Aseptic Loosening
Of Total Hip Arthoplasty
(An Updated Review)

An Essay

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Abstract

For all three bearing couples proper ace tabular component positioning prevents some of the complications associated with theses alternative bearings as cross-linked polyethylene fracture ceramic – on – ceramic squeaking impingement wear and metal –on- metal runaway wear oteolysis.

Key word:

Loosening

Review

Arthoplasty

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List of abbreviations

THA	Total hip arthroplasty
NSAID	Non steroidal ant inflammatory drugs
PE	Polyethylene
EM	Erythromycin
RANKL	Receptor activator of nuclear factor kappa B-ligand
OPG	Ostoprotegerin
MDP	Methylene diphosphonate
PET	Positron emission tomography
RSA	radiostereometric analysis
FDG	Fluorodeoxyglucose
COX	Cyclooxygenase
PGE2	Prostaglandin E2
TNF-α	Tumour necrosis factor alpha
RA	Rheumatoid arthritis
IL	Interleukin
TGF-B	Transforming growth factor -beta

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Introduction

Total hip arthroplasty (THA) is one of the most successful and effective procedures developed for treatment of pain associated with end stage hip arthritis. Long-term follow-up studies report a survivorship greater than 80% at 20 years after surgery. As a result of this success, there have been an increasing number of prostheses implanted into younger, more active individuals. This increased functional demand is coupled with increased implant wear rates with standard bearing materials. Subsequently, there are numerous mechanisms of failure that limit the long term success of hip arthroplasty **(Callaghan et al., 2000)**.

Aseptic loosening is the most common cause for implant failure accounting for 75% of cases. This followed by infection(7%), Recurrent dislocation (6%), Periprosthetic fractures (5%), and technical error at the time of surgery (3%).Aseptic osteolysis and subsequent implant failure occur because of chronic inflammatory response to implant derived wear particles **(Dobzyniak et al., 2006)**.

In aseptic loosening of total hip arthoplasty there is no involvement of bacteria. It can be mediated by several factors, either biological which results from wear particles produced from gliding surface of artificial joint and provoke a chronic, granulomatous inflammatory reaction which triggers oestolysis or mechanical factor due repeated cyclic stresses imposed by every day activities on the bond between prosthesis and the skeleton **(Archibeck et al., 2000)**.

Some authors associate the risk of failure with the thickness of the cement mantle **(Stolk et al., 2002)**, numerical and experimental studies refer the minimum thickness of 2 mm to obtain good results **(Mann et al., 2004)**.

Many authors suggest that a thick cement mantle guarantees long-term stability, thickness higher than 2–3 mm reduced cement stresses **(Ramaniraka et al., 2000)**, more cracks were found in ex vivo thin cement mantles **(Ramos et al., 2008)**.

Hertzler et al. refer that the decrease of the thickness of the cement mantle decreases the time for a crack breakdown of the entire mantle **(Hertzler et al., 2002**). The study showed cracks grow rates for different mantle thickness, but used a simplified geometry.

Another question is to know were do the cracks begin, on the cement–stem interface or at the Cement–bone interface? Race et al. refer the higher probability of cracks at cement–bone interface **(Race et al., 2003).**

Kadakia et al. studied the Charnely stem with a mean cement thickness 4.5 mm and the higher probability of cracks to begin at the cement–bone interface **(Kadakia et al., 2000**).

Other factor that can influence the behaviour of cement is porosity **(Jeffers et al., 2007)**, some studies analysed the influence of porosity on cement behaviour **(McCormack and Prendergast 1999)**.

Relatively to the hip implant, there are several types and geometries, and surgeon has large freedom to choose. Each hip replacement has its philosophy and experimental technique.

A loose total hip joint lies in a cavity that is padded with loose connective tissue. The total joint moves i.e. it changes its position within this cavity. This motion may be apparent on successive x-ray and it maybe the first sign that total joint is gone loose. The stem of the total hip sinks deeper in the femoral bone and the cup migrates **(Archibeck et al., 2000)**.

Early loosening is often painless, therefore regular clinical and radiological view has been recommended to identify and treat it at an early stage.

Aseptic loosening was more commonly related to the cup and needed to be revised earlier than stem. The picture of loose artificial joints is always the same. The layer of bone tissue that was adherent close to the artificial joint is replaced by a layer of loose connective tissue that separate the implant from its bone. This layer is transparent for x-ray pictures. The layer of loose tissue forms a dark line interposed between the radiopaque contour of the skeleton and the contour of the artificial joint. Although these lines are dark, the surgeons speak about radiolucent line **(Dilmma et al., 2003)**.

Loosening of the cup often produces no pain and is usually lately detected. As soon as micromovement at the implant bone interface has begun there is progressive destruction of bone. Because of this symptomless interval, loss of bone stock may be massive before the patient seeks advice. If the patient experiences discomfort or even pain from their total hip joints and the x-ray pictures show signs of incipient aseptic loosening, the first step usually ordered by the surgeon is a restricted weight bearing regime and often this may be all that is needed. The loose prosthesis may find a new stable position, the discomfort and pain disappears, and the radiolucent line seen on the x-ray does not progress. If the radiolucent lines on x-ray pictures widen and if the pain and other discomfort from the artificial joint increase then a revision operation becomes necessary **(Archibeck et al., 2000)**.

Aim of the work

The aim of the present work is to review the subject of aseptic total hip arthroplasty loosening regards:-

1-Definition
2-Aetiology
3-Pathology
4-Diagnosis
5-Treatment

Surgical Anatomy of the Hip Joint

The hip joint is the pivot upon which the human body is balanced in gait. It is a multiaxial joint of the ball and socket type. The head of the femur articulates with the cup shaped fossa of the acetabulum. The hip joint is characterized by high degree of both stability and range of motion. Its stability is largely the result of adaptation of the articulating surfaces of the acetabulum and the femoral head to each other and its great range of motion results from the femur having a neck that is much narrower than the equatorial diameter of the head and also because of the distance from the hip centre of rotation to the greater trochanter **(McMinn and Harty. 1994)**.

Bony Articulation of the Hip Joint:

A-Femur:

The head of the femur is more than half a sphere. It is directed upwards medially and slightly forwards to articulate with the acetabulum. The head is completely covered with articular cartilage, except over the fovea to which the Ligament of the head is attached **(Hanssen. 1996)** .

The neck of the femur is about 5 cm long connecting the head and the shaft. It is narrowest at is middle and is wider at its lateral than its medial end. The upper border is nearly horizontal and is gently concave upwards, the lower border is straight but oblique and is directed downwards, laterally, and backwards to meet the shaft near the lesser trochanter **(McMinn. 1994)**.

The femoral neck has two important angular relationships with the femoral shaft; the angle of inclination of the neck to the shaft in the frontal plane [the neck-shaft angle] and the angle of inclination in the transverse plane [angle of anteversion]**; (Hanssen 1996)**.

Freedom of the hip joint is facilitated by the neck shaft angle, which places the femoral shaft away from the pelvis laterally to enable the lower limb to swing clear of the pelvis.

The anatomical valgus position of the femoral neck on the femoral shaft allows the abductor muscles considerable functional advantage as they counterbalance the body weight in the frontal plane during one-legged stance. The neck shaft angle ranges from115° to 135° with an average of 125°. The angle of anteversion is the angle between the head-neck segment and the transcondylar axis (line along the posterior aspect of the femoral condyles). This angle provides the gluteus maximus with a lever arm to increase its effectiveness. It averages about 14° with a range from 12° to 20°.

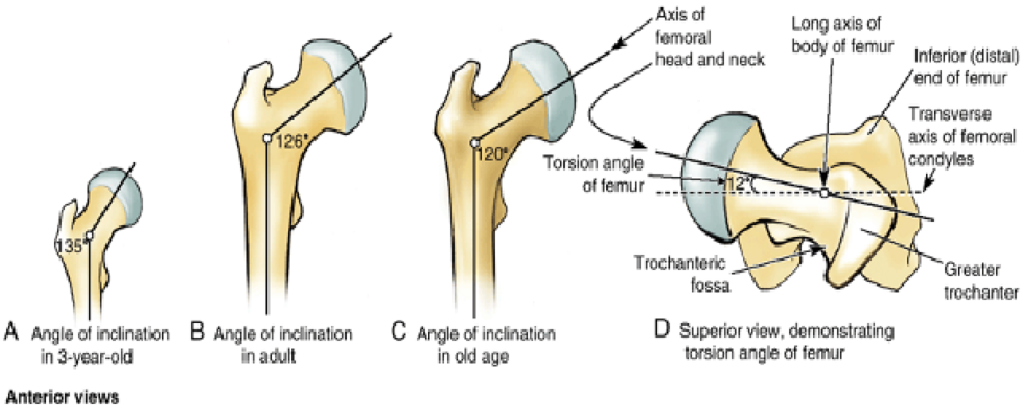

Figure 1: Angle of anteversion and angle of inclination of the femur (**Harty 1984)**.

B- Acetabulum:

The acetabulum is formed by fusion of the three components of the hip bone; ilium, ischium and pubis meeting at a y – shaped cartilage, which forms their epiphyseal junction. The epiphysis closes after puberty. The acetabular articular surface covered with hyaline cartilage is a c- shaped concavity. Its peripheral end is deepened by a rim of fibrocartilage (acetabular labrum) which encloses the femoral head beyond its equator, thus increasing the stability of the joint. The labrum is continued across the acetabular notch as the transverse acetabular ligament giving attachment to the ligament of the femoral head.

The central non–articular part of the acetabulum is occupied by a pad of fat (Haversian pad or pulvinar fat); **(Harty 1984)**. The cavity of the acetabular labrum faces obliquely forward, outward, and downward. A mental visualization of acetabular orientation is essential when directing the reamer for preparation of the acetabulum. A plane through the circumference at its opening would intersect with the sagittal plane at an angle of 40° opening anteriorly, and with the transverse plane at an angle of 60° opening lateral **(Hanssen 1996)**.

Applied Anatomy of the Posterior Hip Structures:

The muscles covering the posterior aspect of the hip joint forms a two layered sheath. The outer layer consists of the gluteus maximus. The inner layer consists of the short external rotators of the hip; the piriformis, the superior gemellus, the obturator internus, the inferior gemellus and the quadratus femoris. The sciatic nerve runs vertically between the two layers down through the operative field **(Moore. 1959)** .

The gluteus maximus inserts partially into the iliotibial tract and partially into the gluteal tuberosity of the femur. Also inserting into the iliotibial band but further anteriorly is the tensor fasciae lata to form a continuous fibromuscular sheath (the outer layer of the hip musculature). As Henry noted the layers can be viewed as a pelvic deltoid, it covers the hip as much as the deltoid muscle covers the shoulder **(Henry 1972)**.

The outer layer can be breached at different points each of which changes the posterior approach. The most natural separation is at the anterior border of the gluteus maximus (inferior gluteal nerve) and the gluteus medius (superior gluteal nerve). This known as the Marcy-Fletcher approach which uses a true internervous plane **(Marcy and Fletcher 1954)** . Other more posterior approaches like Moore approach and Osborne approach involve splitting of muscle fibers **(Osborne 1930)**. They are more popular than the Marcy – Fletcher approach and provide wide exposure to the hip joint. The inner layer is formed of 5 muscles; the piriformis, the superior gemellus, the tendon of obturator internus, the inferior gemellus and the quadratus femoris. There are critical neurovascular structures that enter the buttock from the pelvis and pass through the greater sciatic notch including ; the superior gluteal nerve and artery which pass above the piriformis and the inferior gluteal nerve and artery , the sciatic nerve , the posterior femoral cutaneous nerve and nerve to quadratus femoris.

The sciatic nerve which is formed by the roots from the lumbosacral plexus (L4, L5, S1, S2, S3) appear in the buttocks from beneath the lower border of the piriformis muscle. It is usually surrounded by fat and is often easier to feel than see. It passes vertically down the buttock with its artery lying on the short external rotator muscles distally. It passes deep to the biceps femoris muscle to be divided into two main branches in the middle of the back of the thigh the largest division is medial popliteal nerve which ends at the lower border of