Neck Sparing Total Hip Arthroplasty -Lessons Learned-

Mini-Symposium held prior to AAHKS 20th Annual Meeting Friday, November 5, 2010 2pm-4pm

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The Joint Implant Surgery and Research Foundation Non Profit Founded in 1971 by Professor Charles O. Bechtol, MD www.jisrf.org



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Moderators Terry Clyburn, MD Audley Mackel, MD Ed McPherson, MD

Acknowledgement A number of surgeons over the years have participated and shared some of their work. Pioneers of Neck-Sparing concept: Pipino, Freeman, Townley and Whiteside



Disclosure

In accordance with ACCM guidelines we acknowledge that there is a financial relationship (nonexclusive) between JISRF and orthopaedic industry and that individual members of JISRF and Faculty have financial relationships with a variety of medical device companies.

This meeting was supported in part by and an educational grant from Omnilife scienceTM

Institutional support: From a variety of medical device corporations (+20) Note: JISRF Board Members have a variety of industry relationships



Design Features For a Tissue Sparing THA Stem

Timothy McTighe, Executive Director Joint Implant Surgery and Research Foundation Chagrin Falls, Ohio





Architectural Changes

Changes take place after THA and these changes can lead to a loss of bone, implant loosening and implant revision.





Motivation to improve on tissue sparing (hard & soft)



Both Bone conserving and soft tissue conserving

>Short Curved Stem (following medial curve) >Neck Sparing (mid/high neck resection) ≻Conical Flare for proximal load transfer \succ Intrinsic torsional and axial stability > Proximal porous Ti & HA coating (long-term fixation) >Modular Neck- fine tuning joint mechanics (c.c. modular neck) >12/14 Euro head/neck taper >Lateral T-Back for increased torsional stability >Semi-polished stem for reduced distal fixation Saggital slot for reduced bending stiffness & reduction of potential lateral perforations. >Distal lateral tip angle for reducing end stem contact ≻Simple reproducible instruments > Five stem sizes (+90%) of routine THA >Threaded Tapped hole in neck for retrievability ≻Threaded Tapped hole in stem for retrievability

Short Curved Stem



Saggital slot & distal 11° lateral angle

Why Save The Neck?

 Neck resection generates significant torsional moment at the stem/bone interface





•8% per 1mm increase in true lateral ball-center offset •6% per 1mm increase with the ball's neck-length size adjustment.

offset	Neck- length	Nm	ba
35 mm	49.50	84	
40 mm	56.58	96	
45 mm	63.65	108	
50 mm	70.72	120	
55	77.79	132	





The conical flair was build off conical collar of 1993 stem design

Fig. 2 McTighe et el patent





Transfer hoop tension into compressive loads

Stabilized Stems Fixation Points

Head Stabilized Neck Stem less Stabilized Short Curved Neck Stabilized Short Metaphyseal Stabilized Short Diaphyseal Stabilized **Conventional Stems** Combination example: fit & fill



Retrievable Features



Tapped threaded hole in neck and stem for slap-hammer extraction.

Head Stabilized





The Birmingham Mid-Head Resection both straight and curved stem designs





Hip Resurfacing

Mid-Head Resection



Hip Resurfacing

Steep Learning Curve
Limited Indications
Risk of Fracture
Late Remodeling and Aseptic Loosening
Limited to MOM Bearings
Extensive Soft Tissue Dissection
? Conservative



Australian Registry

HR high learning curve limited indications 8-15%



7.6% HR

92.3% THA

• Decreasing use (8.9% of primary THR 2005) (8.2% of primary THR 2006) (7.6% of primary THA 2008)



■ THA

Yearly Cumulative % Revision Primary THA vs. HR in OA Patients



Neck Stem Less Stabilized









Short Taper Styles

TAPERLOC



Interesting history on conservative devices





Bohlman 1939



Bohlman 1940





Judet grooved 1952









A modern movement



The Birmingham Mid-Head Resection both straight and curved stem designs Some recent short

stems









Neck Retention

•Provides better blood flow vs. hip resurfacing Pipino

 Provides better axial and torsional stability vs.
 conventional THA whiteside



•Provides for more tissue sparring approaches (both hard & soft tissue) Pipino

- Potential for less blood loss
- •Potential for quicker rehab



Save the Neck

There is a historical reference to neck sparing THA



Pipino started arguing save the neck 1977-78
1979 Pipino started implanting the Biodynamic stem
Freeman, made the argument back in 1984 that modern hip stems should retain the femoral neck
Studies showed that 70% of the blood flow to the femoral neck is retained after THA and the vitality of the bone is good (Pipino et. al., 2006)



Pipino was the first, however, Freeman is acknowledged to be the "Godfather of the neck sparing concept"

- Freeman went on to design both cemented and cementless stems and these are still used in the international market
 - He was at that time very concerned with aseptic loosening and the torsional loads that he and many believed to be the principal cause of THA failure
 - Freeman advocated a straight stem and it required significant lateral effort!





Topic For Debate Why Resect The Neck? M.A. R. Freeman JBJS 1984

 The varus-turning moment ncreases by a factor of 4 when the neck is resected
 Increase of femoral offset also ncrease torsional loads on the mplant interface



The bending moment is also reduced by saving the neck



"the neck of the femur is not obviously reduced in strength in the osteoarthritic hip and is no more weaker than the rest of the femur in the inflammatory arthropathies."

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Review of previous work

Surgeon designers have advocated neck sparing designs with variable results and most have been conventional length stems



Professor Pipino

- Is the Acknowledged Leader in advocating short curved neck-sparing THA
- He has argued for tissue sparing both hard and soft tissue
- His original work dates back to 1979 and started implanting his first stem "Biodynamic" from 1983-1996
 - This early design featured c.c. material, collar porous sintered beads on 2/3 of the stem, distal polished tip, 4 stem sizes 1 curve and 135° neck shaft angle.
 - He had encouraging results but was disappointed with bone remodeling

Pipino current stem design CFP™

He has experienced improved results over the c.c. material, but still encounters some stress shielding





- FEA modeling of the MSA/ARC stem has demonstrated better bone loading patters compared to the Biodynamic[™] design
- The CFP stem is the current bench mark in clinical/ surgical results for short curved neck-sparing stems



Concept to improve on Prof. Pipino's work of Tissue Sparing

Tissue Preserving for early intervention Alternative to HR (broader indications) Choice of bearings Revision option after HR Easier surgical technique for anterior approach Reproducible technique for all surgical approaches Modular neck for fine tuning joint mechanics Ease of retrievablity and conversion to conventional THA if necessary



The History of curved stems "The curve was right" The application was wrong!









Thompson

195









A modified shorten Muller Press fit stem function well for 15 years_{. K. Berend}

Short Curved Neck Stabilized





Tissue Friendly



Keggi neck sparring



The design process was to address tissue sparing approaches with improved load transfer in a simple curved stem design. Reduced inventory (instruments & implants). We looked at a lot of different parameters. These are just a sample .patents pending















The conical flair was build off conical collar of 1993 stem design

Fig. 2 McTighe et el patent





Transfer hoop tension into compressive loads



Novel: proximal conical flair loads the medial neck



Prof. K. Keggi, MD Presented in Florence, Italy May 2010







Posterior approach



Anterior approach



Check Range of Motion



Lessons Learned Summary

Three key technique related featuresThe level of neck resection

Sub cap Too high 5-8 mm Sub cap appears to be best target

 Top of level A is too short risk leg length being long and increased in risk of mechanical impingement.
 You can go down to the top of C without risking stability

Lessons Learned Summary

2 The angle of the neck resection

50° at 5-8 mm

Note: Slight varus, valgus does not appear to make any significant difference in early clinical results.



Too vertical stem can
be in varus
Too horizontal stem
can be in valgus

Lessons Learned Summary >Rasp shape the medial curve

③ Work the medial curve



There is a learning curve (3-4 cases) and a different technique as compared to broaching.



Clinical Usage



Stem Sizes - Male



A DE

Clinical Usage

A Fare











Dual Mobility Cups





Anterior Approach J. Keggi



Templating







AP helps determine neck level of resection
 Lateral helps determine stem size

 $>20^{\circ}$ of internal rotation is more accurate for offset and medial curve measurement

You don't template like a conventional stem. This would be too tight. The distal stem is a pilot. A size #2 will ensure proper seating of the conical flair.

(Ideally AP film should be in Internal Rotation)

Intra-operative Assessment X-Rays are helpful Keppler

>70% of the time some change is made (25 yrs.)



 No problem in taking more neck
 Make a intra-operative assessment and fine-tune your mechanics

> Decision to take a little more bone



Less need to go lateral



17 year post index surgery C. Bryant



17 year old Motor cycle accident McPherson



Calcar Cracks



Lesson Learned 12/14 Euro Taper ASTM standard F1636



JISRF



When mixing and matching double check compatibility

MSATM 2 1/2 follow up Woodgate



Lessons Learned Complications

- One case in Au that subsided 1.5 cm (80 yr. old male) no pain stable 12 months post-op was this do to a intra-op fx or post-op?
- 3 cases we needed a smaller stem size (all female)
- Two intra-operative calcar cracks one significant converted to primary stem and one minor treated with a wire.
- One neck/head disassociation (converted to a Mallory/Head)



Neck Stabilized Design





≻Short curved trapezoidal style

- >Proximal conical flare
- ≻T-Back
- ≻Saggital slot
- >Distal lateral portion of the stem angle 11°
- Porous Coating (Plasma Ti & HA)
 C.C. modular neck (two lengths, two varus/valgus angles 8) & 12°, anteverted neck 12°
 Neck has a taped threaded hole for retrievability

Bi-lateral First Side May Second August



Neck Retention Has Value











Continuing Education Mini-Symposium 2-4 PM Friday Nov. 5, 2010 AAHKS Annual Meeting



Thank You





Where we are

•Hundreds of x-rays templated for base line sizing in Australia and U.S.

- •In depth review of the history on neck sparing total hip stems
- •Attendance in Pipino's continuing educational course

•Cadaver workshops in Australia and U.S.

•Five custom cases to validate original concept out 2 1/2 years

•Over 20 intra-operative trials before implantation in two countries by over 12 surgeons

•100 cases in Australia

•150 cases in U.S. (FDA approval May 2010)

•1 case of stem subsidence (1cm) in 80 year old male 6 months post-op no symptoms no plan on revision (was a crack not sure if intra-op or post-op)

• Over 28 (papers, abstracts, oral papers) presented on this concept in past 2 1/2 years (posted on JISRF web site)

• International Study Group established on the concept of tissue sparing THA (JISRF)

•One stem revision to-date.

•All surgeons continue to use the stem, indications increasing (still very early but encouraging at this stage of development and clinical follow-up

