Arthroplasty Today 6 (2020) 492–495

Contents lists available at ScienceDirect

Arthroplasty Today

journal homepage: http://www.arthroplastytoday.org/

Case Report

Late-Onset De Novo Genu Recurvatum after Primary Total Knee Arthroplasty: A Potential Indication for Isolated Polyethylene Exchange

Seyed Mohammad Javad Mortazavi, MD *, Mohammadreza Razzaghof, MD, MPH, Abbas Noori, MD, Ali Okati, MD

Joint Reconstruction Research Center (JRRC), Tehran University of Medical Sciences, Tehran, Iran

ARTICLE INFO

Article history:
Received 9 April 2020
Received in revised form
14 May 2020
Accepted 14 May 2020
Available online xxx

Keywords:
Total knee arthroplasty
Genu recurvatum
Hyperextension knee instability
Polyethylene exchange

ABSTRACT

Knee instability is the second most common cause of revision after total knee arthroplasty (TKA). Genu recurvatum (GR) is the rarest form of instability usually occurring in patients with underlying conditions such as neuromuscular disorders and fixed valgus deformities. The literature regarding de novo post-TKA GR and its treatment is scarce. In this case series and review of literature, we aimed to review the treatment strategies of post-TKA GR and to present our experience in the treatment of late-onset de novo GR after TKA by isolated polyethylene exchange. To our knowledge, isolated polyethylene exchange has not been so far described for GR correction after TKA. We found a unique wear pattern at the base of the liner post in all 3 patients. They showed a satisfactory outcome with no recurrence on a mean follow-up of 26.67 months.

Introduction

Knee instability is the second most common cause of revision after total knee arthroplasty (TKA) after infection and accounts for 10% to 22% of all revision TKAs [1-3]. Instability can occur in 3 forms of flexion-extension, recurvatum, and global instability [2]. Genu recurvatum (GR) is the rarest form of instability with a reported frequency of 0.5% to 1% [4,5]. The risk factors for GR after TKA include neuromuscular disorders such as poliomyelitis, quadriceps weakness, rheumatoid arthritis, fixed valgus deformities, and previous high tibial osteotomy (HTO) [5-7].

This deformity, although rare, is a known cause of TKA failure requiring further corrective surgery [8]. However, treatment strategies have only been scarcely discussed in the literature. These include tightening the collateral ligaments in extension, placing the femoral component in flexion, and replacing with a rotating hinge knee (RHK) implant [4,5,9]. To our knowledge, isolated exchange of a polyethylene (PE) liner has not been so far described in treating GR after TKA. In this case series and review of literature, we aimed to present our experience in the treatment of late-onset and de novo post-TKA GR by isolated polyethylene exchange (IPE) and to review the treatment strategies of post-TKA GR.

Case history

From January 2011 to January 2020, a total of 1864 primary TKAs (796 with single-radius [SR] prostheses) were performed at our institution. To this date, we had 4 cases of postoperative GR with an incidence of 0.21% (0.5% of SR prostheses) over 9 years. All the cases were late onset, developing at an average of 15.75 months (range: 6-32) after primary surgery. The patients were all female with a mean age of 59.25 years (range: 55-67), who presented with complaints of knee pain and hyperextension knee thrust during weight-bearing. None reported a history of knee trauma. On examination, they had varying degrees of GR from 10° to 20° (see Table 1 for detailed patients' data). There was no significant mediolateral or flexion instability of the involved knee; however, some degree of ligamentous laxity was present symmetrically in both knees, as all the patients had generalized ligamentous laxity according to Beighton's criteria [10]. No sign of inflammation such as swelling, warmth, and erythema was present. The radiographs

* Corresponding author. Imam Khomeini Hospital Complex, Baqerkhan Street, East Chamran Highway, Tehran 1419733141, Iran. Tel.: +98 21 66581586.
E-mail address: smjmort@yahoo.com

https://doi.org/10.1016/j.artd.2020.05.014

were normal for all the patients with no sign of loosening and periprosthetic osteolysis. The femoral and tibial cut angles and the mechanical leg axis were appropriate in anteroposterior and lateral projections, respectively (Fig. 1). The erythrocyte sedimentation rate and C-reactive protein levels were within the normal range except in the second patient (C-reactive protein = 14 mg/L) in whom joint aspiration was further performed. However, the result was negative with a synovial white blood cell count of 60 per μL, 50% polymorphonuclear leukocytes, and negative culture. The intraoperative culture was also negative.

None of the patients had a history of neuromuscular disorders, quadriceps weakness, recurvatum deformity, fixed valgus deformity, or HTO before the primary surgery or any sign of a neuromuscular problem at the time of presentation. The indication for primary TKA was osteoarthritis in all except one case with rheumatoid arthritis. All TKAs had been performed by a single arthroplasty surgeon using an SR design prosthesis under the standard surgical protocol. The prosthesis was Scorpio NRG (Stryker, Mahwah, NJ) in all the cases. The knees had been stable on examination at the end of the surgery. On their follow-up, no other complication was seen.

All the patients were first treated conservatively by protected weight-bearing in a hinged knee brace. Range of motion (ROM) from 10° to 130° was allowed for 3 months. Only one of the patients fully improved, but the others needed further surgery. The integrity and mediolateral balance of the collateral ligaments were sufficient, and the posterior capsule was intact during the surgery. However, a unique wear pattern was found at the anterior aspect of the base of the PE liner post in all the patients (Fig. 2). It was exchanged for a PE liner with a higher thickness (Table 1) so that the knee became stable with no residual recurvatum. The mean postoperative follow-up after PE exchange was 26.67 months (range: 18-32). No recurrence of the condition was seen, and all had satisfactory knee ROM and no problem with ambulation. The knee ROM and Knee Society Scores for each patient are presented in Table 1.

Discussion

GR after TKA has been described primarily in patients with underlying conditions. Neuromuscular disorders, with poliomyelitis as the prototype, cause valgus and recurvatum knee deformities because of a loss of motor function and subsequent ligamentous laxity [7]. Quadriceps femoris weakness can lead to a compromise of extensor mechanism locking during the load-bearing phase of gait and subsequent compensation by anterior displacement of the gravity line, which results in GR [11]. Rheumatoid arthritis can damage the integrity of anterior cruciate and collateral ligaments and hence the hyperextension instability [9,12]. There is some degree of ligamentous laxity in all these conditions predisposing patients to GR, although other factors may also play a role. Previously fixed genu valgum might cause GR because of a contracted iliotibial band lying anterior to the lateral femoral epicondyle [6]. Moreover, the anterior slope of the tibial plateau may lead to post-TKA GR in patients with a history of HTO [13]. Except for one case with rheumatoid arthritis, none of these underlying conditions were present in our patients although they all had generalized ligamentous laxity in common.

Most of the reported cases of post-TKA GR are those who had GR before arthroplasty, and the literature regarding de novo cases is scarce [5,14,15]. Erceg and Rakić reported a case of recurring post-TKA GR (55°) presenting upon weight-bearing in a 73-year-old female who underwent 3 revision surgeries until an RHK prosthesis could treat the condition [15]. Wong et al. reported a 77-year-old female presenting with increasing GR (45°) after TKA, which was also finally treated by RHK. However, the authors believed that early intervention might have obviated the need for a highly constrained prosthesis [14]. An RHK prosthesis has been regarded as the preferred technique for correcting post-TKA GR by Abdel and Cottino [4,9]. On the other hand, Krackow and Weiss believed that proper tightening of collateral ligaments combined with a multiple-radius (MR) femoral component could correct GR with no

Table 1
Patient data.

Characteristics	Patient 1	Patient 2	Patient 3	Patient 4
Age (y)	63	67	55	52
Sex	F	F	F	F
BMI (kg/m^2)	30.4	26	24	25
Primary TKA indication	OA	RA	OA	OA
Side	Lt	Rt	Lt	Rt
Recurvatum presentation[a] (mo)	11	32	14	6
Response to conservative treatment[b]	No	No	No	Yes
Follow-up after PE exchange (mo)	32	18	30	–
PE thickness (mm)				
Primary	10	8	8	–
Secondary	15	18	15	–
Knee hyperextension[c]				
Before IPE	15	20	15	10
After IPE				
6 mo	0	0	0	0
18 mo	0	0	0	0
30 mo	0	–	0	0
KSS-1, 2				
Preoperative	73, 65	79, 65	78, 75	84, 70
Postoperative				
6 mo	89, 70	89, 75	93, 80	89, 80
18 mo	–	89, 75	94, 80	–
30 mo	89, 80	–	93, 80	89, 80
Overall outcome[d]	Satisfactory	Satisfactory	Satisfactory	Satisfactory

F, female; BMI, body mass index; OA, osteoarthritis; RA, rheumatoid arthritis; KSS, Knee Society Score.
[a] Presented as months after the primary surgery.
[b] All the patients underwent conservative treatment with a hinged knee brace for 3 months.
[c] Range of knee hyperextension under weight-bearing.
[d] Overall outcome is presented considering the patient's satisfaction and knee examination at the last follow-up visit.

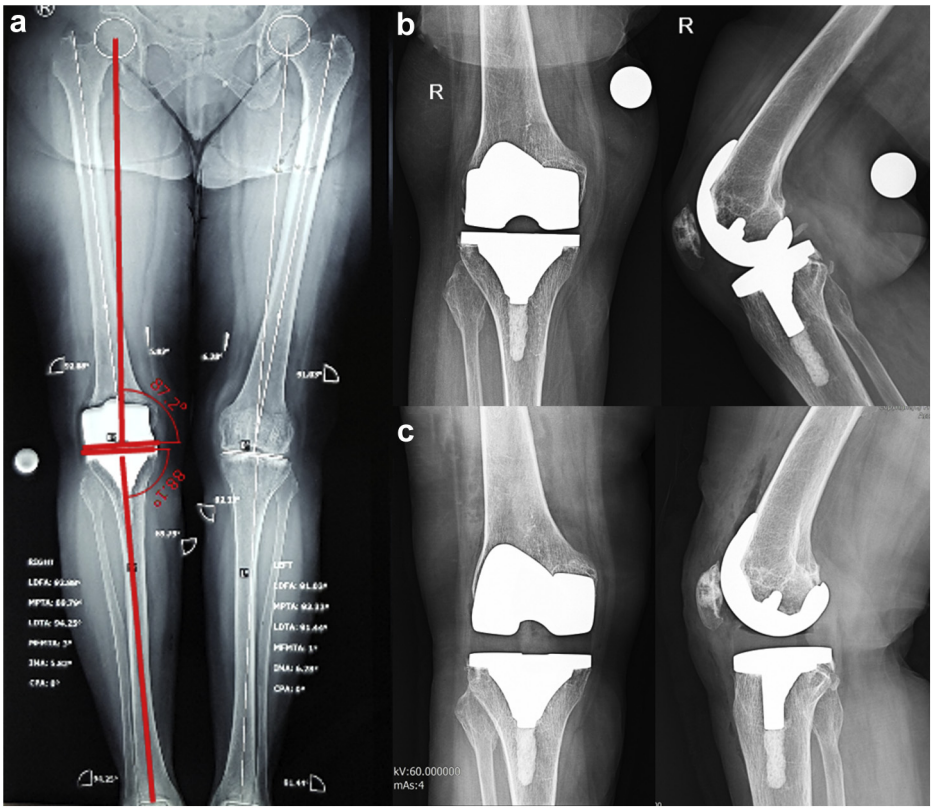

Figure 1. Patient 2; the preoperative 3-joint alignment view showed a tibial cut angle of 88.1° and a femoral cut angle of 87.2° (a), preoperative anteroposterior and lateral radiographs (b), and anteroposterior and lateral radiographs after IPE and increasing thickness from 8 to 18 mm (c).

need for RHK [5]. In our series, the mean age (59.2 years) was lower, the presentation was more delayed (15.75 months), and the recurvatum severity (range: 10°-20°) was lower than those in the mentioned studies. Given the normal tibiofemoral alignment, well-fixed components, and the sufficient stability of collateral ligaments, IPE was performed to correct GR with satisfactory results.

In choosing the appropriate treatment strategy, the severity of recurvatum should be noted. While correcting the severe (>40°) GR cases reported by Erceg and Wong needed the use of an RHK prosthesis, the mild and moderate cases (<30°) of Krackow and our study were treated trying to avoid it. We think it might be prudent to avoid a highly constrained prosthesis when possible because although accepted as a definitive treatment, RHK is associated with more invasive surgery, inferior long-term outcomes, a higher rate of complications, and higher costs [16]. On the contrary, IPE preserves the bone stock and has the advantages of shorter operation time, decreased blood loss, lower costs, and faster rehabilitation [17].

As GR occurred only in patients operated with SR prostheses, we thought that the development of GR after TKA might be affected by

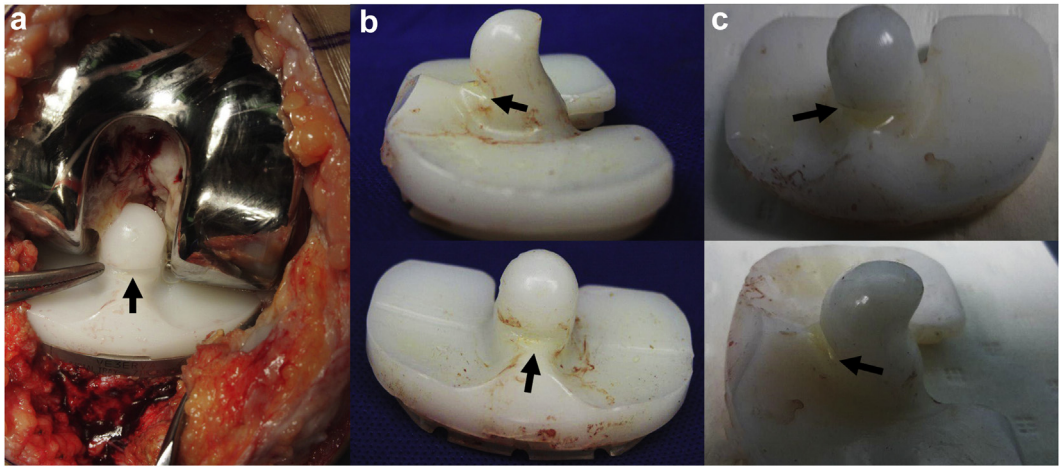

Figure 2. The unique wear pattern of the PE liner post in patients 1 (a), 2 (b), and 3 (c).

the prosthesis design. In a recent meta-analysis comparing SR and MR prostheses, SR prostheses were superior in terms of an increased ROM and a better extensor function [18]. An MR prosthesis is theoretically associated with a more limited ROM in extension and less post-TKA GR. It is because a higher radius of the anterior aspect of the femoral component than that of posterior leads to the stretching of collateral ligaments during knee extension, hence increasing the extension stability and preventing recurvatum. It has been noted by Krackow et al. and used in treating post-TKA GR [5]. In our institute, among 1864 TKAs performed over the last 9 years, 796 were performed using an SR prosthesis, namely Scorpio NRG (Stryker, Mahwah, NJ), of which 4 (0.5%) were complicated with postoperative GR. On the other hand, none of the 1068 TKAs with MR prostheses, that is, Zimmer NexGen© LPS-Flex Knee (ZimmerBiomet, Warsaw, IN) and DePuy Synthes P.F.C. SIGMA® (DePuy Synthes, Warsaw, IN), were complicated with GR postoperatively.

In our series, a unique wear pattern was found over the PE liner, which has not been described so far in the literature. Although the tibial post wear in the posterior stabilized prosthesis affects the posterior surface predominantly because of the post-cam mechanism [19], we found wear at the anterior aspect of the base of the liner post. We hypothesized the defect is from the impact of the edge of the femoral component during knee hyperextension within our group of patients with post-TKA GR.

The known indications for IPE have been the PE wear and osteolysis, early infection, and arthrofibrosis so far [20]. We believe that de novo post-TKA GR could be a potential indication for IPE as well. However, patient selection seems essential, as in the other indications of IPE. In this regard, the prosthesis components should be well aligned and well fixed, and the collateral ligaments and posterior capsule should be sufficient. The limitations of our study were the low number of patients and relatively short follow-up duration. Further studies are required to completely show the cons and pros of IPE in post-TKA GR.

Summary

GR can occur in patients with ligamentous hyperlaxity who undergo TKA using an SR design. IPE could be considered in treating this uncommon complication. Using thicker PE liners at the time of primary TKA in patients with ligamentous hyperlaxity might prevent this complication. However, further studies are required to fully elucidate the potential effectiveness and pitfalls of this technique.

Conflict of interest

The authors declare there are no conflicts of interest.

References

[1] Parratte S, Pagnano MW. Instability after total knee arthroplasty. J Bone Joint Surg Am 2008;90(1):184.
[2] Vince KG, Abdeen A, Sugimori T. The unstable total knee arthroplasty: causes and cures. J Arthroplasty 2006;21(4):44.
[3] Fehring TK, Odum S, Griffin WL, Mason JB, Nadaud M. Early failures in total knee arthroplasty. Clin Orthop Relat Res 2001;392:315.
[4] Cottino U, Sculco PK, Sierra RJ, Abdel MP. Instability after total knee arthroplasty. Orthop Clin 2016;47(2):311.
[5] Krackow KA, Weiss A. Recurvatum deformity complicating performance of total knee arthroplasty. A brief note. J Bone Joint Surg Am 1990;72(2):268.
[6] Meding JB, Keating EM, Ritter MA, Faris PM, Berend ME. Total knee replacement in patients with genu recurvatum. Clin Orthop Relat Res 2001;393:244.
[7] Giori NJ, Lewallen DG. Total knee arthroplasty in limbs affected by poliomyelitis. J Bone Joint Surg Am 2002;84(7):1157.
[8] Chang MJ, Lim H, Lee NR, Moon Y-W. Diagnosis, causes and treatments of instability following total knee arthroplasty. Knee Surg Relat Res 2014;26(2):61.
[9] Abdel M, Haas S. The unstable knee: wobble and buckle. Bone Joint J 2014;96(11_Supple_A):112.
[10] Beighton P, Solomon L, Soskolne C. Articular mobility in an African population. Ann Rheum Dis 1973;32(5):413.
[11] Costanzo D, Pancino N. Problemi Terapeutici Nel Ginocchio Paralitico E Poliomielite. Ortopedia e traumatologia dell'apparato locomotore 1955;23:139.
[12] Laskin RS, O'Flynn HM. The Insall Award. Total knee replacement with posterior cruciate ligament retention in rheumatoid arthritis. Problems and complications. Clin Orthop Relat Res 1997;(345):24.
[13] Insall JN. Surgical techniques and instrumentation in total knee arthroplasty. Surg Knee 1993;1:739–804.
[14] Wong Y, Cheong P, Wai Y. Recurvatum Instability after total knee arthroplasty-case report and literature review. Hong Kong J Orthop Surg 2003;7(1):46.
[15] Erceg M, Rakić M. Genu recurvatum as a complication after total knee arthroplasty. Acta Clini Croat 2012;51(2):265.
[16] Springer BD, Hanssen AD, Sim FH, Lewallen DG. The kinematic rotating hinge prosthesis for complex knee arthroplasty. Clin Orthop Relat Res 2001;392:283.
[17] Engh GA, Koralewicz LM, Pereles TR. Clinical results of modular polyethylene insert exchange with retention of total knee arthroplasty components. J Bone Joint Surg Am 2000;82(4):516.
[18] Li M, Deng Z, Jiang H, Ma Y, Liao J, Zheng Q. Single radius versus multiple radius femoral prostheses in total knee arthroplasty: a meta-analysis. Int J Clin Exp Med 2019;12(8):9508.
[19] Puloski S, McCalden R, MacDonald S, Rorabeck C, Bourne R. Tibial post wear in posterior stabilized total knee arthroplasty: an unrecognized source of polyethylene debris. J Bone Joint Surg Am 2001;83(3):390.
[20] Pang H-N, Abd Razak HRB, Petis S, Naudie DD, MacDonald SJ. The role of isolated polyethylene exchange in total knee arthroplasty. EFORT Open Rev 2017;2(3):66.