
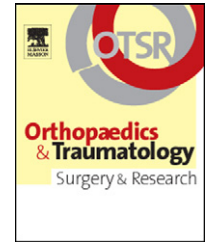




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ORIGINAL ARTICLE

Interprosthetic femoral fractures: Analysis of 14 cases. Proposal for an additional grade in the Vancouver and SoFCOT classifications

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Accepted: 6 July 2011

KEYWORDS

Femoral fracture;
Periprosthetic fracture;
Interprosthetic fracture;
Osteosynthesis;
Internal fixation;
Locking compression plate;
Total femur replacement

Summary

Introduction: Interprosthetic fracture is a rare but serious entity, impairing consolidation and stability due to adverse mechanical conditions related to bone fragility and implant volume.

Objective: The present study highlights the difficulties involved in managing such fractures, details treatment options and reports findings leading to a proposed additional grade in the comparable Vancouver (hip) and French Orthopedic and Traumatologic Surgery Society (*Société française de chirurgie orthopédique et traumatologique*: SoFCOT) (knee) classification systems.

Patients and methods: A multicenter retrospective series included 14 interprosthetic femoral fractures: eight type double C (type C for both hip and knee), five type C for hip and B for knee, and one type double B (type B for both hip and knee) on the Vancouver and SoFCOT classifications. Fracture occurred on standard ($n=15$) or revision ($n=13$) implants. Six cases involved a femoral shaft encumbered by a total knee replacement (TKR) femoral extension stem and eight cases TKR without femoral long stem, assimilable to type C fracture.

Results: None of the six fractures proximal to a constrained TKR with stem-achieved union by primary intention, whereas seven of the eight type-C fractures did so. Finally, 12 cases showed favorable evolution, with three secondary total femur replacements (TFR) and one death at 6 months without bony union or revision and one patient waiting for TFR.

Discussion: To describe the status of the intermediate femur and its medullary canal encumbrance, we propose adding a category D to the SoFCOT and Vancouver classifications, corresponding to interprosthetic fracture on TKR with diaphyseal extension stem. Interprosthetic

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fracture internal fixation should begin with long devices bridging the two prostheses. When the implant is loose, it may be replaced; in case of diaphyseal extension, however, the residual femur between the two extensions should be protected against peak stress by a plate extending upward and downward. In case of limited bone stock, due to osteolysis or initial femoral medullary canal compromise, especially if one or both implants are loose, TFR may be indicated as consolidation, is jeopardized by the uncertain mechanical situation.

Level of evidence: Level IV, retrospective study.

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Introduction

Periprosthetic femoral fracture is rare, with an incidence of 0.1 to 2% around total hip replacement (THR) implants, 0.3 to 2.5% around total knee replacement (TKR) implants [1] and about 1.25% for interprosthetic fracture [2]. The latter is a particular anatomic entity with specific therapeutic requirements due to unfavorable mechanical conditions between two rigid regions related to the presence of more or less extensive material in the femoral shaft. The Vancouver classification [3] is used to describe fractures around THR and the French Orthopedic and Traumatologic Surgery Society (*Société française de chirurgie orthopédique et traumatologique*: SoFCOT) classification [4] for fractures around TKR; neither, however, takes account of the status of the femoral shaft between the two prosthetic components [3,4]. Interprosthetic femoral fracture occurs more frequently in case of revision surgery [5,6] or of osteoporosis [2,7]. It is associated with elevated mortality and revision rates: greater than 50% revision according to Zuurmond et al. [8] and mortality in excess of the reference population according to Bhattacharyya et al. [9]. New osteosynthesis material using locking screws provides improved fixation in fragile bone [10–13] and may meet certain situations, especially if associated to minimally invasive techniques with hematoma and periosteum conservation [12,14–18]; it cannot, however, meet all situations, especially in case of limited bone support in case of arthroplasty with diaphyseal extension or implant loosening concomitant to the fracture [19,20].

The objectives of the present study were:

- 1) to highlight the difficulties of managing this kind of fracture, based on a 14-case series and;
- 2) to introduce an extension to the Vancouver hip classification [3] and SoFCOT knee classification [4], to differentiate prognosis according to form and to adapt treatment.

Patients and method

A retrospective study was conducted in three centers in France (Lille, Strasbourg and Dunkerque) from 2003 to 2009, including 14 interprosthetic femoral fractures (12 females, two males; mean age, 72 years (range, 49–89 years)). Mean fracture-THR interval was 136 months (range, 8–208 months) and mean fracture-TKR interval 84 months (range, 12–192 months). Etiologies were: osteoarthritis in seven cases, osteonecrosis in two, rheumatoid arthritis in four and fracture in one. There were eight primary and six revision

arthroplasties. Table 1 shows the characteristics of the fractures, implants and treatment methods. Fractures around the hip were described on the Vancouver classification [3] (Fig. 1) and fractures around the knee on the SoFCOT classification [4]. Certain fractures around long femoral implants or with diaphyseal extension for the knee, however, fail to fit these classifications. Notably, neither classification takes account of femoral status between the two implant components, particularly in terms of femoral pivot length in THR or type of TKR (with or without extension stem).

Postoperative complications comprised non-consolidation, early osteosynthesis material disassembly, non-union, superficial and deep infection, and any other event requiring revision surgery. Fracture consolidation was assessed as bony callus seen on two orthogonal X-ray incidences, without greater than 3° reduction loss, and allowing total weight-bearing without increase in pain above preoperative levels. Unfavorable evolution was assessed as non-consolidation at 3 months and/or failure to resume total weight bearing at 3 months, generally associated with increase in pain above preoperative levels.

Results

Seven patients had satisfactory clinical and radiological results (cases 3, 6, 7, 9, 10, 11 and 12; Table 1), without

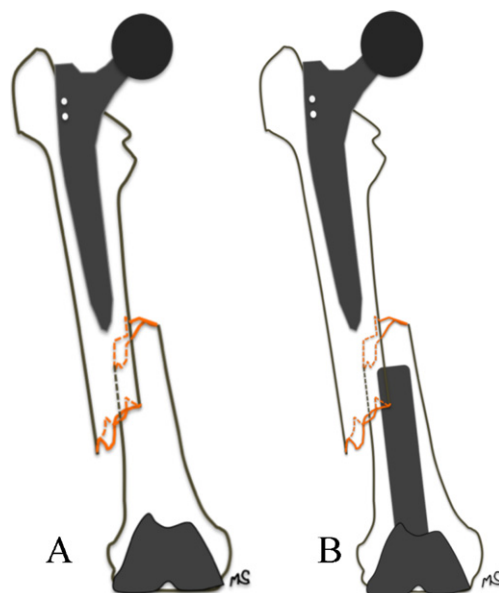


Figure 1 A. Type C interprosthetic fracture. B. Interprosthetic fracture on total knee replacement (TKR) with femoral extension stem (proposed type D).

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