Poster Exhibit
October 2006

Defining The Role Of Modular Stem Designs In THA

Froehlich, J.A.[1], McTighe, T.[2], Cameron, H.U.[3], Keggi, K.[4], Keggi, J.[4], Kennon, R.[4], Woodgate, I.[5]

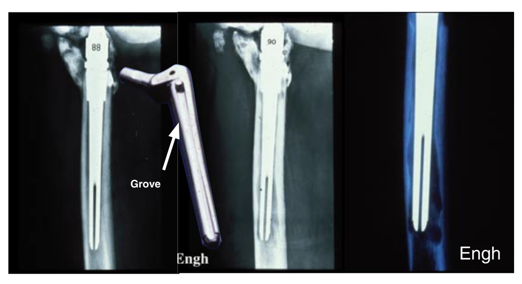
Introduction

APEX K2 Stem

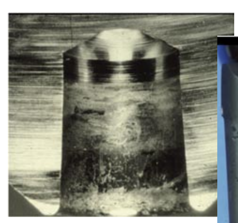
Modularity or multi-piece stems are becoming commonplace in THA with virtually all implant companies offering one version or another. Therefore the role of modularity would seem to be firmly established, but what if any limits or contraindications should be considered in light of increased patient related activities?

Example hihg activity levels.

During the 1980's concern was expressed that the use of a modular stem might produce fretting leading to osteolysis and component failure.



S-ROM 1984 groved stem. This is unique and has not been a significant problem.



Surface corrosion.

Fretting debris.

The early nineties saw a number of first and second-generation modular stems come and go. It is important to understand the specific design features and goals of modular total hip stems and not to lump all designs into one simple category "Modular Stems". In fact, modular sites, designs, features, material and quality can be quite different in nature and sophistication.

Modularity Classification

Proximal

Mid-stem

Distal

Multi-Modularity

Some devices have one or more modular junctions. The RMS was one example of Multi-Modularity that provided up to six modular interface sites.

Methods

This paper is a follow-up to previous work by the authors intended to be a concise review of historical perspective, current trends, surgical experience, and results in using a variety (seven) of modular stems.

Surgeon authors have implanted over 3,000 modular stems since 1984 for both primary and revision THA. This paper will highlight experience for 2,248 stems used for primary THA in both cemented and cementless cases as they relate to femoral component failure (fracture).

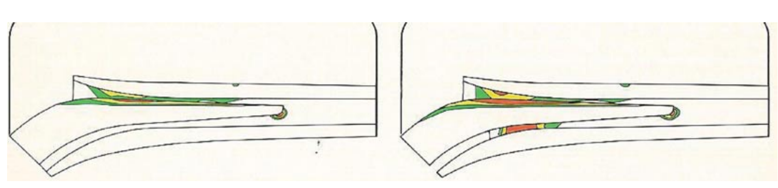
1. S-Rom (JMPC/DePuy)
   1155 stems implanted.
   
2. Apex Modular (Straight Stem)
   500 stems implanted.
   
3. K2 Apex (taper stem)
   109 stems implanted.
   
4. OTI/Encore R-120 cemented stem
   245 stems implanted.
   
5. OTI/Encore R-120 porous cc cementless stem
   82 stems implanted.
   
6. UniSyn (Hayes Medical)
   50 stems implanted.
   
7. Cremascoli Modular Neck (Wright Medical)
   107 stems implanted.
   

Unsupported Stems Will Fail Regardless of Fixation/Material/ Design

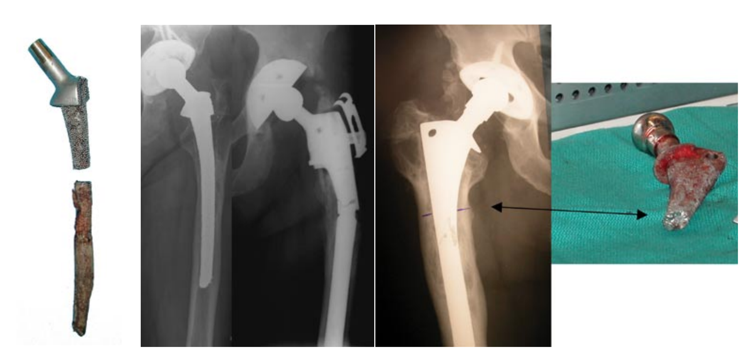
(cement/cementless/monoblock/modular)

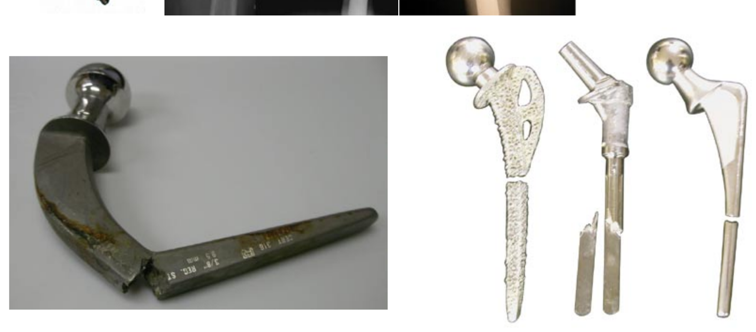
Bechtol described this failure mode in the 1970's.

Available implant material cannot support high BMI and high patient activity in the absence of bony (structural) support.



Fully Supported Stem — Incompletely Supported Stem





Results

12 femoral component failures have occured

2 in a c.c. proximal modular neck cemented stem (fig. A).

Figure A. Fractured neck.

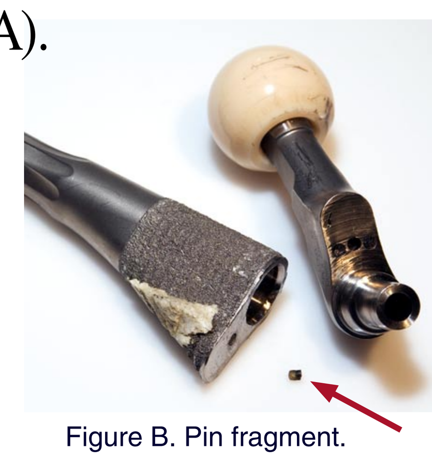


Figure B. Pin fragment.

10 in a proximal modular titanium shoulder neck cementless stem (fig. B).

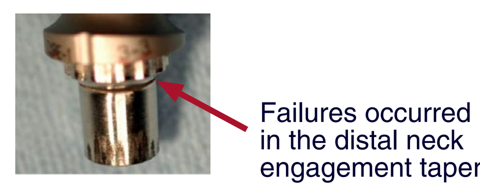
Both of these devices were immediatetly discontinued from clinical use by the authors until redesigned and strength properties significantly improved.

Problems

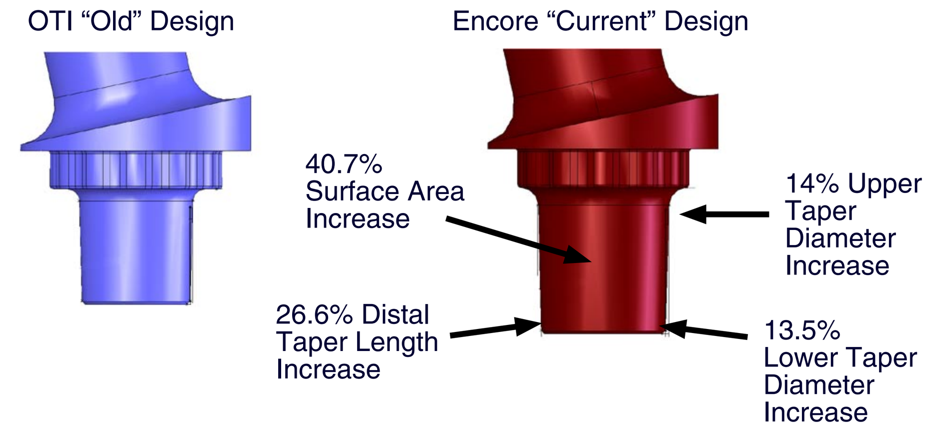
Femoral compenent fractures historically are a result of fatigue failure as the fractured neck show in Figure A.

However, we are beginning to see high impact static- shear failure of femeral components as shown in Figure B (torsional failure of locating pin).

OTI/Encore Modular Neck



Encore Improvements



Fatigue Testing Results

Fatigue Strength @ 5,000,000 cycles

OTI Design 520-700 lbs.

Encore Medical Design > 1200 lbs.

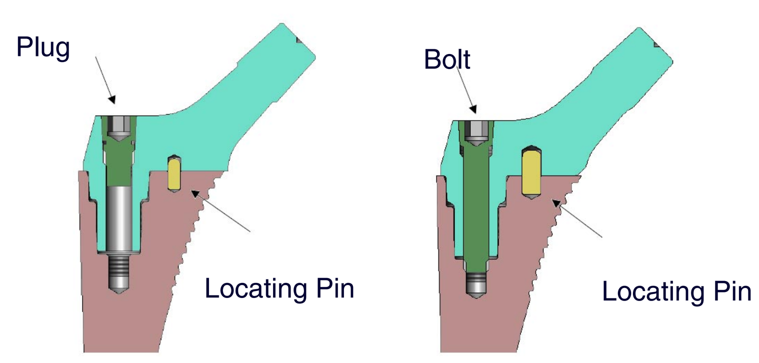
Apex Neck Retrievals

All retrieved stems that we have been examined suggest quasi-static shear failure of the alignment pin – a single high load (high torsion) event.

Apex Improvements

Pin strength:

Old- 95 ft-lbs New- 216 ft-lbs



Pin diameter has been increased from .125" to .188" along with added feature of a bolt that engages the stem. This has resulted in +225% increase in pin shear strength.

Conclusion

Authors remain enthusiastic about the use of modularity and surgeon co-authors continue to use modular stems as part of their routine treatment of THA. It is important to remember all devices are subject to failure. It is also necessary to recognize design and material limits and not to over indicate in high risk patients.

Warn your patients that device failure is directly linked to activity and BMI.

Recognize required technique for specific modular designs and do not attempted to change surgical technique and component selection at the same time.

Revisions are always with us – select devices that take retrievability into account.

UNIVERSITY ORTHOPEDICS

[1]University Orthopaedics, Inc., Providence, RI

JISRF [2]Joint Implant Surgery and Research Foundation

17321 Buckthorne Drive
Chagrin Falls, OH 44023
440-543-0347
www.jisrf.org

SUNNYBROOK & WOMEN'S
Orthopaedic & Arthritic Institute

[3]Orthopaedic & Arthritic Institute, Toronto, CA

[4]Keggi Orthopaedic Foundation, Waterbury, CT

St Vincent's Clinic
[5]Ian Woodgate
Sydney, AU