Management of periprosthetic fractures of the femur

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Introduction

Periprosthetic fractures occur around the tip of the prosthesis in approximately 0.1% to 2.5% of all hip replacements [1]. Although this is only a very small percentage, it is still significant due to the large number of hip procedures undertaken each year and is certain to increase because of the ageing population. When the prosthesis is not loose, the condition is difficult to treat because of the presence of the implant’s stem which precludes the use of screws. A new device for managing periprosthetic fractures of the femur has been described previously [2], which it is believed will provide immediate stabilisation of the fracture site together with sufficient strength and support to allow early mobilisation and optimal conditions to encourage union. This paper will describe the development of the plate and compare its performance with other treatment options.

Other methods of managing these fractures have been critically examined and their overall performances evaluated in relation to the new plate. Generally the methods use either a standard AO-type of fracture plate secured with cables or ties, or a thinner plate construction with prongs which are crimped around the bone. However, clinical experience with both these approaches is not encouraging. With the former, disruption of the blood supply can lead to significant failure rates [3], but with the latter, inadequate stability on the femur and poor mechanical strength of the plate can lead to the crimped plate itself breaking and very poor union rates [4].

Methods

Testing has been conducted on composite femurs fractured at the tip of the hip stem. The fractures were then treated by the various cable and plate systems. The specimens were placed in a tensile tester loaded in compression at an angle of 90° to the vertical.

Results and Discussion

Laboratory tests of the plates on composite femurs have shown that the cable systems are able to withstand loads up to 4 kN without significant deflection. However, the Mennen plates showed characteristic failures as shown for example in Figure 1.

Figure 1: The Mennen plate
The new plate is novel because it is manufactured from titanium and designed to use a series of staggered prongs to apply *a positive clamping force* to the femur with additional proximal and distal fixation. The optimum geometry of the plate was determined by finite element analysis, the results of which were confirmed experimentally. For example, figure 1 compares the finite element and experimental results for an analysis of the prongs of the plate.

The new plate is now ready to be tested and it is hoped that its strength is comparable to that of the cable systems.

![Comparison of finite element analysis and experimental test of the plate’s prongs.](image)

**Figure 2:** Comparison of finite element analysis and experimental test of the plate’s prongs.

**References**


**Acknowledgements**

The financial support of the Department of Health through a MedLINK grant is gratefully acknowledged.

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