Comparison Between Hydroxyapatite And Porous Coated Cementless Total Hip Arthroplasty

Essay
Submitted for Fulfillment of the Master Degree in Orthopaedic Surgery

Presented by
Mohamed Farouk Hamed
M.B., B.Ch.

Supervised by

Prof. Dr. / Ahmed Ahmed Morrah
Professor of Orthopaedic Surgery
Faculty of Medicine
Cairo University

Dr. / Sherif Abd Ellatif Osman
Lecturer of Orthopaedic Surgery
Faculty of Medicine
Cairo University

Faculty of Medicine
Cairo University
2009

بسم الله الرحمن الرحيم

Abstract

The porous coated prosthesis had made better results in the total hip arthroplasty procedures especially in young patients, but the problems of stress shielding, thigh pain, osteolysis and metal ion toxicity remain as an area of concern.

The hydroxyapatite (HA) coated prosthesis led to better bone ingrowth, biocompatibility, corrosion resistance and better results in young patients and those with avascular necrosis of the head of the femur but still there are concerns about the degradation of the HA coating, and the fear whether HA debris increase polyethylene wear or osteolysis.

Key Words :

Primary fixation, Secondary fixation, Prosthesis stability, Biological fixation.

Acknowledgements

I would like to present my great thanks and wish to express my deepest gratitude to **Professor Dr./Ahmed Ahmed Morrah**, Professor of Orthopaedic Surgery, Faculty of Medicine, Cairo University, for his full support, continuous encouragement, construcive criticism and faithfull guidance regards this study and throughout my career as well. Without his help, support and guidance throughout this study, it would have been an impossible task to be done.

I feel greatly indebted and thankfull to **Dr. / Sherif Abd Ellatif Osman**, Lecturer of Orthopaedic Surgery, Faculty of Medicine, Cairo University, for his full assistance, kind co-operation, great effort and contructive notes which made me able to carry out this work.

Special thanks to all my family members; father, mother, wife and son for their endless help and great love which made me able to do everything in my life.

Contents

List of Figures

List of Abbreviations

AML : Anatomical Medullary Locking

APS : Air Plasma Spraying

BCP : Biphasic Calcium Phosphate

CB : Cancellous Bone

CoCr : Cobalt-Chrome

CoCrMo : Cobalt-Chrome-Molybdenum

CP : Commercially Pure

CT : Cortical Thickening

DEXA : Dual-Energy X-ray Absorbtiometry

FDA : Food and Drug Administration

HA : Hydroxyapatite

HAC : Hydroxyapatite Coated

HHS : Harris Hip Score

HIPed Al_2O_3 : High Isostatic Pressed Alumina

JRI : Joint Replacement Implants

PCA : Porous-Coated Anatomic

PMMA : Polymethylmethacrylate

PTEF : Polytetrafluoroethylene

PVD : Plasma Vapor Deposition

RLLs : Radiolucent Lines

RSA : Radiosteriometric Analysis

TCP : Tricalcium Phosphate

THA : Total Hip Arthroplasty

THR:	Total Hip Replacement
Ti-6Al-4V:	Titanium-6 Aluminium-4 Vanadium
UHMWPE :	Ultra High Molecular Weight Polyethylene
VPS :	Vacuum Plasma Spraying

Introduction

Introduction

Total hip arthroplasty (THA) continues to be one of the most successful surgical procedures performed today.

Before the advent of total hip replacement, patients who had end stage arthritis of the lower extremity had unremitting pain and greatly decreased functional capacity. In addition, they often were confined to a wheel-chair and were dependent on the care of others. Prosthetic joint replacement has dramatically improved the lives of millions of people worldwide, [Schmalzried & Callaghan, 1999].

Total hip replacements have been common procedures for over 40 years. Clinicians performing total hip replacements seek prosthesis that reduce pain, have high survival rates, enhance stability and preserve bone in patients, [Schmalzried, 2006].

Good clinical results have been reported with the use of both cemented and cementless components for total hip arthroplasty. And although within each category there are a variety of design options from which to select, criteria for determining the most appropriate femoral stem for a primary total hip arthroplasty continue to elicit debate, [Bourne & Rorabeck, 2000].

The research continuous to improve results, to relieve pain, to reduce disability and to correct deformity.

Cementless femoral stem implantation has become a reliable technique that yields excellent results in selected patients undergoing total hip arthroplasty (THA). As stem designs and biomaterials have evolved, many cementless femoral stems have proved effective and reliable. With regard to rehabilitation, a period of initial protected weight bearing has remained the standard for cementless femoral stems. Avoiding micromotion to allow bone ingrowth prior to weight bearing has been advocated for prevention of implant subsidence and for avoiding fibrous ingrowth at the bone-implant interface, [Taunt et al., 2008].

In response to the problem of loosening of the stem and cup based on the alleged failure of cement, porous coated and hydroxyapatite coated stems and cups are being investigated as ways to eliminate the use of cement and to use bone ingrowth or ongrowth as means of achieving durable skeletal fixation, [Daniels & Harkess, 2003].

Hydroxyapatite and hydroxyapatite-tricalcium phosphate coatings may be applied to nonporous or porous surfaces (e.g., grit-blasted or fiber-mesh surfaces). Bone formation on an implant with a nonporous surface is termed ongrowth, whereas porous surfaces can have both ongrowth and ingrowth into the pores. Rough titanium plasma-sprayed surfaces are usually classed along with porous surfaces, and the bone attachment is frequently referred to as ingrowth, [Dumbleton & Manley, 2004].

Cementless porous coated total hip prosthesis were introduced in the hope of increasing the long term success rate of hip replacement in younger and more active patients, [Burke et al., 1991].

As problems related to the porous coated system began to emerge, specially the stress shielding and loosening rates, the interest in biologically acting calcium phosphate ceramic materials for orthopaedic application has increased.

Hydroxyapatite and tricalcium phosphate are the most widely evaluated materials by Osborne in 1982. The first trial of total hip replacement by this type of prosthesis was done by Furlong in 1985, [Furlong, 1991].

These materials preserve adequate implant strength while presenting an exquisitely biocompatible surface to the surrounding bone which provides a better degree of bone-implant osseous integration without an intervening fibrous membrane, [Daniels & Harkess, 2003].

History of Cementless Total Hip Arthroplasty