REVIEW

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Total Hip Arthroplasty in fracture neck of femur: A review of the literature

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Fracture Neck of Femur (FnF) is a major cause of loss of independence, morbidity and mortality in a vulnerable group of elderly patients; as well as a substantial economic burden on healthcare systems across the world. An increasingly ageing population has resulted in a rise in incidence and prevalence of FnF. Over 76,000 patients were admitted with FnF in the United Kingdom in 2018, with the resulting health and social costs estimated to be in excess of £2 billion. It is therefore important that the outcomes of all management options be evaluated to ensure constant improvement as well as allocation of resources as appropriate. It is widely agreed that patients presenting with displaced intracapsular FnF injuries are managed operatively; with options including internal fixation, hemiarthroplasty or Total Hip Arthroplasty (THA). The volume of THA performed for FnF has significantly increased in recent years. However, compliance with national guidelines on FnF patient selection for THA has been shown to be inconsistent. The aim of this study was to review current literature with regards to the use of THA in management of FnF patients.

The literature describes managing FnF in ambulant and independent patients by THA with dual-mobility acetabular cup and cemented femoral component via the anterolateral approach. There is scope for further research in assessing the outcomes of different prosthetic femoral head sizes and choice of bearing surfaces (tribiology) used for THA as well as cementation of the acetabular cup component specifically in FnF patients.

Keywords : Total Hip Arthroplasty, Fracture Neck of Femur, Hemiarthroplasty and Dual Mobility Prosthesis.

INTRODUCTION

Due to the increasingly ageing population; hip fractures are currently, and will continue to be, a major public health issue. Hip fractures are a known cause of death and disability internationally[1,2]. The National Hip Fracture Database (NHFD) displayed that there were 76,000 patients admitted with Fracture Neck of Femur (FnF) in the United Kingdom (UK) in 2018[3], with the resulting health and social costs estimated to be in excess of £2 billion[4]. Subsequently, it is essential that every aspect of the management of patients with FnF is scrutinised and optimised; this being surgical, medical and social care.

It is widely agreed that the majority of FnF patients are managed operatively[5]. Operative management options include internal fixation (closed or open reduction), hemiarthroplasty and total hip arthroplasty (THA)[6]. This is dependent on the anatomy and configuration of the fracture as well as patient factors including age, co-morbidities and ambulation[7].

In the UK the National Institute for Clinical Excellence (NICE) produce guidelines for the clinical approach and management of FnF[8]. NICE advise THA for patients presenting with displaced intracapsular FnF and are able to walk independently outdoors with no more than use of a stick, are not cognitively impaired and are medically fit for anaesthesia and the surgical procedure[8]. However, the NHFD shows less than one-third of eligible patients undergo THA for FnF in the UK[3], with the proportion ranging between 1% to 60% between individual hospitals[9].

A PubMed and EMBASE search using relevant key words was undertaken to identify all randomised controlled trials and large observational studies utilising national registers based on hip fracture management. International register networks were also utilised to identify registers in the English language of patients with hip fractures. A systematic screening process was carried out to ensure any studies with suspected author or regional bias to management were omitted appropriately.

This review explores current literature with regards to the use of THA in the management of FnF, with a specific focus on comparison to alternative treatment

options, prostheses design, cementation of acetabular cup and femoral stem components, grade of surgeon, surgical approach and health economics.

TOTAL HIP ARTHROPLASTY OR HEMIARTHROPLASTY?

Multiple studies have shown improved functional patient-based outcomes in ambulant elderly patients presenting with FnF managed with THA as opposed to hemiarthroplasty[10-13].

Chammout et al.[14] conducted a randomized controlled trial (RCT) in patients aged over 80 years presenting with a FnF undergoing either hemiarthroplasty or primary THA. The study found no significant difference between the two groups in terms of post-operative patient reported outcomes and complication rates at two years post procedure. It was seen that operative time and bleeding volume was higher in the THA group. The authors concluded that hemiarthroplasty is a suitable procedure in the short term for patients in this group.

A systematic review comparing outcomes in active patients sustaining a displaced FnF aged over 75 concluded that THA may be a preferred management option in this patient group when compared to hemiarthroplasty; with improved hip function and quality of life displayed in the THA group[15]. The authors, however, emphasise strict management in the first 6 months to reduce the associated increased dislocation risk in the THA group.

Park et al.[16] compared minimally invasive THA with conventional hemiarthroplasty in elderly patients presenting with FnF, concluding that hip function is better in the patients undergoing THA, without an increased risk of complications and associated morbidities. It was also seen that time to assisted ambulation was earlier in the THA group, an important post-operative aim in this patient group as per the NHFD in the UK[3].

A further RCT, by Blomfeldt et al[17], comparing bipolar hemiarthroplasty and THA in 120 relatively active, independent and lucid patients (mean age = 81 years) concluded that THA provides better hip function (assessed via the Harris Hip Score), without an increased risk of complications. Patients were formally reviewed in both groups at 4 months and 12 months post-operatively.

Baker et al.[18] also demonstrated improved post-operative function with a lower rate of complications in mobile, independent patients undergoing THA as treatment for FnF, in comparison to patients undergoing hemiarthroplasty. This RCT revealed a noticeable discrepancy in walking distance at three years after surgery - 3.6km (THA group) vs 1.9km (hemiarthroplasty group).

Bhandari et al.[19] conducted the Hip fracture Evaluation with Alternatives of Total Hip arthroplasty versus Hemiarthroplasty (HEALTH) trial; a multi-centre RCT whereby 1465 patients were randomly assigned to undergo THA or hemiarthroplasty and were followed-up at two years. The study also displayed a modest improvement in functional outcome in those undergoing THA, with no significant difference in complication rate or secondary procedure rate between the two groups.

In contrast, a retrospective cohort study by Tol et al.[20] comparing FnF patients (mean age 81 years) undergoing THA or hemiarthroplasty displayed no significant difference in hip function (modified Harris Hip Score), complication rate and rate of revision between the two groups. However, the authors acknowledge there was a significant proportion of patients lost to follow-up.

Complications of any magnitude are likely to have a significant effect on this specific patient group. Results with regards to complications following THA in patients with FnF varies in the literature. Stucinskas et al.[21] assessed the complication rates of FnF patients undergoing bipolar hemiarthroplasty or THA recorded in the Lithuanian Arthroplasty Register; displaying that revision rate at one year for patients undergoing THA was more than double that for patients undergoing bipolar hemiarthroplasty (5.1% vs 2.4%; $p = 0.0054$), most noticeably as a result of dislocation.

Viswanath et al.[22] conducted a retrospective review comparing FnF patients undergoing hemiarthroplasty or THA. This study showed that readmission due to dislocation, pain, and trochanteric bursitis were significantly higher in the THA group, although there was no significant difference in readmission or infection rates between the groups.

Hansson et al.[23] analysed the difference in complication rates between patients undergoing hemiarthroplasty and THA for FnF recorded in the Swedish Hip Arthroplasty Register. It was seen that, after propensity score matching, there were fewer medical complications and a lower 1-year mortality rate in the THA group, however there was a higher rate of specific hip complications, noticeably dislocation and infection, both of which may have a significant effect on long-term morbidity in this patient group.

Dislocation rates have been reported to be higher amongst patients undergoing THA for FnF, than patients undergoing hemiarthroplasty[11,23,24]. A systematic review by Lewis et al.[25] concluded that the increased risk of dislocation is present for the first four years, with no significant difference in risk thereafter. Studies have also shown that a targeted protocol in patient selection, surgical technique and prosthesis used can lead to a reduction in the dislocation rate in FnF patients undergoing THA[26].

Although dislocation risk is higher in patients undergoing THA for FnF, acetabular erosion is a concern with independent, active patients undergoing hemiarthroplasty. Wang et al.[27] and Avery et al.[28] both describe increased erosion in patients undergoing hemiarthroplasty due to direct articulation with cartilage.

Both operation length of time and bleeding volume have been shown to be higher in patients undergoing THA compared to hemiarthroplasty after sustaining a FnF[17]. An important factor to note in this often elderly and frail population group.

TOTAL HIP ARTHROPLASTY OR INTERNAL FIXATION?

Closed or open reduction and internal fixation may be indicated in a younger, fitter patient sustaining FnF[29], due to the presence of good bone quality and preference for preservation of the joint. However, one in three patients having undergone internal fixation for displaced Fnf aged 18-50 undergo re-operation, with one in seven overall undergoing revision to THA, as described in a population base study by Stockton et al.[30].

There is a difference of opinion in the operative management of young, active patients[31]. Wani et al.[31]. concluded patients in this specific age group sustaining a FnF managed by THA had improved hip function (Harris Hip Score) and significantly lower re-operation rates compared to those managed by internal fixation.

Johansson et al.[32] and Chammout et al.[33] both demonstrated significantly lower complication and re-operation rates in patients undergoing THA, with improved hip function (Harris Hip Score), when compared to internal fixation.

Liehu et al.[34] conducted an RCT which compared closed reduction and internal fixation with THA in patients with displaced FnF and found there to be improved post-operative recovery of hip joint function in patients undergoing THA, as well as lower complication and re-operation rates.

Furthermore, an RCT undertaken by Leonardsson et al.[35] comparing outcome at ten years between patients undergoing fixation or arthroplasty (total hip arthroplasty or hemiarthroplasty) for displaced fracture neck of femur in patients aged 70 and above displayed a significant increase in failure rate of subjects undergoing fixation in comparison to arthroplasty (45.6% vs 8.8% respectively). In addition, the authors displayed no significant difference in functional related outcomes at 5 and 10 years post-operatively, excluding individuals who had a failure of metalware or prosthesis.

A combination of improved hip functional outcomes, reduced intra and post-operative complications as well as reduced hospital stay have all lead to the increased use of THA in patients with intracapsular FnF as opposed to internal fixation.

DUAL-MOBILITY PROSTHESES

The use of dual-mobility acetabular cups has increased in popularity in revision hip arthroplasty as well as primary THA of FnF and osteoarthritis patients with risks and concerns of instability[36]. A randomised controlled trial by Rashed et al.[37] compared the outcomes of patients sustaining Garden III or IV FnF undergoing THA with cemented dual-mobility acetabular cups or conventional cemented acetabular cups. The study displayed better functional and patient reported outcomes and range of motion in the dual-mobility acetabular cup group, concluding that this be a useful solution in managing displaced FnF in active elderly patients.

A systematic review by You et al.[38] concluded that use of dual-mobility acetabular cups in THA for FnF patients is associated with lower rates of dislocation than in conventional THA prostheses and hemiarthroplasty, with no increase in other complications associated with the procedures.

Mufarrih et al.[39] also conducted a systematic review comparing the complication and mortality rates in FnF patients receiving THA with dual-mobility acetabular cups and those receiving conventional THA - concluding that both dislocation rates and 1 year mortality rates were lower in patients undergoing THA with dual-mobility acetabular cups.

Jobory et al.[36] carried out a retrospective cohort study assessing the outcomes of the use of dual-mobility acetabular cups in FnF patients. It was shown that dual-mobility cups had a lower risk of requiring revision in this patient group, even when surgical

approach was adjusted for. In addition, there was no difference with regards to revision rate for deep infections.

A further retrospective cohort study[40] also displayed no statistically significant difference in dislocation rate or other complication rate in patients receiving dual-mobility acetabular cups in primary THA, concluding there was equal effectiveness in use of dual-mobility cups in FnF patients and osteoarthritis patients.

Further retrospective cohort studies have also displayed lower dislocation rates and improved hip function (using Harris Hip Scores and Oxford Hip Scores) on use of dual-mobility acetabular cups in comparison to conventional acetabular cups[41,42].

FEMORAL HEAD SIZE

At present, the most commonly used femoral head size in primary THA is 32mm, as per multiple national registries, with 36mm universally regarded as second[43-46]. The risk of dislocation in primary THA and subsequent requirement for revision is lower when a 32mm femoral head is used in comparison to 28mm[47], with this risk being further reduced in use of 36mm femoral heads is used compared to both the aforementioned.

Literature with regards to the functional outcomes and associated complications of different sizes of femoral head used in THA management of FnF is somewhat limited. Cebatorius et al.[48] concluded that there was no increased risk of dislocation in FnF managed by THA when either 28mm or 32mm femoral head sizes were used, and it is in fact the surgical approach that had the most significant relationship with risk of dislocation when assessing patient outcomes from the Lithuanian Arthroplasty Register.

CEMENTATION

In hemiarthroplasty surgery of displaced FnF, use of cemented femoral components has been favourable due to improved mobility and hip function, lower rates of periprosthetic fractures and revision, and less thigh pain, without increasing postoperative complications[49-51]. Caution has always been associated with this patient group with regards to cementation of femoral component due to concerns of cement implantation syndrome[52], associated with hypoxia and hypotension secondary to fat embolism. Despite this, an RCT by Chammout et al.[53] displayed that there is a lower rate of complications amongst those treated by THA with cemented stems as opposed to uncemented stems. Complications included increased rate of dislocation and peri-prosthetic fractures. There were also no cardiovascular events indicating cement implantation syndrome for any patients receiving cemented stems.

Sköldenberg et al.[54] displayed use of uncemented hydroxyapetite-coated femoral components in THA management of FnF patients can lead to good hip function in addition to acceptable position of femoral component at two years follow-up. A further randomised trial[55] comparing such components to modular cemented implants showed no significant difference in hip function at 12 months follow-up, with no significant difference in specific hip complications and re-operation rates. Taylor et al.[56] conducted an RCT that highlighted the risk of a press-fit stem in osteoporotic bone, displaying an increased rate of peri-prosthetic fracture.

Literature is limited with regards to the outcomes of cemented or cementless acetabular cups specific to those undergoing THA for FnF. In patients undergoing THA for osteoarthritis, improved hip function is seen in those with cementless acetabular cups[57,58], however the risk of requirement for revision is also higher[59], particularly in a more elderly population, as would be the case for FnF patients.

SURGICAL APPROACH

The conventional approaches for THA include posterior approach, anterolateral approach and minimally invasive two incision approach[60]. The American Academy of Orthopaedic Surgeons (AAOS)[60] recommend an anterolateral approach based on 'medium-level' evidence on the reduced rate of hip dislocation.

A comparative study by Wang et al.[61] assessed the anterolateral, modified Hardinge and the minimally invasive approach against the conventional posterior approach in THA for management of FnF in elderly patients. It was shown that there was a reduced operative time, length of inpatient hospital bed stay and rehabilitation time in the minimally invasive anterolateral approach group. In addition, the dislocation rate at a mean 13 months follow-up was lower in the minimally invasive anterolateral approach group. It was proposed by the authors that the improved outcomes were a result of intact abductor function as well as intact posterior capsule and tendon elements[62].

A study by Cebatorius et al.[48] also concluded reduced dislocation rates for THA in FnF in use of the anterolateral approach compared to the posterior

approach. The study's assessment of data from the Lithuanian Arthroplasty Register showed THA in FnF by posterior approach had 2.3-times [95% confidence interval (CI): 1.0-5.0, p = 0.04] greater risk of revision for dislocation compared to the anterolateral approach.

More recently, Cichos et al.[63] conducted a population based comparative study of patients with displaced FnF undergoing THA by either direct anterior approach or posterior approach. Ninety day and 1-year outcomes displayed that patients undergoing posterior approach for arthroplasty were more likely to be non-ambulant at the time of discharge in comparison to those undergoing direct anterior approach (27.3% vs. 11.4%). In addition, there was no significant difference in outcomes including dislocation, periprosthetic joint infection, periprosthetic fracture, mechanical complications and revision surgery at 90-days and 1-year. There was a higher mortality rate in the posterior approach group (11%) in comparison to the direct anterior approach group (0%). This may possibly be attributed to the improved ambulation in the direct anterior approach group leading to a decreased likelihood of complications associated with reduced mobility, however further analysis would need to be undertaken to confirm this.

One must note the risk of iatrogenic injury to the lateral cutaneous nerve of the thigh when adopting the direct anterior approach for THA[64]. Homma et al.[64] prospectively investigated 122 patients undergoing arthroplasty by direct anterior approach, of which 39 sustained an iatrogenic injury to the lateral femoral cutaneous nerve of the thigh. The authors displayed that there was no difference in hip specific functional outcome scoring (Harris Hip Score and Japanese Orthopaedic Association Score) between those sustaining the injury and those who did not. However, there was a difference in quality of life between those that did and did not sustain the injury - highlighted by the Forgotten Joint Score.

Further retrospective cohort studies have displayed that use of anterolateral approach for THA results in a lower dislocation rate than the posterior approach, with or without posterior repair[65,66].This remains to be true when confounding factors are adjusted for - including age, American Society of Anaesthesiologists (ASA) grade, gender, cognitive function and experience level of surgeon[65,66].

OPERATING SURGEON

The increasing age of the population has resulted in the requirement for more THA procedures - whether this be for FnF, osteoarthritis or any other reason[67]. Systematic review by Singh et al.[68] concluded that there was no significant difference in complication rates (dislocation and deep infection) between elective THA procedures carried out by senior orthopaedic surgeon or supervised orthopaedic trainees; however the operative time was seen to be longer and functional outcome (Harris Hip Score) slightly lower in procedures carried out by trainees.

Further studies have also shown there to be no significant difference in complication rates, functional outcomes and length of stay in hospital in THA carried out by supervised trainee in comparison to senior/ consultant surgeon[69,70].

Further literature also describes no significant difference in outcomes clinically and radiologically in THA performed by supervised trainees[71], further supporting the notion that a safe and effective service can be provided by trainees as demand is sure to increase over the coming years.

HEALTH ECONOMICS

Economics of management must always be considered. Prosthesis costing of THA is greater than that of hemiarthroplasty in the management of FnF[72]. However, overall cost is mostly levied against the rehabilitation process, and thus a method of addressing this may be early mobilisation and aim for early discharge from hospital in those with a strong social support network and home exercises[73,74].

With THA being more costly in FnF than osteoarthritis patients[72], and the overall costs of FnF increasing for the healthcare system[4], the onus is on the correct patients being selected to undergo THA. In addition, when considering which patients to undergo hemiarthroplasty or ORIF, it is important to note that the overall cost of conversion procedures are more costly than THA primarily[75], thus further emphasising the importance of appropriate patient selection and the initial management decision as individually tailored to each case as appropriate.

Socioeconomic status has been shown to have a systematic effect on the likelihood of whether a patient undergoes THA or hemiarthroplasty - with limited use in those from deprived areas as well as inappropriately higher use in patients from more affluent areas in the UK[9].

CONCLUSION

Fracture neck of femur is a significant injury in the elderly population, often leading to a reduction of

independence, mobility and reserve as well as resulting in an increased risk of morbidity and mortality. Overall compliance with guidance on FnF patient selection for THA has been shown to be inconsistent.

Little has been published in the current literature assessing the outcomes of different prosthetic femoral head sizes and choice of bearing surfaces (tribiology) used for THA as well as cementation of the acetabular cup component specifically in FnF patients. Further research in these particular areas will result in a greater understanding of THA in the context of FnF patients.

The current literature supports managing FnF in ambulant and independent patients by THA with dual-mobility acetabular cup and a cemented femoral stem component by the anterolateral approach.

Rates of THA in the treatment of FnF has increased significantly over the past decade, suggesting surgeons are responding to the clinical evidence supporting such treatment.

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