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A Unique Pattern of Peri-Prosthetic Fracture Following Total Knee Arthroplasty: The Insufficiency Fracture

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ABSTRACT

An isolated periprosthetic compression fracture following total knee arthroplasty has not been described in periprosthetic fracture classifications. Thus, the purpose is to describe this unique type of fracture based on clinical and radiographic analysis and identify the incidence and potential risk factors of this fracture. A retrospective chart review was performed from a database of 5864 primary total knee. A total of 56 (0.9%) periprosthetic fractures were identified with 15 (26.8%) of them demonstrating an isolated lateral compression fracture. Patients exhibiting this fracture pattern had a mean preoperative varus deformity of 176.3° and had poor bone quality (T score: −2.1). It is important to recognize that a compression fracture is not an infrequent finding and that further workup maybe warranted when clinical suspicion is high.

The number of total knee arthroplasty (TKA) has been expected to increase by 673% to 3.48 million over the next decades [1]. While technology has advanced resulting in improved survivorship for total knee arthroplasty (TKA), peri-prosthetic fractures are one of the more common complications, with a reported incidence ranging between 0.3% and 5.5% in primary TKA [2–6].

Typically, these periprosthetic fractures occur above a well-fixed prosthesis [7–11] from a mechanism of lower energy trauma in combination with an axial-torsion force [12]. Furthermore, a number of predisposing factors have been associated with periprosthetic fractures including: osteoporosis [13–15], rheumatoid arthritis [14,16–18], steroid therapy [16–18], anterior femoral notching [13–15,19], neurological diseases, previous revision arthroplasty [13,14], local osteolysis [20], and infection [21]. Several classifications [21–25] have been proposed to categorize the wide variety of distal femur periprosthetic fracture patterns including those of Su et al [25] and Rorabeck et al [21]. Despite the many available fracture classifications, an isolated lateral femoral condyle compression fracture has not been included in any of the described classifications in the literature.

At our institution, we have encountered isolated lateral femoral condyle compression fractures; a fracture pattern that has received little attention or been thoroughly investigated. A potential reason for this is that the fracture pattern is frequently unseen on routine plain radiographs and requires dynamic stress radiographs or computed tomography for visualization. Furthermore, this fracture pattern has mainly been observed in patients with osteopenia and varus deformity, which has led us to hypothesize that this periprosthetic fracture pattern may be an insufficiency fracture, a fracture resulting from abnormal bone e.g. decreased bone quality. Thus, the purpose of this study is to (1) describe this unique type of fracture based on clinical and radiographic analysis, (2) determine the incidence of this fracture, (3) identify potential risk factors for developing this fracture, and (4) report the diagnostic methods used to identify this fracture pattern.

Materials and Methods

An institutional arthroplasty database was used to identify all patients who underwent primary total knee arthroplasty between March 2003 and February 2014. Following this query, a total of 5864 primary TKAs were identified. Over this eleven-year period, a total of 56 patients had periprosthetic fractures following primary TKA based on the International Classification of Diseases Version 9 (ICD 9) code for periprosthetic fracture, 966.44. Of these, fifteen had the documented fracture pattern of interest. None of the patients with this fracture pattern had any systemic inflammatory disease or was receiving immunosuppressive therapy. All procedures were performed by one surgeon with using a medial parapatellar approach and primarily cemented cruciate retaining knees.

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Fracture Identification

This compression fracture was defined as an isolated compression fracture in the lateral femoral condyle that was not found to occur intraoperatively. Clinical symptoms of this fracture include sudden pain following ambulation or any other events that may cause a compression mechanism.

Radiographic Analysis

Routine anteroposterior radiographs were taken for all patients during follow-up. The clinical suspicion (mismatch between X-rays and clinical manifestation) resulted in further radiological investigations. Dynamic stress (varus/valgus force) views were taken (Fig. 1a and b) followed by computed tomography scans (Fig. 2).

Outcome Measures

Alignment deformities were measured from preoperative weight bearing full length lower extremity radiographs using Agfa viewer (Agfa-Gevart, Mortsel, Belgium). Flexion deformities were measured preoperatively using a goniometer. Bone densitometry was performed to characterize the severity of osteoporosis and was measured using T scores. Osteopenia and osteoporosis were based on T score thresholds of −1.0 and −2.5 respectively as established from the World Health Organization criteria [26]. All the measurements and radiographic reports were reviewed by a trained physician (AS).

Outcome Variables

A retrospective chart review was then performed in these patients with periprosthetic fractures to obtain and review the following clinical information: imaging, intraoperative observations, bone density, flexion, and alignment deformities.

Results

Of the 5864 primary TKAs, a total of 56 TKAs (0.9%) subsequently developed a peri-prosthetic fracture. Of these fractures, 15 knees had the described pattern (26.7% of the peri-prosthetic fractures), an isolated femoral compression fracture. There were 4 males and 10 females (one female had bilateral insufficiency fracture) with insufficiency fractures occurring at an average age of 63.7 years (range 52–71 years, Table 1). All patients were diagnosed within the first 21 days of surgery (15.2, 7–21 days).

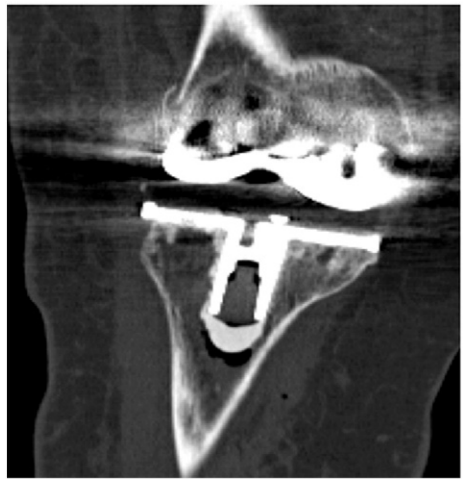

Fig. 2. CT scan showing bone compression in the lateral femoral condyle.

All patients reported sudden onset of pain that disabled them from further ambulation. Of the 14 patients, 11 patients reported no history of trauma, 2 had knee torsion, and 1 experienced blunt trauma at the site of the fracture.

Radiographic Assessment

Plain anteroposterior radiographs showed pathologies in the lateral condyle of femur in all reviewed fracture cases. However, in seven of the radiologist reports, the fracture pathology was not reported despite an observed increase in varus deformity. In suspicious cases for periprosthetic fracture, dynamic stress varus and valgus views were performed (Fig. 1b) and the diagnosis was confirmed with a CT scan by detecting the bone compression in the lateral femoral condyle.

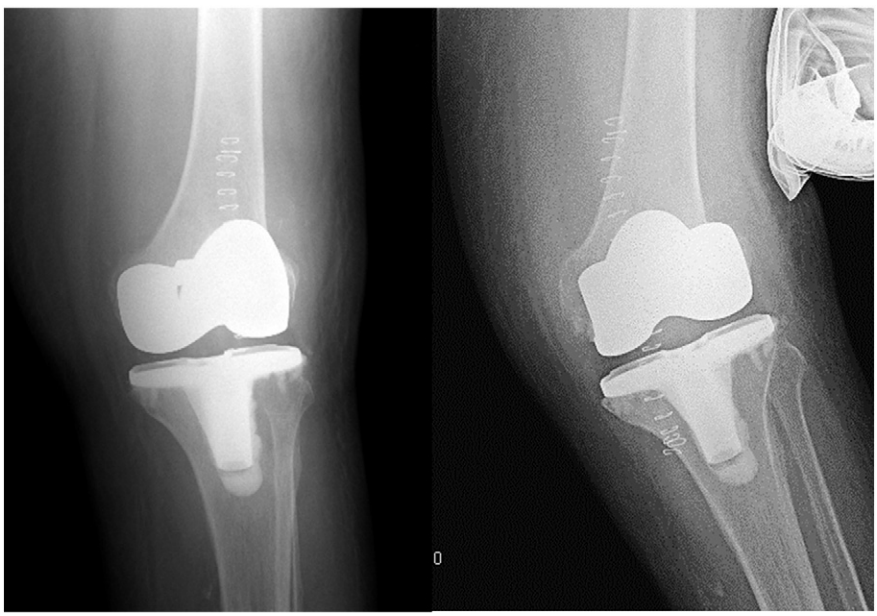

Fig. 1. Compression fracture not visualized on anteroposterior film (a) until valgus stress view.