CASE REPORT

Recurrent Fracture of the Cone of a Morse Taper Junction of the MRP Stem in an Obese Patient - A Case Report

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Abstract

Introduction: The use of modular femoral stem design has grown increasingly popular over the last decade because of the advantage of more optimization of femoral anteversion, limb length, and femoral component offset and intraoperative flexibility when partial hip implant revision is required. Possible complications include corrosion, dissociation and fracture of Morse taper junctions.

Case report: In May 2016 revision arthroplasty due to fracture of the Morse taper junction and the stem/neck interface was performed using a bended MRP Titan revision stem in a 49 year old obese patient (body mass index: 34.3 Kg/m²). Fracture occurred 3 years after index operation. In May 2019 revision arthroplasty due to fracture of the Morse taper junction and the extension sleeve/neck interface was performed using a bended MRP Titan revision stem in the same obese patient (body mass index: 39.8 Kg/m²). Light microscopy and field emission scanning electron microscopy revealed fretting and crevice corrosion and fatigue crack without signs of design or material flaws in both cases. Conclusion: Fractures of the cone of Morse taper junctions in modular femoral stems are rare and underreported complications in THA. Taking all studies into account we come to the conclusion that micro motion at the junctional interface induced fretting and crevice corrosion and led to fatigue fracture of the cone. Long varus modular necks and extension sleeves in obese patients seem to be important risk factors. Facing these constellations modular stems should be avoided as far as possible. Flexibility of modular stems when partial hip implant revision is required is just theoretical if cold welding happens.

KEYWORDS
MRP Titan Revision Stem, Fracture, Cone, Morse taper junction, Modular

INTRODUCTION

The use of modular femoral stems in primary and revision arthroplasty has become popular within the last decade because of the theoretical advantage of more flexibility and optimization of femoral anteversion, limb length, and femoral component offset. Modularity should also provide intraoperative flexibility when partial hip implant revision is required. On the other hand modularity creates new potential problems and complications which should be taken into account. Fretting, crevice and galvanic corrosion, component loosening, fracture and dissociation of modular prostheses in primary and revision hip arthroplasty have been published [1-10,12-17]. Multiple publications about the MRP Titan revision stem showed excellent mid-tem and long-term results in primary and revision arthroplasty the hip [11,12,18,19]. Recently we published the case of a fracture of the cone of the Morse taper junction of the femoral neck of a MRP Titan revision stem 3 years after index operation [12]. We report the follow-up of this patient who suffered a fracture of the cone of the Morse taper junction of the neck/extension sleeve interface of a MRP Titan revision stem 3 years after revision arthroplasty, again.

CASE PRESENTATION

In August 2013 revision arthroplasty of the hip was performed in a 46 year old male patient using an Allofit - Classic-cup (Diameter 56 mm (Zimmer, Warsaw, USA)) and a MRP Titan Revision stem (Diameter: 18 mm, length: 140 mm and a medium neck component) (Peter Brehm GmbH, Weisendorf, Germany). A ceramic on PE bearing was implanted (head diameter: 32 mm) [Figure 1]. The patient was obese (175 cm tall and weighed 105 kg), body mass index: 34.3 Kg/m². In May 2016 revision arthroplasty due to fracture of the Morse taper junction [Figure 2] was performed using a bended MRP Titan revision stem (Diameter: 19 mm. Length: 200mm with long neck and extension sleeve and a 32 mm ceramic head) [Figure 3]. Postoperative healing was uneventful. Light microscopy and field emission scanning electron micros-
copy revealed fretting and crevice corrosion and fatigue crack without signs of design or material flaws [12]. In May 2019 the patient suffered from thigh pain and had to use a pair of crutches. X-ray of the left hip in 2 planes showed an asymmetrically gap of the neck/extension sleeve junction [Figure 4]. Revision arthroplasty of the hip was recommended. 4 weeks later preoperative planning using x-ray in two planes showed dislocation of the fractured neck/extension sleeve junction [Figure 5]. At that time the patient increased obesity (body height: 175 cm, body weight: 122 kg, body mass index: 39.8 Kg/m²). Revision of the hip was performed in hope to exchange extension sleeve and femoral neck only. Due to cold welding removal of the extension sleeve was impossible. Removal of the well-fixed stem was performed via distal fenestration. After fixation with cerclage wires a bended MRP Titan revision stem (Diameter: 21 mm, Length: 200 mm with short neck, 32 mm ceramic head) was implanted [Figure 6]. Postoperative healing was uneventful. We felt uncomfortable using a modular MRP stem again but during revision surgery it seemed to impossible to use a non-modular implant. Postoperatively we encouraged the patient to reduce weight dramatically in order to prevent another fracture.

3 | DISCUSSION

In comparison to monobloc stems modular femoral stems in primary and revision arthroplasty of the hip offer the theoretical advantage of more flexibility and optimization of femoral antversion, limb length, femoral component offset and opti-
Dissociation or fracture of the cone of morse taper junctions is an underestimated complication in modular THA [1-5,7,9,10,12-14,20,21]. Dangles et al. [2] reported the first modular femoral neck fracture in an obese, active man. He discussed potential design flaws for implant failure, but obesity seems to be an important factor. Skendzel et al. [13] presented another 2 cases of modular prosthesis fracture. They discussed that the combination of patient obesity with a long modular neck may have contributed to modular neck fracture. Specifically, the use of a long varus neck increases the bending moment by 32.7% compared with the standard “short varus” neck, with increasing stress concentration at the modular junction [5,13]. In a recently published case of fracture of the morse taper junction at the stem/neck interface light microscopy and field emission scanning electron microscopy revealed fretting and crevice corrosion and fatigue crack without signs of design or material flaws [12]. In the actual case of fracture of the male component of the extension sleeve/neck interface 3 years after implantation light microscopy and field emission scanning electron microscopy revealed fretting and crevice corrosion and fatigue crack without signs of design or material flaws again. It is striking that both fractures of the morse taper junction in our patient occurred 3 years after operation, which is comparable to the case of Uchiyama et al. [14], where fracture of the modular neck occurred 4 years after operation. In the case of Wodecki et al. [20] fracture occurred 3 years after implantation of a modular total hip in an obese patient. Uchiyama et al. [14] analysed the case of a 46-year-old woman who suffered fracture of the modular neck of a MODULUS femoral stem 4 years after index operation. They suggested that active and obese patients implanted with high-offset, small modular components are at increased risk of experiencing stress-induced fractures of the proximal component. Ellmann [5] postulated that micro motion at the junctional interface induces fretting and crevice corrosion, that might contribute to the creation of micro cracks within the zone of corrosion and increasing the risk of dynamic fatigue fracture. The combination of corrosion, large femoral head components with long modular necks, metal-on-metal components, patient obesity, and activity level may create a local microenvironment that can initiate and perpetuate fatigue failure. Increased stress over a long lever arm creates an environment susceptible to modular component fracture/failure [5].

A recent study of S-ROM THAs revealed that 27% of retrieved devices could not be disassociated in operation theatre due to cold welding. This may prevent the production of metallic debris, but a key design feature of these devices -partial replacement in revision surgery- failed [8]. We follow this study as we had to face cold welding of the stem/extension sleeve junction without any possibility to disassociate both components. Additionally it was impossible to use the extraction device as the fracture of the cone destroyed the thread inside the cone to fix the extraction device. We had to remove the well-fixed stem. Lakstein et al. [10] analyzed six patients with a fracture at the mid-stem junction of a modular femoral stem. They concluded that the stem failure was initiated by a fretting fatigue mechanism and was propagated by a pure bending fatigue mechanism. Risk factors for fractures of the modular junction include excessive body weight and inadequate proximal osseous support because of trochanteric osteotomy, reduced preoperative bone stock, osteolysis, loosening, and/or implant undersizing. Surgeons should consider the use of implants with strengthened junctions when using modular stems in such patients.

CONCLUSION

Fractures of the cone of morse taper junctions in modular femoral stems are rare and underreported complications in THA. Taking all studies into account we come to the conclusion that micromotion at the junctional interface induced fretting and crevice corrosion and lead to fatigue fracture of the cone. Long varus modular necks and extension sleeves in obese patients [5,12,14] seem to be important risk factors. Facing these constellations modular stems should be avoided as far as possible. We recommend regular annual or biannual radiological check-up. 3 to 4 years follow-up seems to be a critical cut point in above mentioned patients. Flexibility of modular stems when partial hip implant revision is required is just theoretical if cold welding happens.

CONFLICT OF INTEREST

Nil

SOURCE OF SUPPORT

Nil

CONSENT

The authors confirm that informed consent of the patient is taken for publication of this case report

REFERENCES

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