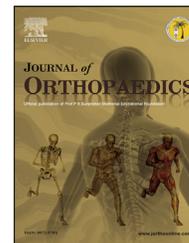




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Original Article

Utility of week one radiographs post total hip arthroplasty



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ARTICLE INFO

Article history:

Received 1 February 2013

Accepted 1 June 2013

Available online 30 July 2013

Keywords:

Orthopaedic surgery

Other categories

Hip

Arthroplasty

Radiograph

ABSTRACT

Introduction: We retrospectively analysed 129 consecutive patients who underwent hip arthroplasty at a university-affiliated hospital in Melbourne, Australia between February and September 2011 with respect to the quality of the week one radiographs, placement of the prosthesis and the presence of a peri-prosthetic fracture or dislocation.

Method: Patient records and radiographs were reviewed to ascertain whether a deviation in routine management occurred based on the information obtained from week one post-operative radiographs.

Results: 116 of the 129 patients met the inclusion criteria for the study. 115 patients underwent routine week one hip radiographs with a mean time after surgery of 2.5 days. 89 (77%) of these patients had radiographs with a typical post-operative appearance. 26 (23%) had radiographs with an atypical appearance defined by the presence of one or more of the following: offset difference of >10 mm (11%), leg length difference of >10 mm (11%), sub-optimal acetabular component inclination of <30° or >50° (9%), sub-optimal femoral stem position of >5° varus or valgus (2%), sub-optimal femoral Greun cement distribution of 2 or more absent zones (2%), cement extrusion (1%), peri-prosthetic fracture (0) or dislocation (0). None of the routine week one radiographs resulted in a change in early post-operative management. 1 patient underwent non-routine, immediate post-operative radiographs.

Discussion: Our study did not demonstrate a case where deviation from standard clinical pathways occurred as a result of routine post-operative radiographs. A higher power study would help the established surgeon to determine whether post-operative radiographs could be performed at a more comfortable and convenient time such as the outpatient setting.

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1. Introduction

Hip arthroplasty is a common and successful orthopaedic procedure shown to improve quality of life.^{1,2} The Australian Orthopaedic Association (AOA) National Joint Replacement

Registry (NJRR) reported over 25,000 primary total hip joint arthroplasty procedures performed in 2010.³ The frequency of this operation has necessitated the generation of standard post-operative clinical pathways of care. These have been shown to have a beneficial impact on the duration of

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admission, and outcomes and are now employed by Australian orthopaedic units.⁴ It is standard practice within the clinical pathway at this tertiary teaching hospital to perform anteroposterior (AP) and lateral radiographs within one week of hip arthroplasty surgery. For the purpose of this study, a “week one” radiograph is defined thus. The utility of this practice is yet to be explored in contemporary literature. This study examines the quality of week one radiographs at our institution, the information obtained from these radiographs, and whether this information corresponds to a change in inpatient management and better patient outcomes.

2. Methods

The study was conducted at a university-affiliated tertiary hospital in Melbourne, Australia. Data was collected by review of case notes, electronic patient records and the picture archiving and communication system (PACS). Patient details were accessed using the orthopaedic departmental audit register. Ethics approval was granted by the hospital ethics review board (QA061/11).

For this pilot study a population size of 100 was to be achieved with approximately 30% over recruitment in anticipation of patients not fulfilling the inclusion criteria. All patients listed as having undergone hip arthroplasty between February 2011 and September 2011 were assessed for this study. A retrospective analysis of patients in this time period was conducted resulting in 129 consecutive patients who had undergone hip arthroplasty. Exclusion criteria for the study included hip revision surgery, hemi-arthroplasty, hip resurfacing, and total hip joint replacement for fracture. This allowed for a review of primary total hip joint replacements which account for the majority of elective hip arthroplasties.³ Week one radiographs were reviewed on the Medical Imaging PACS database by both a radiology registrar and an orthopaedic registrar.

Data was collected regarding the quality of the radiograph, placement of prosthesis and the presence of a peri-prosthetic fracture or dislocation. The patient records were then reviewed to ascertain whether a deviation in routine management occurred. Continuous variables were summarised as a median.

The quality of the computed radiographs was determined by assessing incorporation of the entire prosthesis and by convention, related specific anatomical bony landmarks. The radiographs were subsequently categorised as being “easy” (Fig. 1) or “difficult” (Fig. 2) to interpret. Properties of difficult radiographs included: pelvic malrotation (defined as a pubic symphysis > 2 cm offset from the sacral midline) tilted pelvic view, failure to demonstrate the entirety of the prosthesis (including acetabular screws and cement plug), and failure to demonstrate the entireties of the greater trochanters on AP film.

Other variables evaluated included leg length discrepancy (LLD), femoral neck offset, acetabular inclination (AI), stem placement, cement distribution and the presence of a peri-prosthetic fracture or dislocation. Determination of LLD was performed by drawing a horizontal line on the AP radiograph across the two ischial tuberosities. This trans-ischial line is

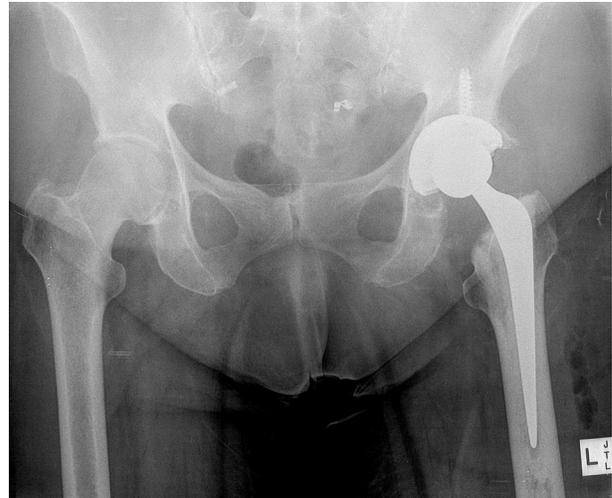


Fig. 1 – Easy to interpret.

extended to the lesser trochanter of both hips as reproducible points of reference and the difference recorded as LLD. A measurement of >10 mm was defined by convention as unacceptable LLD.⁵ Acetabular Inclination was measured as the angle between the acetabular cup and the trans-ischial tuberosity line on AP radiograph.⁶ An AI falling outside of $40^\circ \pm 10^\circ$ was deemed abnormal.⁷ The long axis of the stem was compared against the femoral anatomical axis to determine alignment in terms of varus/valgus. Femoral offset is the perpendicular distance from the centre line of the femur to the centre of rotation of the femoral head.⁸ Offset was considered abnormal if the measurements was 10 mm or more, either greater than or less than, the contralateral side.⁹ For cemented implants the Gruen classification of distribution was employed to determine the cement mantle (Fig. 1).¹⁰ Any peri-prosthetic fractures or prosthesis dislocations were documented.

Patient records were retrospectively reviewed for deviation from standard management plans that stemmed from the week one radiographs.

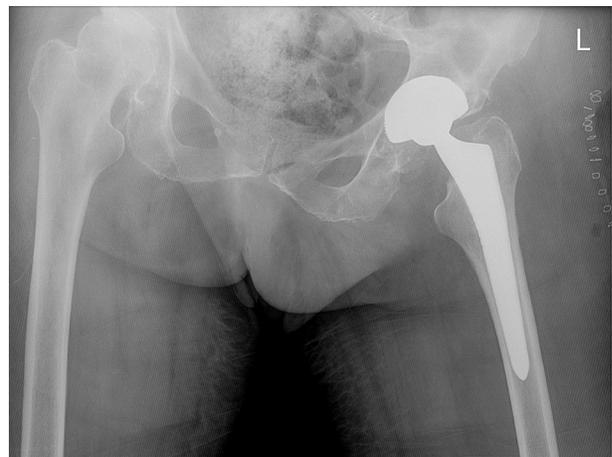


Fig. 2 – Difficult to interpret.

3. Results

Retrospective review of the patient database demonstrated 129 patients who had undergone hip arthroplasty surgery between February 2011 and September 2011. Of these patients, 116 met the inclusion criteria for the study. Of the 13 patients who were excluded, eight had undergone arthroplasty revision surgery, four underwent arthroplasty for fracture and one underwent resurfacing. Ninety-five radiographs were easy to interpret and 21 were difficult. Of those that were difficult, seven radiographs showed malrotation, three radiographs demonstrated a tilted pelvis, three radiographs did not incorporate the inferior aspect of the implant, eight radiographs did not include the greater trochanters adequately, and one radiograph had both malrotation and did not include the implant laterally. All films demonstrated the superior aspect of the prosthesis.

Thirteen of 116 radiographs demonstrated an LLD of >10 mm, one radiograph demonstrated an LLD of >20 mm (25 mm). The average LLD was 5.7 mm. Two radiographs demonstrated a varus/valgus stem position of greater than five degrees. The average stem position was 0.9° varus. Cement distribution was calculated using the Gruen classification. Of the 116 hip arthroplasty surgeries, 94 were cemented and 22 uncemented. Of the 94 cemented implants, 27 demonstrated a deficiency in at least one Gruen zone, 15 of which were in zone one. Two radiographs demonstrated a deficiency in two or more zones and we considered this significant. One radiograph demonstrated cement extrusion. Twenty-seven patients included in the study had existing total hip replacements on the contralateral side. Offset was measured for both unilateral and where present, contralateral hip arthroplasty. Thirteen radiographs demonstrated an offset discrepancy greater than 10 mm. The average difference in offset was 5.5 mm. Ten radiographs were demonstrated to have an implant AI outside the normal range. The median AI was 44.9° (one < 30, and nine > 50). The average time after surgery for the week one radiograph was 2.5 days.

Radiographs complying with the above variable normal ranges were listed as having a “typical” post-operative appearance. Radiographs that showed implant variables outside normal ranges were listed as “atypical”. Eighty-nine (77%) radiographs demonstrated a typical post-operative appearance and 27 radiographs demonstrated an atypical post-operative appearance. Only one (0.8%) radiograph demonstrated an atypical appearance that required immediate change in management. This was a case of recognised intra-operative catastrophic fracture of the broach and resulted in deviation from the routine clinical pathway (Fig. 3). This complication was recognised prior to the radiograph, which served to identify the broach position and depth. Specialised extraction equipment was required as well as long stemmed femoral prosthesis. The patient remained non weight bearing until the second stage surgery had been performed. This in itself is a very rare complication of total hip joint arthroplasty and represented the only non-routine radiograph request Table 1.

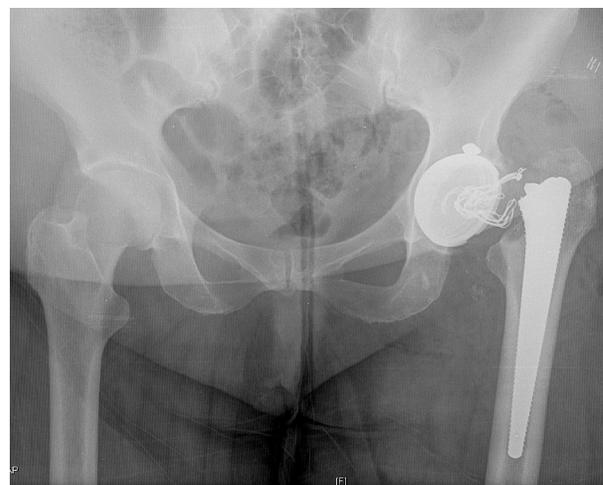


Fig. 3 – Broken broach: a rare complication of hip arthroplasty.

4. Discussion

Performing week one radiographs post hip arthroplasty is an established practice in Australia, the utility of which has not been formally accounted for. Assessment of these radiographs is an essential skill for radiologists and surgeons alike and provides knowledge in the form of verification and education. Review of radiographs is a corner stone in the orthopaedic surgical audit process. The radiologist and surgeon can rapidly assess the position of the prosthesis and exclude complications such as peri-prosthetic fracture or dislocation as well as cement extrusion. One of the major advantages of early post-

Table 1 – Utility of week one hip radiographs post total hip arthroplasty N = 116.

Indication for radiographs	
- Clinical indication	1 (1%)
- Routine post-operative imaging	115 (99%)
Imaging outcomes	
- Typical post-operative appearance	89 (77%)
- Atypical post-operative appearance	27 (23%)
- Large offset difference (>10 mm)	13 (11%)
- Large leg length difference (>10 mm)	13 (11%)
- Sub-optimal inclination of acetabular component (<30° or >50°)	11 (9%)
- Sub-optimal position of femoral stem (>5° varus or valgus)	2 (2%)
- Sub-optimal Chamley femoral Gruen cement distribution (2 or more zones absent)	2 (2%)
- Cement extrusion	1 (1%)
- Peri-prosthetic fracture	0
- Dislocation	0
- Abnormality in routine radiograph with change in management	0
- Abnormality in non-routine radiograph resulting in change in management	1 (1%)

operative radiographs is the ability to provide immediate feedback on both optimal and sub-optimal placement of prosthetic components. Access to this information shortly after surgery is invaluable for the training and experienced surgeon alike and we acknowledge that this benefit alone may for most surgeons be enough to justify any potential difficulties associated with obtaining these radiographs.

Many orthopaedic units using clinical pathways have decreased their average length of stay after THA from more than 10 days—7 days or fewer.⁴ This teaching hospital uses clinical pathways to guide management of post-operative joint replacement patients and is based around a four day hospital admission. This entails patients standing and mobilising with a physiotherapist on day one post-operation. The average time until first radiograph is 2.5 days. Routine patients are therefore being assessed clinically before being assessed radiologically. Any dislocation or undiagnosed fracture is likely to be suspected in this initial mobility phase.

There is both financial and patient burden associated with obtaining an AP and lateral week one post-operative radiographs. We examined the quality of week one radiographs at our institution, the information obtained from these radiographs, and whether this information corresponds to a change in inpatient management. This study demonstrated a high percentage (18%) of radiographs that were difficult to interpret due to sub-optimal quality. Jibri et al showed that late post-operative radiographs taken in the outpatient setting are of statistically significant better quality than those taken in the pre-discharge period.¹¹ Given the high rate of difficult to examine radiographs in our study, it may be worth considering the timing of this investigation an attempt to improve image quality. There is anecdotal evidence of significant discomfort and pain associated with obtaining radiographs in the initial post-operative period.

A substantial amount of information can be obtained from week one radiographs and this comparative data has allowed for the categorisation of routine post-operative radiograph into typical or atypical groups. Eighty-nine radiographs demonstrated a typical post-operative appearance and 27 radiographs demonstrated an atypical post-operative appearance. None of these radiographs demonstrated prosthetic malposition, cement distribution or extrusion, undiagnosed peri-prosthetic fracture or dislocation requiring a change to routine management. We acknowledge that week one radiographs will demonstrate peri-prosthetic fractures or dislocations requiring immediate action, however our data suggests that these diagnoses are likely to be made or suspected clinically when the patient is mobilising with physiotherapists. A weakness of our study is the small sample size and we acknowledge that the very rare complication of retained surgical instruments or swabs would be diagnosed on routine week one radiographs.

A larger prospective review of radiographs and patient management would add power to the findings of this study. Categorising radiographs into typical and atypical groups will allow orthopaedic units to prioritise those radiographs warranting further review. This unit will now look to employ a green light system at our weekly X-ray meeting. Based on radiographic appearance, films will be classified as typical, atypical and those requiring a change to routine management. This will be indicated by a green, amber and red light system.

The continued collection of data will allow for further retrospective reviews of prosthesis placement. The quality of radiographs will be recorded for quality assurance.

5. Conclusion

Week one post-operative radiographs for primary hip arthroplasty is a practice entrenched in orthopaedics throughout the world. We cannot validate this global practice based on 116 patients, however, our study did not demonstrate a case where deviation from standard clinical pathways occurred as a result of routine post-operative radiographs. A high power study would help the established surgeon to determine whether post-operative radiographs can be performed at a more comfortable and convenient time such as the outpatient setting. Perhaps the most valuable use of the immediate post-operative radiograph is to allow comparison with future imaging if adverse symptoms arise.

Conflicts of interest

All authors have none to declare.

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