Total hip arthroplasty for the management of hip fracture: A review of the literature

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ABSTRACT

Total hip arthroplasty (THA) is indicated for completely displaced femoral neck fractures (FNF) in elderly community ambulators. Compared to open reduction internal fixation (ORIF) and hemiarthroplasty (HA), THA has favorable outcomes in this population. Cementless fixation with prophylactic cabling is the technique of choice. THA is costlier for hip fractures than for osteoarthritis, but is cost effective for FNF given its lower rate of revision than HA or ORIF. Postoperative home discharge with a home exercise program in appropriate patients may effectively control costs while optimizing outcome.

1. Introduction

The United States (US) Nationwide Inpatient Sample database identified 808,940 femoral neck fractures from 2003 to 2013 in patients greater than 65 years old.¹ A femoral neck fracture has an estimated mortality rate of 20% or more at one year after injury, and estimates regarding loss of independence approach 50%.² Brauer et al. reviewed the incidence of hip fracture among US elderly.³ Though the incidence has decreased over the last two decades, comorbidities among patients with hip fractures have increased and in-hospital mortality is currently at 6%.

Tidermark et al. reported 73% of femoral neck fractures (FNF) present as displaced⁴ (Fig. 1), and multiple studies have found inferior outcomes when these fractures are treated with closed or open reduction versus arthroplasty. There is significant evidence that displaced intracapsular femoral neck fractures are best treated with either total hip arthroplasty (Fig. 2) or hemiarthroplasty (HA)^{5–9} (Fig. 3A and B). Recently, THA has become more widely utilized for displaced femoral neck fractures due to the superior function and lower rates of reoperation it provides.⁷

This review explores the current literature regarding total hip arthroplasty for the treatment of hip fracture through a discussion of indications, outcomes, technical pearls, and cost.

1.1. Total hip arthroplasty indications for hip fracture

Closed versus open reduction with internal fixation is indicated for displaced FNF in young patients. THA is indicated for the active elderly and those with preexisting hip pain or degenerative joint disease. HA is

indicated for low-demand older patients (household ambulators), particularly in the setting of multiple co-morbidities.¹⁰

THA is reserved for cognitively lucid, community ambulators who are medically fit.¹¹ While it is thought that THA is a higher risk surgery than HA due to the longer operative time, a recent registry study found THA to have lower mortality than HA when groups were matched for age, gender, BMI, and American Society of Anesthesiologists (ASA) classification. However, the authors concede it is unclear if patient characteristics between groups were sufficiently similar.¹² When a high-risk patient with significant medical comorbidities sustains a FNF, consideration should still be given to performing HA to minimize operative and anesthesia time, as well as blood loss.

Patients treated with THA for FNFs have longer hospital length of stay, longer postoperative rehabilitation, and more comorbidities than those treated with THA for osteoarthritis.¹³ Despite these facts, patient-reported outcome measures following THA are superior when performed for FNF than for osteoarthritis, likely due to the significantly greater preoperative pain and limitations in function with hip fracture.¹³

1.2. Total hip arthroplasty versus open reduction and internal fixation

The literature consistently demonstrates that THA has significant advantages over open reduction internal fixation (ORIF) for the treatment of displaced intracapsular FNF with regard to functional outcomes, acute postoperative events, and revision rates.

Many studies have found the incidence of femoral head avascular necrosis (AVN) to be 30–45% with displaced femoral neck fractures and thus support treatment of these injuries in elderly patients with

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Fig. 1. Completely displaced femoral neck fracture.

arthroplasty. Postoperative function, as measured by Harris Hip Score, is far superior for THA and HA as compared to ORIF.^{5,6} Healy et al. compared internal fixation to arthroplasty (HA and THA combined) and found no difference in reoperation or mortality between the two groups. However, arthroplasty was more cost effective, allowed more independent living, and provided a longer interval to reoperation or death. THA was found to result in less pain, better function, lower rates of reoperation than HA, and less cost than HA or ORIF.⁷

Chammout et al. retrospectively compared the long-term results of cemented both component THA and ORIF for patients with displaced FNF older than 65 and concluded that there was no difference in mortality. However, functional scores were higher, pain was less, and reoperation rate was lower in THA patients.⁸

Rogmark et al. prospectively compared closed reduction and internal fixation (CRIF) with arthroplasty (HA and THA combined) at 2 years in patients older than 70. Failure rates were higher, pain was worse, and ambulation was more impaired after CRIF.⁹

Postoperative complication and reoperation rates are higher with ORIF as compared to THA or HA.⁵ Most patients that experience a failed ORIF undergo at least one additional surgery prior to THA.¹⁴ In addition, patients who undergo THA to salvage a failed ORIF report significantly worse outcomes than those who receive THA initially.¹⁴

Significantly displaced FNFs, Garden Types III or IV, have better results with THA. FNFs with little displacement, Garden Types I or II, respond well to CRIF or ORIF with cannulated screws.¹⁵

Fig. 2. Cementless total hip arthroplasty with prophylactic femoral cable performed for completely displaced femoral neck fracture.

1.3. Total hip arthroplasty versus hemiarthroplasty

In the treatment of displaced FNF, several studies have demonstrated THA to have lower re-operation rates and improved functional outcome in active elderly patients compared to HA. Avery et al., in a randomized control trial (RCT) comparing THA to HA, concluded there was lower mortality and a trend towards superior function with THA at 7–10 year follow-up.¹⁶ Another RCT comparing HA and THA found that at 4 years there was improved function and quality of life with THA in elderly, lucid patients with a displaced FNF.¹⁷ Yu et al., in a meta-analysis of randomized controlled trials, reported THA had lower risk of reoperation and higher functional scores at 1 and 4 years post-operatively, but higher risk of dislocation. There was no difference between THA and HA in mortality, infection, or overall complication rates.¹⁸

Reports of dislocation rates with THA and HA in the treatment of FNF vary widely. Lee et al. found a 10% risk of dislocation following THA, a 7-fold higher risk than with HA.¹⁹ Another study found frail patients, those with comorbidities that lacked autonomy, had lower dislocation rates after one year when treated with THA than with HA.²⁰ At 2–5 year follow up, however, dislocation rates were higher in frail patients treated with THA.²¹ Another group found higher dislocation rates at 4-year follow up with THA than HA, which suggests dislocation rates in THA may increase over time at short-term follow up.²² Conversely, multiple studies have found comparable dislocation rates between THA and HA.^{23,24} Technique, including surgical approach and volume, as well as patient-related factors, may explain these discrepancies.

With respect to minimizing revision rate, THA is superior to HA for FNF.^{20–22,25} Acetabular erosion only occurs in HA, and may explain its

Fig. 3. A) Cemented and B) cementless hemiarthroplasty performed for completely displaced femoral neck fracture.

higher revision rate.²⁶ Infection risk is similar across the two procedures.²²

It is well-established that THA requires longer operative time and, as a result, has increased intraoperative blood loss compared to HA.²⁴ This, together with the considerations above, make HA the treatment of choice for FNF in elderly household ambulators with comorbidities. In healthy and active individuals, those who are at least community ambulators, many studies have shown patients who undergo THA for FNF experience far less pain and have higher functional scores than those treated with HA.^{26–28} However, the benefit in quality of life with THA does not become significant until 2 years postoperatively.^{17,24}

1.4. Cemented versus uncemented stems

Many studies have suggested that uncemented stems are favored over cemented stems in patients with adequate bone stock.^{29,30} A registry study of approximately 6500 THAs found that uncemented stems were associated with fewer revisions for aseptic loosening in patients less than 70 years of age (Fig. 2). With revision for any reason as the endpoint, survival was equivalent between cemented and uncemented femoral stems.³⁰

FNF patients have poor bone stock and are given a diagnosis of osteoporosis by virtue of the injury. The preponderance of recent evidence suggests cemented stem fixation is favored during HA in this population (Fig. 3A). A recent retrospective study found that cemented stems in HA have lower rates of periprosthetic fracture requiring reoperation, without increasing risk of all-cause mortality, when compared to uncemented stems.³¹ Frenken et al. also reported significantly fewer periprosthetic fractures, post-operative infections, and reoperations for any reason with cemented stems than with uncemented stems in HA for FNF. However, there was less blood loss, surgery time, and cardiovascular complications with uncemented stems³² (Fig. 3B). Multiple additional studies have established a lower rate of implant-related events, including subsidence and periprosthetic fracture, with cemented stems.^{33,34}

1.5. Surgical techniques

Various surgical approaches for THA exist, each with its own advantages and disadvantages. The posterior approach is the most

commonly utilized, provides excellent exposure of both the acetabulum and femur, and is extensible. With soft tissue repair, the posterior approach has no higher dislocation rate than any other approach.^{35–37} The anterior approach, while it allows discontinuation of ambulatory assistive devices one week earlier than the posterior approach, has a steep learning curve, increased risk of wound complications, and higher rate of femur fracture as well as femoral component revision.^{38–40} The direct lateral and the anterolateral approaches have increased risk of Trendelenburg gait and heterotopic ossification.

In a cadaveric study, Herzwurm et al. found that prophylactic cabling of the proximal femur increases hoop stress resistance, theoretically decreasing the likelihood of intraoperative femur fracture during stem insertion⁴¹ (Fig. 2). A biomechanical study found both braided polyblend suture and steel wire cerclage significantly decreased proximal femoral strain during femoral broaching.⁴²

1.6. Economics of total hip arthroplasty for hip fracture

THA is more costly for FNF than for osteoarthritis.⁴³ Grace et al. noted that expenses for THA for FNF were higher than Bundled Payments for Care Improvement (BCPI) Initiative target prices, while expenses for THA for osteoarthritis were lower. Compared to ORIF, THA is much costlier initially. However, over time, this cost difference is mitigated by subsequent hospital admissions for failed ORIF.⁴⁴

Most of the cost following THA is incurred in the first year through rehabilitation services and nursing homes.⁴⁵ Thus, a potential source of significant cost savings in patients with a high level of preoperative function with strong social support is early mobilization to decrease length of stay followed by home discharge with a home exercise program.^{46,47} Evidence suggests this discharge plan optimizes outcome as well.⁴⁸ When considering HA or ORIF, it should be noted that THA conversion surgeries are much more costly than primary THA.⁴⁹ Selecting the appropriate initial surgical intervention and avoiding revision surgery is imperative in controlling cost.

2. Summary

FNFs are common in the elderly and are associated with a high mortality rate.^{1,2} THA is the treatment of choice for completely displaced FNFs in elderly community ambulators in whom the surgery

does not carry prohibitive medical risks.^{16–18,20–22} Compared to ORIF or HA, THA results in less pain, better function, and lower risk of reoperation when used to treat FNF.⁷ Cementless fixation with prophylactic cerclage cabling is the preferred technique for THA for FNF.^{29,30,41}

While the initial cost of THA is greater than that of ORIF and HA, the cost difference is minimized by the lower likelihood of revision surgery and associated readmission with THA.^{43,44} Most of the costs for THA occur during postoperative rehabilitation and discharge to a facility.⁴⁵ Early ambulation to decrease length of stay, home discharge with a home physical therapy regimen, and optimizing bundled payments for the hip fracture episode of care are all potential measures to control cost while optimizing outcome.^{46–48}

Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.jor.2019.02.012>.

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