Dual mobility (tripolar) cup versus Constrained acetabular cup in management of dislocated total hip arthroplasty

A systematic review of literature & meta-analysis

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Abstract

Background and introduction: Dislocation after total hip arthroplasty is the most common early and short term complication following primary implantation. There are many risk factors for dislocation after total hip arthroplasty (patient related factors, prothesis related factors, surgical technique related factors)·There are many treatment options of dislocated total hip arthroplasty according to cause of dislocation including dual mobility cups and constrained acetabular cups·

Methods: this systematic review of literature consists of 4 steps, including a systematic search of the literature (PUBMED, Cochrane library, JBJS & Google scholar),selection of studies, recording the study characteristics and extraction of data on clinical outcomes.

Results: A total of 570 studies were identified and 18 were included in the meta-analysis. The age of participants ranges from 19-92 years and a follow up ranges from 1 month to 14 years. This meta-analysis indicated that dual mobility cups have statistically lower rate of re-dislocation, lower rate of re-revision, lower rate of definite aseptic loosening of acetabular cup and higher Harris hip score

Conclusion: dual mobility cups and constrained acetabular cups are two effective methods for management of dislocated total hip prothesis but dual mobility cups have less rate of re-dislocation, less rate of re-revision, less rate of definite aseptic loosening of acetabular cup and higher Harris hip score. So, in general dual mobility cups increase stability, decrease return to hospital for re revisions the morbidity and the financial cost and better return to normal daily activites.

Keywords: Dual mobility cup, Constrained acetabular cup, Dislocation, Total hip arthroplasty.

INTRODUCTION

Dislocation after total hip arthroplasty is the most common early and short term complication following primary implantation requiring reoperation within the first 2 years[1]. The incidence of dislocation after primary total hip arthroplasty is reported from 0.2%-1.7%; the Swedish mean rate is reported 0.6%.After total hip arthroplasty revision surgeries performed due to dislocation,re-dislocation rate can be 10 fold higher[2].

Risk factors of dislocation of total hip arthroplasty include neuromuscular conditions, such as cerebral palsy, muscle dystrophy and dementia, also with Parkinson disease, to above 80 years: risk is due to loss of proprioception, frequent falls. Risk also include congenital hip dysplasia [3]. Prior femoral neck fractures, septic or aseptic loosening[4].

Numerous surgical options are described to treat dislocation. Implant designs are altered to improve range of motion before impingement and stability, elevated rim liners, large diameter heads, constrained acetabular cups and dual mobility cups have been used[5].

Constrained acetabular cup first described for treatment of tuberculosis of hip in the 1960s, designed to hold the head in acetabular cup by means of locking mechanism. It is indicated in soft tissue insufficiency, contraindications include acute dislocation and dislocation due to component loosening or

malposition and. Disadvantages are increased rate of aseptic loosening, dissociation of liner[6].

Dual mobility cups also described as (tripolar cups) in English literature was introduced by Dr G Bousquet in 1970, consists of two apparent joints one between metal cup and polyethylene liner and the other between liner and metal femoral head. The main advantage is reduced risk of dislocation, less impingement. Disadvantages are intraprothetic dislocation and wear of polyethylene liner[7].

AIM OF THE WORK

Conduct a systematic review of literature and meta-analysis comparing between result of dual mobility cup and constrained acetabular cup in management of dislocated total hip arthroplasty, according to:

- Rate of re-dislocation.
- Rate of re-revision.
- Rate of definite aseptic loosening of acetabular cup.
- Harris hip score.

Chapter 1

PATHOGENESIS OF DISLOCATED TOTAL HIP ARTHROPLASTY

Prothesis dislocation is defined as the complete loss of articulation contact between two artificial joint component[8]. Depending on the mechanical cause, 3 dislocation directions can be observed. **1- Cranial dislocation**, **2- Dorsal dislocation, 3- Anterior dislocation** [9].

Factors related to dislocation of total hip arthroplasty include factors related to patient such as age. Advanced age has been associated with a higher risk of dislocation. Some series of implants exclusively in elderly patients have reported dislocation rates of 15.2%. Diminished proprioception, poor coordination, muscle dysfunction, poor soft tissue quality, increased frequency of falls, confusion, decreased ability to comply with hip dislocation precautions and prior hip fractures all have been proposed as contributing factors for the higher dislocation rate in this population[10].

Dislocation after total hip arthroplasty was found in most studies to be more common in women. The reason for a higher dislocation rate in women is that they have more complaint soft tissue with greater range of motion that could be implicated[11].

Height have been studied as risk factor for dislocation. It has been theorized that taller patients might have a higher risk

of dislocation because of their longer lever arm attached to the hip, with greater forces transmitted to the hip joint[12].

Several studies have been done to show the relation between preoperative indications for total hip arthroplasty and dislocation rate after total hip arthroplasty. A higher dislocation rate occurs when total hip arthroplasty was performed after trauma and fractures as acute neck femur or in congenital dislocation of the hip, abnormal femoral or pelvic anatomy (e.g., hip dysplasia). It was suggested that the increased range of motion after implantation for fractures when compared with other diagnoses may be a risk factor for instability in this specific diagnosis. Patients lacking the capsular hypertrophy frequently seen in hip arthritis may have a higher rate of dislocation; this is a possible explanation for higher dislocation rates in patients with hip fractures[13].

Another risk factor for dislocation is neuromuscular abnormalites. Because these abnormalites are manifested by muscular weakness specially hip abductors and lack of ability to comply with hip dislocation precautions. The increased dislocation rate reported in patients with psychosis, confusion, dementia, alcoholism, muscular dystrophy, cerebral palsy and other neurologic diseases probably is related to impaired cognition in some patients and inability to control the extremities in others because of contractures, poor muscle control, altered muscle balance and altered body mechanics[14].

Previous hip surgeries predispose to total hip arthroplasty dislocation due to many reasons. Previously operated patients may have compromised abductor function and bone loss or deformity. Bone loss and deformity often lead to compromises in the position and location of component implantation. These compromises can predispose to instability[15].

Some studies have shown that posterior approach has bigger risk factor for dislocation than anterolateral and transtrochanteric approach and the risk increase with hip malformations and prior surgeries. There are two explanations proposed to explain the higher incidence of instability with the posterior approach which are increased tendency to malposition the acetabular component and loss of posterior soft tissue restraints. With a posterior approach in the lateral decubitus position, the pelvis tends to roll anteriorly (by force placed on the femoral retractors) so that the acetabular component falsely appears to be in more anteversion than it is in reality. Disruption of the posterior capsule and short external rotators also plays a role in the higher instability rates associated with the posterior approach. When intact, these structures serve as a checkrein to internal rotation of the hip, but when disrupted, these structures allow posterior dislocation to occur more easily. Careful reconstruction of these structures during closure reduce significantly the dislocation rate after posterior exposures. It is reported a reduction in the dislocation rate from 7.5% to less than 1% with repair of the capsule, external

rotators, and gluteus maximus and also a lower dislocation rate to be associated with anterolateral approach closures that optimize abductor healing and return to function [16,17].

Component orientation is important variable affecting prosthesis instability. However, this factor is unable to be confirmed in all studies. There are probably three explanations for these findings. First, component orientation is difficult to measure accurately on plain radiographs because of pelvic and femoral rotation. Second, the positions of the acetabular and the femoral component interact to provide hip stability. Small but additive malposition of both components in the same hip may be difficult to detect but may lead to significant instability. Isolated malorientation of one component sometimes coexists with a stable joint, provided that the position of the other component compensates. Thirdly is that dislocation is multifactorial outcome. Acetabular component malposition has received the most attention for two reasons: malposition of this component is more frequent, and measurement of the femoral component position on radiographs is more difficult. Extreme acetabular anteversion predisposes to anterior dislocation, retroversion predisposes to posterior dislocation and excessively abducted sockets may lead to a higher risk for lateral dislocation with hip adduction. The authors proposed a safe range of acetabular component position of 15° ± 10° of anteversion and 40° ± 10° of abduction, outside of which the instability rate increased from 1.5% to 6%. Reductions in the

abduction angle of the acetabular component have led to a decrease in the dislocation rate. But excessively horizontal sockets predispose to prosthetic impingement[18].

Soft tissue tension is important factor in total hip arthroplasty instability. Soft tissue tension depends on the location of the acetabular component, orientation of femoral head, neck length, the medial (horizontal) femoral offset[defined as:the perpendicular horizontal distance between the femoral head's center of rotation and the long axis of the femoral stem], the function of the periarticular (abductor) muscles. Proximal placement of the acetabular component or femoral head, short femoral neck,, reduced femoral offset, and proximal migration of greater trochanter tend to decrease soft tissue tension reducing prosthesis stability.Also, proximal cup position can predispose to dislocation by allowing bony impingement of the femur against the pelvis and the final position of the trochanter influences soft tissue tension and hip stability. So instability increases in cases of trochanteric nonunion, especially if associated with proximal migration of at least 1 cm so dislocation is less in patients where an osseous or stable fibrous union of the greater trochanter was obtained[19].

There are other factors related to implant design such as size of femoral head. For the same prosthetic femoral neck diameter, larger prosthetic femoral heads provide greater range of motion before prosthetic impingement between the implant neck and the socket. Greater displacement is required to dislocate