

Hip fractures: The state of the art in 2017

INCIDENCE OF HIP FRACTURE AND THE COST OF TREATMENT

Hip fracture continues to be the most common serious injury in the elderly population, with the United Kingdom National Hip Fracture Database reporting over 64 000 such injuries in the last calendar year.¹ The most recent annual registry report reflects and highlights the socioeconomic challenges faced by our, and all healthcare systems, globally. Patients are getting older, but also fitter. Carers of nonagenarians are often themselves in their 70s, and the state is left undertaking the lion's share of the carer's responsibility. These significant numbers of injured patients result in the use of 1.5 million bed days and a total care bill of over £1 billion. In the United Kingdom, this equates to a single injury requiring approximately 1% of the total NHS budget.¹

Studies estimating future trends have predicted significant increases in annual hip fracture incidence in the context of an ever-ageing population,²⁻⁴ with suggested figures as high as 100 000 hip fractures annually in the United Kingdom by 2033, and associated inflation-adjusted costs of up to £5.6 billion in total care.² This is set against a continuing programme of austerity and value in the majority of developed nations' healthcare systems. In parallel with rising numbers of cases, there is rising complexity. Baker et al³ found a trend of

increasingly complex medical comorbidities and social needs, and surmised that the hip fracture-related healthcare bill would rise disproportionately to incidence changes alone, resulting from the greater cost of treating these higher-demand patients.

The last decade has seen the implementation of several NICE quality standards, rigorous audit and best practice tariffs, with the aim of better patient and cost-effective treatment pathways. This investment in care has had the effect of improving outcomes and reducing length of stay while simultaneously cutting total healthcare delivery costs. In the case of hip fracture, it does appear that spending to save is an important principle. Therefore, upholding these standards, as well as prioritising research into clinical and cost-effective hip fracture surgery and care, is now more important than ever.

RECENT ADVANCES: ORTHOGERIATRICS

Recognition of the complex clinical and social needs of elderly trauma patients is central to providing orthogeriatric care. There are a number of models that have been implemented across the world, but they are for the most part comparable, consisting of a comprehensive medical review, bone health assessment and falls assessments to improve short- and medium-term outcomes for these patients.

In the United Kingdom, the introduction of 'best practice tariffs' included the provision of this comprehensive care model, and a payment uplift has been available since its introduction based on the provision of all 'key performance indicators' prior to discharge. The more structured and defined role for input of orthogeriatricians since the introduction of NICE quality indicators has led to the current model of care in the United Kingdom. This revolves around a dual orthopaedic:orthogeriatrician delivery of a 'hip fracture programme' for patients, facilitating the delivery of rapid assessment and optimisation for surgery, identification of rehabilitation goals and liaison with services such as mental health, falls prevention and social services.⁵

There are data to support this combined model of care, however, much is poor quality retrospective audit data with little in the way of comparison, or historical comparison, making it difficult to draw inferences due to the serial improvements in services over a longer period of time. An excellent systematic review and meta-analysis investigated the effects of orthogeriatric models on patient outcomes.⁶ The authors identified a range of different care models across the literature, with some using routine geriatric 'consultation' in an orthopaedic ward setting, and care on a geriatric ward under a geriatrician with orthopaedic input and the more complex 'shared care' models. This review

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is based on the reported outcomes of just 18 studies, of which only eight were RCTs. Nonetheless, these authors were able to make some broad conclusions:⁶

- the majority of studies demonstrate benefit *versus* standard care;
- it is unclear which model is best;
- geriatric consultation on an orthopaedic ward was the most common model, and resulted in reduced length of stay and reduction in point mortality.

These conclusions broadly mirrored the findings of an earlier review in 2010.⁷

However, since this most recent systematic review, the Trondheim Hip Fracture Trial⁸ has been reported in *The Lancet* – unusual for an orthopaedic paper, and it is even more unusual for one to reach such heights. Their study represents the best evidence to date for orthopaedic: orthogeriatric combined care. They undertook a prospective randomised single-centre cohort of 397 patients, randomising them either to comprehensive geriatric care or traditional orthopaedic ‘standard’ care. The paper found beneficial effects in terms of both mobility and function on the comprehensive geriatric care pathway, which was sustained to four months.⁸

PROBABLE BENEFIT: TOTAL HIP ARTHROPLASTY FOR TRAUMA

In parallel with the improved medical care models, treatment of the intracapsular neck of femur fracture has been the focus of some significant studies and a recent change in practice; the concept, of course, is that not all patients are the same. NICE recognises and recommends that current standard practice should be to offer replacement arthroplasty for patients with displaced intracapsular neck of femur fractures. A further NICE recommendation has been to offer total hip arthroplasty (THA) to patients within this cohort who are outdoor mobilisers with no more than one stick, have no cognitive impairment and are fit for surgery. This guidance does not, however, make much in the way of distinction for age and frailty – simply a distinction for functional outcomes.

There are a huge number of cohort studies on the topic, variably identifying the advantages of longevity and the potential for better functional results in a total hip arthroplasty, offset against the disadvantages of dislocation rates and increased surgical complexity. Perhaps surprisingly, given the strength of NICE’s recommendations, there are few randomised controlled trials, and those which do exist are not as resoundingly in favour of total hip arthroplasty in active patients as one might expect.

A recent systematic review⁹ identified some RCTs looking at THA *versus* modular hemiarthroplasty. The outcomes of these studies were somewhat mixed, with four studies showing improved quality of life or function scores with THA, and three showing no functional difference.¹

A further RCT which has been published since this systematic review reports the 12-year outcomes of a single-centre trial.¹⁰ The initial study cohort included 252 patients undergoing cemented hemiarthroplasty *versus* THA, and did not report any significant difference between modified Harris Hip Score, mortality, complications or revision rates.¹⁰ It is, of course, important to set these results against the obvious attrition bias which occurs in long-term follow-up of patients undergoing hip fracture surgery. At the time of reporting, this study will have been dramatically underpowered.

The generally held fear of acetabular erosion happening in patients treated with a cemented hemiarthroplasty may not stand up to scrutiny in the way that one might think, having read the national guidance. Evidence from Baker et al¹¹ suggests that a fifth of active patients over 60 years of age undergoing hemiarthroplasty result in revision, though acetabular erosion was found in two thirds. This finding is not mirrored in other large series, with the Australian Joint Registry suggesting that the ten-year cumulative rate of revision for bipolar prostheses in neck of femur fractures under 70 years old is 10%. Furthermore, this rate of revision is comparable with that for conventional THAs in the same demographic (12%).¹²

So, if revision is not as much of a problem as one might have been led to believe, is there any evidence to support higher patient satisfaction/function in the active elderly treated with a THA? The evidence is unclear, with some studies showing a mixture of benefits and others no benefits. NICE have therefore suggested that this should be a research priority.

UNSOLVED PROBLEMS

Despite the significant progress that has been made over the past few years in the care for hip fractures, there are still a number of unsolved problems:

Periprosthetic fractures

As the population ages, new fracture patterns are being seen, with periprosthetic fractures now becoming more commonplace, both following arthroplasty, as well as previous hip fixations. There are few implants that address the complex problem of a periprosthetic fracture, which often requires expert surgery and the use of multiple implants (Fig. 1).

Loss of femoral offset

Although there is a widely established concept of ‘high functioning’ intracapsular fracture patients, this is not a concept that has really reached the general orthopaedic consciousness with regard to extracapsular patients. However, loss of femoral offset and proximal femoral deformity are significant problems. Addressing this is tricky as many of the implants used in extracapsular fractures have dynamisation built in. This reduces the incidence of nonunion but dramatically affects femoral offset. Correction of these malunions can be difficult, with complex techniques often required (Fig. 2).

Loss of function

Although linked in many people’s minds to the associated frailty and comorbidity of patients sustaining a hip fracture, there is still the unfortunate outcome that hip fractures are associated with loss of independence. In general terms, even with modern implants and expert surgery, for the average patient a hip fracture is

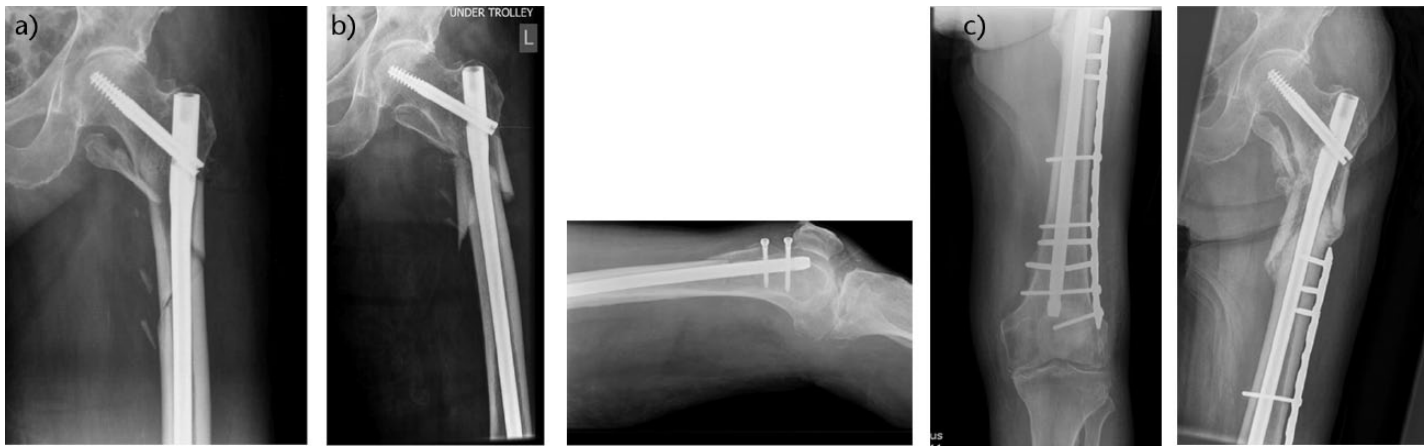


Fig. 1 Radiographs showing a) post-operative extended subtrochanteric fracture with acceptable reduction; b) second fall and periprosthetic fracture and c) composite revision to nail:plate construct with the nail interlocked through the plate. Despite subsequent falls, the patient heals his fracture prior to metalwork failure. Seen here united at 6 months.

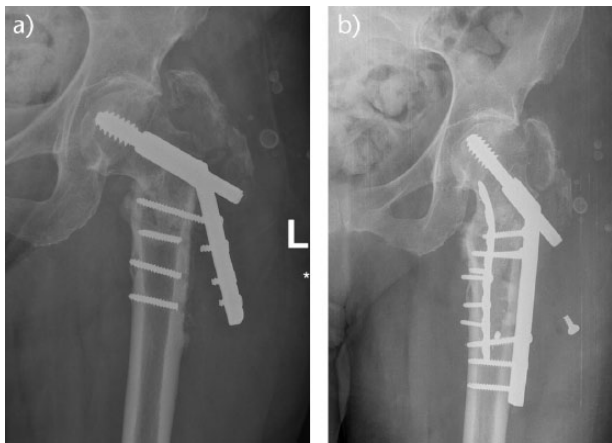


Fig. 2 Radiographs showing loss of femoral offset: a) failed dynamic hip screw with loss of the medial buttress and over dynamisation and b) Endosteal plating as described originally by Geoff Mast. The calcar is restored and the fracture heals.

associated with loss of one grade of independence (i.e. those living without care will require some help, those in residential care will require nursing care), and the temporary or even permanent need for additional walking aids.

Cut-out of femoral fixation

The majority of fixations still utilise a standard single-screw construct. This is not particularly rotationally stable and, when malpositioned in osteopaenic bone, can result in cut-out. There are a variety of technologies that are being developed to address this potential problem (Fig. 3).

NEW SOLUTIONS TO OLD PROBLEMS

While the majority of orthopaedic surgeons are somewhat sceptical of new technologies in hip fracture, many arguing that the venerable dynamic hip screw and Gamma nail offer a

reliable result and have a proven track record for addressing these fractures, there is still a subset of patients who have a poor result, and one could argue that for many patients the loss of independence and mobility status can be a poor outcome.

Femoral head cut-out

Two new and different technological approaches are expected to improve outcomes with regard to cut-out of the implant in the femoral head. Several manufacturers have developed

nails, plates and screws that can be augmented with injectable cements to reinforce fixation locally and reduce cut-out in osteopaenic bone. An alternate approach is to modify the fixation segment itself, as in the X-Bolt.

The dynamic hip screw, first introduced by Clawson in 1964, has become the implant of choice for the treatment of intertrochanteric neck of femur fractures in the United Kingdom. However, there remains a persistent risk of implant failure, specifically screw cut-out. This usually occurs when the femoral neck collapses into varus, resulting in the hip screw migrating superiorly and posteriorly out of the femoral head due to poor quality osteopaenic bone. This failure has been reported to occur in around 1.9% of fixations.¹³

The cement augmentation constructs are, as yet, without clinical data, although cadaveric work has been suggestive of a positive benefit.

The X-Bolt is essentially a modified dynamic hip screw construct with a lateral femoral plate and a single screw entering the femoral head. The screw itself contains expanding flanges that deploy and compress surrounding cancellous bone, theoretically improving fixation.¹⁴ There is, however, limited data on the use of the X-Bolt. Biomechanical testing of 'pushout' force in synthetic bone substitute compared a traditional dynamic hip screw (DHS) with the X-Bolt, disappointingly demonstrated (admittedly in synthetic bone) a cut-out force almost identical to that of a standard DHS to advance the construct 4 mm in the bone.¹⁵

A randomised pilot trial has been conducted comparing the DHS with the X-Bolt with outcomes reported to one year post operation.¹⁶ Of the initial study of 100 patients, 88 remained available for analysis at final follow-up. The EQ-5D, Oxford Hip Score, and mortality were identical between the two groups.¹⁶ More encouragingly, there were no implant failures in the X-Bolt group and three in the DHS group. This pilot suggested that 964 patients would be needed to provide a trial with 90% power.¹⁶ This trial is currently ongoing.

Fixed compression: a new concept

For those intertrochanteric hip fractures not amenable to DHS fixation, antegrade cephalomedullary nailing is commonly used. The agreed indications for each vary somewhat throughout the world, with a propensity for cephalomedullary nails in North America, and a preference for the DHS in Europe. Cephalomedullary nails act as an intramedullary buttress, preventing shaft medialisation where DHS

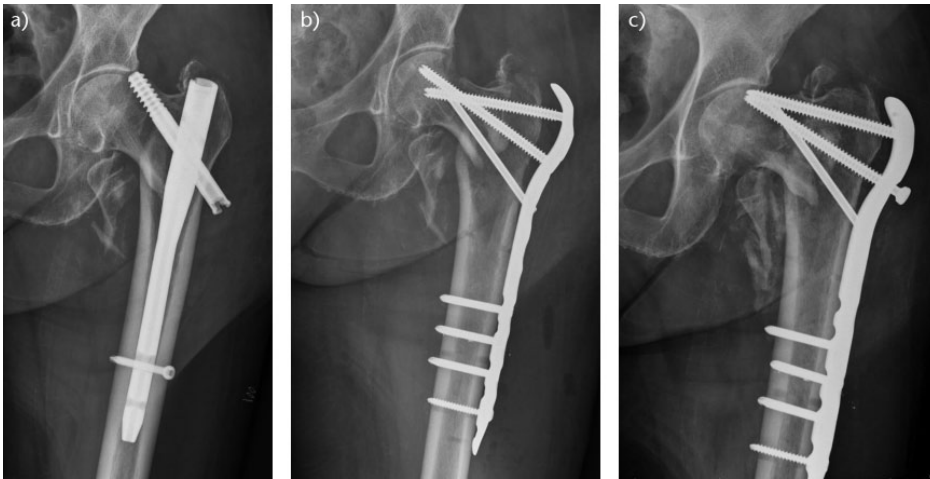


Fig. 3 Radiographs showing Cut out of femoral fixation: a) classic posterosuperior screw cut-out; b) revision fixation with fixed angle device. No compression of the fracture site is possible with proximal femoral plate systems and c) Secondary failure of fixed angle proximal femoral plate system.



Fig. 4 Images showing Smith & Nephew components; a) INTERTAN \diamond Integrated Screws; b) INTERTAN \diamond Nail with Integrated Screws; c) INTERTAN \diamond Nail Proximal Profile and d) INTERTAN \diamond Integrated Screw Compression Mechanism (images reproduced with permission from Smith & Nephew).

fixation would be unsuitable. The biomechanics of cephalomedullary nails are also advantageous, with a shorter lever arm reducing the moment arm and therefore also the bending strain which the implant and bone are subjected to, thereby increasing the strength of fixation.

Common complications associated with femoral nailing include varus collapse of the head and shortening of the femoral neck.¹⁷ Cephalomedullary nails do not overcome the problems of rotational instability of the sliding screw construct, nor the difficulties with loss of femoral neck offset.

The first of the new generation (fourth generation) of femoral nails (InterTan; Smith & Nephew Inc., Memphis, Tennessee) has been available for use for a number of years. There is increasing evidence that it may offer clinical benefits over the third-generation nails. The implant is designed to provide rotational stability with a triangular proximal cross-section and two interlocking screws allowing for greater torsional

stability. The composite head:compression screw allows the head/neck fragment to be compressed into the shaft, and that compression to then be fixed (Fig. 4).

A cadaveric biomechanical study comparing the InterTan with the Gamma3 nail in ten cadavers showed a higher failure load and higher number of cycles to failure, which was associated with increased resistance to rotation and varus collapse. The authors credited the interlocking screw and trapezoidal design for this superior performance.¹⁸ A similar biomechanical analysis of 24 Pauwels type III femoral neck fractures in cadavers compared the InterTan with cannulated screws and a DHS.¹⁹ During cyclical loading, the InterTan survived significantly longer, endured higher loads, and presented a lower inferior head displacement than either of the other implants.¹⁹

These basic science results do seem to be reflected in the early clinical data that are available. A study of 100 patients, treated with an

intramedullary nail with integrated cephalo-cervical screws and linear compression, at a minimum of one year post operation (although just 48 were available for follow-up), showed no instances of loss of reduction, uncontrolled collapse of the neck, nonunion, femoral shaft fractures, or implant failures.¹⁷ The first randomised clinical trial of the InterTan was published in 2013.²⁰ In this well conducted study, 684 patients with either an intertrochanteric or subtrochanteric hip fracture were randomised to either InterTan or DHS (with or without a trochanteric side plate). There were no differences found at 12 months in the pain scores, EQ-5D, or Timed Up and Go test (TUG). There were significantly more intra-operative complications in the InterTan group (18.9% vs 6.7%), but no differences in the number of intra-operative complications that required a re-operation. Screw cut-out occurred in 1.8% of InterTans versus 2.6% of DHS, periprosthetic fractures occurred in 1.5% versus 0.3%; and mechanical failure/nonunion in 0.9% versus 2.9%, respectively, all of which were not significant. The authors concluded that fracture reduction and implant position are probably more important than implant choice.²⁰

A more recent study looked to compare the InterTAN with the DHS in a five-centre randomised controlled trial of 249 patients treated across Canada.²¹ The outcomes were reported at 12 months and the most striking difference was in the high-performing group (able to walk 150 m prior to the injury). The authors reported functional outcomes in terms of the Functional Independence Measure (FIM) and the TUG test. There were significant differences in femoral shortening, with patients in the sliding hip screw group suffering 2 cm of excess shortening over the InterTAN group. With regard to functional outcomes, those patients with a high level of function did better, with the InterTAN group outperforming those with a sliding hip screw in both functional outcome scores.²¹

Although this evidence is not yet conclusive, the option to achieve fixed compression does raise the tantalising possibility of greater stability, and excellent results can be achieved with even the most complex of fractures in young patients (Fig. 5).

CONCLUSION

Although major strides have been made in the integrated care of hip fractures, there is still much room for improvement. It is encouraging to see some newer implant designs, some

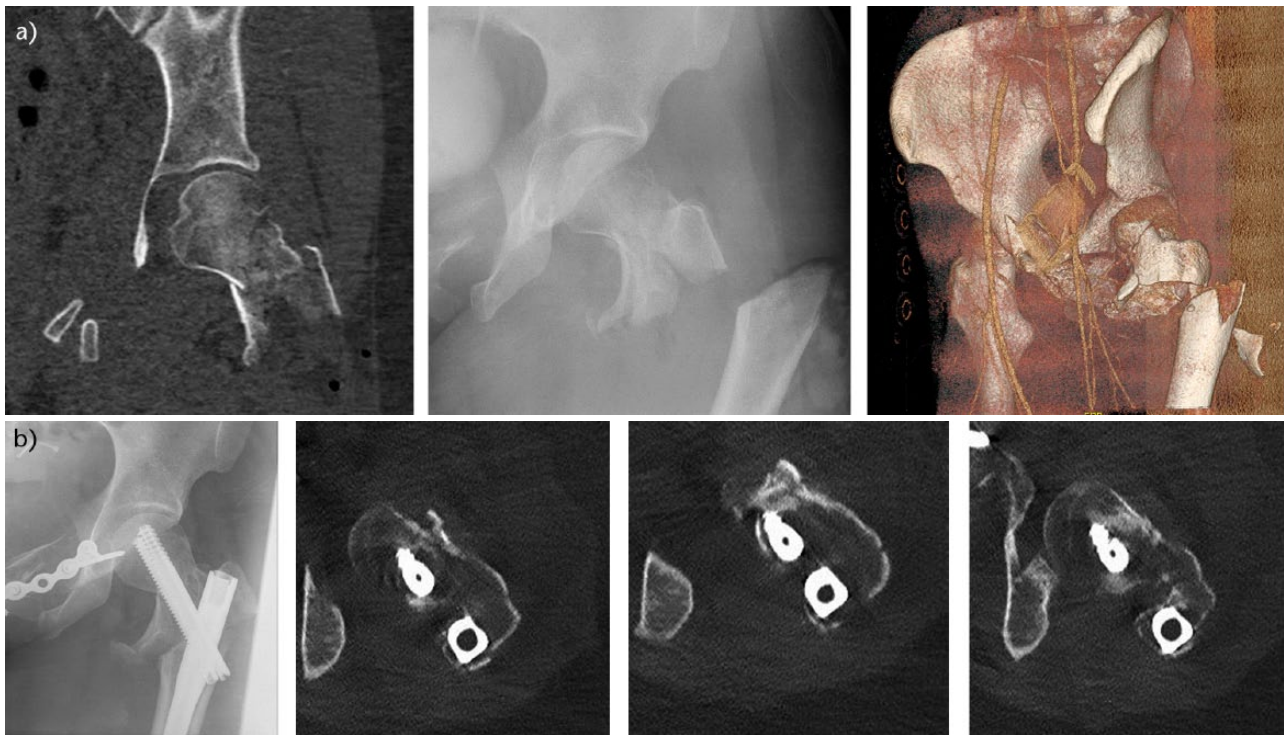


Fig. 5 Images showing fixed compression in a young patient; a) segmental open high energy femoral fracture with wedge component in the neck and b) 12-week radiographs and CT slices demonstrating anatomical reduction of the neck and maintenance of reduction with the fixed compression.

with evidence to support their use. The priority remains improving functional outcomes and reducing complications. If, as a profession, we are to rise to the challenge of the ageing population, more is going to be needed for less.

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