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Intra-operative error during Austin Moore hemiarthroplasty

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INTRODUCTION
For displaced subcapital fractures of the femoral neck, the uncemented Austin Moore is the most frequently used monoblock hemiarthroplasty in Australia.\textsuperscript{1,2} This procedure is commonly reserved for the elderly or frail low-demand patients, who represent poor candidates for revision should the prosthesis fail.\textsuperscript{3–5} Australian Joint Registry data indicate that the uncemented Austin Moore prosthesis has a 3 fold higher rate of revision within 2.4 years than the cemented Thompson prosthesis (hazard ratio [HR], 2.89; 95% confidence interval [CI], 1.8–4.6; \(p<0.0001\)).\textsuperscript{1,2} Technical errors in implantation of the uncemented Austin Moore are common and have been associated with early failure of the prosthesis.\textsuperscript{6–9} Inadequate calcar seating, insufficient residual femoral neck length, insufficient metaphyseal fill and errors in sizing the prosthesis are all associated with early failure of the Austin Moore hemiarthroplasty. In a review of 243 patients receiving Austin Moore prostheses, 61 (25\%) had residual pain and 17 (7\%) required revision surgery for aseptic loosening within one year. Both residual pain and revision for aseptic loosening were strongly associated with shortcomings
in the operative technique—namely caudad resection level of the femoral neck, inadequate seating of the prosthesis, and inappropriate selection of prosthetic head size. Dislocation of the Austin Moore prosthesis was related to inappropriate residual neck length and poor selection of the prosthetic head size.

In patients with acutely displaced fractures of the femoral neck, proximal metaphyseal fill of less than 70% was associated with subsidence and postoperative pain.

In public hospitals, unipolar hemiarthroplasty for femoral neck fracture is frequently performed by less experienced surgeons and under difficult circumstances. This study aimed to assess the technical accuracy of implantation of the uncemented Austin Moore prosthesis.

METHODS

147 consecutive patients who underwent unipolar uncemented Austin Moore hemiarthroplasty at the Cairns Base Hospital, Brisbane, Australia between January 1998 and 2004 inclusive for subcapital fracture of the femoral neck were identified. Identification was by discharge diagnosis coding and operation logs; no patients were excluded. Charts including operative notes were reviewed and preoperative and immediate postoperative radiographs were analysed. The radiographs and the technical accuracy of the prosthetic implantation was assessed using methods described by Sharif and Parker. The following were counted as errors in implantation: an intra-operative periprosthetic fracture or any of the following technical aspects of insertion associated with early failure of the prosthesis:

1. Inadequate length of the neck remnant (≤12 mm)—measured from the superior margin of the lesser trochanter to the resection margin at the calcar femorale (Fig. 1). If an inadequate neck remnant was identified on postoperative radiographs, the neck length from the lesser trochanter to the level of the fracture on preoperative radiographs was also measured.

2. Inadequate calcar seating (>1 mm)—measured from the medial prosthetic collar to calcar (Fig. 1). A prosthesis collar seated on the medial calcar was recorded as zero.

3. Difference in prosthetic head size compared with the contralateral normal femoral head using circular overlays—a diameter of prosthesis up to 2 mm larger to account for articular cartilage was considered satisfactory. If the contralateral femoral head was not suitable for analysis (due to disease or previous prosthetic replacement), the ipsilateral femoral head on preoperative radiographs was used for assessment of the appropriate prosthetic head size.

4. Intra-operative periprosthetic fracture—fracture classification was conducted using the Vancouver system.

RESULTS

147 patients were treated with the unipolar uncemented Austin Moore prostheses over the time period: 128 (87%) had surgery performed by relatively junior doctors—14% by senior medical officers, 57% by training registrars, and 17% by principal house officers; 19 (13%) were performed by a consultant surgeon.

84 errors in implantation were identified in 71 patients; only 76 (52%) had no errors in implantation, while 52 (35%) had one error, 17 (12%) had 2 errors, and 2 (1.4%) had 3 errors.

21 (14%) of the patients sustained intra-operative fractures (Fig. 2), of which 20 involved the proximal
femur; all were Vancouver Classification Type A\textsuperscript{10} and identified during the procedure. Of these, 15 were managed with cerclage wire, 2 with both cerclage wiring and cementing of the prosthesis, 2 were considered stable and not requiring specific management, and one was treated by cementing the prosthesis alone. One patient sustained a non-displaced fracture of the acetabulum, located outside the weight-bearing dome. The latter fracture was not identified during surgery and was associated with oversizing of the prosthetic head by 3 mm. The fracture rate for relatively junior doctors was 15\% compared to 11\% for consultants (p=0.73).

12 (8\%) of patients were excluded from assessment of neck length remnant as postoperative radiographs were either unsuitable or unavailable for analysis. 36 (27\%) of the remaining 135 patients had inadequate length of the neck remnant on postoperative radiographs (Fig. 3). Of the 36 patients with insufficient neck remnant remaining postoperatively, 29 had preoperative radiographs suitable for comparison. 13 (45\%) of the 29 patients had an insufficient neck remnant available prior to surgery due to the pattern of fracture sustained. The resection level of the femoral neck was judged insufficient in 26\% of procedures conducted by relatively junior doctors, and in 29\% of procedures conducted by consultants (p=0.66).

27 (18\%) of patients were excluded from assessment of calcar seating as postoperative radiographs were either unsuitable or unavailable for analysis. 26 (22\%) of the remaining 120 patients had inadequate calcar seating demonstrated on postoperative radiographs (Fig. 1). 13 prostheses were proud by >3 mm. Three prostheses were proud by >10 mm, all of which were implanted by junior doctors. The incidence of inadequately seating the prosthesis on the calcar was 24\% for junior doctors and 7\% for consultants (p=0.09).

Incorrect prosthetic head size was identified in 2 patients. One sustained an intra-operative acetabular fracture associated with implantation of a 3-mm oversized prosthesis.

**DISCUSSION**

In this study, the technical error rate of Austin Moore hemiarthroplasty performed by junior doctors is high, but not significantly different to that of consultants, such findings being similar to other reports in the literature.\textsuperscript{6–8,11}
Inadequate residual neck remnant was the most common error identified. Both increased rates of residual thigh pain and early revision due to loosening have been associated with such neck remnants. Almost half of patients with inadequate residual neck remnant had an insufficient length available due to the fracture pattern, which was evident on preoperative radiographs. Failure to maintain sufficient neck length in these cases represents inappropriate prosthesis selection and preoperative planning rather than an intra-operative technical error. Given the inferior results of the uncemented Austin Moore implants with short neck remnants, the use of this prosthesis in low-neck fractures is questionable, and an alternative should be considered.

Intra-operative periprosthetic fractures sustained during the procedure were common (14%), the rates being similar for trainees and consultants. From a review of the operative notes and discussion with the surgeons involved, most fractures were sustained either during impaction of the prosthesis after broaching or during its reduction. Underbroaching and relative oversizing of the stem with intent to provide interference fit of the prosthesis in osteoporotic bone may result in fracture during prosthesis insertion. The high error rate of implantation without adequate seating implies that surgeons commonly experience difficulty due to the size and proximal geometry of the prosthesis. To assist with adequate prosthetic seating without excessive impaction, the routine use of a narrow stem Austin Moore prosthesis should be considered; however, proximal metaphyseal fill of >70% is required to reduce the risk of early postoperative subsidence and loosening. Both narrow and standard stem Austin Moore prostheses should be available to the surgeon to allow an intra-operative assessment of the most suitable stem to enable appropriate metaphyseal fill so as to provide stability without excessive risk of fracture or inadequate calcar seating.

A loose stem with inadequate rotational stability may predispose to intra-operative fracture during reduction of the prosthesis, particularly if the leg has been lengthened and the capsule preserved. If the rotational stability of the prosthesis after impaction remains questionable, reduction should not be attempted. Options available in this situation include an alternative prosthesis or cementing the Austin Moore prosthesis.

All surgeons regardless of level of experience reliably accomplished selection of correct prosthetic head size using sterile circular sizing rings.

**CONCLUSION**

Intra-operative error during implantation of the uncemented Austin Moore prosthesis is relatively common. The error rates between junior doctors and consultants were not significantly different. Austin Moore hemiarthroplasty is a technically demanding operation; the prosthesis is difficult to implant well. Greater selectivity should be exercised when considering this prosthesis for management of femoral neck fractures.

**REFERENCES**