

Peri-prosthetic fractures around hip and knee prostheses

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ABSTRACT

Peri-prosthetic fractures (PPFs) are a serious complication of total hip and knee arthroplasties, with rising incidences in recent years. Falls and low trauma events remain the leading causes for PPFs as well as increasing age.

PPFs present complex management challenges with a high incidence of complications, failures and compromised long-term clinical outcome. Due to the inherent variability in PPFs, management should be tailored individually. Conservative approaches have generally produced poorer results in comparison to surgical intervention, and are usually reserved for patients with a high anaesthetic risk and for stable fractures around a well-fixed implant. Operative treatment is recommended for unstable and loose prostheses and choice of surgical intervention determined by whether the stem is well fixed (surgery involving open reduction and internal fixation) or loose (revision arthroplasty).

CASE INTRODUCTION

Mr RA is a 66-year-old Caucasian male who presented to the Emergency Department with pain in his right knee and an inability to weight-bear four hours after a mechanical fall that took place in his home.

Mr RA had slipped on some wet tiles on his way from the kitchen to the porch. He landed on the right side of his body; however the precise impact point was unknown. He experienced severe pain immediately in his right knee, and was unable to get up due to being unable to weight-bear on his right lower limb. He called for help and was eventually brought to the Emergency Department within four hours by a friend who happened to be visiting.

Mr RA denied experiencing any shortness of breath, chest pain, dizziness, limb weakness or any other neurological deficits both prior to and after the fall. He also stated that there was no head strike associated with the fall and at no time did he experience any loss of consciousness or incontinence.

Medical Background

Mr RA had total hip replacements to both left and right hips, two years and eight years ago respectively, secondary to osteoarthritis. He also had an appendectomy as well as a history of several injuries including a clavicle fracture, ruptured Achilles tendon and a rib fracture, all of which were treated conservatively.

His medical history included hypertension and hypercholesterolaemia.

Physical Examination

On examination, Mr RA was alert, responsive and appeared to be relatively comfortable despite the pain he reported in his right knee. His vital signs were within normal limits, with a blood pressure of 130/92 and a pulse rate of 65. His heart sounds were dual, with no added sounds; and both his lung fields were clear on auscultation and percussion. His abdomen was soft and non-tender with active bowel sounds. Neurological examination yielded no significant findings.

Mr RA's right lower limb appeared to be shortened compared to his left and was externally rotated at the knee. Slight bruising was also noted on the medial surface of his right knee. The distal right thigh and the right knee were warm and tender on palpation. The range of movement at the right knee was severely restricted due to pain. Mr RA's right lower limb was not neurovascularly compromised with normal neurology, and his dorsalis pedis pulse was clearly palpable.

| | |
|-------------------|------------------|
| Temperature | 36.6°C |
| Blood pressure | 130/92 |
| Pulse rate | 65 |
| Oxygen saturation | 100% on Room Air |

Table 1: Mr RA's vital signs at presentation.

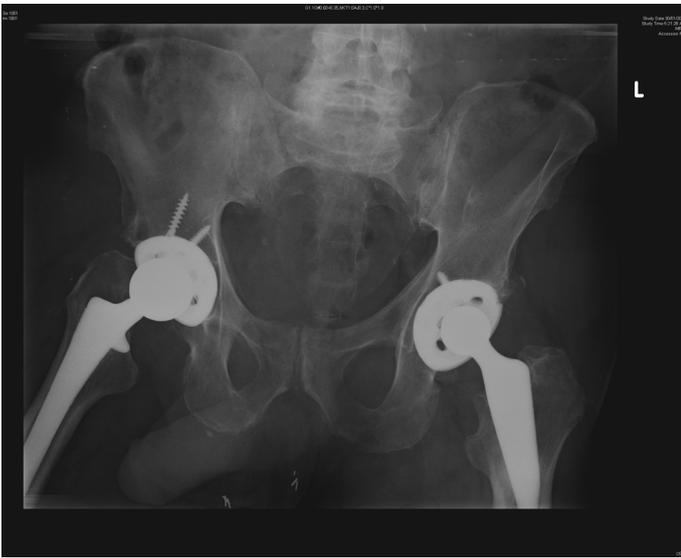


Figure 1: AP X-ray of Mr RA's pelvis.

Investigations

There were no significant abnormalities found on Mr RA's blood investigations or on his chest X-ray.

Mr RA's pelvic X-ray (Figure 1) showed that he had bilateral hip replacements and that the hip implants were in good position, with no signs of loosening of the implants.

X-rays of Mr RA's right femur and knee (Figure 2, 3) showed a spiral fracture of the distal femur that was significantly displaced and externally rotated. However, the fracture line did not appear to be extending down to the knee joint.



Figure 2: AP X-ray of Mr RA's right femur and knee.



Figure 3: Lateral X-ray of Mr RA's femur and knee.

Impression

Information gathered from the clinical history, examination and investigations indicated that Mr RA had a spiral fracture of his right distal femur that was complicated by the fracture's peri-prosthetic location.

Management

The orthopaedic team reviewed Mr RA and came to the conclusion that surgical intervention was necessary. Prior to surgery, Mr RA had optimal analgesia and his right leg was placed in a Thompson splint. As Mr RA's right hip prosthesis was well fixed despite the fracture, the orthopaedic team decided that an open reduction and internal fixation (ORIF) procedure with plates, screws and wire cerclage would be appropriate.

The surgery was carried out successfully with satisfactory, but not anatomical, reduction (Figure 4, 5). Post-operatively, Mr RA was admitted to the surgical ward for pain management and rehabilitation facilitated by the occupational therapists and physiotherapists. Three days after the surgery, Mr RA was discharge from the hospital stable and well on a non-weight bearing status for three months, ambulating with crutches; as well as with a follow-up appointment at the fracture clinic scheduled for two weeks later.

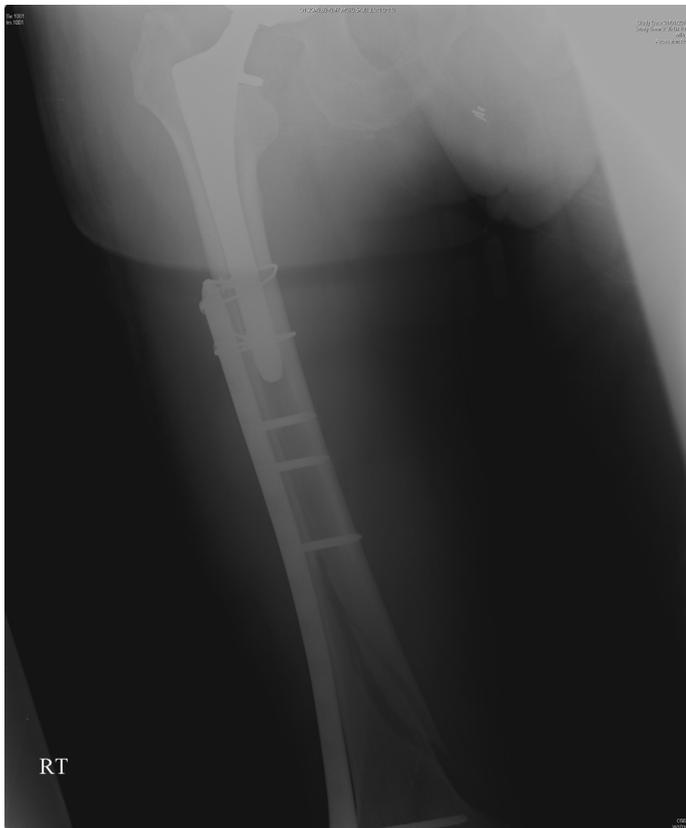


Figure 4: AP X-ray of Mr RA's femur and knee post-operation with plates, screws and wire cerclage in place.

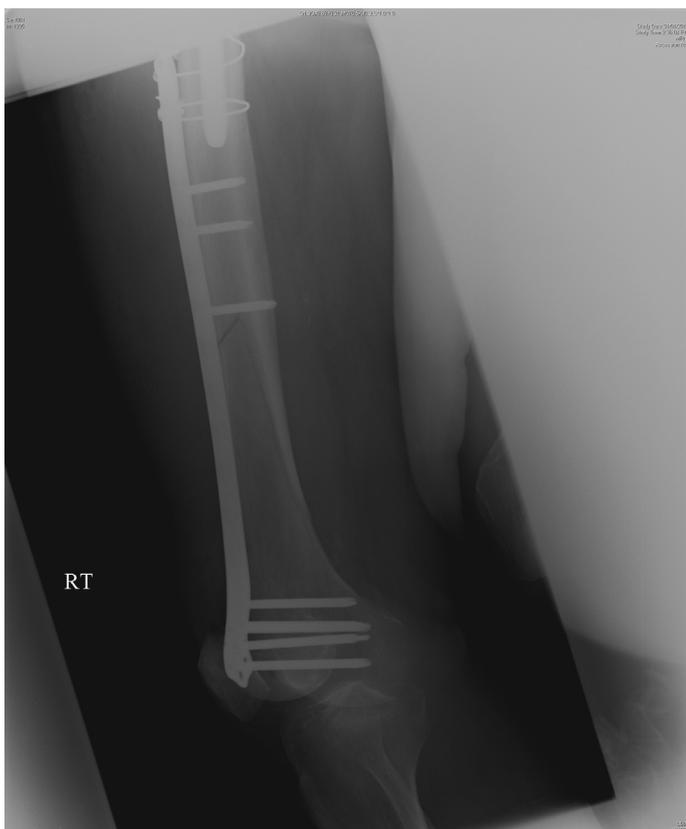


Figure 5: Lateral X-ray of Mr RA's femur and knee post-operation with plates, screws and wire cerclage in place.

This case highlights periprosthetic fractures as an issue that has been rising in incidence over the past years as our population ages and total hip and knee replacement procedures have become more common. A detailed discussion of peri-prosthetic fractures around hip and knee prostheses follows.

DISCUSSION

Introduction

Peri-prosthetic fractures (PPFs) are defined as fractures that occur around joint replacement prostheses. They are among the most serious complications of total hip and knee arthroplasties, with rising incidences in recent years largely due to both the growing popularity of joint replacements as well as the ageing population.¹⁻⁵

Currently, the incidence of peri-hip-prostheses fractures is reported to be approximately 1-5% and that of peri-knee-prostheses to be approximately 0.3-2.5%.⁴⁻⁶ Elderly women with osteopenia appear to be at the highest risk of sustaining PPFs, with a study suggesting that 4 out of 5 PPFs occur within this demographic group.^{7,8}

PPFs have also been found to be a leading cause for revision total hip arthroplasties, second only to aseptic loosening of the prosthesis.⁹

Risk factors

Falls, such as the one Mr RA sustained, appear to be the leading cause of PPFs.^{1,3,10,11} Various studies have also commented that low energy trauma events and spontaneous occurrences during activities of daily living are also common mechanisms leading to PPFs.^{1,3,10}

Risk factors for PPFs include severe osteopenia and osteoporosis, lower body mass index, loosening of hip or knee prostheses as well as increasing age.^{6,10,11,12} Cook et al. found that patients who were over 70 years old had almost a 3-fold increase in their risk of sustaining a PPF while patients who were over 80 years were 4.4 times more likely to suffer from a PPF.¹² Interestingly, Mr RA demonstrated few risk factors for a PPF, given his relatively young age, him being a male and his x-rays not appearing to demonstrate significant signs of osteoporosis.

Management

The principle goal in management of PPF is to return the patient to their pre-morbid level of function.⁸

The choice of treatment is dependent on many factors. Important considerations when determining the management strategy include condition, type and size of the prosthesis, its fixation status (loose or well-fixed), quality of surrounding bone and pattern of fracture.^{6,10} The Vancouver Classification (Table 2) provides an excellent way of stratifying PPFs and the appropriate management for each type of PPF.⁹ By the Vancouver Classification, Mr RA could be stated to have a Type C PPF.

| | |
|---------|--|
| Type A | At trochanter |
| Type B | Around tip of prosthesis stem |
| Type B1 | Well-fixed stem |
| Type B2 | Loose stem |
| Type B3 | Associated with poor bone quality or bone loss |
| Type C | Distal to tip of prosthesis stem |

Table 2: Vancouver Classification of Peri-prosthetic Fractures For Total Hip Replacements.

Conservative management

Conservative management of PPFs has been found to be difficult, generally producing poorer results in comparison to surgical management due to a higher risk of developing a non-union.³ As such, it is reserved primarily for patients who are not suited for surgery, namely those with high anaesthetic risks⁶ or those who have stable, non-displaced PPFs with a well-fixed prosthesis.¹⁰

Conservative management of PPFs involves the application of a cast brace with or without a period of skeletal traction and restricted weight bearing. Close follow-up with routine radiograph is then required to ensure that satisfactory alignment is achieved and maintained.¹⁰

Some of the risks associated with conservative management include a high risk of infections, development of pseudoarthrosis as well as a high demand for supports post-trauma due to the resultant delay in weight-bearing.⁴

Surgical management

There has been a shift in the management of PPF towards surgical intervention due to the poor outcomes associated with conservative management.^{9,13}

Surgical management has become the standard treatment for the majority of PPFs⁹ and has typically consisted of open reduction and internal fixation (ORIF), a revision arthroplasty or a combination of both.¹³ These approaches allow for faster functional recovery with less limitation in joint movement, thereby allowing immediate weight bearing and mobilisation.⁶

The decision as to which form of surgical intervention should be employed is largely dependent on the fixation status of the prosthesis as well as the quality of surrounding bone stock. The general consensus has been as below:^{7,10,13:}

1. Well fixed prosthesis – ORIF alone.
2. Loose prosthesis – revision arthroplasty, with or without ORIF.
3. PPFs associated with poor bone quality or bone loss – revision arthroplasty augmented with structural allografts.
4. Uncertain about status of prosthesis – treat as per loose prosthesis.

In our case, given Mr RA's well-fixed hip prosthesis, ORIF was performed without the need for revision arthroplasty.

Complications

In practice, PPFs present complex management challenges that come with a high incidence of complications, failures and compromised long-term clinical outcome.⁹ Several studies have reported non-union rates post-PPFs to be between 10% and 20%, with overall complication rates of up to 50%.⁶ In fact, Zuurmond et al. found that almost a third of all PPFs eventually require reoperations.¹⁴ The high rate of complications and treatment failure can be attributed to the extensive soft tissue damage and disrupted blood supply associated with the nature of PPFs.¹⁴ Similarly poor bone quality due to osteoporosis and major blood-loss associated with invasive surgery can further complicate the management.⁸

Often patients with PPFs have significant co-morbidities, which make the management of these injuries even more complex¹; therefore suitability for surgery is carefully considered.¹ By identifying high-risk groups (recurrent dislocations, loosening, osteolysis) and ensuring close follow-up, many of these complications can be avoided.¹

Prevention

Steps should be taken to prevent PPFs by managing those with known risk factors. Patients with osteoporosis should be treated prior to undergoing surgical management.¹⁴ Adjuvant fall prevention and post-operative rehabilitation further reduce the risk of PPFs and faster return to the pre-injury level of mobility.¹²

Conclusion

The trend over the past years has demonstrated that PPFs are becoming increasingly common as the prevalence of total hip and knee replacement procedures rises and as our population continues to age. Given this, it is important to be aware of the risk factors that predispose an individual to PPFs, understand the basic principles of PPF management and appreciate the challenges of managing PPF with high rate of complications and their severity.

Consent

Informed consent was obtained from the patient for the publication of this case report and accompanying figures.

Conflicts of interest: None declared.

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