Evolution of Stem Design: shape, coatings, and collars

… how did we arrive where we are today?

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Disclosure

The UCSF Department of Orthopaedic Surgery receives research from private, public, and non-profit entities that includes patients, payers, and technology providers.

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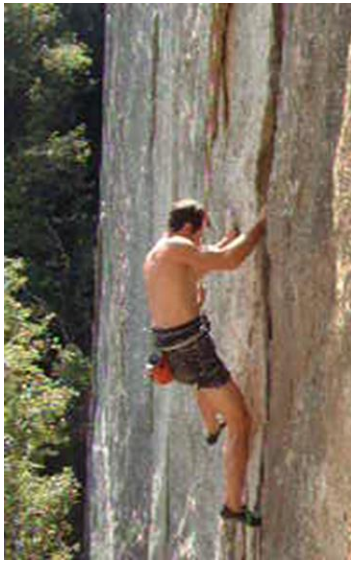
The functional demands of our patients and our own success have **driven constant change**.



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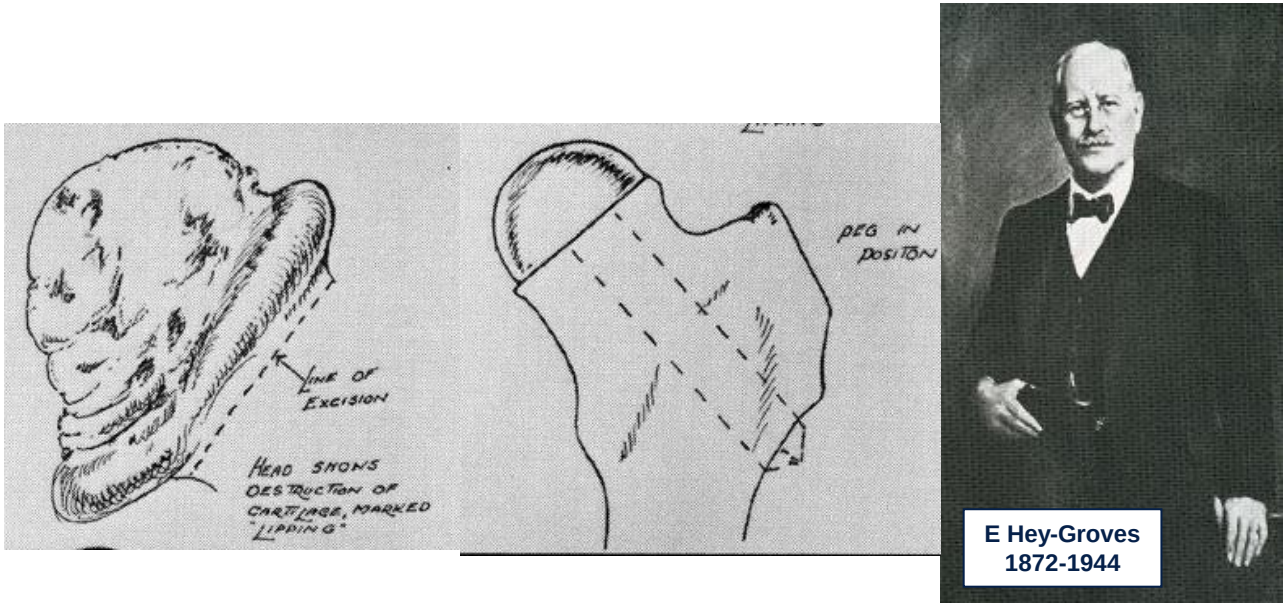
- **Charnley** discouraged anything but **strenuous walking** after THA
- Since 1970 the average **life expectancy** of a total joint patient has increased 28%.
- The prevalence of **college education** among the 65+ age group has nearly tripled in the past 30 years.
- The average age of our patients has changed little (68 years), but the **very young and the very old/high morbidity patients** are now commonly being operated upon.

History and the early innovators – still relevant…



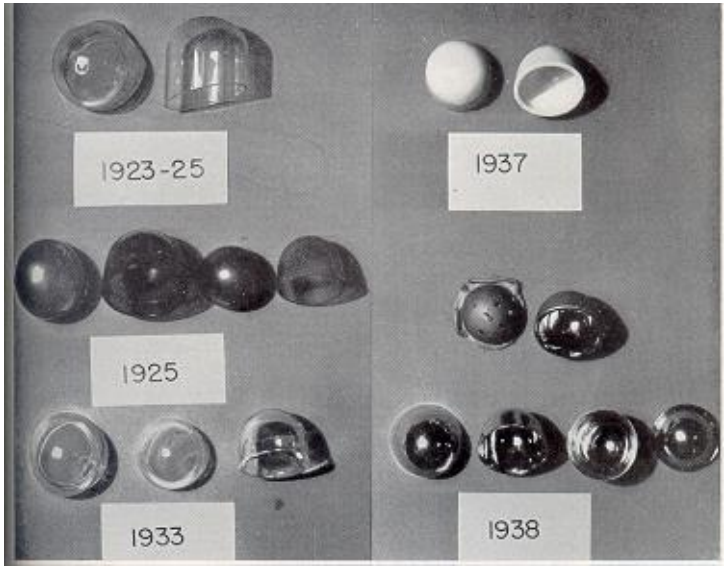
Symposium on surface replacement of the hip; Evolution and development of surface replacement arthroplasty; Marvin E Steinberg; Orth Clin of North Am; Vol 13, No. 4; Oct 1982

First generation: *Mold and interposition arthroplasty*

Glass

Viscaloid

Pyrex

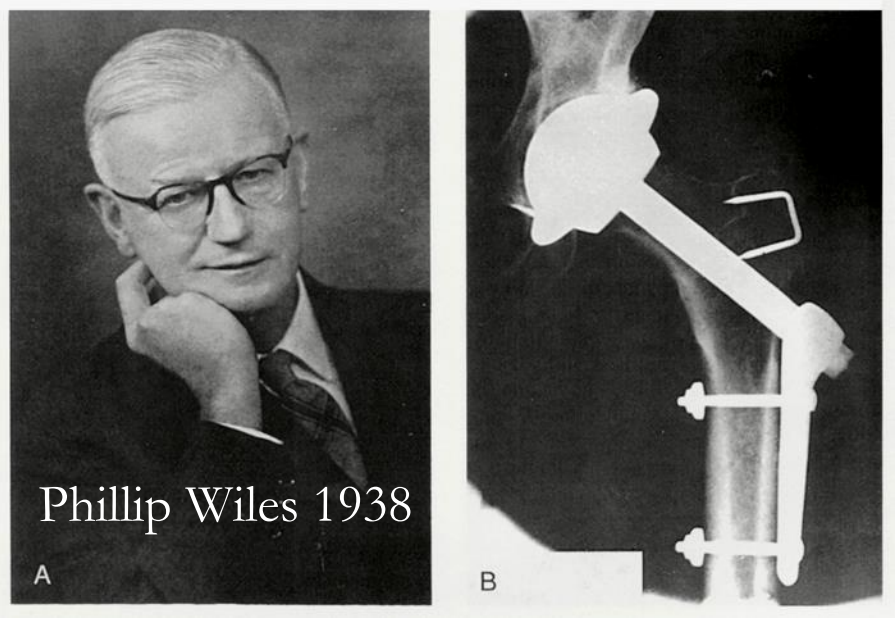


Bakelite

Vitallium

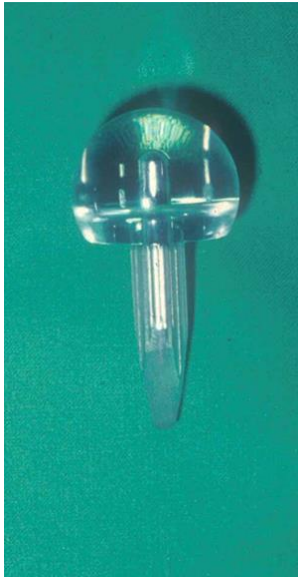
MN Smith-Petersen, JBJS 30B, 1948

Before poly and before Charnley: *large metal heads*

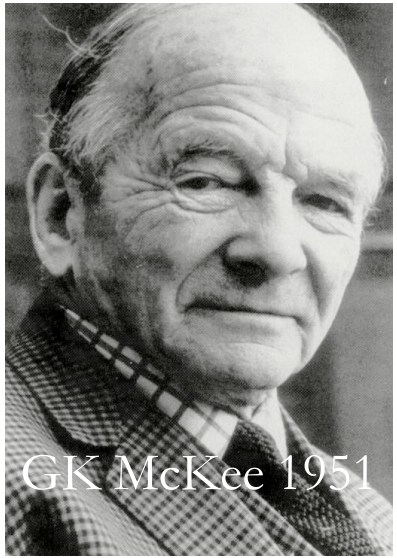


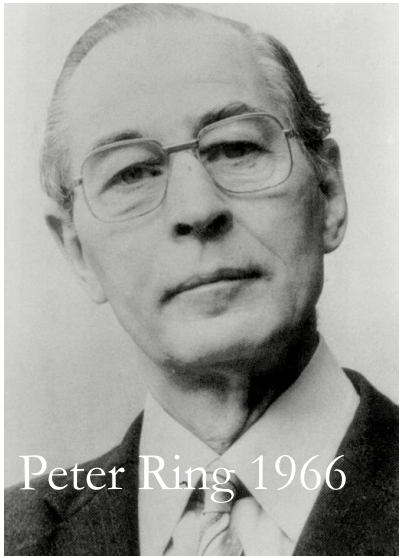
Austin Moore and
Frederick Thompson
1941

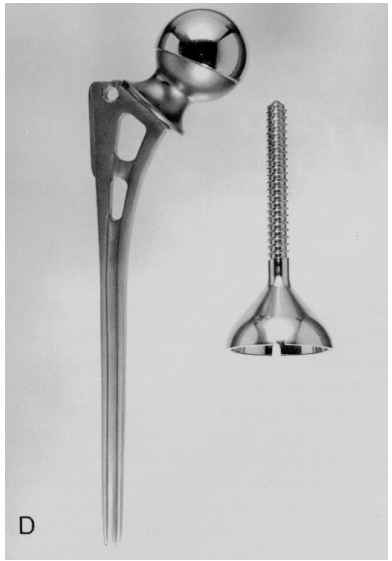
Acrylic.



Other notables…

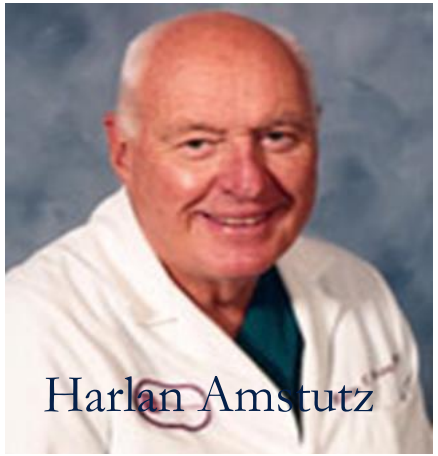


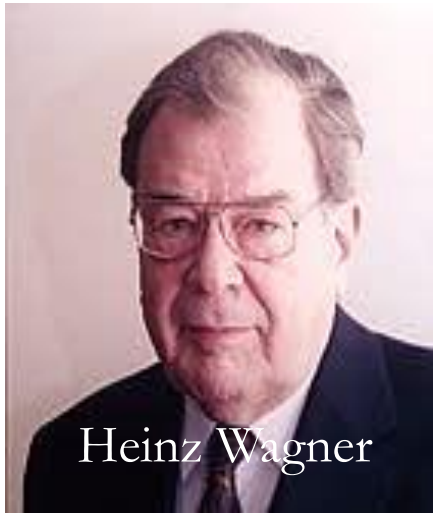




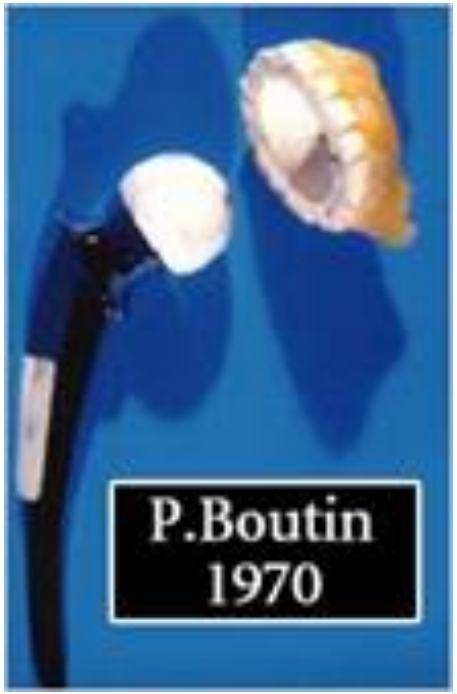
Early failures - *loosening, infection, bearing failure – metallurgy and manufacturing*

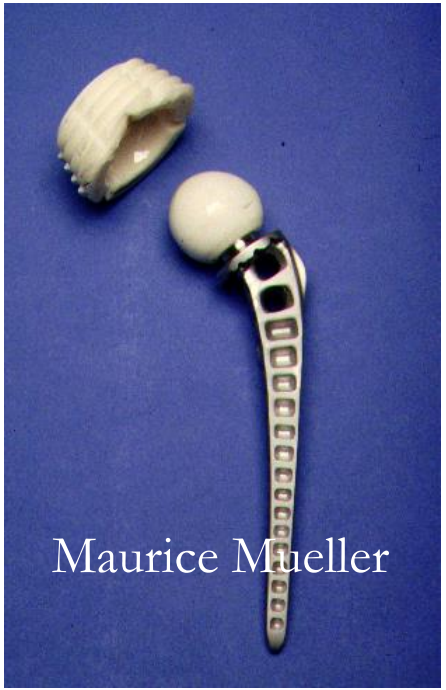
Resurfacing. 1st generation poly.





Fenestrated stems with ceramic bearings.

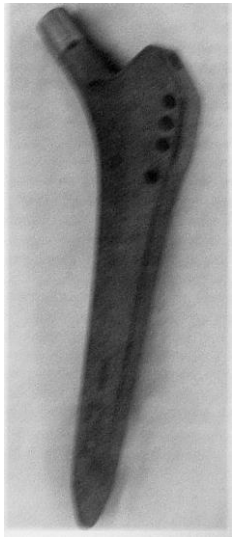




Sir John Charnley: *evolved from Teflon to UHMHPE and polymethylmethacrylate with stainless steel stems – 1960's*

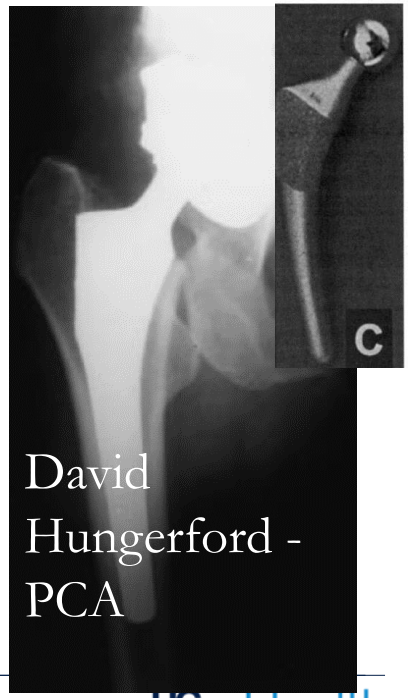
First successful entries into cementless stem design - 1980's

Zweymuller



Engh - AML

Harris - Zimmer



David Hungerford - PCA

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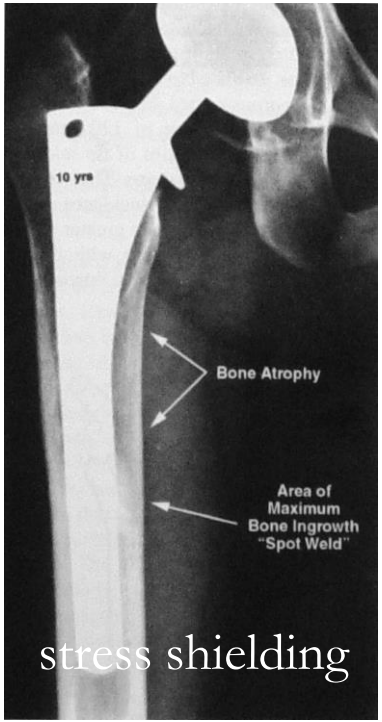
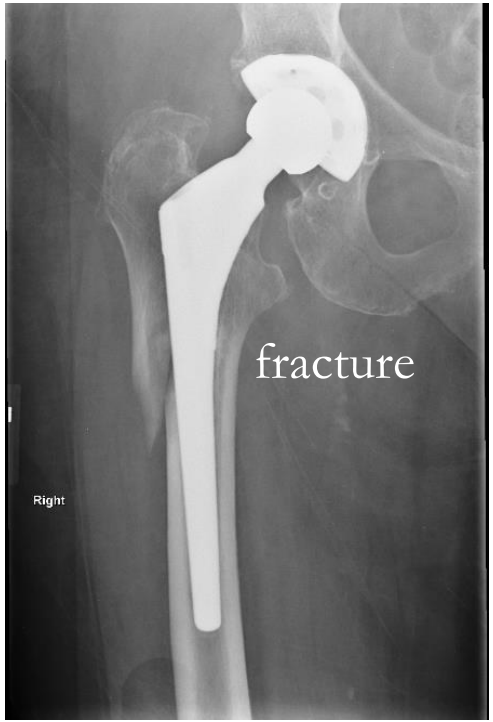
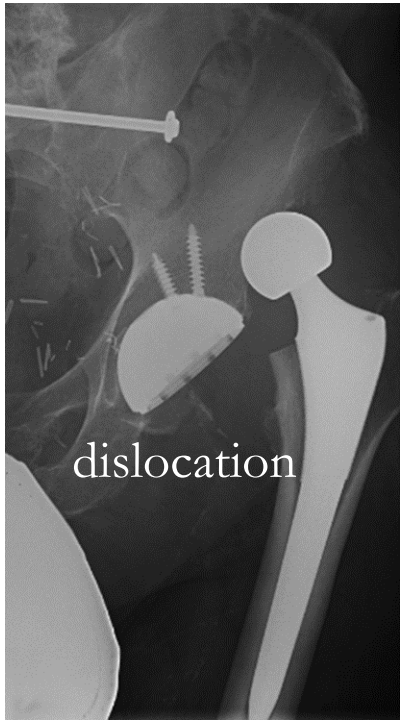
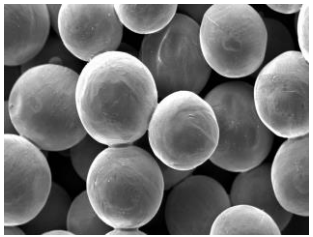
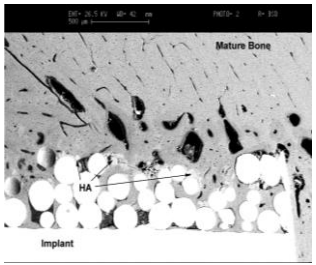
Drivers of modern of stem design…











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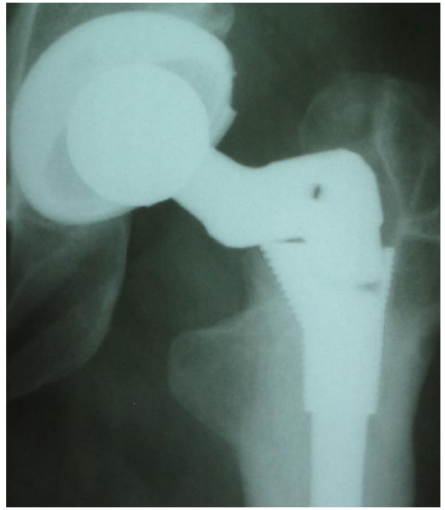
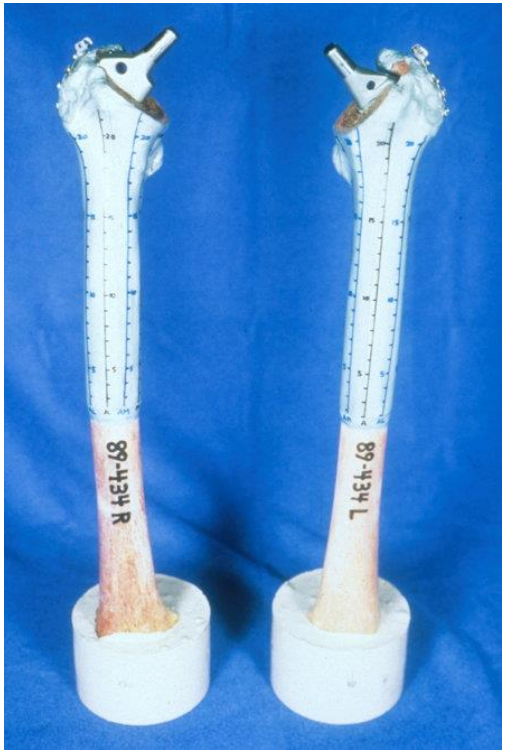
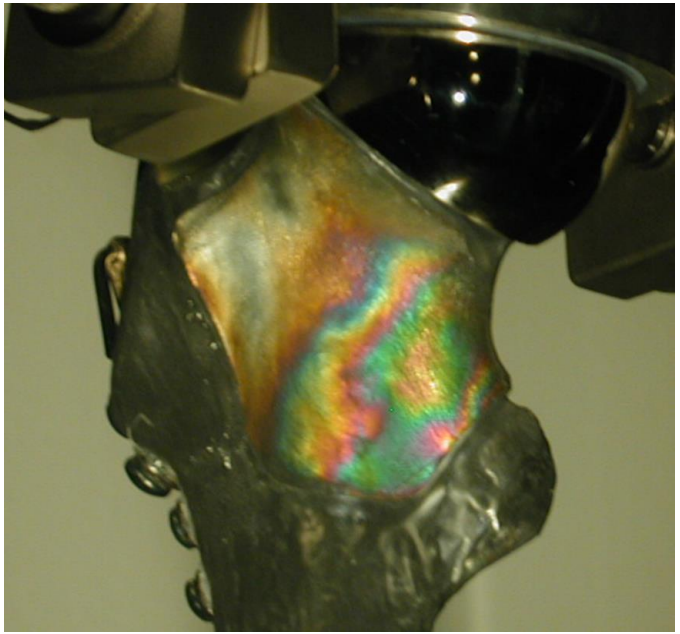
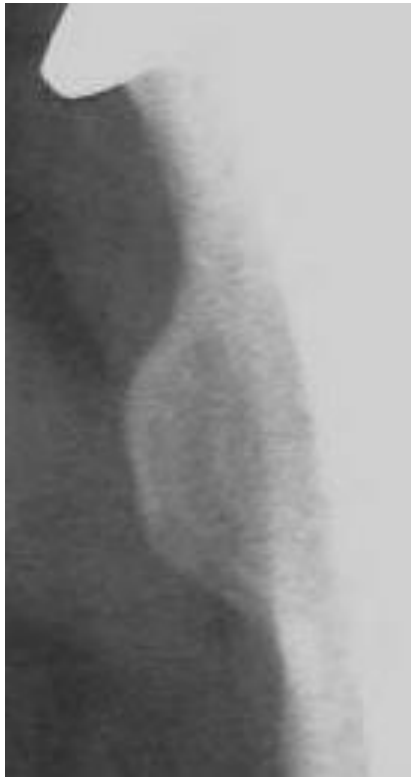
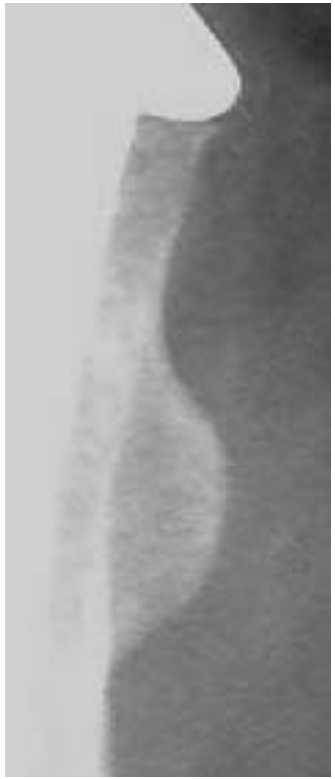


Bone **conservation** – *understanding stress shielding*



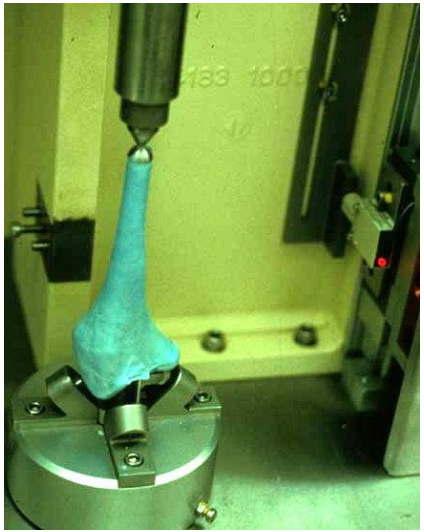


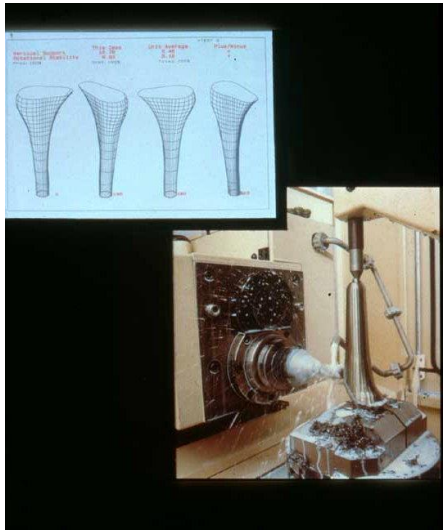




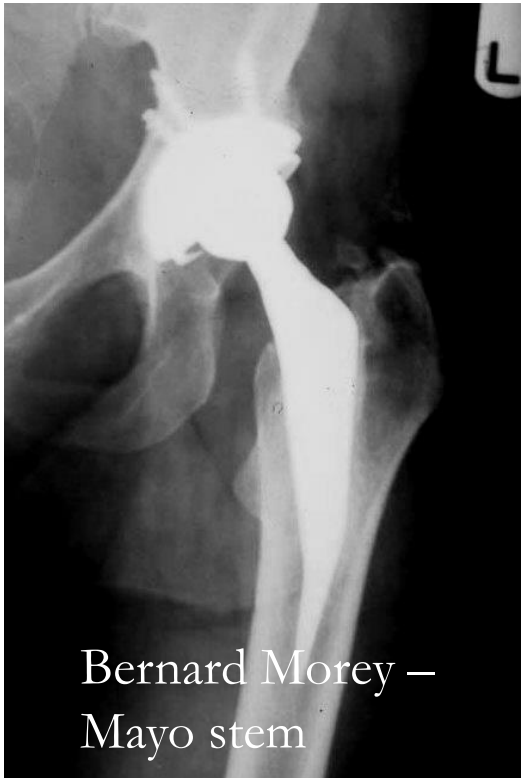
Bone conservation – *carbon fiber stem?*

Bone conservation – *customized and ultra-congruent?*

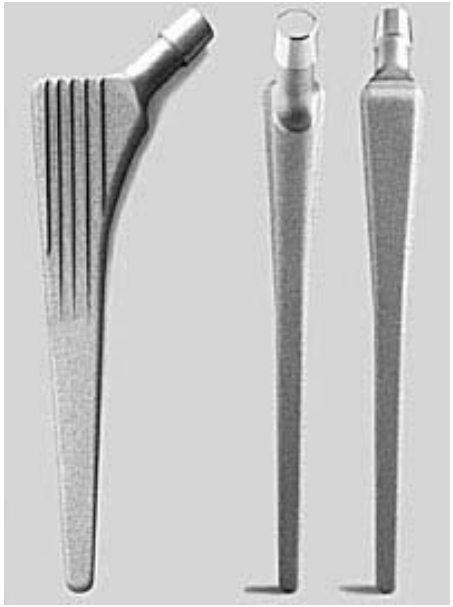




Bone conservation – *mini and short stems?*



Stems that are popular today – *evolution rather than radical change*



Lessons learned.

- **Materials failures have often compromised sound design concepts**
- **Expect the unexpected**
- **Diligent clinical research has provided big wins:** *x-linked poly, porous surfaces, stem shapes*
- **We are still have not solved all of the issues –** *do we really need all that metal and plastic to treat arthritis?*
- ***I have not mentioned infection!***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SYMPOSIUM: PAPERS PRESENTED AT THE HIP SOCIETY MEETINGS 2008

The First 50 Years of Total Hip Arthroplasty

Lessons Learned

William H. Harris MD, DSc

Five lessons: (1) skunk works; (2) Pasteur's motto; (3) the totally unexpected; (4) research works; and (5) the role of alternatives.