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EDITORS FOR THIS ISSUE

Hip hemi-arthroplasty for neck of femur fracture: What is the current evidence?

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Abstract

This editorial reviews and summarises the current evidence (meta-analyses and Cochrane reviews) relating to the use of hip hemi-arthroplasty for neck of femur fractures. Regarding the optimal surgical approach, two recent meta-analyses have found that posterior approaches are associated with: higher rates of dislocation compared to lateral and anterior approaches; and higher rates of re-operation compared to lateral approaches. Posterior approaches should therefore be avoided when performing hip hemi-arthroplasty procedures. Assessing the optimal prosthesis head component, three recent meta-analyses and one Cochrane review have found that while unipolar hemi-arthroplasty can be associated with increased rates of acetabular erosion at short-term follow-up (up to 1 year), there is no significant difference between the unipolar hemi-arthroplasty and bipolar hemi-arthroplasty for surgical outcome, complication profile, functional outcome and acetabular erosion rates at longer-term follow-up (2 to 4 years). With bipolar hemi-arthroplasty being the more expensive prosthesis, unipolar hemi-arthroplasty is the recommended option. With regards to the optimal femoral stem insertion technique, three recent meta-analyses and one Cochrane Review have found that, while cemented hip hemi-arthroplasties are associated with a longer operative time compared to uncemented Hip Hemi-arthroplasties, cemented prostheses have lower rates of implant-related complications (particularly peri-prosthetic femoral fracture) and improved post-operative outcome regarding residual thigh pain and mobility. With no significant difference found between the two techniques for medical complications and mortality, cemented hip hemi-arthroplasty would appear to be the superior technique. On the topic of wound closure, one recent meta-analysis has found that, while staples can result in a quicker closure time, there is no significant difference in post-operative infections rates or wound healing outcomes when comparing staples to sutures. Therefore, either suture or staple wound closure techniques appear equally appropriate for hip hemi-arthroplasty procedures.

Key words: Hemi-arthroplasty; Prosthesis; Stem; Head; Hip; Femoral; Neck; Fracture; Cement

Core tip: From the current evidence on hip hemi-arthroplasty, the following conclusions can be drawn: posterior approaches are associated with higher rates of dislocation and should be avoided; there is no significant difference between unipolar and bipolar hemi-arthroplasty for surgical outcome, complication profile, functional outcome and long-term acetabular-erosion rates, therefore unipolar hemi-arthroplasty, the cheaper prosthesis, is the recommended option; cemented hemi-arthroplasty, the recommended option, has lower rates of implant-related complications and residual thigh pain compared to uncemented hemi-arthroplasty, with no significant difference in medical complications or mortality; there is no significant difference in wound-infections rates or healing outcomes between staples and sutures.

INTRODUCTION

Hip fractures in the elderly represent a major public health concern[1-7]. These account for a quarter of all fractures in patients aged 75 years and over[3]. With a global incidence of 1.7 million hip fractures in 1990, this is targeted to reach 6.3 million in 2050[7].

The management of hip fractures is based on the location of the fracture: the two main categories being intra and extra-capsular fractures[8]. Intra-capsular fractures comprise around 60% of all hip fractures, with up to 80% of these being displaced[1,9]. Fracture displacement increases the risk of disruption to the femoral head blood supply, and so, is associated with increased rates of osteo-necrosis of femoral head, non-union, delayed union and failure of fracture fixation procedures[10-15]. As such, the current treatment guidelines for hip fractures advise that "displaced intracapsular neck of femur fractures be treated with arthroplastyprocedures"[16]. There are two main arthroplasty procedures available for the treatment of displaced intracapsular neck of femur fractures: hip hemi-arthroplasty and total hip replacement[17-22]. Hip hemi-arthroplasty is the recommended option in the frail, low mobility population as the large diameter hemi-arthroplasty "head" component reduces the risk of dislocation: total hip replacement is the recommended option in the more active population as it can provide a better functional outcome[17-22]. The current guidelines from the "National Institute for Health and Care Excellence" (NICE) advice for orthopaedic surgeons to consider total hip arthroplasty over hip hemi-arthroplasty as treatment of displaced neck of femur fractures in patients who are: independently mobile out-doors, requiring one stick or less for support; cognitively intact; and considered suitably healthy to undergo the operation by both the orthopaedic and anaesthetic teams. When such criteria are not met, a hip hemi-arthroplasty is indicated[16]. The current registry data suggests that around 90% of displaced intra-capsular fractures are treated with hip hemi-arthroplasty, with 10% treated with total hip replacements[1,2,23].

Despite the perceived simplicity of the hip hemi-arthroplasty procedure, there are a number of variations to the procedure[15,24-26]. These include the approach[26-28], the type of prosthesis head[25,29-31], the method of stem insertion[25,32-34], and the type of prosthesis assembly[35]. The optimal selection for each of these factors remains to be determined[15,24-26].

This editorial reviews and summarises the current evidence (meta-analyses and Cochrane reviews) relating to the use of hip hemi-arthroplasty for neck of femur fractures.

SURGICAL APPROACH - LATERAL *VS* POSTERIOR *VS* ANTERIOR APPROACHES

Surgical approaches to the hip for hip hemi-arthroplasty can be divided into three main categories: lateral approaches (LA), posterior approaches (PA) and anterior approaches (AA).

LAs commonly involve (partial or complete) division or retraction of the hip abductor muscles (gluteus medius and minimus) to enable access to the hip capsule[26,27]. These include the Hardinge (direct lateral), the transgluteal and the Watson-Jones (anterolateral) approach[26,27].

PAs commonly involve a trans-gluteus-maximus approach, followed by division of the tendons of the short external rotators, to enable access to the hip joint[26,27]. These include includes the Moore, the Southern, the true posterior and the posterolateral approaches[26,27].

AAs commonly involve use the inter-nervous plane between the femoral and the superior gluteal nerves (the superficial interval between sartorius and tensor fasciae latae; and the deep interval between rectus femoris and gluteus medius) to enable access to the anterior hip capsule[26-28]. These include the direct anterior and the Smith-Petersen approaches[26-28].

There are two recent meta-analyses[27,28] and one Cochrane review[26] comparing outcomes of hip hemi-arthroplasty by type of approach used.

The most recent meta-analysis is that by van der Sijp *et al*[27]. The authors performed a systematic database search, until October 2017, to identify all studies on hip hemi-arthroplasty for fracture, which compared outcome by approach used[27]. Twenty-one studies were included in the meta-analysis [3 randomized controlled trials (RCT), 7 prospective and 11 retrospective cohort studies],

with a synthesis cohort of 61487 patients[27]. On meta-analysis, PAs were found to have a significantly higher rate of dislocation compared to AAs (OR = 2.61; 95%CI: 1.26 to 5.43; *P* < 0.01); and LAs (OR = 2.90; 95%CI: 1.63 to 5.14; *P* < 0.0003)[27]. PAs also had a higher risk of re-operation (*i.e.*, revision procedures, relocation of dislocations, intra-operative fracture fixation, and repair of capsule for repetitive instability) compared to LAs (OR = 1.25; 95%CI: 1.12 to 1.41; *P* < 0.0001); however no significant difference was found when comparing the re-operation rates of LAs and AAs (OR = 1.54; 95%CI: 0.50 to 4.77; *P* = 0.45)[27]. There was insufficient data to allow meta-analysis comparison of the re-operation rates of PAs and AAs[27]. On further meta-analysis between the three approaches, no significant differences was found for rates of surgical site infection, intra-operative fracture, and length of hospital stay[27]. It was not possible to perform meta-analysis on the "functional outcome" data between the three approaches[27]. The authors concluded that PAs are associated with a higher rate of dislocation and further operations in comparison to LAs and AAs in hip hemiarthroplasty for fracture[27].

The other recent meta-analysis is that by Kunkel *et al*[28]: this compared the direct anterior approach (DAA) for hip hemi-arthroplasty to all other approaches for this procedure. The authors performed a systematic database search, until October 2016, identifying RCTs and cohort studies on hip hemi-arthroplasty for fracture, which compared the DAA to other surgical approaches (lateral, anterolateral, posterior, posterolateral)[28]. Nine studies were included in the meta-analysis (3 prospective randomised studies, 3 prospective non-randomised studies and 3 retrospective cohort studies)[28]. The synthesis cohort comprised a total of 698 hips (direct anterior approach *n* = 330; posterior approach *n* = 108, posterolateral approach *n* = 114; anterolateral approach *n* = 57; lateral approach *n* = 89)[28]. On meta-analysis, PAs were found to have a significantly higher dislocation rate compared to the DAA (OR = 0.18; 95%CI: 0.05 to 0.63; *P* = 0.007)[28]. However, there was no significant difference in dislocation rate between the DAA and LAs (OR = 0.19; 95%CI: 0.01 to 4.03; *P* = 0.29)[28]. On further meta-analysis, no significant difference was found between the approaches for intra-operative blood loss, perioperative fracture, duration of procedure, post-operative pain levels, length of hospital stay, post-operative infection rate, further operation rate, total complication rate and mortality[28]. The authors concluded that for fracture-related hip hemi-arthroplasty, PAs are associated with a significantly higher rate of dislocation in comparison to the DAA[28].

Prior to this, Parker *et al*[26] performed a Cochrane review in 2002 assessing the influence of surgical approaches on outcome from hip hemiarthroplasty. The authors performed a systematic database search, until February 2002, to identify all RCTs comparing outcome from different surgical approaches in fracture-related hip hemi-arthroplasty[26]. Only one RCT was identified that was suitable for inclusion: this comprised 114 hip

fracture patients who were managed with a cemented Thompson hemi-arthroplasty, either through an ante-rolateral or a posterior approach[26]. Unfortunately, the study was found to be of sub-optimal quality to allow for reliable analysis, owing to selection bias, insufficient patient follow-up and insufficient results reporting[26]. The authors concluded that, at that time, the evidence from RCTs was inadequate to decide which approach was most effective for hip hemi-arthroplasty in femoral neck fractures[26].

Of the available National Guidelines which provide recommendations on the practice of hip hemiarthroplasty for hip fracture: the NICE Guidelines currently advise clinicians to favour the anterolateral approach over the posterior approach for hip hemiarthroplasty surgery[16]; and the Scottish Intercollegiate Guidelines Network (SIGN) Guidelines advise "the anterolateral approach is recommended for hemiarthroplasty surgery"[36].

The current evidence would suggest that, in hip hemi-arthroplasty for fracture, PAs are associated with a higher rate of post-operative dislocation compared to LAs and AAs, and a higher risk of reoperation compared to LAs. There appears no significant difference between LAs and AAs in terms of post-operative dislocation rates and re-operation rates. Thus, PAs should be avoided when performing hip hemi-arthroplasty for femoral neck fracture.

PROSTHESIS HEAD COMPONENT - UNIPOLAR *VS* BIPOLAR HEM-ARTHROPLASTY

There are two main categories of hemi-arthroplasty prosthesis, when assessing head component utilised: unipolar hemi-arthroplasty (UH) (Figure 1A) and bipolar arthroplasty (BH) (Figure 1B)[25,29-31]. An UH comprise a large single endo-prosthetic head component, while BH has both an endo-prosthetic "bipolar" head component and an inner metal bearing[25,29-31]. The theoretical benefit of the BH design, with its mobile bearing concept, is to reduce component-induced wear on the acetabulum[25,29-31]. Other theoretical benefits include improved range of hip motion, decreased risk of dislocation and improved hip function, to provide a better clinical outcome over UH[25,29-31]. However, the proven benefits of BH over UH remain to be confir-med[25, 29-31].

There are three recent meta-analyses[29-31] and one Cochrane review[25] which compare the outcomes of unipolar to bipolar hip hemi-arthroplasties for femoral neck fracture.

The most recent meta-analysis is by Zhou *et al*[29]. The authors performed a systematic database search, till April 2014, to identify all RCTs which compare UH to BH, as treatment of displaced femoral neck fractures[29]. Eight RCTs were included in the meta-analysis, providing a synthesis cohort of 1100 patients[29]. On meta-analysis, no significant difference was found
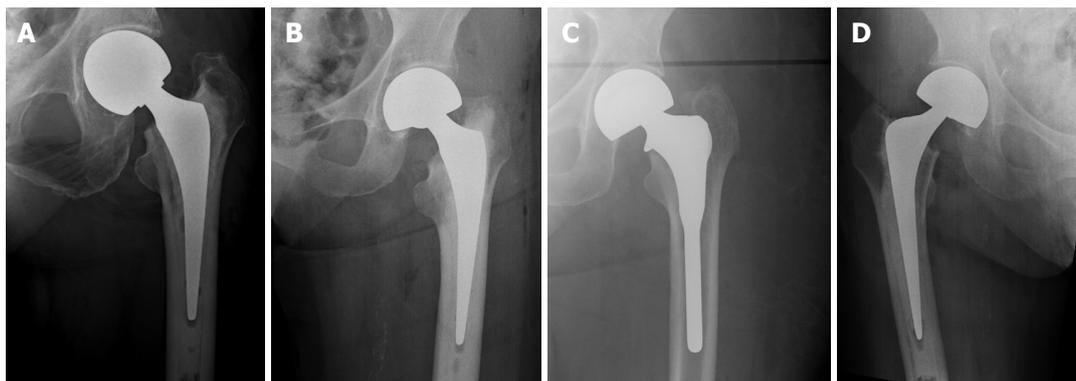
Figure 1 A hip hemi-arthroplasty with a unipolar component head (A); a hip hemi-arthroplasty with a bipolar component head (B); a hip hemi-arthroplasty with an uncemented femoral stem (C); and a hip hemi-arthroplasty with a cemented femoral stem (D).

between UH and BH for acetabular erosion rates (RR = 2.29; 95%CI: 0.85 to 6.12; P = 0.10), rate of dislocation (RR = 1.20; 95%CI: 0.47 to 3.07; P = 0.71), rate of reoperation (RR = 0.64; 95%CI: 0.33 to 1.26; P = 0.19), mortality (RR = 0.85; 95%CI: 0.63 to 1.13; P = 0.26), post-operative complication rates (RR = 1.05; 95%CI: 0.70 to 1.56; P = 0.82), and post-operative Harris Hip Scores (WMD -1.32; 95%CI: 3.29 to 0.65; P =0.19)[29]. The authors concluded that there was no apparent difference in clinical results between UH and BH, when used as treatment for displaced intra-capsular neck of femur fractures[29].

The second of the recent meta-analyses was that by Jia *et al*[30]. The authors performed a systematic literature search, until April 2014, to identify all RCTs which compared UH to BH as treatment of displaced intra-capsular neck of femoral fractures[30]. The meta-analysis comprised ten RCTs, providing a synthesis cohort of 1190 patients[30]. On systematic review of the included studies, the authors found descriptive evidence that BH was superior to UH for post-operative hip function, quality of life and post-operative hip pain; however on meta-analysis, there was no significant difference in post-operative Harris Hip Scores between UH and BH (MD, -0.51, 95%CI: -4.43 to 3.42, P = 0.80)[30]. UH was also found to have increased rates of acetabulum erosions at one year post-surgery, in comparison to BH (RR = 0.24; 95%CI: 0.06 to 0.89; P = 0.03): however there was no significant difference between the two groups for acetabular erosion rates at four months post-surgery (RR = 0.35; 95%CI: 0.10 to 1.21; P = 0.10), two years post-surgery (RR = 0.46; 95%CI: 0.20 to 1.10; P = 0.08), or four years post-surgery (RR = 0.48; 95%CI: 0.20 to 1.19; P = 0.12)[30]. On further meta-analysis, no significant difference was found between UH and BH for: mortality (RR = 0.92; 95%CI: 0.59 to 1.44; P = 0.71); reoperation rates (RR = 0.98; 95%CI: 0.42 to 2.27; P = 0.95); dislocation rates (RR = 0.76; 95%CI: 0.30 to 1.93; P = 0.57); implant-related complications (RR = 0.84; 95%CI: 0.39 to 1.81; P =0.66); general complications (RR = 0.65; 95%CI: 0.28 to 1.49; P = 0.31)[30]. Furthermore,

two of the RCTs which reported on cost of prosthesis both noted that BH was more expensive than UH[30]. The authors concluded that, comparing UH to BH, no significant difference could be found between post-operative result and longer term rates of acetabular erosion; however BH was consistently noted to be the more expensive implant[30].

The last of the recent meta-analyses was that by Yang *et al*[31]. The authors performed a systematic database search, till July 2013, to identify all prospective RCTs that compare UH to BH for the treatment of neck of femur fractures in patients aged 65 years and over[31]. Six RCTs were included in the meta-analysis, with a combined cohort of 982 patients[31]. On meta-analysis, the acetabular erosion rates was noted to be significantly increased in the UH group (5.5%) compared to the BH group (1.2%) (OR = 0.22; 95%CI: 0.07 to 0.74; P =0.01)[31]. However, there was no significant difference between the two groups for: rate of mortality (OR = 1.08; 95%CI: 0.71 to 1.65; P = 0.72), overall post-operative complication rates (OR = 1.00; 95%CI: 0.67 to 1.50; P = 1.00), post-operative rate of dislocation (OR = 0.87; 95%CI: 0.29 to 2.60; P = 0.80), rate of infection (OR = 1.36; 95%CI: 0.60 to 3.09; P = 0.47), rate of reoperation (OR = 1.56; 95%CI: 0.66 to 3.68; P = 0.31), Harris hip scores (SMD -0.03; 95%CI: -0.23 to 0.17; P = 0.76) and return to pre-fracture function (OR = 1.36; 95%CI: 0.94 to 1.96; P =0.10)[31]. The authors concluded that there was no significant difference noted in clinical outcome for UH compared to BH when used as treatment of displaced intra-capsular neck of femur fractures in patients aged 65 or over[31]. Given the similar clinical outcomes, they advised that unipolar implants appear the more economical prosthesis[31].

Lastly, the most recent Cochrane review on the topic is that Parker *et al*[25]. The authors performed a systematic database search till September 2008, to identify all RCTS and quasi-RCTs comparing the use of different arthroplasty prostheses as management of femoral neck fractures[25]. In total, twenty-three studies were included, with a synthesis cohort of 2861

patients[25]. A sub-group analysis was performed, assessing all studies which compared UH to BH: this comprised seven studies, with a combined cohort of 857 patients (863 fractures[25]. On meta-analysis, no significant differences was found between UH and BH for: dislocation rate (RR = 1.09; 95%CI: 0.36 to 3.31; *P* = 0.88), acetabular erosion rate (RR = 3.83; 95%CI: 0.81 to 18.15; *P* = 0.090), acetabular erosions requiring revision (RR = 2.97; 95%CI: 0.47 to 18.85; *P* = 0.25), rate of deep wound infection (RR =1.34; 95%CI: 0.50 to 3.62; *P* = 0.56), reoperation rate (RR = 1.41; 95%CI: 0.54 to 3.69; *P* =0.49), deep vein thrombosis (RR = 0.71; 95%CI: 0.03 to 16.45), mortality at 6 months (RR = 1.13; 95%CI: 0.73 to 1.76; *P* = 0.58); mortality at 1 to 2 years (RR = 0.90; 95%CI: 0.64 to 1.26; *P* =0.54) and recovery of pre-fracture mobility (RR = 0.94; 95%CI: 0.40 to 2.16)[25]. The authors concluded that from the available evidence, UH and BH implants demonstrated no significant clinical difference when used as treatment for displaced femoral neck fractures[25].

Of the current National Guidelines, the SIGN Guidelines recommend that "BH should not be performed in preference to UH, as there is limited evidence of any clinical benefit"[2]. In keeping with this, data from the recent English hip fracture audit has found that 79% of all hip hemi-arthroplasties performed in England in 2017 were UH[1].

From the current evidence, it would appear, that while UH can be associated with increased rates of acetabular erosion at short-term follow-up (up to 1 year), there is no significant difference between the two prosthesis types for surgical outcome, complication profile, functional outcome and acetabular erosion rates at longer-term follow-up (2 to 4 years). Thus, with BH being the more expensive prosthesis, UH would appear to be the recommended option.

TECHNIQUE OF FEMORAL STEM INSERTION - CEMENTED *VS* UNCEMENTED HEMI-ARTHROPLASTY

The optimal technique for femoral stem implantation, using either an uncemented (Figure 1C) or a cemented (Figure 1D) femoral stem remains another keenly debated topic[25,32-34]. In theory, a cemented femoral stem is more uniformly and more securely fixed within the femoral canal; this has been postulated to result in lower rates of post-operative thigh pain and reduced revision rates from aseptic loosening[25,32-34]. However, the use of cement intra-operatively potentially confers the risks of cardiac arrhythmias and cardio-respiratory compromise, secondary to fat embolism and cement reaction phenomena[25,32-34]. Revision of a cemented hemi-arthroplasty is also considered more challenging than that of an uncemented hemi-arthroplasty[25,32-34]. Uncemented hemi-arthroplasties theoretically incur a shorter operating time, due to the lack of cementation

required; they also have been noted to be the cheaper of the two prosthesis types[25,32-34]. As such, the optimal technique for femoral stem insertion remains to be decided[25,32-34].

There are three recent meta-analyses[32-34] and one Cochrane review[25] which compare the outcomes of cemented to uncemented hip hemi-arthroplasties for femoral neck fracture.

The most recent meta-analysis is that by Veldman *et al*[32]. The authors performed a systematic database search, till April 2016, to identify all RCTs comparing outcomes for cemented versus uncemented hemi-arthroplasties for femoral neck fracture, which used contemporary generation femoral stems only[32]. Five RCTs were included in the meta-analysis, with a synthesis cohort of 950 patients (950 hips)[32]. Complications were categorised as: prosthesis-related (dislocation, aseptic prosthesis loosening, peri-prosthetic fractures); cardiovascular-related; local (deep and superficial wound infections); and other general complications[32]. On meta-analysis, cementless hemi-arthroplasties had higher rates of overall complications compared cemented hemi-arthroplasties (OR = 1.61; 95%CI: 1.12 to 2.31; *P* = 0.01), especially implant-related complications (OR = 3.15; 95%CI: 1.55 to 6.41; *P* = 0.002)[32]. However, cementless hemi-arthroplasties were associated with a shorter operating time compared to cemented hemi-arthroplasties (WMD -9.96 mins; 95%CI: -12.93 to -6.98; *P* < 0.001)[32]. On further meta-analysis, there was no significant difference between the two methods of femoral stem insertion for: cardio-vascular complications (OR = 0.54; 95%CI: 0.24 to 1.20; *P* =0.13); local complications (OR = 0.71; 95%CI: 0.27 to 1.86; *P* = 0.49); general complications (OR = 1.09; 95%CI: 0.62 to 1.91; *P* = 0.76); number of re-operations (OR = 1.24; 95%CI: 0.53 to 2.88; *P* = 0.62); length of hospital stay (WMD 0.36 d; 95%CI: -1.13 to 1.85; *P* = 0.63); intra-operative blood loss (WMD -36.19 mL; 95%CI: -89.45 to 17.07; *P* = 0.18)[32]. It was not possible to perform meta-analysis on the "functional outcome" data[32]. The authors concluded that, for fracture-related hip hemiarthroplasty using contemporary femoral stems, cemented hemi-arthroplasties were associated with fewer prosthesis-related complications, though with similar mortality rates, as compared to uncemented hemi-arthroplasties[32].

However, it must be noted that the data regarding implant-related complications, in this meta-analysis, was heterogeneous[32]. Review of the three studies, which reported on implant-related complications, revealed the most common complication was peri-prosthetic femoral fracture[32]. However, no formal break-down of the individual implant-related complications was provided in the meta-analysis[32]. As such, a more detailed meta-analysis is required to properly define the increased risk posed by uncemented prostheses. Nevertheless, the current evidence suggests that the cemented technique is safer.

The second most recent meta-analysis is that by

Ning *et al*[33]. The authors performed a systematic database search, till March 2012, to identify all RCTs which compared cemented to uncemented hemi-arthroplasty for fracture, including all available prosthesis types[33]. Twelve RCTs were included in the meta-analysis, providing a synthesis cohort of 1805 patients[33]. On meta-analysis, cemented hip hemi-arthroplasties were associated with a prolonged operative time when compared to uncemented hemi-arthroplasties (SMD -0.43; 95%CI: -0.56 to -0.30; *P* < 0.001)[33]. However, no significant difference was found between the two techniques for: intra-operative blood loss (SMD -0.12; 95%CI: -0.33 to 0.10; *P* = 0.291); length of hospital stay (SMD -1.21; 95%CI: -0.05 to 0.22; *P* = 0.224), overall complications (OR = 0.82; 95 %CI 0.63 to 1.08; *P* = 0.163); post-operative pain (OR = 1.42; 95%CI: 0.99 to 2.03; *P* = 0.056) and mortality rates (OR = 1.08; 95%CI: 0.88 to 1.34; *P* = 0.469)[33]. The authors concluded that the outcomes of uncemented and cemented hip hemiarthroplasty for femoral neck fracture, showed no significant difference[33].

The last of the recent meta-analyses was that by Luo *et al*[34]. The authors performed a systematic database search, till December 2010, to identify all RCTs comparing uncemented and cemented hip hemiarthroplasty (all prosthesis types included), as treatment for neck of femur fractures[34]. Eight RCTs were included in the meta-analysis, providing a synthesis cohort of 1175 hips[34]. On meta-analysis, uncemented hemi-arthroplasties were noted to have higher rates of post-operative pain 1-year post-surgery compared to cemented hemi-arthroplasties (RR = 0.69; 95%CI: 0.53 to 0.90; *P* = 0.007).There was however no significant difference between the two techniques for: peri-operative mortality (RR = 0.92; 95%CI: 0.58 to 1.45; *P* = 0.71), 1-year mortality (RR = 0.89; 95%CI: 0.73 to 1.09; *P* = 0.26), rates of reoperation (RR = 0.75; 95%CI: 0.44 to 1.25; *P* = 0.27), general medical complications (RR = 0.83; 95%CI: 0.61 to 1.14; *P* =0.25) and local complications (comprising dislocation, wound infection, periprosthetic fracture and radiographic prosthesis loosening) (RR = 0.85; 95%CI: 0.58 to 1.23; *P* =0.38)[34]. Meta-analysis could not be performed for the "functional outcome" data[34]. The authors concluded that, while the cemented prostheses were associated with lower rates of post-operative pain as compared to the uncemented prostheses, the two types of hemi-arthroplasty showed no significant difference in complication rates, reoperation rates and mortality rates[34].

Lastly, the most recent Cochrane review on the topic is by Parker *et al*[25], as described in "Prosthesis Head Component" section. On sub-group analysis, six studies were identified which compared cemented to uncemented hemi-arthroplasties for neck of femur fracture, providing a synthesis cohort of 899 participants[25]. All prosthesis types were included in the review[25]. On meta-analysis, cemented hemi-arthroplasties had a significantly prolonged operation time (MD 7.24 min; 95%CI: 4.75

to 9.73 min; *P* < 0.00001), though had reduced rates peri-operative of femoral fracture (RR =0.09; 95%CI: 0.02 to 0.44; *P* =0.0031), lower rates of residual hip pain at both three-month follow-up (RR = 0.77; 95%CI: 0.60 to 0.98; *P* = 0.034) and longer term follow-up (RR = 0.55; 95%CI: 0.40 to 0.75; *P* = 0.00017), and improved recovery of post-operative mobility scores (RR = -0.80; 95%CI: -1.23 to -0.37)[25]. No significant difference was found between the two techniques in mortality rates at any of the follow-up time intervals: 1-mo post-surgery (RR = 0.84; 95%CI: 0.38 to 1.84; *P* = 0.66); one to three months post-surgery (RR = 0.98; 95%CI: 0.68 to 1.41; *P* = 0.90); 1-year post-surgery (RR = 0.90; 95%CI: 0.71 to 1.13; *P* =0.35); and 3-years post-surgery (RR = 1.13; 95%CI: 0.76 to 1.67)[25]. Similarly, no significant difference was found between the two techniques for: peri-operative blood loss (RR = 49.00; 95%CI: -22.10 to 120.10); requirement of blood transfusion (RR = 0.12; 95%CI: -0.04 to 0.27; *P* = 0.13); occurrence of medical complications (RR = 0.82: 95%CI: 0.59 to 1.13; *P* = 0.23); rate of re-operation (RR = 0.55; 95%CI: 0.27 to 1.14; *P* = 0.11); duration of hospital stay (RR = -1.42; 95%CI: -3.15 to 0.32; *P* = 0.11); percentage of patients who were able to return to their pre-injury place of residence (RR = 0.62; 95%CI: 0.34 to 1.12; *P* = 0.11) and restore their pre-injury mobility levels (RR = 0.84; 95%CI: 0.64 to 1.11; *P* = 0.23)[25]. The authors concluded that cemented hip hemi-arthroplasties can reduce the risk of peri-operative femoral fracture, reduce post-operative pain levels and provide improved post-operative mobility, when compared to uncemented hip hemi-arthroplasties for displaced femoral neck fractures, with no significant difference between the two techniques for mortality at any of the follow-up time points[25].

Of the available National Guidelines: the NICE Guidelines currently recommend "the use cemented implants in (hip fracture) patients undergoing surgery with arthroplasty"[16]; and the SIGN Guidelines recommend that "cement should be used when undertaking hemiarthroplasty, unless there are cardiorespiratory complications, particularly in frail older patients"[36]. In keeping with this, data from the recent Scottish and English Hip Fracture Audits have found that 90% and 87% of all hip hemi-arthroplasties, from Scotland and England in 2017 respectively, were performed with a cemented femoral stem[1,2].

The current evidence would suggest that while uncemented hemi-arthoplasties can allow for a shorter operative time, cemented hemi-arthroplasties are associated with lower rates of prosthesis-related complications (particularly peri-prosthetic femoral fracture) and improved post-operative results in terms of residual thigh pain and mobility. In addition, there appears to be no significant difference between the two techniques for intra-operative blood loss, medical complications and mortality (peri-operative and 1-year). In accordance with the current literature, a cemented hip hemi-

arthroplasty would appear to be the superior technique.

TYPE OF PROSTHESIS ASSEMBLY - MONOBLOCK *VS* MODULAR HEMI-ARTHROPLASTY

There are two main types of prosthesis assembly that can be used in hip hemi-arthroplasty: monoblock prosthesis and modular prosthesis[35].

A monoblock hemi-arthroplasty is produced as a single unit, with variations in prosthesis size based on the diameter of the patient's femoral head[35]. The most commonly used monoblock implant is the collared Thompson Hemi-Arthroplasty[35]. Given the pre-fabricated nature of this prosthesis, there is limited ability to adjust the prosthesis intra-operatively to accommodate for variations in femoral neck offset or leg length: thus, such implants often poorly recreate the patient's original hip geometry[35]. A modular hemi-arthroplasty is produced in individual components: stem, neck and head components[35]. On assembling these intra-operatively, the surgeon is able to alter component size, and so better recreate the patient's original hip geometry[35]. However, the theoretical benefits of modular prostheses in hip hemi-arthroplasty as treatment of femoral neck fractures remain to be confirmed[35].

There is one recent meta-analysis[35] which compare the outcomes of monoblock to modular hip hemi-arthroplasties for treatment of femoral neck fractures.

The available meta-analysis is that by Sims *et al*[35]. The authors performed a systematic database review, until September 2015, identifying all RCTs, well-designed case control studies, retrospective cohort studies and prospective cohort studies, which compared outcomes between Thompson hemi-arthroplasties and modular unipolar hemi-arthroplasties for femoral neck fracture[35]. Four studies were included in the review (1 RCT, 2 Retrospective Cohort Studies, 1 Swedish Joint Registry Paper), providing a synthesis cohort of 21017 patients[35]. On meta-analysis, the odds ratio favoured modular designs for both mortality (OR = 1.3; 95%CI: 0.78 to 2.46) and post-operative complications (OR = 1.1; 95%CI: 0.79 to 1.55); however no significant difference was noted for either factor, between the prosthesis types[35]. On review of the study quality of the included studies, the authors found these all to be subject to potential bias with significant heterogeneity noted in the methods and results[35]. Thus the authors concluded that there is insufficient evidence at present to accurately compare monoblock to modular hemi-arthroplasty prosthesis for patients with femoral neck fractures[35].

To note, the same authors subsequently published a multi-centre, pragmatic RCT comparing the outcome of the Thompson monoblock cemented hemi-arthroplasty to a modular hemi-arthroplasty using a cemented Exeter femoral stem and a Unitrax hemi-arthroplasty head (The WHITE 3: Hemi Trial) (2018)[37]. The initial recruitment cohort comprised 964 patients (monoblock group *n* = 482; modular group *n* = 482); however four-month follow-up data was only available for 482 patients (50%)[37]. Outcome assessment was performed using the EuroQol questionnaire (EQ-5D-5L)[37]. At four-month follow-up, the modular cohort had a marginally improved mean EQ-5D-5L (mean EQ-5D-5L for modular cohort 0.379; mean EQ-5D-5L for monoblock cohort 0.321); however, this difference did not meet the minimum required clinical difference of 0.08 , nor was it statistically significant (MD = 0.037; 95%CI: -0.014 to 0.087; *P* = 0.156). Other factors which failed to show significant difference between the two groups included: mortality (OR = 1.02; 95%CI: 0.72 to 1.46; *P* = 0.911); post-operative walking ability (OR = 0.76; 95%CI: 0.54 to 1.06; *P* = 0.107); local complications (*i.e.*, wound complications; revision procedures; structural injury; deep vein thrombosis; dislocation) (OR = 1.50; 95%CI: 0.828 to 2.741; *P* = 0.179; requirement for blood transfusion (OR = 1.51; 95%CI: 0.530 to 4.316; *P* = 0.439); and medical complications (OR = 0.95; 95%CI: 0.665 to 1.358; *P* = 0.779). Length of hospital stay was marginally higher in the monoblock group (mean stay for monoblock group = 9.67 d; mean stay for modular group = 9 d; *P* = 0.039). There was no significant difference in post-operative radiographic femoral offset between the two groups (mean neck length for monoblock group = 3.01 mm; mean neck length for modular group = 2.91 mm; *P* = 0.834). The authors concluded that, accounting for the limited follow-up, there was no significant difference detected in clinical outcome between the two prosthesis types, when used as treatment for femoral neck fractures.

Of the current National Guidelines, the NICE guidelines advise to "use a proven femoral stem design (*i.e.*, those with an Orthopaedic Data Evaluation Panel rating of 10A, 10B, 10C, 7A, 7B, 5A, 5B, 3A or 3B) rather than Austin Moore or Thompson Stems for arthroplasties"[16]. However, such guidance is directed from evidence in primary total hip arthroplasty and expert opinion[35].

Thus, despite clear recommendations from NICE, the current evidence which compares monoblock to modular hemi-arthroplasty prosthesis for femoral neck fracture remains limited and equivocal. Despite the logical bio-mechanical advantage of the modular prosthesis, further research is required in this area to confirm their clinical benefit.

WOUND CLOSURE TECHNIQUES - SUTURES *VS* STAPLES

Wound closure technique remains a controversial area in hip hemi-arthroplasty surgery[38]. The two most common skin closure methods are staples and sutures[38]. Historically, it has been felt that staples were more time efficient, though associated with a higher rate of post-operative infection[38]. This belief was strengthened by a systematic review and meta-

analysis on the topic, from 2010, which reported that the rate of post-operative infection following orthopaedic surgery, was over three times greater for staple wound closure compared to suture wound closure[39]. However, the recent evidence provides a more balanced perspective[38].

There is one recent meta-analyses comparing the outcomes of skin closure techniques (sutures vs staples) in orthopaedic surgery, with a sub-group analysis on hip surgery procedures[38].

This meta-analysis is that by Krishnan *et al*[38]. The authors performed a systematic database review, until January 2015, identifying all RCTs and observational studies which compared the outcome of suture to staple wound closure technique following orthopaedic surgery[38]. The rate of post-operative wound infection was the primary outcome measure, with secondary outcome measures comprising time of closure, wound dehiscence, inflammation, post-operative pain, length of hospital stay, necrosis, abscess formation, discharge, allergic reaction[38]. Thirteen studies were included meta-analysis (ten RCTs, three observational studies), with a combined cohort of 1255 patients (suture group = 563 patients, staple group = 692 patients)[38]. Six of the studies comprised patients undergoing hip surgery (suture group = 164 patients, staple group = 245 patients)[38]. On meta-analysis, no significant difference was found in post-operative infection rates between sutures and staples (RR = 1.06; 95%CI: 0.46 to 2.44; P = 0.89)[38]. On sub-group analysis, for the patients who underwent hip surgery, no significant difference was also found in post-operative infection rates between sutures and staples (RR = 0.48; 95%CI: 0.10 to 2.45; P = 0.38)[38]. On further meta-analysis of the total cohort, closure time was found to be quicker for staples compared to sutures (MD = 5.84; 95%CI: 4.52 to 7.15; P < 0.001)[38]. However, there was no significant difference between the two techniques for all other outcome measures: wound dehiscence (RR = 0.96; 95%CI: 0.32 to 2.84; P = 0.94), inflammation (RR = 0.22; 95%CI: 0.00 to 12.07; P = 0.46), discharge (RR = 0.66; 95%CI: 0.14 to 3.23; P = 0.61), necrosis (RR = 0.51; 95%CI: 0.07 to 3.88; P = 0.52), allergic reaction (RR = 1.37; 95%CI: 0.22 to 8.60; P = 0.74), abscess formation (RR = 1.86; 95%CI: 0.22 to 15.71; P = 0.57)[38]. The authors concluded that, apart from time of closure, no significant difference was found between suture and staple wound closure techniques[38].

The current orthopaedic literature, particularly with regards to hip-related procedures, provides an equivocal conclusion on the optimal wound closure technique. From the available evidence, either suture or staple wound closure techniques appear equally appropriate for hip hemi-arthroplasty procedures.

AUTHORS' CURRENT PRACTICE

Within the affiliated institution of the first author, the default choice for fracture-related hip hemi-arthroplasty

is a cemented modular bipolar hemi-arthroplasty, through an antero-lateral approach. The wound closure technique varies, as per the preference of the responsible surgeon, with either skin clips or sub-cuticular sutures used. At present, there is a randomised controlled trial being run in this unit between cemented modular bipolar hemi-arthroplasty prostheses and cemented modular UH prostheses: the result from this may influence the future choice of prosthesis head component selection in the institution.

The second author manages this fracture with a cemented, monoblock hemiarthroplasty through an antero-lateral approach, using a triple wound closure technique, which comprises monocryl, staples and glue.

CONCLUSIONS

From the current evidence on Hip Hemi-Arthroplasty, the following conclusions can be drawn: (1) posterior approaches are associated with: a higher rate of dis-location compared to lateral and anterior approaches; and a higher rate of re-operation compared to lateral approaches. Thus for fracture-related hip hemi-arthroplasty, posterior approaches should be avoided; (2) while UH can be associated with increased rates of acetabular erosion at short-term follow-up (up to 1 year), there is no significant difference between unipolar and bipolar hemi-arthroplasty for surgical outcome, complication profile, functional outcome and acetabular erosion rates at longer-term follow-up (2 to 4 years). Thus, with bipolar hemi-arthroplasty being the more expensive prosthesis, UH is the recommended option; (3) while cemented hip hemi-arthroplasties are associated with a longer operative time compared to uncemented hip hemi-arthroplasties, cemented prostheses have lower rates of implant-related complications (particularly peri-prosthetic femoral fracture) and improved post-operative outcome regarding residual thigh pain and mobility. No other significant difference has been found between the two techniques, regarding medical complications and mortality. As such, cemented hip hemi-arthroplasty appear to be the superior technique; (4) there is insufficient evidence at present to accurately compare the outcome of modular to monoblock hemi-arthroplasty prostheses for femoral neck fractures. However, based on evidence from total hip arthroplasty and expert opinion, current recommendations advocate for "a proven femoral stem design" with a modular prosthesis, as opposed to a monoblock prosthesis; and (5) while staples can result in a quicker closure time, there is no significant difference in post-operative infection rates or wound healing outcomes when comparing staples to sutures. Thus, either suture or staple wound closure techniques appear equally appropriate for hip hemi-arthroplasty procedures.

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