CURRENT CONCEPTS IN FEMORAL STEM LENGTH IN TOTAL HIP REPLACEMENT

Essay

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Summary and Conclusion

SUMMARY

Total hip Replacement is one of most dramatically successful procedure performed in medicine. Relief of pain & restoration of function are predictably achieved in a very high percentage of cases.

The development of total hip arthroplasty in the sixties by Sir John Charnley represents a milestone in orthopaedic surgery.

Total hip replacement is indicated in degenerative arthritis, rheumatoid arthritis, ankylosing spondylitis, primary and secondary avascular necrosis, ankylosis secondary to previous infections, spontaneous ankylosis, post surgical ankylosis, benign and malignant bone tumors around the hip joint, and hip fracture.

Total hip femoral and acetabular components of various materials and a multitude of designs are currently available. No implant design or system is appropriate for every patient, and therefore a general knowledge of the variety of component designs, as well as their strengths and weaknesses, is an asset to the surgeon.

Selection is based on the patient's needs, anticipated longevity and level of activity, bone quality and

List of Contents

List of Abbreviations

PTFE	**:**	Polytetrafluoroethylene
UHMWPE	**:**	Ultra High Molecular Weight Polyethylene
BHR	**:**	Birmingham Hip resurfacing
THR	**:**	Total Hip replacement
CO/Cr	**:**	Cobalt Chrome
CAD	**:**	Computer Aided design
CAM	**:**	Computer aided manufactured
TM	**:**	Trade mark
FDA	**:**	Food and drug administration
CCD	**:**	Caput Collum Diaphysis
BW	**:**	Body weight
Ti	**:**	Titanium
Al	**:**	Alloy

List of Figures

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بسم الله الرحمن الرحيم

الوا سُبْحَانَكَ لاَ عِلْمَ لَنَا إِلاَّ مَا
عَلَّمْتَنَا
إِنَّكَ أَنتَ الْعَلِيمُ الْحَكِيمُ

صدق الله العظيم

البقرة الآية ٣٢

Introduction

Although substantial progress has been made in the development of cementless total hip arthroplasty (THA) in recent years, a number of limitations remain. The implantation of the femoral component requires a large surface area of bone to be prepared.

To address such limitations, new THA implant designs with shorter stems have been developed. Some designs, such as the IPS™ the Mayo Conservative Hip or the Santori Custom stem have involved shortening or discarding much of the distal stem with the aim of maximizing bone and soft tissue conservation.(1)

In studies of short stemmed femoral implants showed more initial migration than for conventional stems. The short stem implants stabilized when cortical contact was achieved or cancellous bone was compacted sufficiently. Lower cyclic motion of short stems indicate better physiological loading of the bone. Not only intra-operative destruction of the proximal femur is comparatively small but also secondary bone remodeling around the ingrown implant appears closure to physiological conditions.(2)

Due to the specific shape of the stem an adapted insertion technique is required to avoid damage to the great trochanter and gluteus muscles. The broaching and final implant insertion is performed using a slight curved movement.(1)

Biomechanical in vitro tests show that adequate stability can be achieved with the selection of a small implant size and cancellous fixation of the stem when good bone quality is present. Therefore, a sufficient amount of healthy cancellous bone around the implant should already be considered in the pre-operative templating.(1)

Arthrodesis of the hip remains an alternative treatment for severe unilateral arthritis after traumatic injury or infection in young persons successful Arthrodesis provides long term pain relief and allows the resumption of activities. However, over time, a fused hip may be associated with functional disability such as pain in low back region, contra-lateral hip, ipsilateral knee.(3)

There is therefore a need for alternative conservative prostheses. There are two major contemporary issues that are driving the development of conservative implants firstly the increasing popularity of minimally invasive surgery and secondly the desire younger patients to restore of their quality of life.(4)

Chapter (1):

Anatomy of Hip Joint

Anatomy of proximal femur:

The femur is the longest and strongest bone in the human body. Its length is necessary to accomplish the biomechanical needs of gait. Its strength is necessary to transmit the muscular and weight-bearing forces. It is mostly cylindrical throughout its length, and it is anteriorly and laterally bowed in its midportion. The extent of bowing is clinically relevant because if excessive, it may not be possible to utilize long straight implants without considerable under-sizing. The proximal metaphysis and neck are anteverted in relationship to the posterior aspect of the femoral condyles by approximately 15°.**(5)**

Femoral head and neck:

The femoral neck is 5 cm long, narrowest in its mid part and widest laterally, and connects the head to the shaft at an angle of 125° (angle of inclination; neck-shaft angle): this facilitates movement at the hip joint, enabling the limb to swing clear of the pelvis.**(6)**

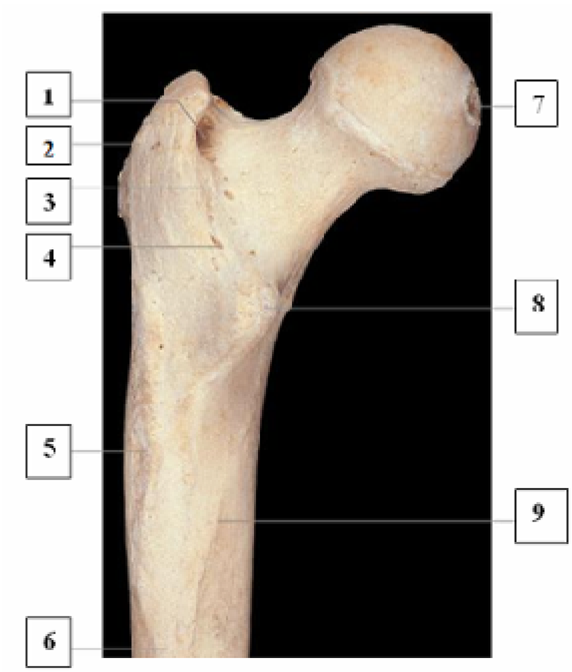

Fig. (1): Proximal end of left femur. (6)

1. Trochanteric fossa.
2. Greater trochanter.
3. Quadrate tubercle.
4. Intertrochantric crest.
5. Gluteal tuberosity.
6. Linea aspera.
7. Fovea for ligamentum teres.
8. Lesser trochanter.
9. Spiral line.

The neck also provides a lever for the action of the muscles acting about the hip joint, which are attached to the proximal femur. The neck is laterally rotated with respect to the shaft (angle of anteversion) some 10-15°, although values of this angle vary between individuals and between populations.

The contours of the neck are rounded: the upper surface is almost horizontal and slightly concave, the lower is straighter but oblique, directed infero-laterally and backwards to the shaft near the lesser trochanter the femoral head is not a perfect sphere, and the joint is congruous only in the weight-bearing position. **(6)**

The orientation is along lines of stress, and thicker lines come from the calcar and rise superiorly into the weight-bearing dome of the femoral head. Forces acting in this arcade are largely compressive. Lesser trabecular patterns extend from the inferior region of the foveal area across the head and superior portion of the femoral neck into the trochanter and lateral cortex. **(6)**

This system is based on the presence or absence of the five normal groups of trabecular in the proximal femur, as described by Ward **(6)**

The trabecular of this region are divided to:

1. **<u>The main system:</u>**
   - **The principle tensile group:** arises from the lateral aspect of the femoral shaft to run an arched course medially to reach the inferior aspect of the femoral head.**(7)**

The principle compressive group:

A rises from the medial cortex of the shaft and the inferior aspect of the neck to ascend along the direction of the compressive forces to the cortical bone of the superior aspect of the head **(Fig. 2)** (also known as the medial system) **(7)**

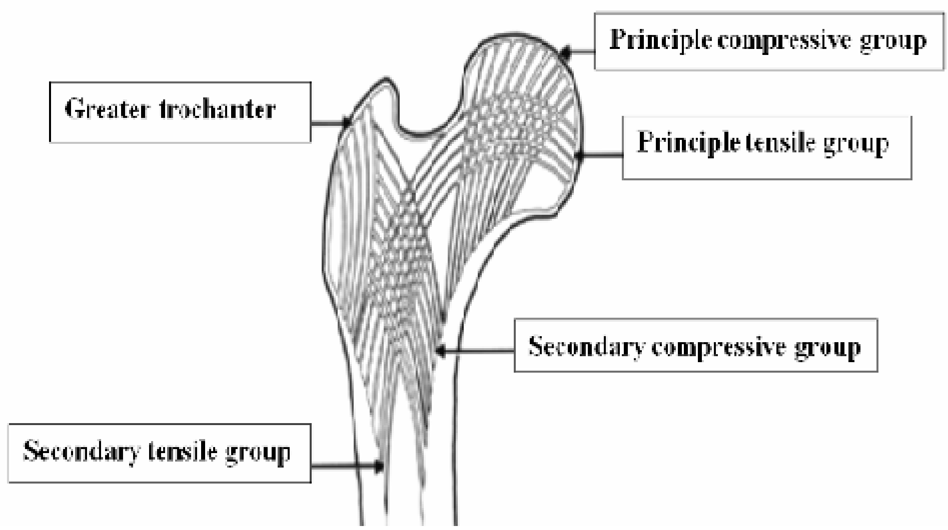

Fig.(2): Anatomy of the bony trabeculae in the proximal end of the femur. In a nonosteoporotic femur the ward's triangle (W) is a small area in the neck of the femur that contains thin and loosely arranged trabeculae only.**(8)**