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EDITORIAL

Intraoperative femoral fractures

PREVENTION IS BETTER THAN CURE

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Intraoperative peri-prosthetic fracture (IPPF) is an often-overlooked category of patients who can end up with poor results and early loosening if fracture is not identified intraoperatively and managed correctly. Such results affect both femoral and acetabular fixation and are often under recognized and under reported. As one might expect, reported rates of IPPF are significantly higher in uncemented prostheses. Two studies suggest the rate in cemented arthroplasty is around 0.3% to 1.2%,[1-3] and several studies of uncemented implants suggest rates of 2.95% to 27.8% depending on a multitude of variables.[1-5]

Worldwide trends in arthroplasty show an increased tendency to favour uncemented fixation. In the United Kingdom this remains the case, with 65% of all hip replacements performed in 2016 either uncemented or hybrid fixation.[6] While the National Joint Registry (NJR) records revision for postoperative peri-prosthetic fracture (PPF), which currently stands at 9.6% of all revisions, IPPF is not specifically recorded. Furthermore, whilst PPF carries a high rate of mortality with reported rates of 6% to 13%, and a high revision rate,[7,8] mortality rates for IPPF remain unknown. With increasing numbers of arthroplasty performed year on year and a trend towards uncemented fixation,[6] it stands to reason that IPFF rates will rise. This yearly increase highlights the potential need for registries and future studies to specifically record IPPF and its associated morbidity and mortality.

A number of factors can be associated with IPFF including: patient factors such as increasing age, gender, osteoporosis, or developmental dysplasia; comorbidities such as rheumatoid arthritis;[9-12] implant design factors such as uncemented components and implant geometry;[12,13] surgeon-related factors such as minimally invasive surgery and familiarity with prosthesis;[14] and type of surgery such as revision procedures, conversion of internal fixation, longer and larger diameter stems, and more extensive reaming.[15-17] Given the high rate of osteoporosis in elderly female patients and association with IPPF with uncemented implants, there has been a significant drive towards cemented implants in this group.[18] Interestingly a recent paper by Zhao et al[19] performed multivariate analysis on a group of 24 IPPF patients and also noted an association with anterolateral approach and a low metaphyseal-diaphyseal index, i.e. a wide metaphysis and/or narrow isthmus.

Specifically looking at uncemented femoral implant design, 90% of IPPFs are in double wedge or 'fit and fill' stems, and the remaining 10% are in porous coated 'anatomic' stems.[20] These are type 2 and type 6 stems according to the system established by Khanuja et al.[21] This is probably not surprising, given the significant variability in patients' proximal femoral geometry, which can affect mechanical stress distribution.[22] Studies have shown that these stems show significant differences in their dynamic responses to load in all planes,[23,24] though no studies to date have looked at load to failure, nor during implantation.

A high index of suspicion and recognition intraoperatively with appropriate treatment is also important in relation to patient outcome. These intraoperative fractures are most often classified using the Vancouver system,[15] which is a subtle modification of their well-known postoperative PPF classification system. Their IPPF system also considers location, pattern and stability of fracture to guide management. The most important step, however, is identification of the fracture at the time of surgery, and appropriate steps taken to stabilize it. This may involve use of cable plates, cerclage cables, internal

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fixation or conversion to a longer/revision stem.[15] If fractures are not identified until the postoperative radiographs, the stability of the fracture should be established, and either protective weight-bearing or revision surgery undertaken.[25]

In terms of prevention, some studies have suggested that prophylactic cerclage cabling with either steel cable or braided suture can theoretically reduce the risk of IPPF by reducing strain and increasing hoop stress resistance.[26,27] There are no current studies showing clinical correlation, though a cadaveric study by Waligora et al[28] suggested that the rotation and energy to failure is higher when using one or more monofilament calcar wires. Interestingly, Greenhill et al[29] have shown that not only implant choice, but also broach design, could affect IPPF. They showed that curved broach handles, used for minimally invasive procedures, increase the moment to force ratio by 163% to 235% in an experimental model, theoretically increasing risk of IPPF. Undoubtedly the most important factor in treating IPPF is prevention. Appropriate preoperative planning and strategies to minimize fracture, such as implant choice,[30] templating and patient selection, are vital.

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