"THA-Keep The Neck"

by

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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]

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 future 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."

Methods: Review of previous published work was evaluated along with 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 disappointed 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.

In theory neck retaining devices provide for:

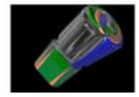
- **Bone and/or Tissue conservation**
- **Restoration of joint mechanics**
- **Minimal blood loss**
- **Potential reduction in rehabilitation**
- **Convertible to standard THA in case of revision**
- **Simple reproducible surgical techniques**
- **Opportunity to pick modular options for appropriate bearing surface**
- **Opportunity to select optimum femoral head diameter**
- **The selection of any standard surgical approach to the hip**

There are a number of trends occurring in THA that are worth noting that can be selectively addressed with the MSA™/ NSA™ Neck Sparing Stem System.

- Hip resurfacing is getting more attention with Metal on Metal bearings and the demand from patients requesting a device that allows them an opportunity to get back to their active lifestyles.[9]
- Large head diameters provide a sense of hip stability and appear to be reducing short-term dislocation. There is more awareness to restoring joint mechanics providing for better long-term results.
- There is a movement to bone and tissue sparing approaches. [10]

Does hip resurfacing really address these concerns?

- 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 drastic clinical results
  - Most surgeons do not recommend Metal on Metal for woman of childbearing age
  - MOM has been shown to be contra-indicated in post- menopausal women
  - Current resurfacing has a high demand 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



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 thermal conical shape designed to stimulate and transfer compressive forces to the medial calcar. 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.

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.

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

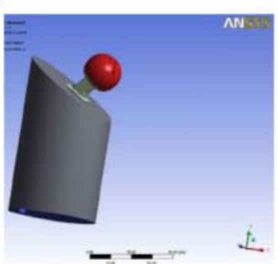
Anterior Approach J. Keggi

Posterior Approach L.Keppler

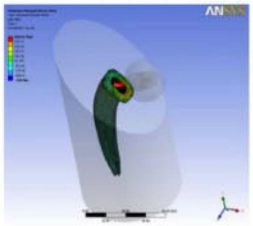
The femoral canal is opened with either a starting awl or curved curette. A flexible reamer may then be used to open the femoral canal or selection of the smallest starting broach. The stem is designed for simplicity in preparation and impaction broaching is used in sequence to the proper fit. The final implant is line-to-line with the broach and the proximal porous coating and later T-back design provide for a tight press fit. The final broach is selected by checking for torsional and axial stability. Trial stems are provided along with modular trial necks and heads ensuring restoration of joint mechanics. Trials can also be done off the definitive implant providing for last minute fine-tuning of joint mechanics.

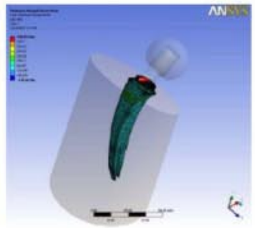
Results

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

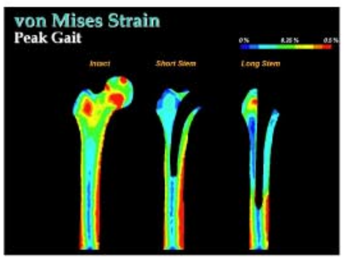


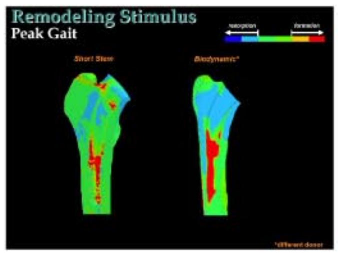
MSA Stem in-situ in femur





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 $538MP_a$.





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

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

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