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A Rare Case of Posterior Dislocation of Hinge Knee Prosthesis due to Wear of Anti-Luxation Device: A Case Report

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Learning Point of the Article:

A highly constraint hinge knee prosthesis with an anti-dislocation mechanism restores its intrinsic stability by balancing flexion-extension gap and prevents dislocation of TKR.

Abstract

Introduction: Hinge knee joint prosthesis are utilized in a variety of surgical scenarios, including complex primary, revision, salvage surgeries, and radical resection of tumor's. Link's Endo-model Hinged Knee Prosthesis is a newer design that includes ramped tibial components for controlled pivot point motion during flexion and an anti-dislocation feature to prevent prosthesis dislocation.. The re-design of the hinge prosthesis has resulted in less force transfer along the implant bone junction. However, despite the improved design, complications can still arise. This report presents a rare complication of posterior dislocation due to polythene wear of the anti-dislocation device in a patient with a rotating hinge knee prosthesis.

Case Report: After 4 years, a 42-year-old patient who had undergone multiple total knee replacements (TKRs) with a history of pain, swelling, and difficulty walking for the previous 2 months presented to us. Radiographs from the initial presentation revealed aseptic loosening, for which a revision TKR using a Link-Waldemier non-modular (rotational) joint endo-model with an anti-dislocation mechanism was performed. Three years later, the patient began experiencing episodes of instability, and a radiograph revealed posterior dislocation of the hinge knee prosthesis. As a result, a decision was made to perform revision surgery, during which the worn-out polyethylene was replaced with a new polyethylene insert, and stability was confirmed intraoperatively. Four weeks after surgery, the patient's knee range of motion was 0–120°, and all discomfort had completely subsided. At a year's follow-up, the patient's Knee Society score had improved from 40 before surgery to 90 after surgery.

Conclusion: Interference in the normal framework of knee anatomy distorts its intrinsic stability. This interference can be in variable form such as bone deficiency, infection, multiple revision surgeries, and ligamentous laxity. Restoration of intrinsic stability in today's world has been made possible by a highly constraint, hinged knee prosthesis. An anti-dislocation mechanism on the rotating hinge prosthesis guards against dislocation brought on by distracted engagement. In our instance, the anti-dislocation mechanism had aseptically loosened, increasing flexion laxity and permitting severe distraction. The anti-dislocation mechanism will eventually relax, but its lifespan can be increased by proper gap balancing, which offers inherent stability and increases the anti-dislocation mechanism's stability.

Keywords: Anti-dislocation mechanism, hinged total knee replacement, endo-model, distraction stability.

Introduction

Hinge knee joint prosthesis is utilized in a variety of surgical scenarios, including complex primary, revision, salvage surgeries, and radical resection of tumors. Since their inception as fixed hinged prosthesis, they have evolved into rotating hinge (RH) designs, resulting in decreased rates of complications such as aseptic loosening and improved implant survival [1]. Link's

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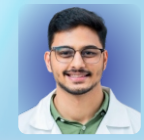
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Figure 1: Radiographs demonstrating primary knee replacement.

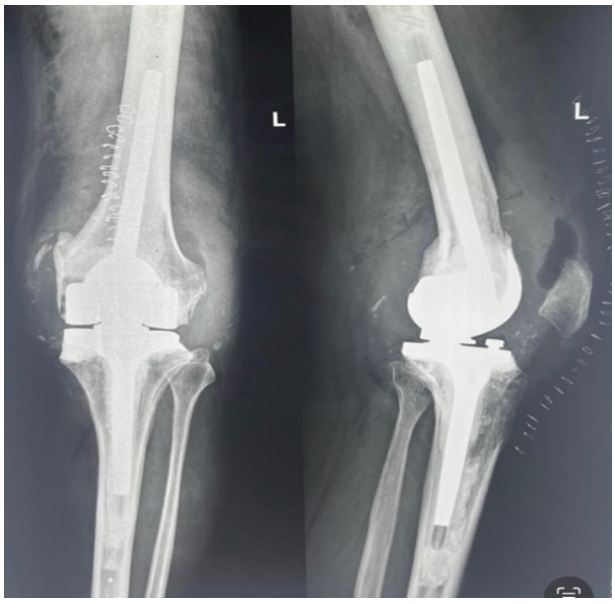

Figure 2: Radiographs demonstrating revision knee replacement.

endo-model hinged knee prosthesis is a newer design that includes ramped tibial components for controlled pivot point motion during flexion and an anti-dislocation feature to prevent prosthesis dislocation [2]. The re-design of the hinge prosthesis has resulted in less force transfer along the implant-bone junction. However, despite the improved design, complications can still arise. This report presents a rare complication of posterior dislocation due to polythene wear of the anti-dislocation device in a patient with a RH knee prosthesis.

Case Report

A 42-year-old man with a history of two total knee replacements (TKRs) 4 years apart presented to us with chief complaints of pain, swelling of the left knee, and inability to bear weight for 2 months. The patient had undergone a primary total left knee replacement 8 years ago (Fig. 1). Four years later, the patient sustained an aseptic failure of primary TKR, after which a revision TKRs was performed (Fig. 2). Revision was performed through the previous incision (medial parapatellar approach), and loosening of the femoral component was noted. The medial tibial bone graft was resorbed (F2B defect in both femoral

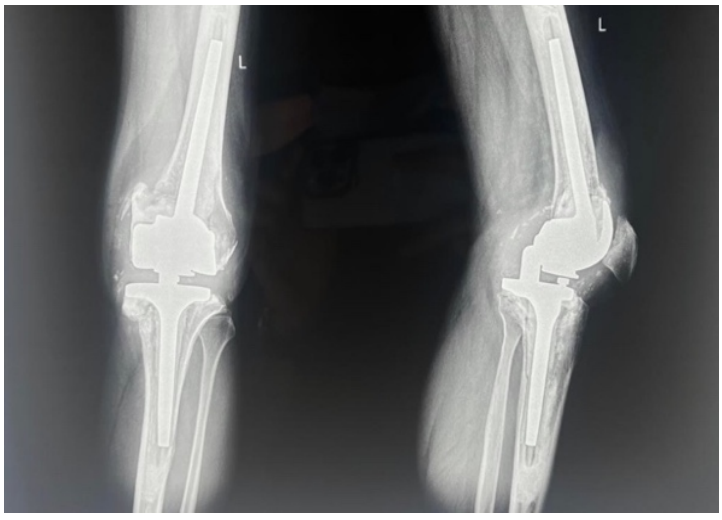

Figure 3: Radiograph demonstrating posterior dislocation of hinged knee prosthesis.

Figure 4: Worn-out polyethylene liner with complete wear of anti-luxation device.

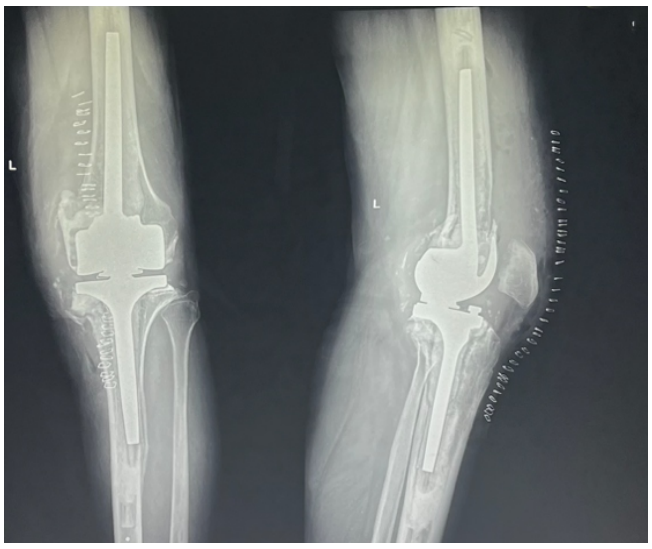

Figure 5: Post-operative X-ray after exchange of worn-out anti-luxation device.

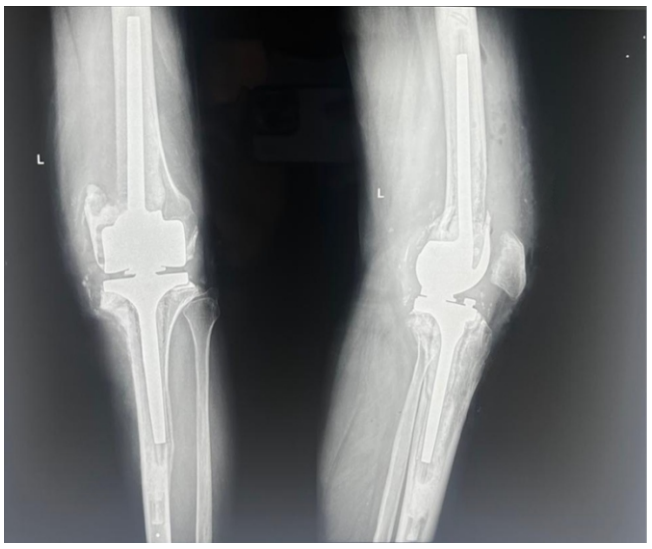

Figure 6: Radiographs at 1-year follow-up.

condyles and T2A defect in the medial tibial condyle). In view of this, the prosthesis was explanted and a rotational knee replacement with anti-dislocation mechanism was inserted (Link-Waldemier, non-modular (rotational) joint endo-model). In this procedure, the femoral defect was reconstructed with a polyethylene spacer, and the tibial defect was reconstructed with cement. After the revision surgery, the patient was asymptomatic for 3 years. Subsequently, he began to experience episodes of instability. He presented to us 2 months after the onset of symptoms, with complaints of pain in the knee. A radiograph was obtained and a posterior dislocation of the hinge prosthesis was diagnosed (Fig. 3). The patient was taken for surgical intervention through the previous incision. When the knee joint was exposed, it was found that there was complete polyethylene wear of the anti-dislocation mechanism (Fig. 4). The fixation screw which had loosened was removed, the polyethylene insert was replaced, and a new polyethylene insert was implanted. The anti-dislocation mechanism's wear and tear has no specific cause. An examination of the literature does point to aseptic loosening as one of the causes in our situation, although improper placement is also a possibility. Stability was confirmed intraoperatively. The post-operative period was uneventful (Fig. 5). The patient achieved a range of motion of 0–120° in the knee at 4 weeks post-operative with complete resolution of pain. The knee society score of the patient improved from 40 pre-operatively to 90 postoperatively at 1-year follow-up (Fig. 6).

An explained informed consent has been taken from the patient and their legal guardian for publishing images concerning them before writing this case report.

Discussion

Prosthetic dislocations in rotational joint arthroplasties have been reported in the literature with various underlying mechanisms. Even with the enhanced third-generation design, RH-TKAs have been associated with complication rates ranging from 9.2% to 63%. [3]Risk factors for dislocation include trauma, periarticular soft-tissue laxity, surgical factors, implant fracture, and failure of hinge mechanism [4]. Balancing the flexion-extension gradient is critical to the stability of RH-TKA. Lack of flexion-extension stability is associated with posterior capsule laxity, which promotes dislocation of the joint mechanism. Failure of the articular mechanism includes fracture of the axle, fracture of the metallic tibial post, uncoupling of the tibiofemoral joint, and fracture of the tibial insert [5].

The post-in channel mechanism of RH allows distraction of the femorotibial component. The maximum amount of distraction that can be achieved is often limited by the surrounding soft-tissue tension. The jump distance is the maximum amount of distraction that can be achieved before dislocation of the stem can occur [6].

Ward et al. concluded in their biomechanical study evaluating the stability of rotational knee prostheses that the design of the pivot, the length of the stem, and the taper play an important role in determining the stability of the prosthesis. Long-stemmed (>5 cm), non-tapered stems thus have greater stability. The shorter the stem, the less distraction is required to

dislocate it [7]. Link Endo-Model has the shortest shaft length and therefore requires the least amount of distraction to dislocate. However, due to its anti-dislocation function, it is a safer design and the distraction is limited by it.

During repetitive activities, fatigue fracture of the dislocation guard can occur. This gradually loosens and allows excessive distraction, whereupon the patient experiences instability and dislocates. This occurs over a long period of time and is therefore often not detected until 3–5 years later. In the case of early onset, trauma to the dislocation guard may be the cause.

Friesenbichler et al. [8] investigated the biomechanical stability of knee joint prostheses from six different manufacturers, comparing stem length, stem taper, and polyethylene insert. Among these, the minimum distraction required for dislocation was highest for Zimmer Next gen with a stem length of 60 mm and no taper. Although the minimum length was not reached, the minimum distraction required for dislocation was required for Depuy S-rom noiles with a stem length of 46 mm and a taper of 5° [8]. Not appropriate for analysis were the Link Endo-Model (Waldemar Link GmbH und Co. KG, Hamburg, Germany) and the GenuX (Implantcast GmbH, Buxtehude, Germany) due to their anti-dislocation mechanism, which prevents distraction. The anti-dislocation mechanism acts as a safety control and prevents it from dislocating at maximum distraction. [8]

Implant design with cylindrical pins provides better stability than that with conical pins [8].

Pacha-Vicente et al., in his reports of 2 cases, mentions dislocation of the RH knee as a result of fatigue failure of the anti-luxation mechanism. This is the only case report in the literature that mentions fatigue failure of the anti-dislocation mechanism. In his report, he mentions radiographic assessment to determine fatigue failure of the anti-dislocation mechanism. On a lateral radiograph of the knee, the anti-dislocation lip of the femoral rotation canal is oblique and is higher posteriorly than anteriorly. This sign indicates that the distraction release mechanism of the tibial polyethylene insert often resists anteriorly with increased posterior capsular laxity [9].

Bistolfi et al in his study of 98 Endo-model Prosthesis studied the causes of failure of the hinge mechanism, which includes tibiofemoral distraction uncoupling, fracture of the tibial insert, rupture of the metallic tibial post, and rupture of the anti-dislocation mechanism, is one of the reasons behind RH-TKA failure. Simple dislocation occurs far less frequently. After mechanical loosening, this is the second long-term problem and one of the most common. According to some sources, the polyethylene component of these hinges is the most brittle aspect of the system and, as such, is the reason for revisions most frequently [10]

Summary

The rotating-hinge prostheses that have anti-dislocation features have proven to be highly effective in treating severely compromised knee joints. However, it is important for surgeons to not solely depend on the knee prosthesis intrinsic distraction stability to avoid dislocation. Instead, it is crucial to balance the flexion-extension gaps to prevent posterior capsular laxity and reconstruct the soft-tissues surrounding the joint.

Conclusion

Appropriate gap balancing is to be carried out for long-term survival of the TKR and one must not rely solely on intrinsic stability of knee prosthesis.

Clinical Message

For all patients, whose knee joint stability has been significantly impaired by several surgeries, a Rotating Hinge knee prosthesis with an anti-dislocation mechanism may be a good solution after sufficient gap balancing has been achieved.

Declaration of patient consent: The authors certify that they have obtained all appropriate patient consent forms. In the form, the patient has given the consent for his/ her images and other clinical information to be reported in the journal. The patient understands that his/ her names and initials will not be published and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.

Conflict of interest: Nil **Source of support:** None

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