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A novel technique of reshaping the post of a constrained liner to avoid post and primary box mismatch in a case of recurrent dislocation after total knee arthroplasty

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Abstract
Knee dislocation after total knee arthroplasty, although rare, is a dangerous injury that can lead to neurovascular compromise and permanent disability. With the increase in number of total knee arthroplasty, more and more cases of dislocations are being reported. We describe a novel technique of reshaping the post of a constrained liner to fit into the box of a vanguard primary knee system in a patient with recurrent posterior knee dislocation after a PS TKA with a follow-up of 5 years.

Keywords Dislocation · Total knee arthroplasty · Constrained liner · Reshaping

Introduction

The incidence of dislocation after total knee arthroplasty (TKA) ranged from 1 to 2%, but has fallen to 0.15–0.5% with newer designs that incorporate changes in the height of the tibial polyethylene post and its anterior translation [1–3]. The incidence of recurrent dislocations following TKA is not known as there are only few cases reported in the literature. Instability is the third most common cause of failure of a TKA, and dislocation TKA is the worst form of instability [4]. Dislocation after TKA can be acute, chronic (≥4 weeks), posterior (commonest), anterior (rare) or mediolateral. The majority of patients with prosthetic knee dislocations are successfully reduced under conscious sedation; however, there had been several cases in which there were concurrent neurovascular injuries, necessitating vascular intervention to restore blood perfusion [1, 5]. Although more common with a CR design, this complication has been reported with every prosthesis design reinforcing the fact that the more important factors in deciding the long-term result after a total knee is the technique and decision making rather than the design of the prosthesis itself [6].

We present a novel technique of reshaping the post of a constrained liner to match the primary femoral component box (vanguard system) in a patient with recurrent dislocation of TKA. Written informed consent was obtained from the patient for the publication of this case report and accompanying images.

Case history

A 55-year-old female presented to our hospital with pain, swelling, deformity right knee and difficulty walking in March 2012. On examination, there was joint effusion, medial joint line tenderness, fixed flexion contracture of 20° and flexion to 135°, and valgus deformity of 12°. She was neurovascularly intact distal at presentation. Radiographs of right knee showed severe lateral joint and patellofemoral arthritis with valgus deformity (Fig. 1a, b). Scanogram of the lower limb revealed mechanical axis passing outside the lateral joint space and a valgus of 15° (Fig. 1c). Patient was diagnosed as rheumatoid arthritis with lateral knee joint destruction with flexion deformity and Ranaw at type 2 valgus deformity. Total knee replacement with patellar replacement was done using vanguard PS knee system (Biomet). Posterolateral release was performed using pie crusting technique of the iliotibial band and posterior capsular release to correct the valgus deformity. A 5-mm

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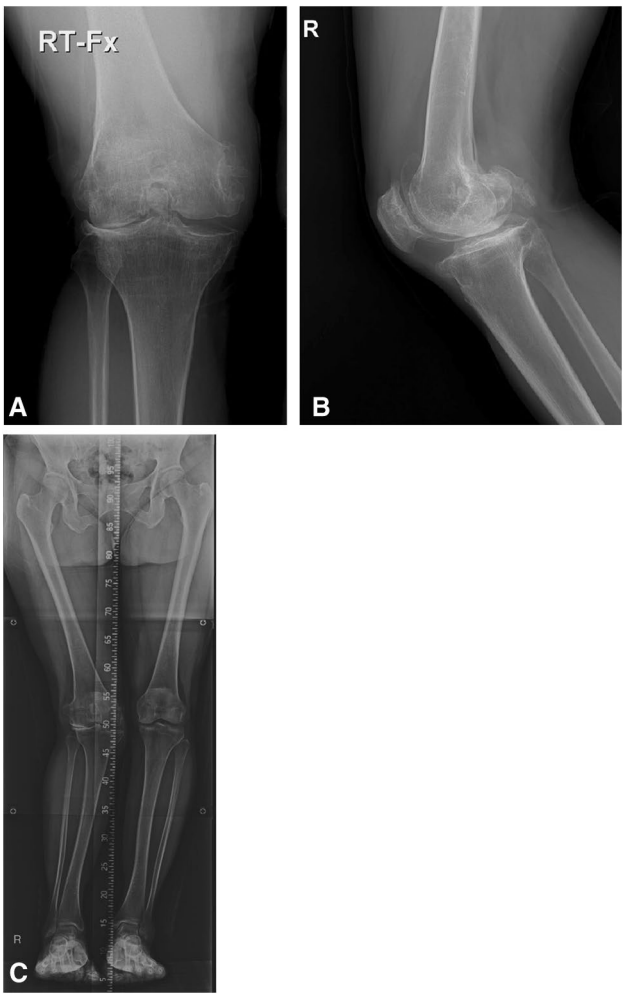

Fig. 1 Radiograph right knee. Anteroposterior (**a**) and lateral view (**b**). **c** Scanogram lower limbs showing lateral mechanical axis deviation and valgus

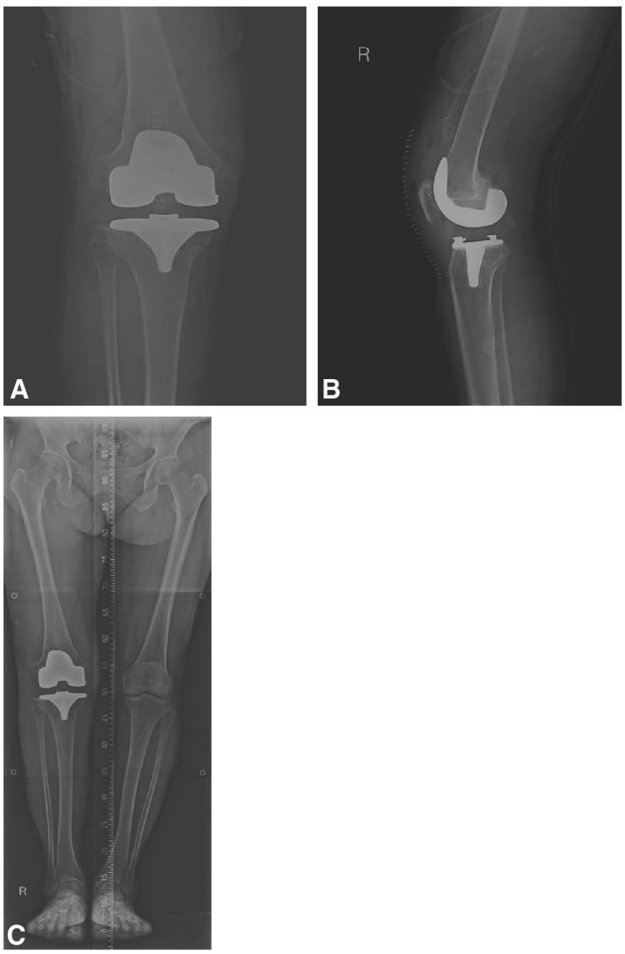

Fig. 2 Postoperative AP (**a**) and lateral radiograph (**b**) right knee after primary TKA. **c** Postoperative scanogram lower limbs showing align right limb

posterior femoral augment was used to match the flexion extension gap. Intra-operatively, the knee was found to be stable and standard postoperative rehabilitation protocol was followed. Postoperative radiographs and scanogram showed a well-fixed and aligned knee with mechanical axis passing through the center of knee joint (Fig. 2). After 3 months, patient presented with sudden non-traumatic pain, effusion, deformity right knee and inability to walk after getting up from her bed. On examination, the knee was tender, swollen and deformed. There was no sensory disturbance in the leg, and the dorsalis pedis and posterior tibial vessels were palpable. Radiographs of the knee revealed a posterior dislocation of the TKA (Fig. 3). Patient was taken to the operation room, and closed reduction was successfully achieved under sedation. Postoperatively, the knee was kept in a knee immobilizer. Post-reduction radiograph confirmed an anatomically reduced TKA (Fig. 4). However, after only 1 week, the patient presented with similar episode and again the knee was reduced but this time a cylindrical cast was applied. Subsequently, after only 1 month, the patient reported another episode of dislocation at home. The patient

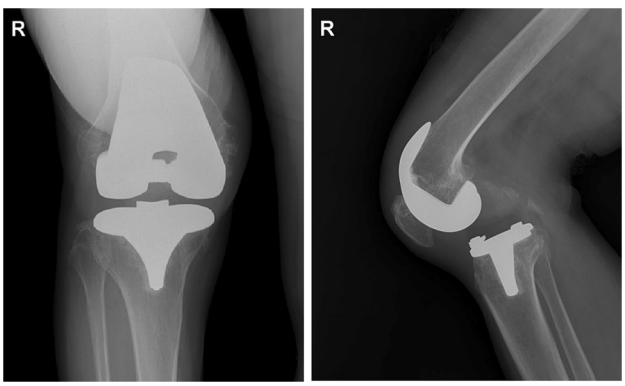

Fig. 3 AP and lateral radiograph right knee showing dislocation of the TKA

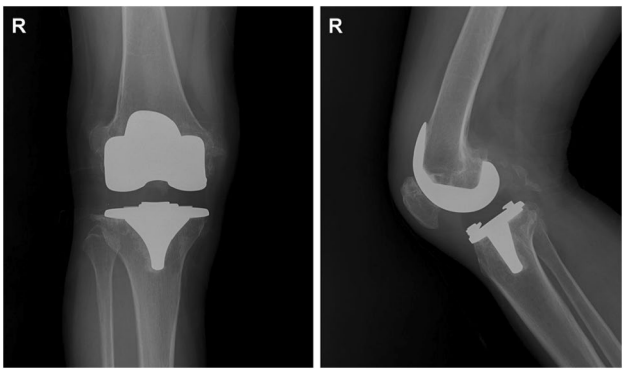

Fig. 4 AP and lateral radiograph post-reduction, showing a reduced TKA

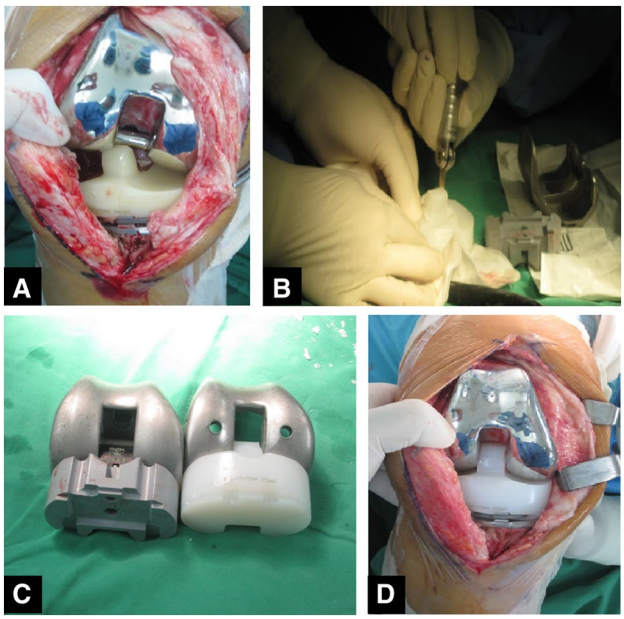

Fig. 5 Intra-operative photographs. **a** Cam out of the box with intra-operative varus stress. **b** Reshaping of constrained liner post by carving and trimming with an electric saw. **c** Reshaped constrained liner post fitted into the trial vanguard femoral component. **d** Reshaped constrained liner well fixed and stable into narrow primary (vanguard) knee box

was able to self-reduce the dislocation. A forth episode of dislocation occurred 10 days later despite cylindrical cast immobilization. The last (fifth months) dislocation occurred in September 2012. So, after five episodes of dislocation in a short span of 6 months despite continued conservative measures, the patient was examined thoroughly and posterolateral and mediolateral instability was found. The patient was planned for revision surgery. Intra-operatively, the post of the polyethylene liner subluxed out of the femoral box when varus stress was applied to the knee (Fig. 5a). The knee remained unstable even with the use of the thickest available PS plus trial liner (18 mm thickest polyethylene liner for the Vanguard knee). We then attempted to use a constrained PS liner, but there is a post-box mismatch between the constrained PS post and the primary vanguard knee femoral box. The wider constrained post would not fit into the narrower femoral box of vanguard knee system. Available options included: (1) revision of the primary femoral component to a revision femoral component or (2) to modify the post of the constrained liner to fit the primary femoral box. The first option required a more extensive surgery with potential significant bone loss. The second option would potentially avoid an extensive surgery which was advantages in a young patient with no mal-alignment or loosening of the components. We opted for the second option. The post of the 24 mm SSK constrained liner was reshaped by trimming and carving with an electric saw to fit into the primary vanguard femoral box (Fig. 5b). The post-box fit was checked on the trial vanguard femoral component on the operating trolley before putting it into the knee (Fig. 5c). Intra-operatively, the knee was found to be stable with no mediolateral or posterolateral instability (Fig. 5d). Postoperative radiographs and scanogram revealed an anatomically reduced and well-aligned knee with the mechanical axis passing through the knee center (Fig. 6). Routine rehabilitation protocol was used as the knee was stable. Patient was followed up at 6 months, 1 year and 5 years. At the last follow-up after 5 years, the patient was ambulating without pain or walking-aid. The knee was found to have 0°–130° of ROM without evidence of instability. The radiographs and scanogram taken at the final follow-up revealed a well-reduced and aligned knee (Fig. 7).

Discussion

Dislocation after TKA is a rare event and recurrent dislocation even rarer [7]. Many factors contribute to this complication, after detailed analysis of patient's history, physical examination, operative report and radiographs, Song et al. [8] identified six categories: flexion/extension gap mismatch, component malposition, isolated ligament insufficiency, extensor mechanism insufficiency, component loosening and global instability.

Acute knee dislocation requires an urgent attempt at closed reduction, with careful evaluation of neurovascular status [9]. If unsuccessful, the patient likely requires open reduction with subsequent immobilization for 3–10 weeks [10]. If the patient continues to have symptoms of instability, revision surgery is likely necessary [11]. Adequate identification of the causes leading to TKA dislocation is mandatory for successful treatment [1].

Unfortunately, the literature neither clarifies which design is most appropriate for knee prosthetic instability nor defines

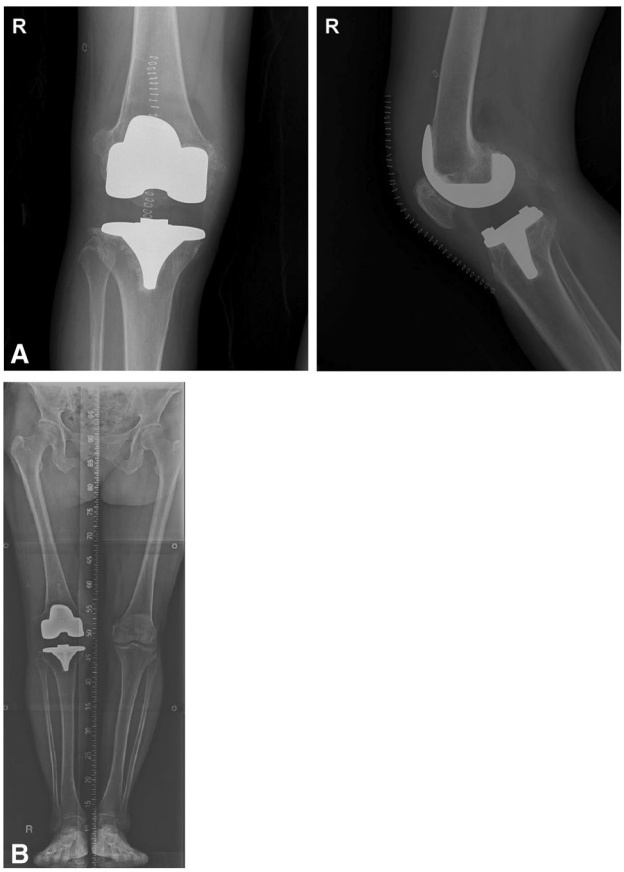

Fig. 6 **a** Postoperative radiographs after revision surgery with reshaped constrained liner. **b** Postoperative scanogram with aligned right knee

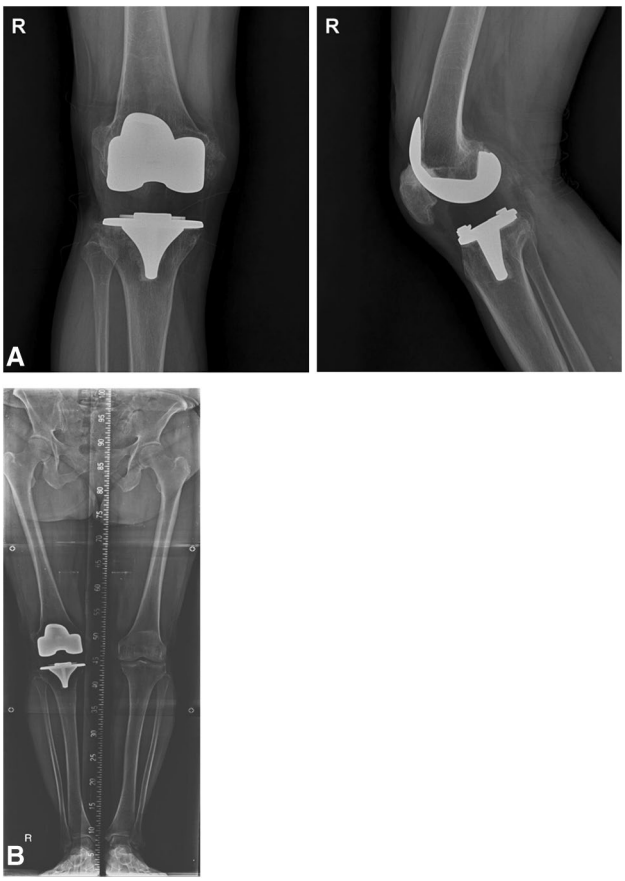

Fig. 7 **a** Radiographs at final follow-up, well-fixed components with no signs of loosening. **b** Final follow-up scanogram shows maintained lower limb alignment

the rates of component loosening associated with the use of more constrained implants. Future studies should define the rates of recurrent instability after revision using implants with various levels of constraint [11]. Prosthesis selection should be individualized, based on the patient's level of instability, age, history and expectations. Ideally, the lowest level of constraint required to maintain a stable knee is the best choice for implant longevity and maximal function. Avoiding excessive constraint to preserve range of motion is especially important in patients with subtle instability [7]. This complication has been reported with every prosthesis design reinforcing the fact that the more important factors in deciding the long-term result after a total knee is the technique and decision making rather than the design of the prosthesis itself [6].

Knee dislocation after total knee replacement was first reported in 1979 after total condylar knee replacement in 4 patients by Insall et al. in a series of 220 patients. The authors attributed the dislocations to inadequate stability in flexion which was addressed with revision to a thicker tibial insert [12]. Until now, many treatment options have been used to deal with this complication ranging from conservative to surgical (thick liner, constrained liner or total revision of components). In CR design, simply increasing the height of the polyethylene insert or replacing it with an ultracongruent polyethylene insert has been associated with a high percentage of failures (30–35% at 5 years) [13, 14]. Complete exchange and implantation of a PS design is the gold standard [1]. In PS design, knee immobilization and muscular strengthening may sometimes be sufficient to provide adequate knee stability or insertion of thick polyethylene liner can occasionally solve the problem. However, if there is severe ligamentous laxity, significant flexion–extension gap mismatch or femoral and tibial component malpositioning, a complete revision or an intercondylar constrained design is necessary [15]. Lombardi et al. reported fifteen cases of posterior dislocations out of 3032 primary total knee arthroplasties performed using the Insall-Burstein Posterior Stabilized Condylar Prosthesis. Conservative management was successful in 11 cases, and in 3 cases, a revision surgery was necessary, and stronger polyethylene (2–4 mm) was reimplanted [2]. Though many cases of dislocation after total

knee replacement are now reported, there is still very limited literature on recurrent dislocation after TKA.

Ng and Chiu report an unusual case of recurrent dislocation of posterior stabilized TKA secondary to fracture of the polyethylene insert. Recurrent dislocation occurred 21 months after primary TKA and revision surgery was done [16].

In a series of 136 patients with primary TKA using posterior stabilized prosthesis, Erceg et al. reported a female patient with Parkinson's disease with recurrent posterior dislocation, occurring several times a day. The patient was always able to reduce the dislocation by herself. Two months after the first dislocation, revision of thicker polyethylene tibial insert was done [17].

Thompson et al. presented a case of TKA using a mobile-bearing prosthesis. Four days postoperatively, the patient experienced the first of several acute knee dislocations. Three consecutive knee dislocation episodes with subsequent closed reductions were performed at an outside hospital prior to presentation at their institution. A two-stage exchange of the TKA was recommended due to the clinical suspicion for an infected prosthesis [18].

Our case had history of five dislocations in a short period of 6 months after a primary vanguard PS total knee replacement. As there was persistent instability even after using the thickest PS plus poly liner available and constrained liner could not be utilized because of the post-box, a new technique was used to avoid revision of the components in a 55-year-old female patient (young for revision) without any mal-alignment, mal-rotation or loosening of the primary components. This novel technique was devised to allow the wide post of the constrained liner to fit into the narrow vanguard knee femoral box. The post of the 24 mm SSK constrained liner was reshaped by trimming and carving it with a saw to fit into the box. The knee was clinically stable after the use of reshaped liner. After 5 years of follow-up, the patient is symptom-free with a clinically stable knee.

Conclusion

Dislocation after total knee arthroplasty is a difficult problem and is even more challenging if it is recurrent. After urgent reduction of the dislocation, identification of the causes leading to dislocation is mandatory for successful treatment. This complication has been reported with every prosthesis design, although more common with CR design. Surgical options include the use of thicker polyethylene liner, constrained liner or complete revision of components. We present a novel technique of reshaping the post of a constrained liner in patients with a primary total knee arthroplasty having post-box mismatch (vanguard system, Biomet). This technique was successful in the unnecessary revision of components and prevented further instability in a patient with chronic knee dislocations. The authors hope that this technique will provide another option of treatment in the treatment of this challenging dilemma.

Compliance with ethical standards

Conflict of interest The authors declare that they have no competing interests.

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