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ORIGINAL STUDY

Insert dissociation after fixed bearing PS constrained Genesis II total knee arthroplasty. A case series of nine patients

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Dissociation of the polyethylene insert after fixed bearing posterior stabilized Genesis II total knee arthroplasty has been rarely described. We present a case series of nine patients with a dissociation of the insert within a period of two years after surgery. Revision surgery was performed in all patients. In this report we discuss clinical presentation, patient characteristics and possible etiologies for tibial insert dissociation seen in the presented cases. In conclusion, tibial insert dissociation does not lead to a uniform clinical presentation. Therefore, in this point of view regular physical examination and imaging after TKA regardless the presence of symptoms seems to be indicated.

Keywords : insert dissociation ; Genesis II ; polyethylene ; total knee arthroplasty.

INTRODUCTION

Tibial insert dissociation has been listed by The Knee Society as one of 22 complications and adverse events important for reporting outcomes of Total Knee Arthroplasty (TKA) (*3*). This complication is rare since the insert is primarily loaded with a compressive force and there is a relative absence of tensile stress on the insert-baseplate locking mechanism (*2*). In mobile bearing TKA systems a higher incidence of dissociation of the insert is observed than fixed bearing TKA (*8,9*). In fixed bearing TKA, it is nearly always associated with cruciate retaining (CR) type prostheses (*8*). Main reasons for dissociation of a fixed bearing insert after TKA described in previous literature include a) misplacement of the insert, b) inadequate ligament balancing (eg resulting from trauma) causing the locking mechanisms to fail due to excessive polyethylene wear, and c) impingement of the insert on soft tissue or osseous structures in flexion (*5,8,9*). Furthermore, the use of a posterior stabilized (PS) insert with post can contribute to polyethylene insert dissociation due to strong lift-off forces during high flexion damaging the post of the insert and eventually dissociating it (*5,8*).

The Genesis II prosthesis (Smith and Nephew, Memphis, TN) – having both CR and PS designs – has an asymmetrical tibial baseplate for maximal coverage of the asymmetrical resected tibial surface and an asymmetrical femoral component with a posterolateral femoral condyle thicker than the posteromedial condyle for filling of the trapezoidal

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flexion space without externally rotating (*6*). Using revision for any reason as endpoint, the mean five years survival rate of this prosthesis as primary TKA is 97.0%. Most important device-related causes underlying failure of this prosthesis are polyethylene wear, aseptic loosening, instability, malalignment or malposition (*1*).

Dissociation of the polyethylene insert from the tibial baseplate in the high flexion PS Genesis II TKA is described in a couple recent case reports (*5,8,9*). We present a series of nine cases in which dissociation of the insert after fixed bearing posterior stabilized Genesis II TKA was seen.

MATERIAL AND METHODS

From January 2012 to December 2013 885 fixed bearing PS constrained Genesis II total knee arthroplasties were performed in our clinic by eight different orthopaedic surgeons. During these two years nine patients were diagnosed with dissociation of the polyethylene insert from tibial baseplate after this type TKA.

Since this complication is rarely described in literature, we performed a retrospective analysis on patients records. Acquired data included demographic data (sex, age, length, weight), patient history and clinical presentation during insert dissociation. Furthermore we reviewed radiological images made after TKA, and reports of the revision surgery for insert dissociation.

Possible aetiologies for insert dissociation described in earlier literature were compared to the cases in our series.

RESULTS

Insert dissociation was diagnosed in nine patients after PS constrained Genesis II TKA. Of these nine patients, five were female ; the mean BMI was 30.5 ; mean age during primary TKA was 63.8 years (Table I). Indication for the primary TKA in all patients was osteoarthritis, with two of the patients having prior surgery in the affected knee. None of the patients had rheumatoid arthritis. In all patients the components were fixed with cement, and five patients had their patella resurfaced during primary TKA.

In six patients dissociation of the polyethylene insert followed primary surgery for TKA ; in one patient insert dissociation was diagnosed after manipulating the knee under narcosis for arthrofibrosis after primary TKA ; two patients had insert dissociation after preceding insert renewal, of which one was performed because of instability and the other because of suspicion of early infection. Surgeries prior to dissociation were performed by four different orthopaedic surgeons. Mean duration between diagnosis of dissociated insert and latest surgery was 145 days. A delay in diagnosing the dissociation of the insert – and thus in revision surgery – was seen in four patients. The dissociation was missed on earlier X-rays in three patients (with one patient having two earlier X-rays) by both orthopedic surgeon and radiologist and in one patient by the treating orthopedic surgeon (Table I).

Table I. — Patient characteristics and diagnosis of dissociated insert

	M/F	BMI	age	latest surgery prior to diagnosis of dissociation	ΔT (days) latest surgery – diagnosis of dissociation	insert dissociation missed on earlier X-ray	resulting delay in surgery
Patient 1	F	31.9	44.4	liner exchange (instability)	47	by radiologist only	no
Patient 2	F	31.6	59.1	total knee arthroplasty	49	by radiologist only	no
Patient 3	M	28.6	77.6	total knee arthroplasty	30	no	not applicable
Patient 4	F	29.1	72.9	total knee arthroplasty	133	no	not applicable
Patient 5	M	42.3	63.3	total knee arthroplasty	89	by both R and O	6 weeks
Patient 6	M	26.6	58.7	liner exchange (infection)	348	by O only	10 months
Patient 7	M	28.4	68.2	total knee arthroplasty	433	by both R and O (twice)	8 months
Patient 8	F	27.6	56.1	manipulation (arthrofibrosis)	125	by both R and O	8 weeks
Patient 9	F	28.0	74.2	total knee arthroplasty	50	no	not applicable

M = Male; F = Female; BMI = Body Mass Index; ΔT = time; R = radiologist; O = orthopaedic surgeon.

Trauma prior to insert dissociation was documented for none of the patients. Documented patient history revealed one patient noticed a clicking sensation, one patient complained about instability in extension and one patient noticed a decreased range of motion. Three patients complained about pain (one of them specifically about anterior pain). Three patients had no complaints at all.

Physical examination revealed an extensor lag in three patients and instability was found in another three patients.

All patients were diagnosed anterior dislocation of the polyethylene insert on plain X-rays. On the post-operative X-ray of two patients an osteophyte was seen on the dorsal side of the distal femur.

During revision surgery, all inserts were indeed dislocated anteriorly. A possible physical cause for the dislocation was seen in 5 patients. In one operation a deformation of the postero-lateral lip of the dislocated insert was observed. Wear of the metal components by polyethylene displacement and potentially metal on metal contact were not documented in operation reports (Table II, Fig. 1).

The dislocated inserts were removed and replaced, with three new inserts having a 2 mm increase in thickness. One of these was placed in a patient who already had a prior insert renewal for suspicion on early infection. During the revision surgery, tissue samples were taken for culturing in one patient, but these showed no bacterial growth. One of the revision surgeries was complicated by an infection, for which a re-operation was performed. None of the new inserts had a recurrent dislocation.

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DISCUSSION

Worldwide, most common complications leading to revision surgery after TKA are aseptic loosening and periprosthetic joint infection (*6*). Only a couple recent case reports describe dissociation of the

Table II. — Clinical presentation of insert dissociation

	history	physical examination (range of motion ; stability)	radiology (osteophyte dorsal distal femur)	intra-operative findings
Patient 1	pain (anteriorly)	ROM not described ; clear anterior luxation	no	damage / deformation of the insert
Patient 2	no complaints	no extensor lag ; stable	no	not documented
Patient 3	decreased ROM	extensor lag (15 degrees) ; stability not described	yes	possible soft tissue impingement
Patient 4	clicking sensation	extensor lag (5 degrees) ; stability not described	no	possible soft tissue impingement
Patient 5	no complaints	no extensor lag ; slight instability	no	some synovitis and hydrops
Patient 6	no complaints	no extensor lag ; stable	yes	possible soft tissue impingement
Patient 7	pain ; instability in extension	no extensor lag ; stability not described	no	possible soft tissue impingement
Patient 8	pain	extensor lag (10 degrees) ; evident subluxation in flexion	no	not documented
Patient 9	not documented	ROM and stability both not documented	no	not documented

ROM = range of motion.

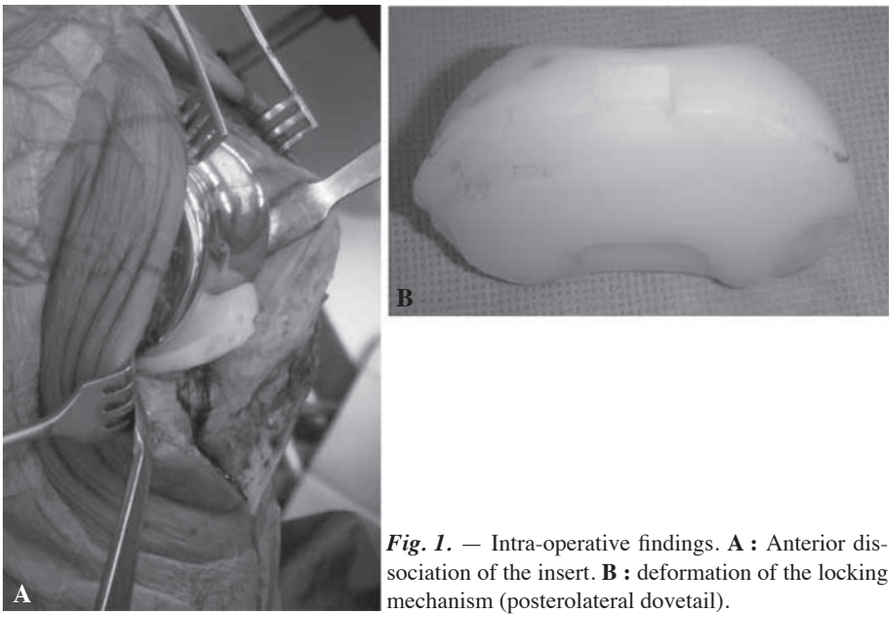

Fig. 1. — Intra-operative findings. **A :** Anterior dissociation of the insert. **B :** deformation of the locking mechanism (posterolateral dovetail).

polyethylene insert from the tibial baseplate after fixed bearing high flexion PS Genesis II TKA (*8,9,5*). Despite this complication is commonly labelled rare, we presented a case series of nine tibial insert dissociations within two years in our clinic.

Trauma and failure of the locking mechanism are usually presented as a cause for tibial insert dissociation (*5*). Trauma may result in ligament laxity, likely causing polyethylene wear which in turn might result in late dissociation of the insert (*2,8*). However, in none of our cases a history of trauma was documented. Nevertheless, one knee was manipulated because of arthrofibrosis before the insert dislocated.

Locking mechanisms regularly used in TKA can be categorized as linear, peripheral or central capture mechanisms. The design of the capture mechanism and the multi-axial dynamic loading of the components influence magnitude and direction of relative motion between insert and tibial tray (*10*). If locking mechanisms fail, the polyethylene insert tends to lift-off anteriorly of the tibial baseplate during flexion because of the downward force on the posterior half of the insert (*2,10*). Anterior dislocation is then presumably caused by the femoral cam engaging the tibial post in flexion, thereby producing an anteriorly directed force (*4*). Repetitive and minute anterior lift-off may cause wear of the snap-fit locking mechanism and eventually failure (*2*). Reasonably, higher BMI results in greater downward force during flexion, which in turn increases the risk of anterior lift-off and failure of the locking mechanism. All patients in our series had BMI over 25 (overweight), with three of them being obese (BMI > 30). Previous liner exchange may also cause weakening of the locking mechanism, resulting in higher chances of recurrent dislocation (*9*). Two of the cases we presented actually had preceding liner exchange before dislocation. Adequate placement of the insert remains critical for proper functioning of the locking mechanism. As presented in an earlier case report, the surgical exposure using the mini subvastus approach is limited because of the extensor mechanism and misplacement of the insert or soft tissue impingent could occur (*5*). Osseous impingement of an osteophyte at the dorsal distal femur on the posterior insert in flexion may lead to gradual posterior lift-off of the insert from the baseplate (*8,9*). In retrospect, the postoperative X-ray of two of our cases showed an osteophyte at the dorsal side of the distal femur, possibly causing impingement leading to dissociation.

In four patients a delay in diagnosing the dissociation – and thus revision surgery – was seen since

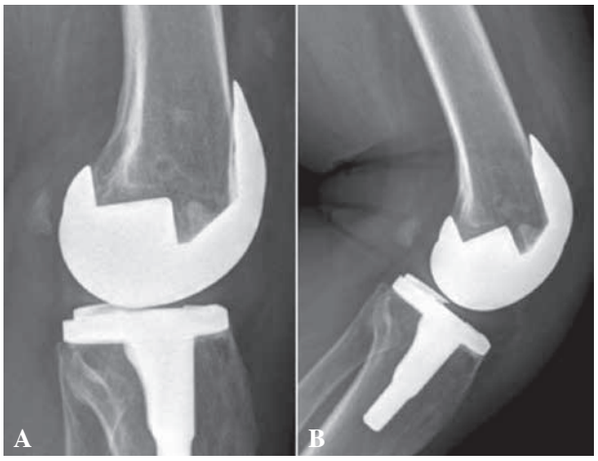

Fig. 2. — Insert dissociation after Total Knee Arthroplasty may be missed on standard lateral view with extended knee (A) while lateral view of the flexed knee (B) may reveal insert dissociation more evidently.

dissociation was missed on standard postoperative X-rays with anteroposterior and lateral view of the extended knee. However, a lateral view with the knee flexed 90 degrees eventually did expose the dissociation (Fig. 2).

Previous case reports suggest the PS Genesis II design may be prone to dissociation due to the combination of the shallow anterior tab snap-fit locking mechanism, facilitating transition from initial lift-off to complete dissociation of the insert from tibial component, and thin dovetail lips susceptible to damage (*5,8*). In one of our cases deformation of the posterolateral lip of the insert was found (Fig. 1). None of the operation reports mentioned a damaged tibial post. However, it is believed that strong lift-off forces during high flexion can damage the post of the insert, eventually leading to dissociation of the insert. One case report describing recurrent dislocation of PS insert, states after conversion to a non-posted deep dished insert no recurrent dissociation occurred (*5*).

Although it has been assumed that high flexion PS inserts may increase the risk of component wear, and so increase the risk on insert dissociation, compared to standard PS inserts, analyses indicate the high flexion design of the Genesis II does not harmfully affect outcomes of TKA (*1*).

Although previous case reports present insert dissociation diagnosed because of mechanical malfunctioning, pain or clunking sounds, not all patients in our series presented with a malfunctioning knee prosthesis. In fact, two of them were completely satisfied with their prosthesis and had no disturbing abnormalities during physical examination. This indicates the urge for both thorough physical examination and imaging after TKA regardless the presence of symptoms indicating a complication. Postoperative X-ray with lateral view of the knee flexed 90 degrees may be considered. A systematic approach could prevent a delay in needed revision surgery for insert exchange.

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