"A New Approach To Neck Sparing THA Stem"

Muscle Sparing Approach™ / Neck Sparing Approach™ Total Hip Stem Design Concept

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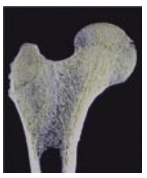
Introduction:

Architectural changes occurring in the proximal femur (resorption) after THA (due to stress shielding) continues to be a problem [1,2]. Proximal stress shielding occurs regardless of fixation method (cement, cementless). This stress shielding and bone loss can lead to implant loosening and or breakage of the implant. [3,4]



High neck resection

In an attempted to reduce these boney changes some surgeon designers (Freeman, Whiteside, Townely and Pipino) have advocated the concept of neck sparing stem designs.[5,6,7,8]

Freeman, in describing the biomechanical forces in the reconstructed hip went as far as to say " the design of all conventional arthroplasty is made worse since the femoral neck is routinely resected." He further stated "This is done for reasons that are purely historical. Drs. Moore and Thompson designed stems for the treatment of femoral neck fractures, and for this reason, the femoral neck had to be discarded. In the typical arthritic hip, the neck is intact and therefore it can be retained. There is significant mechanical advantage in retaining the femoral neck, which results in a reduction of torsional forces placed on the implant / bone interface."

Thompson stem-1948

Methods:

Review of previous published work was evaluated along with new FEA modeling in creating a new approach to neck sparing stems for primary THA.

Examples of short and neck sparing stems

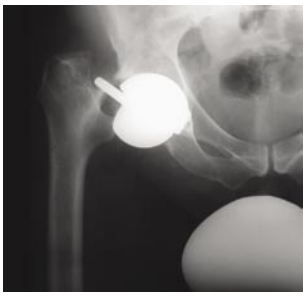
Note: Not all short stems are neck sparing and not all neck sparing have short stems.

To-date most if not all neck-sparing stems have been somewhat disappointing in their long-term ability to stimulate and maintain the medial calcar. Partially for that reason a new design approach was undertaken to improve proximal load transfer and to create a bone or tissue sparing stem that would be simple in design, amenable to reproducible technique and provide for fine tuning joint mechanics while stimulating and maintaining compressive loads to the medial calcar.

Is hip resurfacing really a conservative approach?

- Hip resurfacing requires a larger soft tissue approach vs. small or MIS conventional surgical incisions

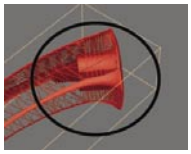
- Most hip resurfacing is done by the posterior approach, which has been shown to significantly affect blood flow to the femoral head
- Currently only Metal on Metal and Metal on Poly are available for resurfacing and Metal on Ploy in the past has demonstrated poor clinical results
- Most surgeons do not recommend Metal on Metal for woman of childbearing age



- Resurfacing has been shown to be contra-indicated in post- menopausal women
- Resurfacing has a high learning curve
- Hip resurfacing is not bone conserving on the socket side
- Hip resurfacing does not allow for adjusting or fine tuning femoral offset
- There is concern as to long-term systemic reaction on metal ions
- Femoral neck failure is a significant problem

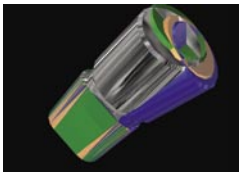
A New Approach

The MSA™ Stem is a combination of a simple curved stem with a unique lateral T-back designed for maximum torsional stability, ease of preparation and insertion. The proximal design has a novel (internal) conical shape designed to stimulate and transfer compressive forces to the medial calcar.



Novel (Internal) Conical Shape

A modular neck provides for fine-tuning joint mechanics without disruptions of implant bone interface and a distal sagittal slot reduces chances of lateral cortex perforation. In case of stem removal a threaded hole is provided for a solid lock with a slap hammer for retrievability.



Note: Risk of short stems is varus stem position resulting in perforation of cortex.

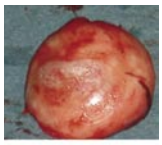
Distal sagittal slot with angled lateral stem reduce risk with varus stem placement.

Surgical Technique

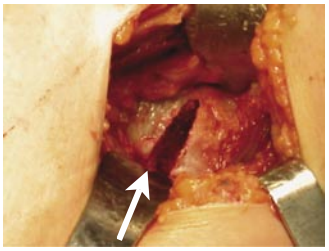
Pre-operative templating is helpful making sure that x-rays are taken with 20 degrees of internal rotation. This will provide reliable data as to femoral offset and medial neck curve.

Neck sparing resection

Typical neck resection.



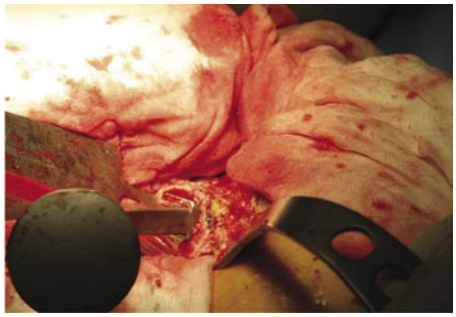
Head resection



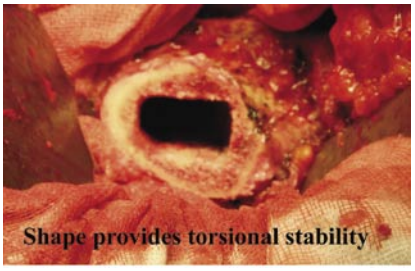
High Neck Resection

Any surgical approach will work with the MSA™ Stem System. The femoral head is cut at the base of the head, perpendicular to the cervical axis. The distance between the osteotomy and the base of the neck is approximately 1.5 cm so this conserves the existing femoral neck.

Anterior Approach "J. Keggi"



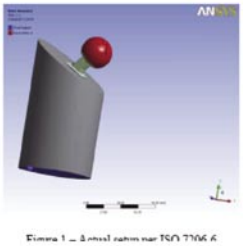
Posterior approach "Woodgate"



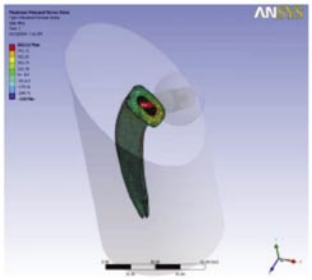
The femoral canal is opened with either a starting awl or curved curette. A flexible reamer may then be used to open the femoral canal or selection of the smallest starting rasp. The stem is designed for simplicity in preparation and rasping is used in sequence to the proper fit. The final implant is line-to-line with the rasp and the proximal porous coating and later T-back design provide for a tight press fit. The final rasp can be used with a trial neck, and head ensuring restoration of joint mechanics. Trials can also be done off the definitive implant providing for last minute fine- tuning of joint mechanics.

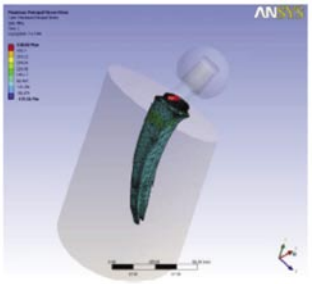
Testing on Modular Neck

FEA modeling was conducted to look at stress in the modular neck when assembled and subjected to loading prescribed by ISO 7206-6.



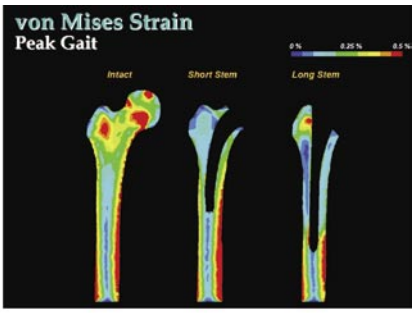
MSA Stem in-situ in femur

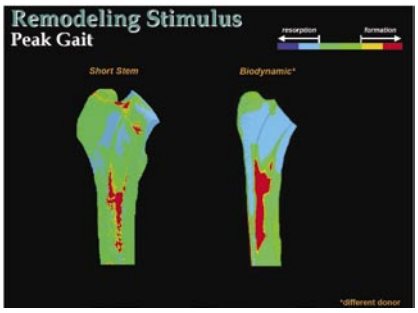




Illustrations show a change in stress in the stem with the increased load capacity of the extended taper and changed taper angle from 3.5m to 4˚ included. Stress is reduced from 662MP$_a$ to 538MP$_a$.

Testing on Bone





Strain patterns for the MSA™ stem demonstrated better patterns vs. long stems or the short Biodynamic neck sparing stem.[11] We are encouraged with testing to-date. Additional FEA modeling and mechanical testing is underway.

Discussion and Conclusion

In theory neck retaining devices provide for [9]:

- **Bone and/or Tissue conservation [10]**
- **Restoration of joint mechanics**
- **Minimal blood loss**
- **Potential reduction in rehabilitation**
- **Ease of revision if necessary**
- **Simple reproducible surgical techniques**
- **Modular options for appropriate bearing surface**
- **Selection of optimum femoral head diameter**
- **Standard surgical approach to the hip**

We are encourage and believe there are significant advantages in the concept of neck sparing stems. Clinical / surgical evaluation are now underway and will be reported on in the future.

Note: This device is currently not available for sale in the U. S. (Patent Pending)

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