Short Stemmed Femoral Component In Primary Total Hip Arthroplasty

Essay

Submitted for partial fulfillment of
the master degree in orthopedic surgery

By

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2013

Acknowledgment

First and foremost I thank **God** the most merciful, whose magni-ficent help was the main factor in completing this work.

I wish to express my deep gratitude *to* ***Prof.Dr. / Maged Mohamed Samy and Dr. / Tameem Elkhateeb*** for giving me the great honor to work under their eminent guidance, constant support and outstanding encouragement during the progress of this work.

Words are not enough to express my grateful acknowledgement and particular thanks to my professors to whom I am deeply indebted for their keen and generous support.

Again my particular appreciation is due to ***prof.Dr. Maged Mohamed Samy*** for his invaluable supervision and advice.

I am deeply grateful to **my mother and father** *who directed and encouraged me during the preparation of this work.*

Ahmed Mahmoud Elkhateeb

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Introduction

Hip replacement is one of the most effective operations known for hip arthritis and should give many years of freedom from pain after failure of conservative treatment. Surgery is not a pleasant prospect for anyone, but for some people with arthritis, it could mean the difference between leading a normal life or putting up with a debilitating condition. Surgery can be regarded as a part of treatment plan.[1]

Total hip arthroplasty has become a common procedure with generally good long-term results, although it is applied increasingly to younger patients, the procedure has shown correspondingly poorer results. It has been suggested that the use of a short stem could conserve proximal femoral bone, so that more bone might be available should a revision procedure become necessary. Furthermore, a shorter stem could potentially reduce the extent of proximal stress shielding (a phenomenon that has been associated with bone resorption around traditional stems which can lead to implant loosening). Short-stemmed implants may also facilitate the use of a less invasive surgical approach reporting lower blood loss, shorter operating times and greater bone retention. This could potentially lead to faster postoperative recovery as well as improved long-term implant survival rates.[2,3]

To improve this high quality of treatment with shorter prosthesis stems, a targeted approach is required where the implantation must be increasingly bone-preserving, muscle-sparing and anatomically correct, and the shape of the femoral neck must support a shorter stem length and implant size. When attempting to maintain an intact trochanteric musculature and preserve as much femoral bone as possible during the first implantation, the increased life expectancy and therefore increased statistical risk of a surgical revision for younger patients should be taken into account.[4]

A comparative clinical follow-up study of a short and standard stem with a similar design showed that equivalent lifetimes were essentially possible and that intraoperative complications with shorter stems could be reduced.[5] Even the short-stem implants newly developed in recent years follow this hip arthroplasty treatment concept.[6]

Indications to short hip implants are the same indications as traditional hip stems including osteoarthritis, avascular necrosis, rheumatoid arthritis, slipped capital epiphysis, other inflammatory and developmental dysplasia but these short implants could only be used in cases with good bone quality and no gross deformity of the proximal femur.[7]

Short-stemmed endoprostheses in total hip arthroplasty (THA) are classified into two main categories: Femoral neck fixed(femoral neck preserving) endoprostheses, like Thrust Plate prosthesis, Spiron, Cut, Silent, Proxima and CFP stems, and metaphyseal short stem systems (metaphyseal bone stock preserving) which are anchored exclusively in the metaphysis and the proximal part of the diaphysis, therefore, they are much shorter than the classic standard stems, like Mayo,Metha, Nanos and Fitmore hip stem systems.[8]

Aim of The Work

The aim of this study is to review the literature about short stemmed femoral component in the primary total hip arthroplasty as regards technique, advantages, disadvantages and reported results.

History of Total Hip Replacement

The first attempt to replace the hip joint was made by Gluck from Berlin (Germany) in 1880.The prosthesis was manufactured from ivory but it wasn't successful. A second attempt was made by French surgeon Jules Pean from Paris in 1890 with a prosthesis made from platinum but it also failed. It wasn't until 1923 when Smith Peterson from USA invented new replacement prosthesis and the cup was made of glass as an interpositional arthroplasty between the formal head and the acetabulum. Unfortunately, these glass cups frequently fractured as they couldn't withstand the mechanical demand and eventually led to the use of Vitallium. Between 1938 and 1948 Smith Peterson performed 500 Vitallium cup arthroplasties reporting a high percentage of satisfactory results. However,all patients required prolonged physical therapy after surgery and surgical revisions were done to improve motion or to relieve pain.(2)

In 1938 the Judet brothers(9) in Paris invented an acrylic hip prosthesis (fig. 1) but failed again as it became loose and had to be removed.(2)

Fig (1): First Judet stem.[9]

It was obvious that joint replacement couldn't succeed till appropriate materials were found or manufactured till the inventions of a chrome cobalt alloy characterized by high mechanical and surface resistance and also high density polyethylene and bone cement. Initially only the femoral head was replaced using cementless Moore (fig.2) and cemented Thompson prothesis limiting the indications just to femoral neck fractures but it was a highly successful technique still used sometimes nowadays because it is cheap.[2]

Fig. (2): Austin Moore Original Prosthesis.[10]

Austin Moore prosthesis was later used in the Mc Kee Farrar total hip. It was the first metal on metal joint formed by Mc Kee from Britain and later by Herbert from France(fig.3,4). First generation metal on metal bearing was used and they were mostly abandoned due to excessive wear and metal particles release causing metallosis. Also large number of patients developed pain because of loosening of the implants and the desired results were still not achieved.[3]

Fig. (3): McKee Farrar Prosthesis Employing Cement Fixation.[11]

Fig. (4): McKee s Ring Prosthesis Employing Stem Fixation[12]

The first successful series of the total hip prosthesis was reported by John Charnley in the sixties of the last century. The initial prosthesis consisted of a Teflon acetabular cup and a stainless steel femoral component. In order to allow artificial joint to function, he realized that a cartilage substitute was necessary at extremely low friction level as seen in nature. The head diameter used was 22 mm consistent with his idea of low friction arthroplasty. The prosthesis was fixed to bone using Polymethylmethacralyte (PMMA) but actually Teflon proved to be unsuitable as a prosthetic bearing with high wear and tear and was replaced by high density polyethylene. In later designs with this change, the results improved dramatically and the prevalence of osteolysis and bone resorption diminished significantly.[2,3]

The PMMA, known as bone cement, was mixed during the operation and used as a strong grounting agent to firmly secure the artificial joint to the bone. This was really the birth of THR. This led to further development of a socket made of high molecular weight Polyethylene (HMWPE) with wear properties that were 500 to 1000 times better than Teflon[3] (fig.5).

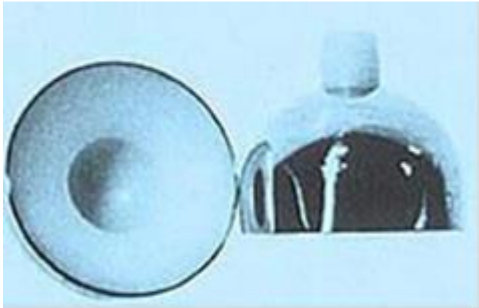

Fig. (5): The UHMWPE Socket Articulated With a Highly Polished Stainless Steel Ball.[10]

Although not the first to introduce THR, John Charnley is appropriately credited as being the father of modern hip replacements. Townley in 1961 performed a hemiarthroplasty using a metal cup mounted on a short, curved, intramedulary stem and inserted over the reamed femoral head. He combined the femoral component with a polyurethane acetabular cup, thus making this a total arthroplasty rather than a hemiarthroplasty. The polyurethane soon deteriorated and was later replaced by polyethylene. The femoral and acetabular components were now attached with cement. This device became known as a total articular replacement arthroplasty (TARA). Although Townley reported excellent results, this device never gained the popularity of other forms of hip replacement.[3]

In the late 1960 and early 1970 numerous surface replacements arthroplasties were developed in the United States and aboard. These included components designed by Wagner in Germany, Freeman in England, and Eicher and Amstutz working in the United States. This latter component known as the THARIES (total hip articular replacement with internal eccentric shells) employed a metallic femoral cup that was articulating with a thin, high density polyethylene acetabular component, both fixed with cement. Initially the results with these components seemed satisfactory, but within a short period of time an alarming failure rate was noted with virtually all designs. The most common causes of failure were loosening of the acetabular component which resulted from fracture of the cement under the extremely thin acetabular shell, loosening of the femoral component,and fracture through the femoral neck. As a result, double cup or surface replacement arthroplasties were abandoned in the early 1980s.(2)

The concept of a bipolar endoprosthesis was introduced in the 50s using Teflon lined metal cups placed over a metallic femoral endoprosthesis. These components were modified, and in 1973 the Giliberty and

Bateman components were introduced. They used metallic cups lined with high density polyethylene that were locked securely onto the head of the metallic femoral component. These were used for the treatment of various arthritic conditions of the hip as well as for femoral neck fractures. Despite the initial enthusiasm that accompanied their use, with time it was found that the bipolar endprosthesis had few advantages over a simpler unipolar prosthesis and were substantially inferior to total hip replacement in the long term results.[2,3]

The era of modern hip arthroplasty in the United States can be dated to 1970 with the introduction of total hip replacement using methylmethacrylate to anchor both the femoral and actabular components. The Charnely and the Mueller prostheses were among the most popular components used in the United States. They were quite similar in a metallic

femoral endoprosthesis articulated with an polyethylene
acetabular component, both of which were anchored to bone using methylmethacrylate. The design of the femoral components was somewhat different. The Charnley components