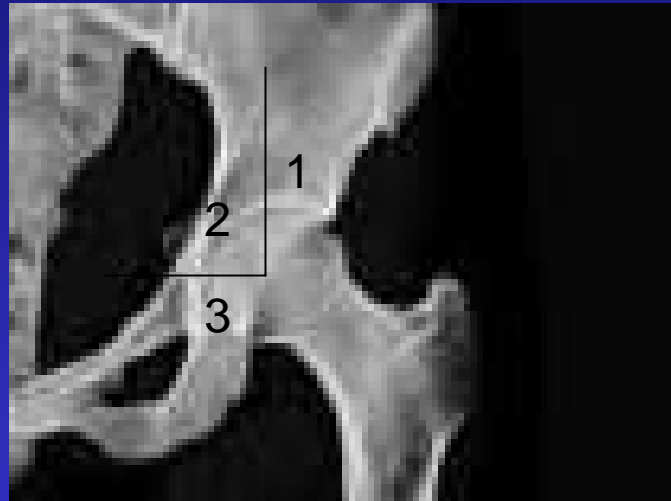


Polyethylene Wear in Total Hip Replacement

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- Three Delee-Charnley zones :-



- What is the first sign of loosening ?

What is the Goal in THR

- 1- Removal of loose component without significant destruction of host bone and tissue .
- 2- Reconstruction of bone defects with bone graft and / or metal augmentation .
- 3- stable revision implant .
- 4- Restoration of normal hip center of rotation .

Defect Classification

- 1- Segmental : loss of part of the acetabular rim or medial wall .
- 2- Cavitory : Volumetric loss in the boney substance of the acetabular cavity .
- 3- Combined deficiency : combination of segmental bone loss and cavitory deficiency .
- 4- Pelvic discontinuity : complete seperation between the superior and inferior acetabulum usually due to combined deficiency and fracture.
- 5- Arthrodesis : obliteration of the acetabulum .

Osteolysis and wear

- [1] Wear source – generate particulate debris .
- [2] Initiates the osteolytic reaction .
- What are the wear sources :-
- 1- UHMPE
- 2- PMM
- 3- Co-Cr
- 4- Ti
- [3] Particle ingested by macrophage .
- [4] Activated macrophage liberate osteolytic factors
- [5] Dissolution of bone around prosthesis .
- [6] allowing prosthesis micromotion
- [7] Leads to further generation of wear debris .

Osteolytic Factors

- 1- IL1
- 2- TNF alpha
- 3- Prostaglandins .
- 4- Oxide Radicals .
- 5- H₂O₂
- 6- Acid Phosphatase (Dissolve Bone)

- Osteolytic process -> inflammatory response generate within the joint .
- Lead to increase hydrostatic pressure inside the joint .
- Dissemination of particles debris within the effective joint space which can be pumped to the prosthetic surface also .
- The debris size (0.2 μm – 7 μm) micron or submicron size .

How The wear particles generate

- [1] Abrasive Wear :-
- rough articular surface (scratches, carbide, asperities)
- [2] Third-body particles -> abrasive wear
- [3] Adhesive Wear PE beads .
- Combination of abrasive and adhesive can generate billions of particles .
- So reduce adhesive at primary articulation and reduce abrasive within the total joint construct .

Sterilization

- The component sterilize via radiation
- 1- Irradiated PE undergoes intermediate step of free radical formation .
- 2- four path ways can be taken (recombination, unsaturation, chain scission, or cross-linking)
- 3- in presence of o₂ environment, oxidized PE is favored .
- 4- without o₂ environment, cross-linked is favored .

Cross-linked

- Advantage :-
- Improve resistance to adhesive and abrasive wear .
- Improve wear rates in wear simulator data.
- Disadvantage :-
- Diminish the mechanical properties -> may fail catastrophically if excessive stress are applied .

Packing technique

- [1] oxidize PE causes subsurface delamination and cracking .
- [2] ethylene oxide gas sterilization or peroxide gas plasma sterilization (may have deleterious effects on the surrounding human tissues .
- [3] Modern Packing with free O_2 , achieved via:-
- Argon, nitrogen, or vacuum packing .

Prosthetic Articular Bearing

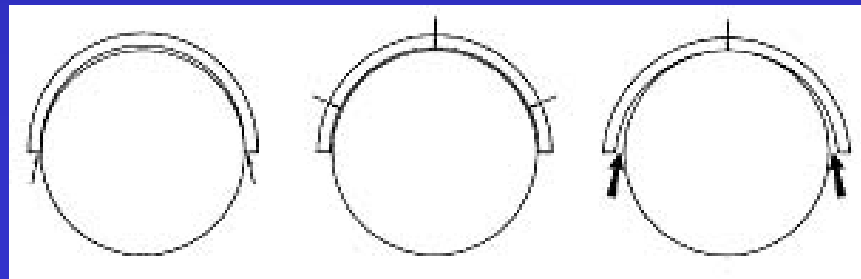
- The traditional bearing is “ hard-on-soft couple”
- Co-Cr alloy or Ti alloy mated to PE cup.
- Ceramic head (alumina ceramic or zirconia ceramic) mated to PE cup .
- Ti alloy heads should be avoided (Third body debris)

Co-Cr-PE

- Optimum wear is realated to the roughness of the head surface and it is sphericity .
- Residual roughness is a result of carbide asperities (pick up from surface after polishing .

Ceramic

- Residual pits within the surface cause the surface to be rough .
- The synovial fluid with its long chain protein can cause boundary lubrication can separate the two surfaces enough to prevent severe wear .



Hard-on-hard

- Ceramic on ceramic :-
- It has less formation of a granulomatous tissue that ultimately invades the bone-implant interface and results in aseptic loosening and/or the related phenomenon of osteolysis that may travel through the screw holes
- Pidhorz LE, Urban RM, Jacobs JJ, et al. A quantitative study of bone and soft tissue in cementless porous coated acetabular components retrieved at autopsy. *J Arthroplasty*, 1993;8:213-225
- Summer DR, Jasty M, Jacobs JJ, et al. Histology of porous-coated acetabular components: 25 cementless cups retrieved after arthroplasty. *Acta Orthop Scand* 1993;64:619-626

Survival ratio of polyethylene

- 25 y survival. Exceed 90% with wear rate $< 0.1\text{mm/y}$
- 20 y survival $< 30\%$ with wear rate $>0.2\text{mm}$
- 25y nonsurvival. For every additional mm .
- Relationship of acetabular wear osteolysis and loosening in THA, David H. Sochart, MB, ChB, MD Clinical orthopedics and related research 363 : 135-150, 1999

Age – Gender - Weight

- In Porous-coated acetabular metal shells in patients less than 50y was excellent after a mean duration of follow up 11y
- No relation between the wear and gender , weight, polyethylene thickness, the abduction angle, or the femoral neck length .
- Non cemented has better results than cemented acetabular cup .
- Survival and polyethelene wear of porous-coated acetabular components in patients less than fifty years with follow up min 9y old, James D. Crowther, M.D and Paul F. Lachiewicz , JBJS

Types of acetabular cups

- Fixation with press-fit technique .
- Augmentation with screws .
- Pegs
- Hydroxyapatite coating .
- Comparison in 81 patients for cup migration and wear over 5 y.
- H.A has tendency of less proximal migration , and with hardly any signs of radiolucent lines .
- Cups with screws or pegs has more radiolucent lines and osteolytic lesion .
- Increase also in young age and female gender .
- Effect of augmented cup fixation on stability wear, and osteolysis, Stephan M. Rohrl, M.D Bosse Nivbrant, M.D, PhD, Hakan Strom, M.D and Kjell G. Nilsson, M.D PhD the journal of arthroplasty Vol 19 no 8 2004