“Evolution of the Modern Hip Replacement”

Prof Eric Masterson, Consultant Orthopaedic Surgeon, Bon Secours Health System, Irish representative to the European Hip Society
The Evolution of the Modern Total Hip Replacement

Professor Eric Masterson BSc MCh FRCSI FRCS(Orth)
History of Total Hip Replacement

- 1800 – 1900s – Surgeons used various tissues, fascia lata, skin, pig bladder and submucosa between the femoral head and acetabulum
- 1891 German surgeons (Gluck) used ivory to replace femoral head for patients whose femoral heads were destroyed by tuberculosis
History of Total Hip Replacement

- 1925 – Smith- Peterson created first mould prosthesis out of glass
- 1930s – Smith-Peterson and Wiles trialled stainless steel prosthesis
- 1938 – Judet developed short stemmed acrylic prosthesis
- 1938 – Wiles total hip utilises nail and plate.
- 1939 – Thompson and Moore developed monobloc femoral stems
History of Total Hip Replacement

• 1947 – Scott-Venable developed Vitallium prosthesis
• 1951 – Haboush implanted first metal on metal resurfacing
• 1951 – McKee develops first cementless metal on metal THR
• 1956 – Sivash developed cementless THR
History of Total Hip Replacement

- 1960s – Charnley starts to develop low friction arthroplasty
  - PTFE Double cup implant
  - Numerous materials (Teflon, plastic)
  - Acrylic resin as method of fixation
  - 22mm articulation
  - High molecular weight polyethylene (HMWPE)
  - ‘Greenhouse’ clean air enclosure
History of Total Hip Replacement

• 1960s
• Peter Ring develops cementless MoM
• McKee/Farrar develops first cemented metal on metal
• Metal and metal from Sulzer
  • Huggler & Muller
History of Total Hip Replacement

- 1966 – Muller doesn’t want to follow same route as Charnley and develops curved Muller stem with 28 & 32mm articulation
- 1970 – Boutin develops ceramic on ceramic
- 1977 – Muller develops the straight stem
- 1977 – Boutin develops modular ceramic bearing
History of Total Hip Replacement

• 1970s – Smith-Peterson cemented metal on poly resurfacing
• 1970 – First Exeter hip stem implanted (tapered, polished)
• 1970 – Ring metal on metal
• 1971 – Judet develops prosthesis with ‘direct anchoring’
• 1971 – Freeman & Furuya conduct poly on metal resurfacing
• 1972 – Zimmer GB launch Stanmore Stem
• 1974 – Lord develops prosthesis with balls for cementless fixation
History of Total Hip Replacement

- 1970s see development in differing cement philosophies
  - Taper slip (Exeter, CPT etc)
    - Full cement mantle (2-4mm) and stem subsidence
  - Composite Beam (Stanmore, Charnley)
    - Perfect bonding at the stem-cement interface. Contact between stem and bone in M/L plane aims to promote additional stability
  - French paradox
History of Total Hip Replacement

- 1970s Cement disease
  - Early failure of cemented stems with first generation cementing technique was frequent.
  - Attributed to localised areas of bone destruction and resorption. (osteolysis)
  - Initially thought to be infection, but was subsequently attributed to local inflammatory response to cement particles
History of Total Hip Replacement

- 1970s rise in cementless stem development
  - Lord
  - Judet
  - Autophor Mittlemeier
History of Total Hip Replacement

- 1970s rise in cementless stem development
  - Full circumferential fixation
  - Distal fixation/loading of the femur
  - Stress loading in diaphysis = thigh pain
  - Osteopenia
  - Proximal bone resorption
History of Total Hip Replacement

- 1977 – Engh and Zweymueller development cementless stems
- 1978 – Wagner develops metal on poly resurfacing
- 1980s – Sulzer metal on metal
- 1980s – Second generation cementing technique
- 1983 – Biomet launch Taperloc with plasma sprayed titanium coating
History of Total Hip Replacement

• 1980 cementless components evolve because of ‘particle disease’
  • Stems incorporate circumferential coating to aid osseo-intergration
  • Cups designs vary on geography
  • Threaded versus coated?
History of Total Hip Replacement

- 1987 – Wagner introduced long splined revision stem
- 1988 – Exeter modular stem launched
- 1990 – Zimmer launch CPT
- 1990’s – Introduction of highly cross linked polyethylene (HXLPE)
- 1990’s – Corin introduce Birmingham metal on metal resurfacing
- 1991 – 3M launch Capital Hip (Low cost Charnley hip copy)
- 1995 – CeramTec launch Biolox Forte ceramic
- 1999 – Implex introduce Hydrocel to market (Trabecular metal)
History of Total Hip Replacement

- 2002 – ODEP set up to monitor NICE hip guidelines
- 2002 – National Joint Registry for England and Wales
- 2004 – CeramTec launch Biolox *delta* ceramic
- 2005 – DePuy launch ASR
- 2005 – Total Hip Replacement reclassified as Class 3 Device
- 2010 – Biomet launch first vitamin E stabilised polyethylene
- 2014 – Beyond Compliance set up to help reduce risk
The Five R’s

• 1. Resection

• 2. Realignment

• 3. Replacement

• 4. Resurfacing

• 5. Arthrodesis
Girdlestone Arthroplasty
Intertrochanteric osteotomy
Periacetabular Osteotomy
Hip arthrodesis
Ring Prosthesis
Fixation Techniques

Cement Versus No Cement
Cementing Techniques

1st generation: digital insertion

2nd generation: canal occlusion, thorough bone cleaning, cement gun

3rd generation: vacuum mixing, centrifuge cement, centralisers
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HARRIS-GALANTE II
G7 Instruments and Surgical Technique
Cemented or Uncemented Implants?

- Uncemented THRs are quicker
- Uncemented cups last longer
- Well cemented & Uncemented stems are equivalent
- Cemented stems have a role in old, soft bone
- Cemented components are cheaper
Bearing Surfaces in Total Hip Replacement:

Metal

Plastic

Ceramic
Polyethylene liners
Metal Liners
Developed in conjunction with healthcare professionals.

G7 ACETABULAR SYSTEM
Surgical Technique

Ceramic liners
The Hip Resurfacing Experiment
Birmingham Hip Resurfacing
Hip Resurfacing

- Birmingham Hip Resurfacing still in production
- ASR (De Puy) withdrawn
- Technically demanding
- Inferior Registry Data
- Concerns over Chromium & Cobalt ion levels
- Concerns over ARMD, ALVAL
- The Lawyers dream
Choice of Surgical Approach to the Hip
Minimally Invasive Hip Replacement
Minimally Invasive Hip Replacement

- Industry-led
- Inappropriate marketing tool
- Higher complication rates
- Reductions in inpatient stay from improved patient education, not smaller skin incisions
Choosing a THR in 2018

- The Patient
- The Surgeon
- The Healthcare Provider
Patient perspective:

“My THR should..”

- Allow normal function
- Never loosen
- Never wear out
- Never dislocate
- Never become infected
Surgeon Perspective

- Ease of insertion
- Immediate stability
- Friendly instruments
- Sufficient modularity
- Allow normal bone loading
Healthcare Provider Perspective

Value For Money
Patient: “My THR should never come loose”

- Predictable osseointegration
- Initial stability
- Cemented implants for the elderly
- Minimal wear-related osteolysis
Patient: “My THR should never dislocate”

- Range of head sizes
- Minimize cup/stem impingement
- Compromise between head size & liner thickness
- Availability of constrained & dual-mobility options
Bearing Surfaces appropriate to age and activity level:
- Metal/Polyethylene
- Metal/Metal
- Ceramic/Polyethylene
- Ceramic/Ceramic

Patient: My THR should never wear out
Patient: “My THR should never become infected”

- General anti-infection measures
- Antibiotic-impregnated bone cement
- Anti-bacterial coatings on uncemented implants
Surgeon requirements: The Acetabular Component

- Easy instruments
- Predictable initial scratchfit
- Predictable liner locking mechanism
- Range of screw & liner options
- Sufficient size range
- Good porous ingrowth surface
Surgeon requirements: Femoral Components

- Sufficient range of stems to fill the medullary canal & reproduce offset
- Proximal porous coating with metaphyseal loading preferable
- Predictable initial stability to allow immediate weight-bearing
- Predictable porous ingrowth surface
- Availability of cemented options for elderly bone
And finally, the healthcare provider...
It’s a battle...
Future Challenges

• We now have a predictable THR with 99% good results at 10 years

• Minor technical improvements will continue

• The main challenge lies in future population demographics
We are facing huge challenges
Garry likes his shooting...
Thank You