AN IN VITRO COMPARATIVE STUDY OF THE PERFORMANCE OF DIFFERENT COMMERCIALLY AVAILABLE INTRAMEDULLARY FEMORAL PLUGS DURING TOTAL HIP REPLACEMENT

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INTRODUCTION

Insertion of femoral cement plugs in the intramedullary canal to prevent distal flow of polymethyl-methacrylate (PMMA) cement in total hip replacement during cementing of femoral prostheses is well accepted and has become current practice (Prendergast et al., 1999). As a result, many designs of cement plugs exist on the market. The aim of this study is design an experimental set-up to compare the performance of the following four designs of cement plugs: (a) REX (A1 Medical), (b) Hardinge (DePuy), (c) Amber Flex (Summit Medical Ltd) and (d) Cemlock (Sulzer). This was done by recording data of proximal and distal pressures and migration of the cement plugs during cement pressurisation and insertion of the femoral prosthesis in prepared Sawbone femurs.

MATERIALS AND METHODS

Sawbone femurs were reamed and cement plugs were inserted at the same position by the same orthopaedic surgeon for all the tests. Two holes were drilled through the femurs, at 4 cm and 14 cm below the medial proximal end of the prepared femur, to accommodate pressure transducers (Entran, 35 bar), which were used to measure cement pressure during cement pressurisation and insertion of femoral implant. A special jig was manufactured to hold the femur into position on a mechanical testing machine (Instron 8874) during the tests and to accommodate a linear potentiometric displacement transducer (LPDT) (Techni Measure), which was used to measure migration of the cement plugs during PALACOS cement pressurisation and insertion of femoral prosthesis. A mechanical testing machine was used to control the speed at which the prostheses were inserted into the prepared femurs. Data captured by the pressure transducers and LPDT were digitized, using an analogue/digital converter (Instrunet 100) and recorded electronically. The prepared sawbone femur was positioned into the jig and fixed to the testing machine. A mechanical testing machine was used to control the speed at which the prostheses were inserted into the prepared femurs. The same femoral component (Charnley roundneck) was used. Cement was pressurised into the intramedullary canal of the prepared sawbone femur, using the DePuy pressuriser. The femoral prosthesis was then introduced at a controlled speed of 10mm/s into the femur. An average number of 3 tests was carried out for each cement restrictor and data of distal pressures and cement restrictor displacement was recorded electronically. The room temperature was kept at 24°C. Following the tests, the reconstructed femurs were x-rayed and trans-sectioned at 1 cm above the cement plugs. These samples were then sectioned to investigate any cement escaped through the cement restrictors.

RESULTS AND DISCUSSION

Average values of distal pressure and migration of cement restrictors during controlled insertion of the femoral implant for each cement plug are illustrated in Figures 1 and 2. Figure 1 shows that Hardinge and REX cement restrictors produce higher distal pressures of 881 and 725 kPa, respectively. Lower migration values of less than 0.3 mm are associated with Amber Flex and REX cement restrictors. Remarkably low distal intramedullary pressure and high migration values were recorded for Cemlock because this cement restrictor usually breaks during insertion. This is confirmed by X-ray images showing significant amount of cement passing through Cemlock restrictor.

REFERENCES


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