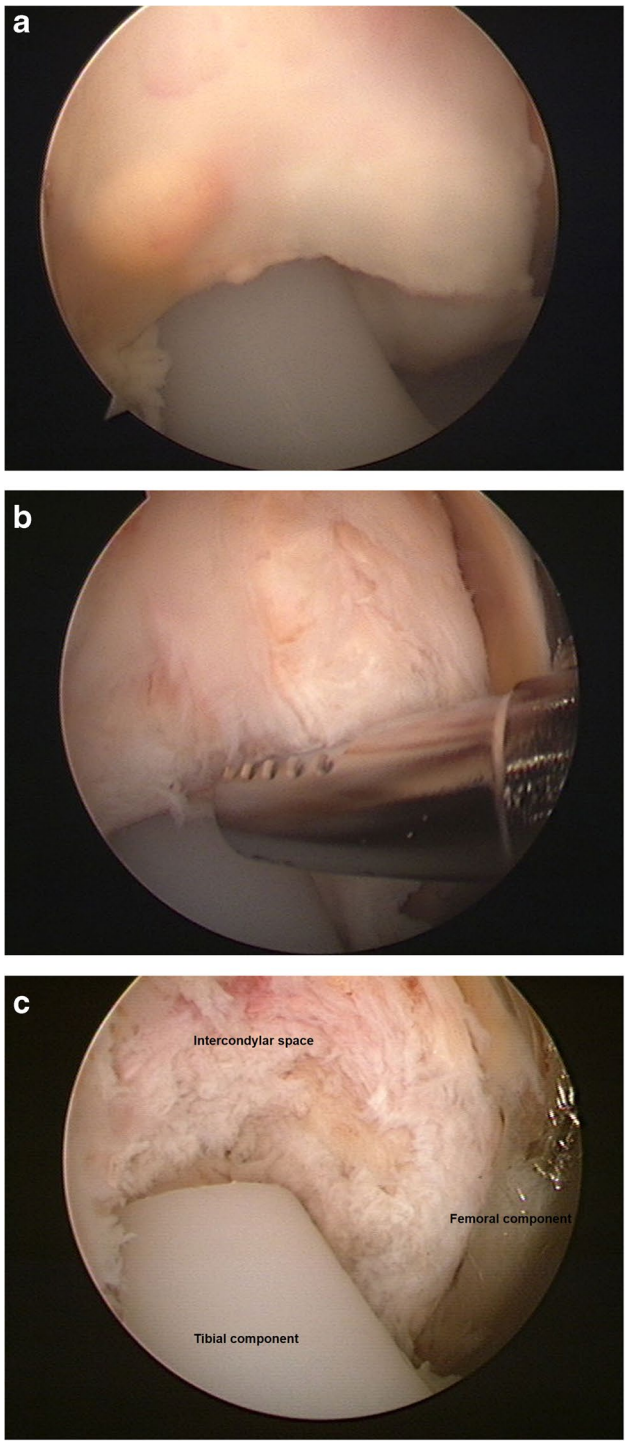

Fig. 1 Cyclops (fibrosis) between the prosthetic components, total knee arthroplasty, as observed by arthroscopy (**a**), shaver blade resecting the fibrosis (**b**), intercondylar distal femur post-resection, femoral and tibial components (**c**)

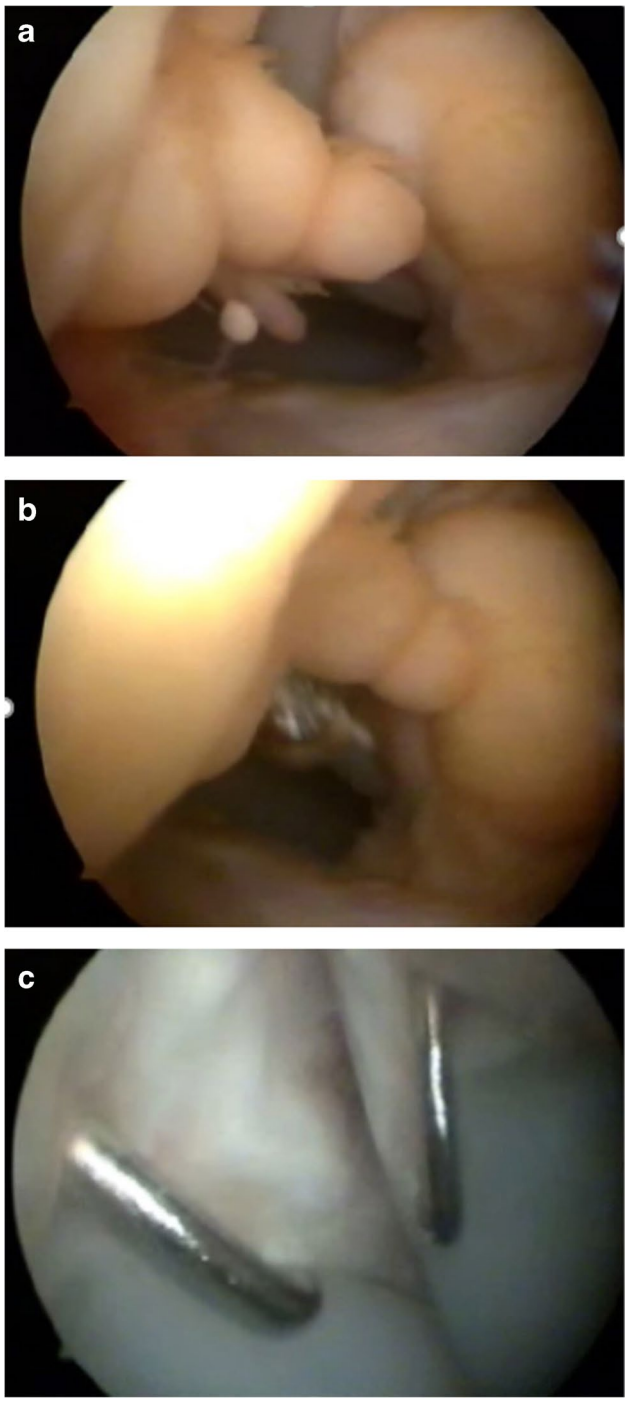

Fig. 2 Anterior synovitis between the components of the unicompartmental prosthesis, initial aspect of the synovitis (**a**), resected with a shaver blade (**b**), and visualised after resection (**c**)

which maintained the presentation of pain and underwent revision arthroplasty, three due to changes in polyethylene. The other three cases (8.57%) did not undergo another surgery despite symptom persistence.

The post-operative ROM in flexion varied from 50° to 125°, with a mean of 100°, with a significant difference compared with the pre-operative flexion ROM ($p = 0.0210$). The post-operative ROM in extension varied from − 10° to 0°, with a mean of − 1°, with a significant

difference compared with the pre-operative extension ROM ($p < 0.0001$) (Table 1).

Patient assessment with the Lysholm scale showed a significant difference between the pre-arthroscopy and post-arthroscopy scores, varying from a mean of 40.6 pre-arthroscopy to 82.5 post-arthroscopy ($p < 0.0001$). Patient assessment with the HSS scale showed a significant difference between the pre- and post-arthroscopy scores, with a pre-arthroscopy mean of 50.6 and a post-arthroscopy mean of 79.8 ($p < 0.0001$). Patient assessment with the KSS scale showed a significant difference between the pre- and post-arthroscopy scores, with a pre-arthroscopy mean of 41.6 and a post-arthroscopy mean of 86.3 ($p < 0.0001$) (Table 2).

Considering the ROM and the Lysholm, HSS and KSS scale scores, excellent or good results were obtained in 80% of patients who underwent arthroscopy for the diagnosis and treatment of pain and functional limitation post-arthroplasty, without pre-established cause. There was a poor outcome in 11.43%, which maintained the presentation of pain and underwent revision arthroplasty, and, in 8.57%, did not undergo another surgery despite symptom persistence.

Discussion

Arthroscopy of the arthroplastic knee is not a frequent procedure. The surgeon encounters technical difficulties that are not usual in classical procedures because implants reduce joint mobility and elasticity. In some cases, it is necessary to use uncommon accessory portals and avoid damage to the prosthetic components, metal or polyethylene [8].

Arthroscopy is indicated as a diagnostic and therapeutic method for symptoms of pain in the knee after knee arthroplasty [12] and, in cases of diagnostic uncertainty, leads to a more accurate indication of the revision of a component or the entire prosthesis because the loosening of prosthetic components, intra-articular free bodies, fractures or other abnormalities can be visualised [5, 13–18].

In this study, polyethylene wear and debris were detected in two patients, and bouncing of the mobile tibial polyethylene platform on the metallic base was observed in one patient with unicompartmental arthroplasty. In these three patients, these findings were not seen in the imaging tests, and all three, who had outcomes that were deemed poor, subsequently underwent total revision arthroplasty.

In addition, arthroscopy may be used as a method to collect material in cases of suspected infection or for the removal of an intra-articular haematoma [12, 13, 19–21], which was not necessary in any of the cases in this study because cases with infection were excluded.

Several studies recommend, before arthroscopy, manipulation under anaesthesia of the stiff prosthetic joint [22–27]. Thompson et al. [2] created an intervention protocol for post-TKA knee stiffness and pain. According to them, these patients should be immediately started on physical therapy regimen and pain control with NSAIDs. Treatment failure should progress to more aggressive management: for patients within 12 weeks of TKA, manipulation under anaesthesia should be pursued. Patients failing manipulation, or who are outside the 12-week window, should progress to arthroscopic debridement. Manipulation under anaesthesia was not performed in the present study because only one of the patients presented relevant joint motion limitation, and arthroscopy was still performed for joint release instead of manipulation under anaesthesia. Also, the mean time between arthroplasty and arthroscopy in this study was 12.6 months, exceeding 12 weeks.

According to Ries and Badalamente [28], it is not clear what triggers the proliferation and formation of extensive scar tissue in patients with arthrofibrosis. Some patients may have a predisposition for this condition or they may develop arthrofibrosis as a response to post-operative trauma and surgical rehabilitation. The authors believe that upon the development of arthrofibrosis after total knee arthroplasty, some improvement in the knee and pain may be obtained with a revision surgery. In our series, we only subjected to revision surgery those patients who showed polyethylene wear with obvious scratches at the time of the arthroscopy. Sekiya [29] found moderate or severe scar tissue impingements in 30% of patients.

Several studies [2, 5, 12, 22, 28–37] have shown the importance of arthroscopy as a diagnostic and therapeutic method for knee arthrofibrosis, leading to significant improvement of the symptoms of pain and compromised knee function. In this study, joint arthrofibrosis was seen in six arthroplastic knees that were subjected to joint shaving

Table 1 Pre-arthroscopy *versus* post-arthroscopy knee range of motion

ROM	Sample size	Mean (SD)	95% CI	Mean difference (SD, 95%CI)	*P* value
Initial flexion	35	92 (±20)	84.9 to 99	6.8 (±16.7) (1.0 to 12.6)	0.0210
Final flexion	35	98 (±15)	93.6 to 104		
Initial extension	35	−7.2 (±5.7)	−9.2 to -5.3	6.2 (±5.4) (4.4 to 8.1)	<0.0001
Final extension	35	−1.0 (±3.7)	−2.3 to 0.3		

ROM range of motion, *SD* standard deviation, *CI* confidence interval

Table 2 Pre-arthroscopy *versus* post-arthroscopy with the Lysholm, HSS and KSS scales

Knee scoring system		Sample size	Mean (SD)	95% CI	Mean difference (SD, 95%CI)	*P* value
Lysholm	Initial	35	40.6 (±14.1)	35.7–45.4	41.8 (±19.9) (35 to 48.7)	$P<0.0001$
	Final	35	82.5 (±15.7)	77.1–87.9		
HSS	Initial	35	50.6 (±13.3)	46–55.1	31.9 (±15.1) (26.7 to 37.1)	$P<0.0001$
	Final	35	82.5 (±13.4)	77.9–87.2		
KSS	Initial	35	41.6 (±8.9)	38.5–44.6	44.7(±17.3)	$P<0.0001$
	Final	35	86.3 (±15.1)	81.1–91.5		

SD standard deviation, *CI* confidence interval, *HSS* Hospital for Special Surgery score, *KSS* Knee Society Score

with symptom improvement, with good outcomes in four patients. Two of these patients exhibited results considered normal according to three scales (Lysholm, HSS and KSS). Localised fibrosis, called cyclops, which consists of the presence of fibrous tissue interposed between the prosthetic components without joint adhesions, was observed in 17 patients (Fig. 1). All these patients presented significant improvement, as well as eight patients for whom synovitis was visualised (Fig. 2) and who improved with synovectomy.

In a systematic review of arthroscopies in symptomatic patients after TKA, the complication rate was only 0.5% [38]. Despite most series reported there were no complications related to arthroscopic procedures, arthroscopic surgery is not risk-free. As a complication of this method, Diduch et al. [6] reported 6% of patients with infection after the procedure, which was not found in other studies [2, 5, 13, 19, 36, 37, 39], as infection was not reported or was reported with low rates of involvement. No complications were noticed in the present study, in particular infection, following the arthroscopic procedure.

According to Klinger et al. [39], peri-operative preventive antibiotic therapy is important to minimise the complications of the method. With the 34 patients in this study, prophylactic antibiotic therapy had been applied (one day of intravenous cephalosporin), with no infections occurring for any patient.

Many studies [2, 17, 30, 32, 33, 40] have reserved open surgery exclusively for cases of the revision of prosthetic components or when their removal is essential for treatment; yet one study [37] advocates conservative treatment combined with manipulation of the joint under anaesthesia. However, these procedures may lead to a rupture of the patellar tendon, intra-articular tissue lesions or regional knee pain syndrome [2]. As cited above, Thompson et al. [2] created an intervention protocol that defends the following triad: arthroscopic release, pain control and intense physiotherapy for patients with arthrofibrosis. The present study had good outcomes in the improvement of pain symptoms in patients with the use of only diagnostic and therapeutic arthroscopy for the resection of localised fibrosis (cyclops) or hypertrophied synovium.

In this study, poor outcomes occurred in patients with polyethylene scratches (wear and debris) whose imaging tests did not show these defects and who underwent revision surgery, and normal outcomes occurred in two patients with arthrofibrosis.

The indication of arthroscopy in symptomatic arthroplastic knees is not well defined in the literature because the published studies are case series, with low numbers of patients, were analysed retrospectively and had low levels of evidence [2, 14, 16]. All the studies cited the analysis of post-total knee arthroplasty outcomes. Furthermore, one of them cited knee pain after unicompartmental arthroplasty, and in this series, we had 11 patients with those symptoms. [2, 14, 16].

Several studies are in favour of arthroscopic surgery for the treatment of post-arthroplasty pain [2, 5, 12, 13, 30, 31, 34–37]. Sekiya [29] concluded that arthroscopic debridement appears to be a good resolution option in a painful knee after TKA. Of the 30 patients the author analyzed, 63% were free of pain, 3% had marked improvement, 20% moderate improvement, 3% slight improvement and 11% had no improvement.

Current data suggest that arthroscopy is an effective procedure for the treatment pf patients with symptomatic knee pain after TKA, with approximate percentage of effectiveness of 90% in arthrofibrosis, 85% in soft-tissue impingement and 55% in periprosthetic infection [38].

The present study has strong points: a series of 35 knees evaluated by three scales (Lysholm, HSS and KSS), both before and after arthroscopy procedure, by the same protocol, same surgical team with a and mean follow-up time of five years and eight months.

Our results show that the outcome of post-arthroplasty pain may be modified with clinical benefits by arthroscopy treatment, as evidenced by the high resolution of symptoms and the absence of complications from the procedure.

Additional clinical studies are needed to determine in which populations and patient contexts knee arthroscopy after TKA can be applied more appropriately and effectively.

Conclusion

Post-arthroplasty knee arthroscopy seems beneficial in patients with pain and without a pre-established diagnosis and who had already undergone conservative treatment unsuccessfully, resulting in significant improvement of pain symptoms as assessed by the Lysholm, HSS and KSS scales. As a cause of the symptoms, cyclops (localised arthrofibrosis) or synovitis was observed in most patients and could be treated during the same procedure with good outcomes.

Authors' contributions Fabricio Roberto Severino MD assistant surgeon, work on all phases of the project.

Victor Marques de Oliveira MD assistant surgeon, clinical evaluation.

Ricardo de Paula Leite Cury MD assistant surgeon, clinical evaluation.

Nilson Roberto Severino MD, PhD create the project, responsible surgeon for the patients, work on all phases of the project.

Patricia Maria de Moraes Barros Fucs MD, PhD elaboration of the project, written and correction of the text, work on all phases of the project.

Declarations

Ethical approval Study approved by the Ethical Board CEP-ISCMSC CAAE 20,287,013.0.0000.5479.

Conflict of interest The authors declare no conflict of interest.

References

1. Wylde V, Beswick AD, Dennis J, Gooberman-Hill R (2017) Postoperative patient-related risk factors for chronic pain after total knee replacement: a systematic review. BMJ Open 7(11):e018105. https://doi.org/10.1136/bmjopen-2017-018105
2. Thompson R, Novikov D, Cizmic Z, Feng JE, Fideler K, Sayeed Z, Meftah M, Anoushiravani AA, Schwarzkopf R (2019) Arthrofibrosis after total knee arthroplasty: Pathophysiology, Diagnosis and Management. Orthop Clin N Am 50:269–279. https://doi.org/10.1016/j.ocl.2019.02.005
3. Hurst JM, Ranieri R, Berend KR, Morris MJ, Adams JB, Lombardi AV Jr (2018) Outcomes After Arthroscopic Evaluation of Patients With Painful Medial Unicompartmental Knee Arthroplasty. J Arthroplasty 33(10):3268–3272. https://doi.org/10.1016/j.arth.2018.05.031
4. Beswick AD, Wylde V, Gooberman-Hill R, Blom A, Dieppe P (2012) What proportion of patients report long-term pain after total hip or knee replacement for osteoarthritis? A systematic review of prospective studies in unselected patients. BMJ Open 2:e000435. https://doi.org/10.1136/bmjopen-2011-000435
5. Wasilewski SA, Frankl U (1989) Arthroscopy of the painful dysfunctional total knee replacement. Arthroscopy 5(4):294–297. https://doi.org/10.1016/0749-8063(89)90144-8
6. Diduch DR, Scuderi GR, Scott WN, Insall JN, Kelly MA (1997) The efficacy of arthroscopy following total knee replacement. Arthroscopy 13(2):166–171. https://doi.org/10.1016/S0749-8063(97)90150-X
7. Bocell JR, Thorpe CD, Tullos HS (1991) Arthroscopic treatment of symptomatic total knee arthroplasty. Clin Orthop Relat Res 271:125–134. https://doi.org/10.1097/00003086-199110000-00018
8. Vandenbroucke JP, von Elm E, Altman DG, Gotzche PC, Mulrow CD, Pocock SJ, Poole C, Schlesselman JJ, Egger M (2007) STROBE Initiative. Strengthening the Reporting of Observational Studies in Epidemiology (STROBE): explanation and elaboration. PLOS Med 4(10):e297. https://doi.org/10.1371/journal.pmed.0040297
9. Lysholm J, Gillquist J (1982) Evaluation of knee ligament surgery results with special emphasis on use of a scoring scale. Am J Sports Med 10(3):150–154. https://doi.org/10.1177/036354658201000306
10. Słupik A, Białoszewski D (2009) A comparative analysis of the clinical utility of the Staffelstein-score and the hospital for special surgery knee score (HSS) in monitoring physiotherapy of total knee replacement patients-preliminary study. Ortop Traumatol Rehabil 11(1):37–45
11. Insall JN, Dorr LD, Scott RD, Scott WN (1989) Rationale of the Knee Society clinical rating system. Clin Orthop Relat Res 248:13–14
12. Mintz L, Tsao AK, McCrae CR, Stulberg SD, Wright T (1991) The arthroscopic evaluation and characteristics of severe polyethylene wear in total knee arthroplasty. Clin Orthop Relat Res 273:215–222. https://doi.org/10.1097/00003086-199112000-00032
13. Havel PE, Giddings JC (1994) Fracture of polyethylene tibial component in total knee arthroplasty diagnosed by arthroscopy. Orthopedics 17(4):357–358
14. Johnson DR, Friedman RJ, McGinty JB, Mason JL, St Mary EW (1990) The role of arthroscopy in the problem total knee replacement. Arthroscopy 6(1):30–32. https://doi.org/10.1016/0749-8063(90)90093-S
15. Hirsh DM, Sallis JG (1989) Pain after total knee arthroplasty caused by soft tissue impingement. J Bone Joint Surg Br 71(4):591–592
16. Bae DK, Lee HK, Cho JH (1995) Arthroscopy of symptomatic total knee replacements. Arthroscopy 11(6):664–671. https://doi.org/10.1016/0749-8063(95)90106-X
17. Court C, Gauliard C, Nordin JY (1999) Modalités techniques de l'arthrolyse arthroscopique après prothèse totale du genou. Rev Chir Orthop Reparatrice Appar Mot 85(4):404–410
18. Lo CS, Wang SJ, Wu SS (2003) Knee stiffness on extension caused by an oversized femoral component after total knee arthroplasty: a report of two cases and a review of the literature. J Arthroplasty 18(6):804–808
19. Vidil A, Beaufils P (2002) Arthroscopic treatment of hematogenous infected total knee arthroplasty: 5 cases. Rev Chir Orthop Reparatrice Appar Mot 88(5):493–500
20. Gonzalez MH, Mekhail AO, MS. (2004) The failed total knee arthroplasty: evaluation and etiology. J Am Acad Orthop Surg 12(6):436–446. https://doi.org/10.5435/00124635-200411000-00008
21. Peersman G, Laskin R, Davis J, Peterson M (2001) Infection in total knee replacement: a retrospective review of 6489 total knee replacements. Clin Orthop Relat Res 392:15–23
22. Bong MR, Di Cesare PE (2004) Stiffness after total knee arthroplasty. J Am Acad Orthop Surg 12(3):164–171. https://doi.org/10.5435/00124635-200405000-00004
23. Gollwitzer H, Burgkart R, Diehl P, Gradinger R, Bühren V (2006) Therapy of arthrofibrosis after total knee arthroplasty. Orthopade 35(2):143–152. https://doi.org/10.1007/s00132-005-0915-5
24. Yercan HS, Sugun TS, Bussiere C, Selmi TAS, Davies A, Neyret P (2006) Stiffness after total knee arthroplasty: prevalence,

management and outcomes. Knee 13(2):111–117. https://doi.org/10.1016/j.knee.2005.10.001
25. Ipach I, Schäfer R, Lahrmann J, Kluba T (2011) Stiffness after knee arthrotomy: evaluation of prevalence and results after manipulation under anaesthesia. Orthop Traumatol Surg Res 97(3):292–296. https://doi.org/10.1016/j.otsr.2011.01.006
26. Ghani H, Maffulli N, Khanduja V (2012) Management of stiffness following total knee arthroplasty: a systematic review. Knee 19(6):751–759. https://doi.org/10.1016/j.knee.2012.02.010
27. Rubinstein RA Jr, DeHaan A (2010) The incidence and results of manipulation after primary total knee arthroplasty. Knee 17(1):29–32. https://doi.org/10.1016/j.knee.2009.07.001
28. Ries MD, Badalamente M (2000) Arthrofibrosis after total knee arthroplasty. Clin Orthop Relat Res 380:177–183. https://doi.org/10.1097/00003086-200011000-00024
29. Sekiya H (2017) Painful Knee is not Uncommon after total Knee Arthroplasty and can be Treated by Arthroscopic Debridement. Open Orthop J 11:1147–1153. https://doi.org/10.2174/1874325001711011147
30. Arya RC (2003) Arthroscopic arthrofibrolysis of the knee - results of 28 cases. Arthroscopy 19(6 Suppl Abstracts Paper #155):80. https://doi.org/10.1016/S0749-8063(03)00556-5
31. Ayers DC, Dennis DA, Johanson NA, Pellegrini VD Jr (1997) Common complications of total knee arthroplasty. AAOS Instr Course Lect. J Bone Joint Surg Am 79(2):278–311
32. Kim J, Nelson CL, Lotke PA (2004) Stiffness after total knee arthroplasty. Prevalence of the complication and outcomes of revision. J Bone Joint Surg Am 86(7):1479–1484
33. Tirveilliot F, Migaud H, Gougeon F, Laffargue P, Maynou C, Fontaine C (2003) Traitement des raideurs sur prothèse totale du genou: indication des différents gestes mobilisateurs à propos de 62 cas. Rev Chir Orthop Reparatrice Appar Mot 89(1):27–34
34. Djian P, Christel P, Witvoet J (2002) Arthroscopic release for knee joint stiffness after total knee arthroplasty. Rev Chir Orthop Reparatrice Appar Mot 88(2):163–167
35. Magit D, Wolff A, Sutton K, Medvecky MJ (2007) Arthrofibrosis of the knee. J Am Acad Orthop Surg 15(11):682–694. https://doi.org/10.5435/00124635-200711000-00007
36. Chen MR, Dragoo JL (2011) Arthroscopic releases for arthrofibrosis of the knee. J Am Acad Orthop Surg 19(11):709–716. https://doi.org/10.5435/00124635-201111000-00007
37. Carro LP, Suarez GG (1999) Intercondylar notch fibrous nodule after total knee replacement. Arthroscopy 15(1):103–105. https://doi.org/10.1053/ar.1999.v15.015010
38. Encinas-Ullán CA, Rodríguez-Merchán EC (2019) Arthroscopy treatment of total knee arthroplasty complications. EFORT Open Rev 4:33–43. https://doi.org/10.1302/2058-5241.4.180035
39. Klinger HM, Baums MH, Spahn G, Ernstberger T (2005) A study of effectiveness of knee arthroscopy after knee arthroplasty. Arthroscopy 21(6):731–738. https://doi.org/10.1016/j.arthro.2005.03.012
40. Campbell ED Jr (1987) Arthroscopy in total knee replacements. Arthroscopy 3(1):31–35. https://doi.org/10.1016/S0749-8063(87)80007-5