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Case Report

Surgical Treatment of a Stress Fracture of the Distal Femur due to a Severe Osteoarthritis of the Knee Joint: A Case Report

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Abstract

Background: To the best of our knowledge, this is the first reported case of a distal femoral stress fracture due to severe osteoarthritis of the knee joint, treated with a cemented long stemmed modular constrained total knee prosthesis. This injury of nonpathological bone tissue occurs due to recurrent overloading with an intensity that does not exceed the critical bone strength.

Case Presentation: In June 2020, a 79-year-old woman with several internistic comorbidities was presented to the emergency department by the emergency medical services. She had pain in the right knee without trauma. We diagnosed a stress fracture of the distal femur due to a severe osteoarthritis of the knee joint. We described the fracture as a non-displaced simple sagittal distal femoral fracture (33-B2 AO-Classification). After a prolonged preoperative course we implanted a cemented long-stemmed modular constrained total knee prosthesis with a cerclage wiring on the distal femur. An iatrogenic rupture of the patella tendon was caused intraoperatively. Soon after removal of the sewing material a wound dehiscence and a rerupture of patellar tendon occurred. The tendon was sutured again and a McLaughlin cerclage was implanted. The postoperative course went unsatisfactory. The mobilization of the patient was insufficient, despite being instructed by a physiotherapist. Later, the patient developed a severe urosepsis and a pulmonary oedema. In the intensive care unit the patient was intubated, artificially respirated and became bedridden.

Conclusion: In general, positive points of our treatments were the satisfactory surgical treatment of this complicated knee fracture, avoiding unilateral leg shortening and avoiding secondary dislocation of the distal femoral fracture. However, the general functional outcome is unsatisfactory due to a large number of avoidable and unavoidable deficiencies and problems. Patients with severe osteoarthritis of the knee joint should be followed-up more closely and probably treated earlier in order to avoid complications.

Level of Evidence: 5.

Keywords: *Total Knee Prosthesis; Stress Fracture; Knee Replacement; Case Report*

Abbreviations

ASA: American Society of Anesthesiologists; ED: Emergency Department; EMS: Emergency Medical Services; NNM: Neutral Zero Method; OKS: Oxford Knee Score; ROM: Range of Motion; VAS: Visually Analogue Scale

Background

Stress fractures were first described as "march fractures" in 1855 in Prussian soldiers [1-3]. A structured overview of this type of fractures was given by Astur in 2016 [4]. This injury of non-pathological bone tissue occurs due to recurrent overloading with an intensity that does not exceed the critical bone strength [5-7]. There are two other related fracture types. Fatigue fractures occur after recurrent microfracturing in normal bone tissue. Insufficiency fractures, on the other hand, occur in pathological bone tissue [7]. Stress fractures occur mostly in some kind of athletes, soldiers and dancers [7-9]. They can affect almost every bone of the human body [4]. Most frequently, stress fractures occur in the tibia, the metatarsals and the fibula [3,10]. There are two groups of factors, influencing the occurrence of stress fractures: extrinsic and intrinsic. The intrinsic factors are such as anatomical, muscular and hormonal alterations, age, gender and ethnicity [8,10-14]. Extrinsic factors relate to nutrition, smoking, alcohol consumption, movements, to type of sport, equipment and ground [7,8,11-16].

Case Presentation

Ethical statement

All procedures were performed in accordance with the ethical standards and the Declaration of Helsinki. The patient gave his informed consent for participation and publication of the case report. This study was performed in accordance with relevant guidelines and regulations.

Clinical data and diagnostics

In June 2020, a 79-year-old woman was presented to the emergency department (ED) by the emergency medical services (EMS) with immobilizing lower back pain with radiation to the right knee. The examination by the emergency physician in the ED found that the leading pain syndrome was located in the right knee. The pain occurred spontaneously, without any trauma. The patient status and history showed an elderly woman in reduced general condition with several internistic comorbidities (COPD, adipositas permagna, metabolic syndrome, stomach ulcer). In anteroposterior and lateral (Figure 1) radiographs the patient seemed to have a split depression fracture of the right medial tibial plateau (Schatzker Type IV and 41-B3 AO-Classification) with a moderate osteoarthritis of the knee joint. The right leg was immobilized in a cast and the patient was admitted to trauma department. The next day a computer tomography was performed. It revealed that the upper mentioned tibial defect was not an acute fracture but a chronic condition due to a severe erosive osteoarthritis of the knee joint (Kellgren-Lawrence-Score 10/10). It also showed a non-displaced simple sagittal distal femoral fracture (33-B2 AO-Classification) which was not visible in conventional radiography. The fracture line started from the notch and ended in the medial femoral shaft (Figure 2). According to general symptoms, clinical history, imaging examinations we diagnosed a stress fracture of the distal femur due to a severe osteoarthritis of the knee joint. We decided to replace the knee joint with a cemented long stemmed modular constrained total endoprosthesis. The patient gave his consent for surgery. On day 3 after admission we performed an internistic consultation in order to enhance the reduced general status preoperatively. A spirometry and an echocardiography were conducted. The medication of the patient was changed accordingly. On day 13 after admission we noticed a presacral decubital ulcer (II grade). Prophylactic measures against decubitus were taken from now on. The patient was classified as ASA 3 and released for surgery by the anaesthetist on day 17 after admission. The operation was performed the next day.

Operative procedures

On day 18 after admission, we operated using an extended anterior approach to the knee joint (incision length 20 cm). First we positioned cerclage wiring on the distal femur in order to protect the distal femur fracture from intraoperative dislocation during implanta-

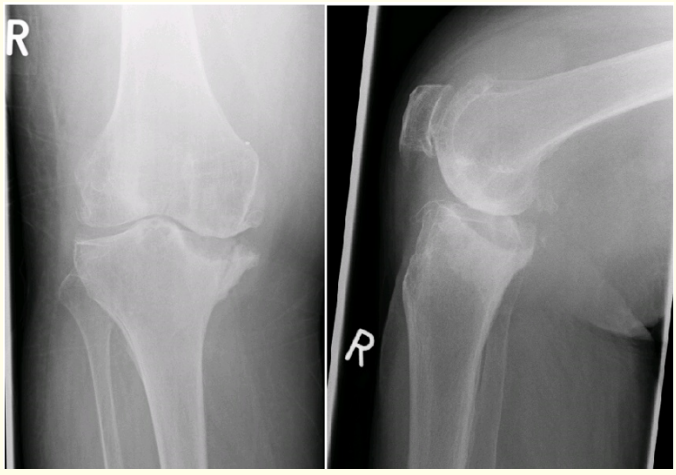

Figure 1: *Anteroposterior and lateral radiographs of the knee joint at patient admission.*

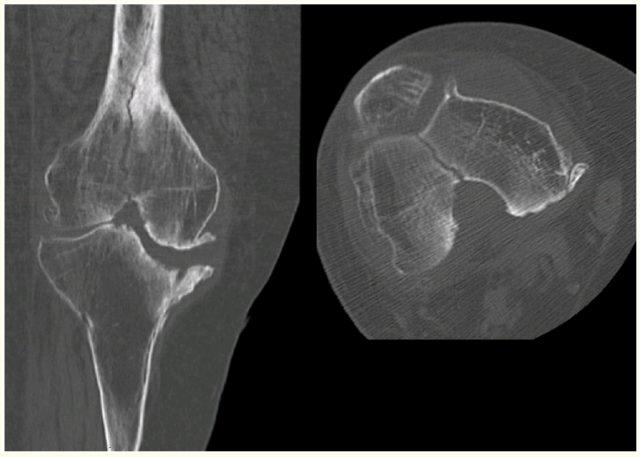

Figure 2: *Computer tomography images of the knee joint after admission.*

tion of the femoral stem. We implanted the trial long-stemmed femoral component after intramedullary reaming and resection of the femoral condyles. The medial tibial plateau defect could not be restored. Therefore, we performed a resection of the tibial head to the level of the proximal fibula. After intramedullary reaming of the tibia, we implanted the trial long-stemmed tibial component. A rupture of the patellar tendon was caused by manipulation with the Hohmann retractor holder. After successful trial reposition we changed the implants to their definitive cemented constrained equivalents (LimaCorporate). The patellar tendon was reinserted and the wound closed in usual manner. Figure 3 shows the anteroposterior and lateral radiographs of the operated knee after implantation of a cemented long-stemmed modular constrained total knee prosthesis.

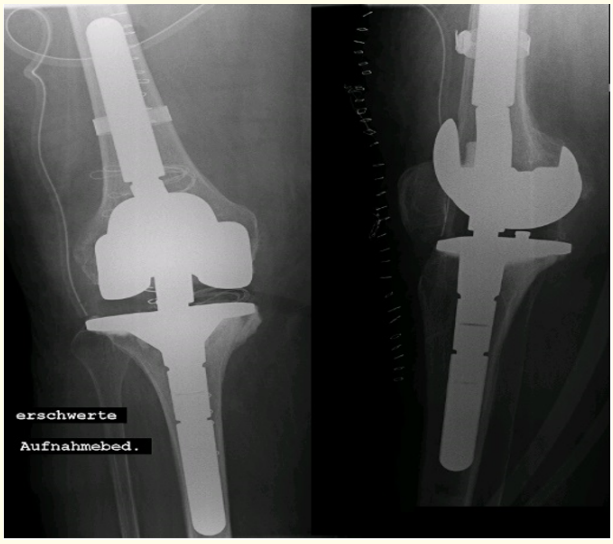

Figure 3: *Anteroposterior and lateral radiographs of the knee joint after implantation of the a cemented long-stemmed modular constrained total knee prosthesis.*

Postoperative course

The postoperative course was complicated. Table 1 provides an overview of the patient's total hospital stay with details of key events. We performed control examinations in regular intervals during the two months follow-up period (Table 2).

Day after Admission	Day after implantation of total knee prosthesis	Key event
0		Admission to trauma department
1		CT-diagnosis
13		Presacral decubitus II°
18	0	Implantation of a total knee prosthesis
28	10	Moved to geriatric rehabilitation
35	17	Sewing material removed
38	20	Moved to trauma department and reoperation (suture of patellar tendon and McLaughlin cerclage)
46	28	Moved to internistic department after severe urosepsis
72	54	Moved to intensive care unit after pulmonary oedema
85	67	End of follow-up period; patient bedridden

Table 1: *Overview of the patient's total hospital stay with details of key events.*

	Before stress fracture	1 day postop	3 days postop	7 days postop	14 day postop	21 day postop	35 days postop	67 days postop
VAS at rest	5/10	9/10	5/10	5/10	4/10	8/10	5/10	3/10
VAS at weight bearing	5/10	-	-	7/10	5/10	-	-	-
ROM	0/0/90°	0/0/0°	0/0/20°	0/0/30°	0/0/30°	0/0/0°	0/0/30°	0/0/60°
Walking distance	20 m	0 m	0 m	1 m	5 m	0 m	0 m	0 m
OKS	17	1	1	14	24	1	8	9

Table 2: *Overview over the control examinations during the two months follow-up period.*

Postoperative course in trauma ward

In general, the postoperative course went unsatisfactory. Full weight-bearing with completely extended operated lower extremity was permitted, but it could not be achieved. The mobilization of the patient was insufficient, even instructed by a physiotherapist. The wound showed a good healing tendency. The bilateral leg length was equal. Due to the iatrogenic rupture of the patellar tendon we prescribed a knee orthosis with limited range of motion (ROM). The follow-up treatment plan was as follows: The ROM of the right knee limited to 0/0/30° according to neutral zero method (NNM) for two weeks postoperatively, to 0/0/60° NNM for further two weeks postoperatively, to 0/0/90° NNM again for two weeks postoperatively; full movement of the knee permitted after that. The patient was moved to geriatric rehabilitation on day 10 postoperatively.

Postoperative course in geriatric rehabilitation

The patient could still not be properly mobilized. With the help of the physiotherapist, she was able to walk 2 - 3 steps next to the bed. The sewing material was removed on day 17 after surgery. Soon afterwards a postoperative wound dehiscence with 10 cm length occurred. The patient was moved back to trauma ward immediately on day 20 after surgery.

Reoperation and postoperative course in trauma ward

On day 20 after first surgery, we performed a reoperation. Intraoperatively, we diagnosed a rerupture of the patellar tendon. It was sutured again and a McLaughlin cerclage was implanted. Figure 4 shows the anteroposterior and lateral radiographs of the operated knee postoperatively. Again, full weight-bearing with completely extended operated lower extremity was permitted, but it could not be achieved. The follow-up treatment plan was as follows: The ROM of the right knee limited to 0/0/30° according to neutral zero method (NNM) for three weeks postoperatively, to 0/0/60° NNM for further three weeks postoperatively, to 0/0/90° NNM again for three weeks postoperatively; full movement of the knee permitted after that. The patient could not be mobilized and became bedridden. The sewing material was removed 3 weeks after second surgery. The McLaughlin cerclage should be explanted after 3 months postoperatively. The wound was healed completely.

Hospital stay in the internistic ward

On day 28 after first surgery, the patient developed a severe urosepsis and was moved to the internistic ward. The infection was treated successfully with antibiotics. Later, the patient developed a left ventricular insufficiency with pulmonary oedema and was moved to the intensive care unit. During the stay in the internistic ward all mobilization attempts were in vain. The patient stayed bedridden.

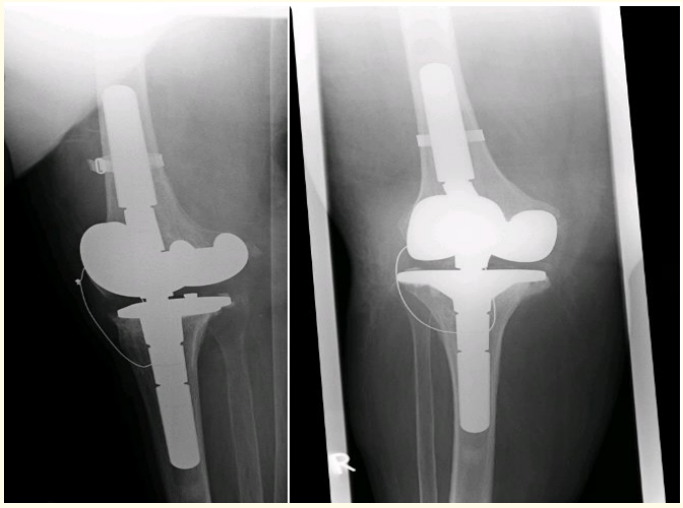

Figure 4: *Anteroposterior and lateral radiographs of the knee joint after second surgery and implantation of a McLaughlin cerclage.*

Hospital stay in the intensive care unit

The patient was intubated. She stayed under continuous respiration, artificial alimentation and bedridden until the end of the follow-up period (day 85 after admission, day 67 after first surgery). In our opinion, there was no longer any chance of mobilizing the patient in future. The documentation in our computer system showed that the patient was again admitted to the internist ward because of her comorbidities. She was still bedridden 6 months after the first surgery.

Discussion

Distal femoral fractures in elderly patients with osteoporosis are a challenge for successful treatment with a good outcome. The incidence of this fracture is around 4.5 per 100,000 with a female predominance [17]. Insufficient results were reported for osteoporotic fractures around the knee in elderly patients, treated with open reduction and internal fixation [18]. It is almost impossible to achieve stable situation after open reduction and internal fixation, due to osteoporosis or fracture comminution [19-24]. Elderly patients are not able to use crutches without weight-bearing, which leads to a longer period of immobilization with a consecutive higher mortality [18,21-24]. A solution to this problem is a primary knee replacement, since it is stable enough to make early resumption of full weight-bearing possible [20-24]. In the past, several case reports of distal femoral fractures, treated by knee arthroplasty, showed satisfactory results [25-28]. More recently, in a systematic review and meta-analysis modular constrained implants were recommended for comminuted intra-articular fractures [29].

In our case, we treated a distal femoral stress fracture due to severe erosive osteoarthritis of the knee joint. The medial defect of the knee joint, must have caused high shearing forces to the distal femur, leading to a failure of osteoporotic bone tissue. We treated our patient with a cemented long-stemmed modular constrained total knee prosthesis. Retrospectively, we can state an unsatisfactory outcome. 85 days after admission and 67 days after first surgery, the last control examination showed a pain VAS of 3/10 [30], a ROM of the knee of 0/0/60° NNM, and an OKS of 16 [31]. The patient became permanently bedridden. On the one hand, the reason for this must certainly be seen in the reduced general condition and internistic multimorbidity of the patient. On the other hand the prolonged preoperative

period must be considered critically. The patient was bedridden in the trauma department for 2.5 weeks until she underwent surgery. Reasons for the delayed operation were the measures taken to enhance the preoperative general status of the patient, the delivery of the ordered prosthesis and the lack of operating capacity. This delay led to the development of a presacral decubital ulcer and to a prolonged and more difficult postoperative mobilization. After second surgery and the following complications the mobilization became impossible. A longer immobilization period is known to influence mortality in elderly patients negatively [18,21-24]. Early surgery in hip fractures, for example, is associated with lower mortality and fewer perioperative complications [32]. Furthermore, it must be considered critically that an immediate implantation of a McLaughlin cerclage during the first surgery would probably have prevented the patellar tendon from rerupturing and would have avoided a reoperation.

In general, positive points of our treatments were the satisfactory surgical treatment of this complicated knee fracture, avoiding unilateral leg shortening and avoiding secondary dislocation of the distal femoral fracture. This made full weight-bearing possible which is of utmost importance in elderly patients. However, the general functional outcome is unsatisfactory due to a large number of avoidable and unavoidable deficiencies and problems.

Conclusion

To the best of our knowledge, this is the first reported case of distal femoral stress fracture due to severe osteoarthritis of the knee joint, treated with a cemented long-stemmed modular constrained total knee prosthesis. However, patients with severe osteoarthritis of the knee joint should be followed-up more closely and probably treated earlier in order to avoid complications.

Key Clinical Message

This is the first reported case of a distal femoral stress fracture due to severe osteoarthritis of the knee joint, treated with a cemented long stemmed modular constrained total knee prosthesis. This patient should have been followed-up more closely and probably treated earlier in order to avoid complications.

Ethics Approval and Consent to Participate

The patient gave his consent to participate. Ethical approval is not applicable.

Consent to Publish

The patient gave his consent for publication.

Availability of Data and Material

Not applicable.

Competing Interests

Not applicable.

Funding Support

No funding.

Authors' Contributions

NR performed the whole case report.

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