CASE REPORT

Failure of the femoral stem – condyle junction in a semiconstrained knee prosthesis. Analysis of two cases

Uszkodzenie połączenia trzpień – element udowy w półzwiązanej endoprotezie stawu kolanowego. Analiza dwóch przypadków

Adam Zawojski1,2, Łukasz Niedźwiedzki1, Paweł Zieliński1, Paweł Kamiński1, Magdalena Wilk-Frańczuk1,2

1Cracow Center of Rehabilitation and Orthopedics, Cracow, Poland
2Department of Rehabilitation WNZ Jagiellonian University Collegium Medicum, Cracow, Poland

Abstract

Failure of the stem – condyle junction in a modular knee prosthesis is a rare phenomenon, but it has been described and carries serious consequences. Loosening of the femoral component increases the loads acting on the stem – condyle junction and increases the risk of fatigue fracture of the implant. The aim of this paper was to describe two cases of such damage in the revision semiconstrained prosthesis with used stems and sleeves.

Key words: revision knee arthroplasty, modular knee prosthesis, stem-condyle junction failure

Streszczenie

Uszkodzenie połączenia trzpień – element udowy w modularnych endoprotezach rewizyjnych stawu kolanowego nie jest zjawiskiem częstym, ale opisywany niosąc poważne konsekwencje. Obluzowanie elementu udowego zwiększa obciążenia działające w miejscu łączenia z trzpieniem i zwiększa ryzyko złamania zmęczeniowego implantu. W pracy przedstawiono opis i analizę dwóch przypadków takiego uszkodzenia w rewizyjnej endoprotezie połóżczonej z zastosowanymi trzpieniami i sleevami.

Słowa kluczowe: aloplastyka rewizyjna stawu kolanowego, modularna endoproteza stawu kolanowego, uszkodzenie połączenia trzpień – element udowy
Introduction

Nowadays, due to the need for primary total knee allograft (TKA) in increasingly younger patients, the incidence of revision TKA has also increased [1]. The modularity of the revision systems allows to match the implants to the intra-operative anatomical conditions and mimicking of the knee biomechanics. On the other hand, it requires more junctions between the parts of the implant, which creates the risk of their damage [2,3,4]. Ligamental insufficiency and bone defects are often a consequence of a failure of primary knee replacement. Thanks to stems extension, cones, sleeves and condylar augment, it’s a better fixation in epiphysis, metaphysis and diaphysis. The revision prostheses are characterized by a greater degree of constraint, facilitating the solution of the single- or multiplane instability problem. However, this causes an increase in the loads transmitted through the implant [5-11]. In this article, we presented two cases of failure of the femoral stem – condyle junction of the semiconstrained TC3 prosthesis (DePuy Synthes). We could not find similar reports from Poland in the literature. In our Center from March 2008 to December 2018, a total of 250 modular prostheses (TC3 and S-ROM) were used, using sleeves and stems in the femoral and tibial parts in various combinations. In this revision system, the damage of metaphyseal bone are complemented by metal sleeves (femoral made of titanium and tibial made of titanium alloy) covered with a porous coating enabling osteointegration. The degree of porosity of sleeves ranges from 50-80%. In contrast to cones made of tantalum or titanium, sleeves do not require cementing the implant within them and allow immediate loading of the operated limb [12].

Aim

The aim of this paper was to present two cases of failure of femoral stem-condyle junction in the semiconstrained knee joint prosthesis TC3 (Depuy Synthes) with their analysis.

Materials and methods

Case 1

A 77-year-old patient, in 2007, underwent a right total knee replacement surgery (TKA) due to advanced arthrosis. In 2014, due to aseptic loosening, a revision procedure was performed with use of a semiconstrained TC3 prosthesis with femoral and tibial stems together with sleeves and augmentation of the posterior femoral condyles. In November 2017, he was admitted to the hospital because of a fracture of the prosthesis at the level of stem – condyle junction, confirmed in the radiological image (Fig. 1). The injury occurred during a torsional movement of the knee, after which the patient fell down. It should be mentioned that before the injury the patient did not feel pain in this joint. During the revision procedure, bone defects were found under the anterior and posterior surface of the femoral component together with the fracture of the metaphysis and breaking of the screw connecting this element with the adapter in the place where the prosthesis was joined to the sleeve. Due to the extensive bone loss of the femoral condyles, and hence the inability to support the femoral component, the resection implant LPS (DePuy Synthes) was used after sleeve removing. Due to a great osteointegration of the sleeve, its removing was possible only after the osteotomy of the metaphysis along with its partial resection. There was no loosening of the tibial component. At the most recent follow up visit (6 months after surgery), the patient felt no pain and the operated knee presented range of motion (ROM): 0-120 °.

Case 2

A 73-year-old patient due to advanced right-sided gonarthrosis, underwent TKA procedure in 2010. In 2015, a one-stage revision procedure was performed due to implant loosening, which turned out to be septic after obtaining positive results of intraoperative cultures (no macroscopic marks of infection during the revision surgery). There were used semiconstrained implant TC3 (using femoral and tibial stems together with sleeves and condylar augmentation for the femoral component - posterior and distal medial). After the implementation of targeted antibiotic therapy, there were no signs of infection in subsequent laboratory tests. In May 2018, she was admitted to the hospital because of a fracture of the femoral – condyle junction of TC3 prosthesis. A few days earlier she had suffered a torsional injury of the knee (Fig. 2). During the revision procedure, total loosening of the femoral component and failure of the screw connecting the adapter
Adam Zawojski et al.: Failure of the femoral stem – condyle junction in a semiconstrained knee prosthesis. Analysis of two cases

CASE REPORT

with the femoral component were found. The bone defects in femoral condyles were not extensive enough, so there was a possibility of implantation of the rotational-hinged prosthesis S-ROM (DePuy Synthes). Due to the modularity of the system there was no need to remove femoral sleeve and stem.

In the interview before admission, knee pain was present for over 2 years, intensifying during loading. Nevertheless, radiological examination and bone scintigraphy did not show signs of implant loosening. At the most recent follow up visit (6 months after surgery), the patient felt periodic moderately severe pain and the operated knee presented ROM 0-95 °.

In both revision surgeries, there were no signs of loosening of the tibial implant, and the intraoperative cultures were negative.

Discussion

The TC3 implant (Depuy Synthes) has been used for many years as both a primary and revision implant with good clinical results in short-term [13-17] and long-term [18] observation. Damage of the prosthesis at the level of stem - condyle junction is a rare phenomenon, but it is described in the literature and carries serious consequences for the patient [6]. In both cases, due to the action of low-energy torsional injury, the implant was damaged at the connection point of the stem to femoral component, which suggests earlier fatigue fracture of the implant. Baral et al. [9], who also described the case of damage to the TC3 prosthesis, in the same place, analyzed the damaged elements in an electron microscope. The test confirmed fatigue fracture due to cyclic loading. In addition, Christner et al. [10], in the LCS implant from Depuy Synthes, observed a phenomenon of corrosion at the point of implant failure. Ahn et al. [11] indicated that it might be one of the causes of such a fracture.

Analysis of x-rays in case 1. showed a gradual bone loss of the distal femur under the prosthesis, and hence its lower stability and increased loads transmitted through the femoral part of prosthesis (Fig. 3). In the case 2. with the appearance of pain, radiographs showed a gap in the point where the implant is connected to the sleeve, which indicated on its gradual fatigue damage (Fig. 4). In both cases, the problem concerned only the femoral component, with proper tibial stability. In first case, the increased load at the junction between the stem and the femoral component was due to the insufficient bone support of the condylar implant, while in second case the loosening of femoral component was revealed only intraoperatively.
Nikolopoulos et al. [8] pointed out, the risk of such damage increased with the aseptic loosening of the femoral component and the lack of loosening of the stem. In the cases described in this paper, x-rays and intraoperative assessment confirmed the full stability of the stems. The reason for this was undoubtedly the use of sleeves, which provide very good stability in the metaphysic thanks to the osteointegrative properties. In addition, sleeves improved rotational stability much more better than then cylindrical stems only. However, it should be taken into account in a case of sleeve removal during revision surgery [1, 19, 20].

Damage of stem – condyle junction is a problem independent of the implant manufacturer and increases with a degree of constraint.

Lee et al. [6] described the damage of this junction in the Stryker’s semiconstrained prosthesis Scorpio TS. Westrich et al. [2] reported this problem in the semiconstrained implants Insall - Burstein II CCK by Zimmer, while Sandiford et al. [5] described the same failure in Stryker’s rotating-hinge MRH prosthesis.

This showed the general problem of revision modular systems, where loads in the joint were transmitted through the implant. In the tibial part, the loading forces were mainly directed axially, whereas in the femoral part there were omnidirectional loads: varus-valgus, flexion-extension, axial and rotational. The use of intramedullary stems and sleeves allowed to transfer loads through the implant from the metaphysis to the intact diaphysis. It created an increased risk of damage of stem – condyle junction, which was the weakest point [5-12,19].

Lim et al. [7] described 5 cases of damage of stem – condyle junction and considered the use of nonmodular prosthesis or a component with a substantial Morse taper junction site.

Sandiford et al. [5] recommended in the case of use of revision systems a precise assessment of x-rays after surgery, especially in the proximal femoral part, as well as considering the use of nonmodular implants.

Radiological analysis “post factum” enabled us in our cases to find the cause of complications, which in the future will allow us to predict a fatal fracture and possibly even to avoid it by improving the surgical technique during revision procedures. Undoubtedly, due to the observed problem of fatigue fracture of stem-condyle junction in modular systems, it should be taken into account when planning revision procedures.

**Conclusions**

The modular knee prosthesis can be damaged at the stem-condyle junction.

**References**