The Journal of Arthroplasty 31 (2016) 1040–1046

Contents lists available at ScienceDirect

The Journal of Arthroplasty

journal homepage: www.arthroplastyjournal.org

Primary Arthroplasty

The Cemented Unipolar Prosthesis for the Management of Displaced Femoral Neck Fractures in the Dependent Osteopenic Elderly

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ARTICLE INFO

Article history:
Received 16 September 2015
Received in revised form
14 November 2015
Accepted 24 November 2015
Available online 2 December 2015

Keywords:
femoral neck fracture
hemiarthroplasty
total hip arthroplasty
cemented femoral stem
unipolar

ABSTRACT

Background: Significant variability exists across orthopedic surgeons in the management of the displaced femoral neck fracture in the elderly patient (>75 years old). These patients tend to be less healthy, have inferior bone quality, and gait instability leading to increased risk of periprosthetic fracture, compromised implant fixation, dislocation, and need for revision. The surgeon's goals should be to restore mobility while eliminating pain and need for reoperation.

Methods: In this review article, we examine the best available evidence in the literature to determine which strategy achieves optimal outcomes. We examine outcome studies comparing use of hemiarthroplasty and total hip arthroplasty, unipolar and bipolar hemiarthroplasty, and cemented vs cementless fixation of femoral stems.

Results and Conclusions: For the active, healthy, and lucid patient, or one who has preexisting groin pain, who sustains a displaced femoral neck fracture, the literature supports a total hip arthroplasty. Patients sustaining a displaced femoral neck fracture and who are less active, have decreased bone mass, and are at increased risk of falls would benefit most from a device that optimally balances the need for revision surgery, restores ambulation, and eliminates pain. Thus, the current evidence favors cemented, unipolar hemiarthroplasty for the dependent osteopenic elderly patient with a displaced femoral neck fracture.

Femoral neck fractures are a common injury in the elderly population, and their incidence is increasing [1-3]. These fractures represent a major social and economic burden, with costs of more than $13 billion a year for medical care in the United States alone, and 89% of this cost attributed to those older than the age of 65 years [4]. Optimizing surgical management is of increasing significance as life expectancy increases and population size grows.

Orthopedic surgeons have successfully treated the displaced femoral neck fracture with reduction and internal fixation, hemiarthroplasty, or total hip arthroplasty to restore patient function and ambulation, eliminate pain, and prolong survival. Reduction with internal fixation for the displaced fracture is rarely indicated in the elderly because there is an 8-fold increased risk of needing a revision surgery and an increased mortality risk compared to arthroplasty for the elderly patient [5-7]. The literature clearly supports cementless total hip arthroplasty as the best treatment for the active, cognitively intact patient, whose age ranges 50-75 years; however, controversy exists for the osteopenic elderly patient, older than 75 years old, who may be less active and more prone to falls [8,9]. The elderly patient has unique attributes, which must be considered when planning for surgery. Among these differences include multiple medical comorbidities, gait instability leading to increased risk of falls, dementia, and variable bone integrity because of larger femoral canals with thin cortices and soft metaphyseal trabecular bone. Also, the elderly patient's goals differ from the active, young patient, as the elderly patient tends to place lower demands on their prosthesis. In this vulnerable population, goals of treatment should be focused on restoring ambulation, eliminating pain, and decreasing operative risk while minimizing the need for reoperation.

One or more of the authors of this paper have disclosed potential or pertinent conflicts of interest, which may include receipt of payment, either direct or indirect, institutional support, or association with an entity in the biomedical field which may be perceived to have potential conflict of interest with this work. For full disclosure statements refer to http://dx.doi.org/10.1016/j.arth.2015.11.029.

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http://dx.doi.org/10.1016/j.arth.2015.11.029
0883-5403/

In this article, we will use an evidence-based approach to answer the following questions: (1) Does the literature support hemiarthroplasty or total hip arthroplasty in the treatment of a displaced femoral neck fracture in the low-demand elderly patient (>75 years old)? (2) Is a unipolar or bipolar articulation preferred for hemiarthroplasty? (3) What are the advantages and disadvantages of cementing vs press-fit femoral stems in the osteopenic elderly population? With each topic, we use these specific treatment goals in the elderly population to outline an optimal treatment strategy based on current evidence.

Hemiarthroplasty vs Total Hip Arthroplasty

While joint arthroplasty is the preferred method for treating displaced femoral neck fractures in the elderly patient, controversy exists over whether to perform a hemiarthroplasty or a total hip arthroplasty. Surgeons tend to rely on evidence, training, and experience when counseling patients on optimal treatment and must weigh the advantages and disadvantages of each option for the elderly patient. Hemiarthroplasty does not require resurfacing of the acetabulum, thus decreasing procedure time and blood loss and avoids nuances associated with placement of the acetabular socket which is often technically challenging to nonarthroplasty-trained surgeons. Hemiarthroplasty also uses a large femoral head, which helps to decrease the risk of dislocation. However, as the acetabulum is not resurfaced, there is increased potential for wear of the acetabular cartilage and development of groin pain in a more active individual, which will ultimately require reoperation for conversion to a total hip arthroplasty at a later date.

Total hip arthroplasty may be preferable in the more active elderly patient or the individual with preexisting groin pain with advanced acetabular wear. The literature has demonstrated benefits of total hip arthroplasty over hemiarthroplasty, including improved function for these patients. In 1986, Dorr et al [10] demonstrated that patients who were treated with a total hip arthroplasty showed continuous functional improvement compared to deteriorating outcome scores in the hemiarthroplasty group. Similar outcomes were found in other randomized control trials demonstrating improved pain, walking, and functional scores for total hip arthroplasty and suggested that there was possibly a lower revision rate as well [11-18]. However, these studies often focused on mobile, independent patients, and qualified their conclusions to recommend total hip arthroplasty (THA) only for the active and lucid patient.

The elderly patient can have different requirements, and hemiarthroplasty may be optimal for certain subgroups of the elderly population as one considers the benefits previously stated. The most significant outcome for this patient group should be stability of the hip joint as these patients often have poor balance control and may be less compliant with hip precautions. In a meta-analysis of 8 randomized controlled trials that included a total of 1122 patients, Zi-Sheng et al [18] showed a clear increase in dislocation in total hip arthroplasty (17.2%) compared to hemiarthroplasty (4.5%). In another randomized controlled multicenter trial, 252 patients were allocated to cemented hemiarthroplasty or cemented total hip arthroplasty and followed to five years [19]. In this study, no dislocations were found in the 137 cemented hemiarthroplasties, compared to 8 of 115 (7%) for the total hip arthroplasty group ($P < .001$). Although this was the most robust evidence for the increase dislocation rate, this conclusion has been repeated across multiple studies [10,14,16]. It should be recognized that the use of modern large headed THA ($\geq$36 mm) and the impact of surgical approaches such as the direct anterior or anterolateral approach are not reported in these studies, which may lead to lower dislocation rates in the elderly after femoral neck fractures. Indeed, in the registry study by Leonardsson et al [20-22] which compared outcomes for approaches for hemiarthroplasty, they report a decreased risk of reoperation because of dislocation for the anterolateral transgluteal approach compared to the posterior approach, which matched previous studies. Whether these potentially decreased dislocation rates with the use of anterior and anterolateral approaches are equally beneficial to hemiarthroplasty and THA or favor 1 strategy requires further investigation.

Van den Bekerom et al further highlighted the benefits of hemiarthroplasty, demonstrating a higher intraoperative blood loss ($P < .001$) and an increased duration of the operation ($P < .001$) for total hip arthroplasty compared to hemiarthroplasty. Higher perioperative complication rates, likely due to the increased surgical time, and increased complexity of the operation have been a concern for total hip arthroplasty [16]. Based on these findings, many studies do not recommend THA as the treatment of choice for the dependent elderly patient (>70 years) with a femoral neck fracture in the absence of radiologic acetabular osteoarthritis.

For both treatment options, strategies to mitigate the need for revision surgery plays a major role in decision-making, especially in an elderly patient who is already at increased risk for complications from a revision surgery because of their multiple comorbidities. Arguments for increased use of THA cite a high rate of conversion of hemiarthroplasty to THA secondary to acetabular wear. Reported rates of acetabular erosion after hemiarthroplasty surgery for femoral neck fracture vary considerably, ranging from 0.6% to nearly 100%, although the rate of conversion is <10%, with most studies reporting between 1% and 4%, and only a portion of these conversions secondary to acetabular wear [19,23-26]. This large difference in reported acetabular wear and actual conversion rates may be related to radiographic vs symptomatic acetabular erosion. We recommend conversion surgery for acetabular wear from hemiarthroplasty to THA for only those patients with sufficiently symptomatic groin pain or implant instability.

Differentiating the patients who will most benefit from either a total hip arthroplasty or a hemiarthroplasty has been dependent on patient age and activity level. For the ambulatory, independent patient, the literature clearly supports total hip arthroplasty over hemiarthroplasty for improved functional outcomes, improved quality of life, and reduced revision rates. However, for a patient population over 75 years old, which may include a less active, elderly patient, with increased comorbidities, the combined benefits of reduced operative time, decreased dislocation rates, and a patient who places less demand for a high functioning prosthesis make hemiarthroplasty a more appropriate choice for the dependent, elderly patient. However, in practice it not always simple to distinguish between the active, lucid 75 years old and the sedentary, less independent 75 years old. With these differences in mind, Rogmark et al [6,27] developed a multicenter randomized controlled trial comparing internal fixation and arthroplasty in which patients were assigned treatment within the arthroplasty group to either hemiarthroplasty or total hip arthroplasty based on a scoring system that took into account age, activity level, and mental status. A score >15 warranted a total hip arthroplasty, and using this system, they reported a relatively low dislocation rate of 8% and good functional outcomes. Similar studies are needed to focus on the less active, elderly patient to elucidate the appropriate algorithm for determining the optimal treatment strategy.

In addition to patient characteristics, system-wide and surgeon-dependent factors may also be considered when analyzing appropriate treatment strategies. A portion of femoral neck fracture literature has focused on associations between hospital and surgeon volume and patient outcomes after femoral neck fractures [28-32]. A number of studies have found significant association between high-volume surgeons and high-volume hospitals, with