Ten-year survival and complications of total knee arthroplasty for osteoarthritis secondary to trauma or surgery: A French multicentre study of 263 patients

S. Putman[a,*], J.-N. Argenson[b], P. Bonnevialle[c], M. Ehlinger[d], P. Vie[e], S. Leclercq[f], P. Bizot[g], S. Lustig[h], S. Parratte[b], N. Ramdane[i], M. Colmar[j], the Société française de chirurgie orthopédique et traumatologie (SOFCOT)[k]

[a] *Département universitaire de chirurgie orthopédique et de traumatologie, hôpital Salengro, CHRU de Lille, rue Emile-laine, 59037 Lille, France*
[b] *Département de chirurgie orthopédique, hôpital Sainte-Marguerite, hôpital universitaire de Marseille, 270, boulevard Sainte-Marguerite, 13009 Marseille, France*
[c] *Département d'orthopédie et de traumatologie, hôpital P.P.-Riquet, place Baylac, 31052 Toulouse cedex, France*
[d] *Service de chirurgie orthopédique et de traumatologie, hôpital de Hautepierre, 1, avenue Molière, 67098 Strasbourg cedex, France*
[e] *Clinique du Cèdre, 950, rue de la Haie, 76230 Bois-Guillaume, France*
[f] *CHP Saint-Martin, 18, rue des Roquemonts, 14000 Caen, France*
[g] *Service de chirurgie orthopédique et traumatologique, hôpital Lariboisière, université Paris Diderot, 3, rue Amboise-Paré, 75010 Paris, France*
[h] *Département de chirurgie orthopédique, centre Albert-Trillat, hôpital de la Croix-Rousse, 103, boulevard de la Croix-Rousse, 69004 Lyon, France*
[i] *EA 2694 – Santé publique : épidémiologie et qualité des soins, université de Lille, CHU de Lille, 59000 Lille, France*
[j] *Hôpital privé des Côtes-d'Armor, 12, rue François-Jacob, 22198 Plerin, France*
[k] *56, rue Boissonade, 75014 Paris cedex, France*

Keywords:
Knee
Post-traumatic knee osteoarthritis
High tibial osteotomy
Total knee arthroplasty
Survival

A B S T R A C T

Background: Previous surgical procedures raise technical challenges in performing total knee arthroplasty (TKA) and may affect TKA outcomes. Survival rates of TKA done after trauma or surgery to the knee have not been accurately determined in large populations. The objectives of this retrospective study in 263 patients with TKA after knee trauma or surgery and a follow-up of 10 years were to assess survival, functional outcomes, and the nature and frequency of complications.
Hypothesis: Knee trauma or surgery before TKA increases the risk of complications and decreases implant survival.
Material and methods: Two hundred and sixty-three patients (122 [47%] females and 141 [53%] males) underwent TKA between 2005 and 2009 at nine centres in France. Mean age at surgery was 61 years. The patients had knee osteoarthritis secondary to a fracture ($n = 66$), osteotomy ($n = 131$), or ligament injury ($n = 66$). Mean time from trauma or surgery to TKA was 145 months (range, 72–219 months).
Results: Major complications were infection ($n = 12$, 4.5%), skin problems ($n = 8$, 3%), and stiffness ($n = 8$, 3%). Ten-year survival to implant exchange for any reason was 89% ± 2.8%. Flexion range increased by 2.5° ± 17° ($p = 0.02$) to a mean of 110° (range, 30° to 140°); extension range increased by 4° ± 7° ($p < 0.001$) to a mean of −1.19 (range, −20° to 0°). Of the 263 patients, 157 (60%) reported little or no pain at last follow-up. Mean postoperative hip-knee-ankle angle was 179° ± 3.2° (range, 171°–188°).
Conclusion: TKA performed after knee injury or surgery carries a risk of specific complications (infection, skin problems, and stiffness) and may have a lower survival rate compared to primary TKA.
Level of evidence: IV, retrospective cohort study.

1. Introduction

Total knee arthroplasty (TKA) has shown a large gain in popularity, particularly over the last decade, and this trend is expected to continue as the spectrum of indications broadens [1,2]. Mean age at TKA for knee osteoarthritis was 70 years in 2012 [3]. The

* Corresponding author.
E-mail address: sophie.putman@chru-lille.fr (S. Putman).

ageing of the population, increasing patient expectations regarding function, and growing use of surgery to treat multiple conditions (trauma, ligament injury, conservative surgery) will increase the number of TKA procedures performed after trauma or surgery to the same knee.

A study done for the 2010 SoFCOT symposium showed that the 10-year survival of TKA for primary knee osteoarthritis was 92% [4]. In theory, TKA to treat knee osteoarthritis caused by trauma or surgery is associated with a higher risk of complications and a lower survival rate, but no accurate data from large populations followed-up for 10 years are available.

This retrospective study in 263 patients with TKA after knee trauma or surgery and a follow-up of 10 years was therefore designed based on the 2010 SoFCOT study of TKA survival in primary knee osteoarthritis. The objectives were to assess survival, functional outcomes, and the nature and frequency of complications. The working hypothesis was that knee trauma or surgery before TKA increased the risk of complications and decreased prosthesis survival compared to TKA for primary osteoarthritis.

2. Patients and methods

2.1. Patients

This multicentre study was designed to reflect the daily practice of nine centres in performing TKA to treat secondary knee osteoarthritis after knee injury or surgery between 2005 and 2009. The nine centres were each in a different French city (Caen, Lille, Lyon, Marseille, Paris Lariboisière, Rouen, Saint-Brieuc, Strasbourg, and Toulouse). Each centre used an electronic case-record form to collect data on eligible patients. The statistical analysis of those data was then conducted by the medical statistics department of the university hospital in Lille, France. Exclusion criteria were septic complications before TKA, unicompartmental knee arthroplasty, and hinged knee arthroplasty.

The study included 263 TKA procedures in 263 patients with a mean age of 61 years (range, 45–83 years). There were 122 (47%) females and 141 (53%) males. The patients had osteoarthritis secondary to a fracture ($n = 66$), ligament injury ($n = 66$), or osteotomy ($n = 131$). Patients with a history of fracture [5] or ligament injury [6] were classified as having post-traumatic knee osteoarthritis. Patients with a previous knee osteotomy were included in the study, since an osteotomy is a controlled fracture; in addition, knee osteoarthritis after an osteotomy cannot be considered primary, and an osteotomy is a major event that can be likened to a knee injury [7–9].

Of the 66 fractures, 42 involved the tibia and 24 the femur; 32 and 7 fractures were intra-articular in these two groups, respectively. Of the 66 ligament injuries, 22 were anterior cruciate ligament (ACL) tears managed by reconstruction, 39 were ACL tears managed non-operatively, and 5 were multiligaments injuries managed surgically. Finally, of the 131 osteotomies, 126 involved the tibia (medial opening wedge, $n = 51$; lateral opening wedge, $n = 2$; medial closing wedge, $n = 2$; and lateral closing wedge, $n = 71$) and 5 the femur (medial opening wedge, $n = 1$; lateral opening wedge, $n = 1$; and medial closing wedge, $n = 3$).

Mean time from knee injury or surgery to TKA was 145 months (range, 72–219). Before TKA, mean extension was −5° [range, −50° to 0°] and mean flexion was 108° [range, 30° to 130°]. Varus deformity (hip-knee-ankle [HKA] angle > 177° was noted in 152 patients and valgus deformity (HKA angle > 183°) in 73 patients; alignment was normal in the remaining 38 patients.

2.2. Operative technique

Standard sliding knee prostheses were implanted without retaining the posterior cruciate ligament. The implants, approach, and use of navigation varied according to standard practice at each centre. Navigation was used in 61 patients. Anterior tibial tuberosity (ATT) osteotomy was required to improve exposure via the lateral approach in 14 patients, including 8 of 66 in the fracture group, 2 of 66 in the ligament injury group, and 4 of 131 in the osteotomy group.

2.3. Assessment method

The patients were evaluated during visits before and after the TKA procedure. The Knee injury and Osteoarthritis Outcome Score (KOOS) was determined at last follow-up [10] but not before TKA. The radiographic work-up performed before TKA and at last follow-up consisted of antero-posterior and lateral weight-bearing views, antero-posterior telemetry to determine the mechanical axis of the lower limb (HKA angle), and a tangential femoro-patellar view with the knee flexed at 60°. The radiographs were used to determine the mechanical axis and to look for lucent lines suggesting loosening.

2.4. Statistical methods

The data were analyzed using SAS version 9.4 (SAS Institute Inc, Cary, NC, USA). Values of p below 0.05 were taken to indicate significant differences. Qualitative variables were described as number (%) and quantitative variables as mean ± SD and as median (interquartile range, IQR). Quantitative variables were assessed for distribution normality by applying the Shapiro-Wilk test and a graphical method. Flexion and extension ranges at baseline and last follow-up were compared using the Wilcoxon test for paired data. Survival was evaluated by plotting Kaplan-Meier curves and computing the 95% confidence intervals (95% CIs). Between-group comparisons of estimated survival were with the log-rank test. Survival was assessed to the date of revision surgery for implant exchange or last follow-up.

3. Results

3.1. Complications

Three patients died of conditions unrelated to the TKA. The major complications were infection ($n = 12$, 4.5%), skin problems ($n = 8$, 3%), and stiffness ($n = 8$, 3%). Revision surgery was required for infection in 12 (4.5%) patients and skin necrosis in 6 (3%) patients. Of the 12 patients with infection, 4 (4/263, 1.5%) required early revision within the first 3 months without implant exchange and 8 (3%) delayed revision after 3 months with implant exchange. Revision with implant exchange was performed for mechanical loosening in 7 patients and dislocation of a rotational polyethylene insert in 1 patient. Thus, implant exchange was required in 16 (6%) patients, for infection in 8 and non-infectious complications in 8. In addition, in 8 (8/263, 3%) patients, postoperative stiffness was managed by manipulation without implant revision.

3.2. Implant survival

The survival rate with implant exchange for any reason as the endpoint was 89% ± 2.8% (95% CI [0.82–0.94]) after 10 years (mean, 9.27 ± 0.12 years) (Fig. 1). Survival was not significantly different across the three groups (fracture, ligament injury, and osteotomy) (Fig. 2) ($p > 0.05$).

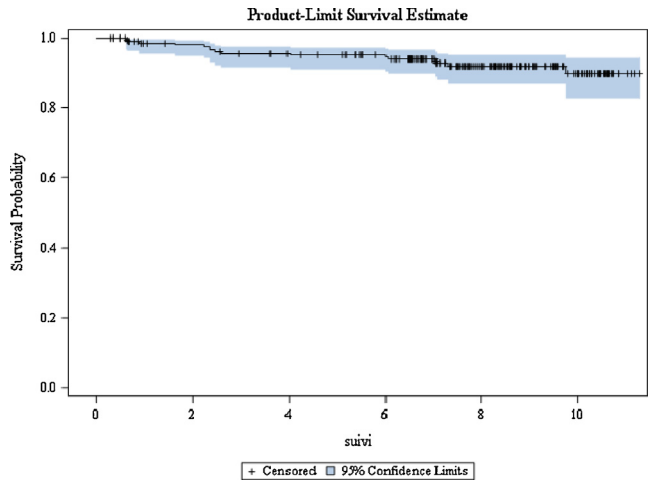

Fig. 1. Overall survival of TKA after trauma or surgery, with the 95% confidence interval.

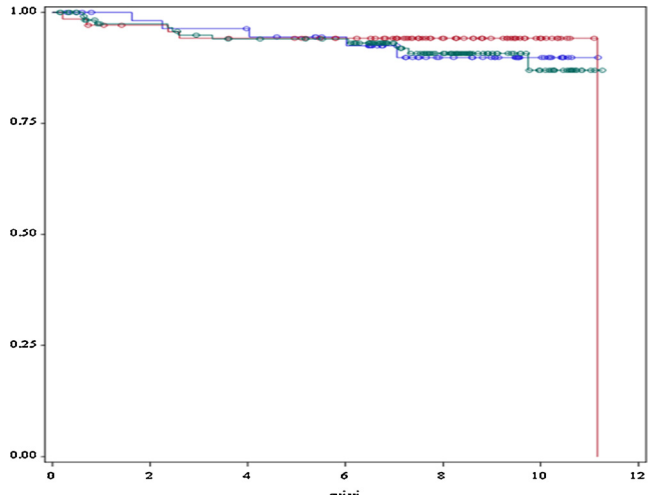

Fig. 2. Survival of TKA after trauma or surgery according to the previous condition: fracture (in red), ligament injury (in blue), or osteotomy (in green).

3.3. Clinical and functional outcomes

Flexion range improved by 2.5° ± 17° ($p = 0.02$) to a mean of 110° (range, 30° to 140°) and extension range by 4° ± 7° ($p < 0.001$) to a mean of −1.19° (range, −20° to 0°). The walking distance was greater than 1000 m in 175 (66%) patients and less than 500 m or limited to indoor ambulation in 27 (10%) patients. Quality of life data collected by the KOOS at last follow-up indicated little or no discomfort in 159 (60%) patients, little or no pain in 157 (60%) patients, and extreme or severe distress in 41 (16%) patients.

3.4. Radiographic outcomes

Mean HKA angle after TKA was 179° ± −3.2° (range, 171°–188°), with no significant difference between patients managed with and without navigation (178° ± 2° [range, 175°–183°] and 179° ± 3° [range, 171°–188°], respectively; $p > 0.05$). Among the patients who did not require revision surgery, none had radiographic evidence of loosening at last follow-up 10 years after TKA.

4. Discussion

Survival to implant exchange for any reason was 89% ± 2% (95% CI [0.82–0.94]) after 10 years (mean, 9.27 ± 0.12 years) in this multicentre retrospective nationwide study of 263 patients managed with TKA for osteoarthritis secondary to trauma or surgery. The study cohort was established as performed previously for the 2010 SoFCOT symposium on 10-year TKA survival in patients with primary osteoarthritis [4]. Implant survival in patients with previous trauma or surgery to the knee was lower, despite a shorter mean follow-up, compared to those with primary osteoarthritis (89% [95% CI: 0.82–0.94] versus 92% [95% CI: 0.9–0.94%), confirming our working hypothesis.

Despite the larger sample size for the 2010 study ($n = 846$), the methodological similarities between the two studies (multicentre recruitment, multiple surgeons, and different implants across centres) allow a comparative analysis. Our population was younger compared to the 2010 study (61 versus 71 years) and to published epidemiological studies of TKA (mean age, 70 years) [3].

The choice of the three aetiological groups (fracture, ligament injury, and osteotomy) may appear criticisable but is fully consistent with the objective of the 2016 SoFCOT symposium. Osteotomy carries the same risks and requires the same precautions as previous trauma to the knee (history of surgery with a previous approach and possible ligament damage) [8–10].

Specific complications were more common in our study compared to the population with primary knee osteoarthritis studied in 2010. Thus, the infection rate was higher (4.5% versus 1.8%), skin problems were not infrequent (3% versus none reported), and stiffness was more common (3% versus 1%). These complications are usually seen in studies of TKA for knee osteoarthritis after trauma [10] or osteotomy. Thus, in a study by Efe et al. [11] of 6-year outcomes in 41 TKAs after high tibial osteotomy and 41 primary TKAs, the active flexion range was nearly 10° greater in the primary TKA group and the revision rate was twice as high in the osteotomy group. Ehlinger et al. [12] recorded a 12.3% rate of early complications in a study of 135 patients comparing outcomes of any type of TKA after opening- versus closing-wedge high tibial osteotomy. In a study by Lunebourg et al. [13] of outcomes after post-fracture TKA ($n = 33$) versus primary TKA ($n = 407$) assessed after at least 5 years, the post-fracture group had a lower 10-year survival of 79% compared to 99% in the primary group. A comparison of TKA after ACL reconstruction versus primary TKA conducted by Magnussen et al. [14] showed a higher rate of stiffness requiring manipulation under general anaesthesia in the ACL group.

Our results confirm the improvement in flexion range achieved after TKA, in keeping with the data from the 2010 symposium (flexion increase by 7° to a mean of 112° ± 12° (range, 25° to 125°) [4]. In 1607 primary TKAs studied by Pasquier et al. [15], mean flexion increase after 2 years was 8.4°. A study by Massin et al. [16] of 40 TKAs for post-traumatic osteoarthritis with flexion limitation to 90° or less showed a large mean flexion gain of 26.7° ± 20°. However, among our patients only 60% reported little or no pain, an outcome that makes a major contribution to patient satisfaction [17,18].

The treatment goal in our patients was to obtain a neutral or near-neutral mechanical axis. The use of navigation did not significantly change the proportion of patients achieving this goal in our population. Other studies, in contrast, found benefits from navigation in complex cases [19–21]. The difference in navigation systems across centres in our study may explain the absence of significant benefits. Consequently, our results should not be construed as evidence that navigation systems are unnecessary in complex cases [22,23]. In addition, several studies indicate that maintaining the original knee malalignment may provide better kinematics compared to restoring normal alignment and may, therefore, result in better patient satisfaction [24–27].

The limitations of this study include the diversity of the previous knee conditions (fracture, ligament injury, and osteotomy), differences in practices across centres, and possible bias due to data collection by the surgeons who performed the TKAs.

Nevertheless, the use of an electronic data collection form limited the amount of missing data, standardized the collection of the data, and minimized the risk of collection bias. Our multicentre recruitment provided a major advantage over single-centre studies by producing a far larger sample size.

5. Conclusion

In this study, survival was lower (89%) after TKA for osteoarthritis secondary to trauma or surgery, compared to TKA for primary osteoarthritis [4]. Three complications deserve special attention: infection, skin problems, and stiffness. Although TKA improved knee range of motion, only 60% of patients were satisfied with the procedure.

Disclosure of interest

SPu is an educational consultant for Tornier-Corin; JNA a consultant for Zimmer-Biomet; PBo a consultant for Stryker and Depuy-Synthes; ME a consultant for Depuy-Synthes, Lepine, and NewClip; PV a consultant for Medacta; SLe a consultant for Ceraver; SLu a consultant for Medacta and Smith & Nephew and a provider of institutional research support for Amplitude and Corin-Tornier; SP a consultant for Zimmer-Biomet, Arthrex, Newclip, Graftys, and Adler Ortho, and MC a consultant for Ceraver.

PBi declares that he has no competing interest.

Acknowledgements

We thank Evamed for the data collection and Henri Migaud for assistance in writing the study report.

References

[1] Kurtz S, Ong K, Lau E, Mowat F, Halpern M. Projections of primary and revision-hip and knee arthroplasty in the United States from 2005 to 2030. J Bone Joint Surg Am 2007;89:780–5.
[2] Niemeläinen MJ, MäKelä KT, Robertsson O, W-Dahl A, Furnes O, et al. Different incidences of knee arthroplasty in the Nordic countries. Acta Orthop 2017;88:173–8.
[3] Carr AJ, Robertsson O, Graves S, Price AJ, Arden NK, et al. Knee replacement. Lancet 2012;379:1331–40.
[4] Argenson JN, Boisgard S, Parratte S, Descamps S, Bercovy M, et al. Survival analysis of total knee arthroplasty at a minimum 10 years' follow-up: a multicenter French nationwide study including 846 cases. Orthop Traumatol Surg Res 2013;99:385–90.
[5] Sanders TL, Pareek A, Kremers HM, Bryan AJ, Levy BA, et al. Long-term follow-up of isolated ACL tears treated without ligament reconstruction. Knee Surg Sports Traumatol Arthrosc 2017;25:493–500.
[6] El-Galaly A, Haldrup S, Pedersen AB, Kappel A, Jensen MU, Nielsen PT. Increased risk of early and medium-term revision after post-fracture total knee arthroplasty. Acta Orthop 2017;88:263–8.
[7] Gaillard R, Lording T, Lustig S, Servien E, Neyret P. Total knee arthroplasty after varus distal femoral osteotomy vs native knee: similar results in a case control study. Knee Surg Sports Traumatol Arthrosc 2017;25:3522–9.
[8] Fröhlich V, Johandl S, De Zwart P, Stöckle U, Ochs BG. Navigated TKA after osteotomy versus primary navigated TKA: a matched-pair analysis. Orthopedics 2016;39:S77–82.
[9] Ornetti P, Parratte S, Gossec L, Tavernier C, Argenson JN, et al. Cross cultural adaptation and validation of the French version of the Knee injury and Osteoarthritis Outcome Score (KOOS) in knee osteoarthritis patients. Osteoarthritis Cartilage 2007;16:423–4.
[10] Benazzo F, Rossi SMP, Combi A, Meena S, Ghiara M. Knee replacement in chronic post-traumatic cases. EFORT Open Rev 2016;1:211–8.
[11] Efe T, Heyse TJ, Boese C, Timmesfeld N, Fuchs-Winkelmann S, Schmitt J, et al. TKA following high tibial osteotomy versus primary TKA – a matched pair analysis. BMC Musculoskelet Disord 2010;11:207.
[12] Ehlinger M, D'ambrosio A, Vie P, Leclerc S, Bonnomet F, Bonnevialle P, et al. Total knee arthroplasty after opening — versus closing — wedge high tibial osteotomy. A 135-case series with minimum 5-year follow-up. Orthop Traumatol Surg Res 2017;103:1035–9.
[13] Lunebourg A, Parratte S, Gay A, Ollivier M, Garcia-Parra K, Argenson JN. Lower function, quality of life, and survival rate after total knee arthroplasty for posttraumatic arthritis than for primary arthritis. Acta Orthop 2015;86:189–94.
[14] Magnussen RA, Demey G, Lustig S, Servien E, Neyret P. Total knee arthroplasty for secondary osteoarthritis following ACL reconstruction: a matched-pair comparative study of intra-operative and early postoperative complications. Knee 2012;19:275–8.
[15] Pasquier G, Tillie B, Parratte S, Catonné Y, Chouteau J, et al. Influence of preoperative factors on the gain in flexion after total knee arthroplasty. Orthop Traumatol Surg Res 2015;101:681–5.
[16] Massin P, Bonnin M, Parratte S, Vargas R, Piriou P, Deschamps G. Total knee replacement in post-traumatic arthritic knees with limitation of flexion. Orthop Traumatol Surg Res 2011;97:28–33.
[17] Lange T, Schmitt J, Kopkow C, Rataj E, Günther KP, Lützner J. What do patients expect from total knee arthroplasty? A Delphi consensus study on patient treatment goals. J Arthroplasty 2017;32:2093–9.
[18] Jiang Y, Sanchez-Santos MT, Judge AD, Murray DW, Arden NK. Predictors of patient-reported pain and functional outcomes over 10 years after primary total knee arthroplasty: a prospective cohort study. J Arthroplasty 2017;32:92–100.
[19] Huang TW, Chuang PY, Lee CY, Lin SJ, Huang KC, et al. Total knee arthroplasty in patients with Ranawat type-II valgus arthritic knee with a marked coronal femoral bowing deformity: comparison between computer-assisted surgery and intra-articular resection. J Orthop Surg Res 2016;11:88.
[20] Saragaglia D, Cognault J, Refaie R, Rubens-Duval B, Mader R, et al. Computer navigation for revision of unicompartmental knee replacements to total knee replacements: the results of a case-control study of forty-six knees comparing computer navigated and conventional surgery. Int Orthop 2015;39:1779–84.
[21] Cip J, Widemschek M, Bach C, Ruckenstuhl P, Benesch T, Studer K, et al. Encouraging treatment algorithm for computer-assisted navigated total knee arthroplasty (TKA): a retrospective cohort analysis. J Orthop 2017;14:377–83.
[22] Desseaux A, Graf P, Dubrana F, Marino R, Clavé A. Radiographic outcomes in the coronal plane with Iassist™ versus optical navigation for total knee arthroplasty: a preliminary case-control study. Orthop Traumatol Surg Res 2016;102:363–8.
[23] Yang HY, Seon JK, Shin YJ, Lim HA, Song EK. Robotic total knee arthroplasty with a cruciate-retaining implant: a 10-year follow-up study. Clin Orthop Surg 2017;9:169–76.
[24] Parratte S, Pagnano MW, Trousdale RT, Berry DJ. Effect of postoperative mechanical axis alignment on the fifteen-year survival of modern, cemented total knee replacements. J Bone Joint Surg Am 2010;92:2143–9.
[25] Matsumoto T, Takayama K, Ishida K, Hayashi S, Hashimoto S, Kuroda R. Radiological and clinical comparison of kinematically versus mechanically aligned total knee arthroplasty. Bone Joint J 2017;99:640–6.
[26] Almaawi AM, Hutt JRB, Masse V, Lavigne M, Vendittoli PA. The impact of mechanical and restricted kinematic alignment on knee anatomy in total knee arthroplasty. J Arthroplasty 2017;32:2133–40.
[27] Rames RD, Mathison M, Meyer Z, Barrack RL, Nam D. No impact of undercorrection and joint line obliquity on clinical outcomes of total knee arthroplasty for the varus knee. Knee Surg Sports Traumatol Arthrosc 2017, http://dx.doi.org/10.1007/s00167-017-4507-9.