Short Stems for THA

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Variety of Short Stems
The past few years has seen an influx of so-called short stems with very little clarification as to design features, required surgical technique and clinical outcomes.
Most devices, meet with some level of learning curve and most systems do little in the way of warning new surgeons as to the pearls and pitfalls during the initial surgical phase.

Note: Not all short stems are equal in design and or function.
As we have seen with modular junctions we need to differentiate short stem designs.

Design Consideration for Modular Stems

By
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RLO*: Charleston
Joint replacement Surgery 2010, May 6-7, 2010
Charleston, South Carolina
* Real Life Orthopaedics
Short Stems
Need to have a classification system
"JISRF Stem Classification System"

Stems come in a variety of sizes and shapes

- **Conventional Stabilized Stems**
  - Straight
  - Anatomical
  - Curved

- **Neck Sparing Stabilized**
  - Conventional Neck Sparing straight
  - Short Curved Neck Sparing

- **Metaphyseal Stabilized**
  - Head Stabilized
    - HR
    - Mid-Head
Short Stems
Classify by Stabilization point

**Head Stabilized**

The **Birmingham Mid Head Resection Prosthesis** is a device which, in terms of the bone resected, lies between the Birmingham Hip Resurfacing and a more standard total hip replacement. It can be used when it is possible to preserve part, but not all, of the femoral head.
Neck Stabilized
(neck plugs)

There is growing interest.
Historically traditional neck stabilized stems have had disappointing results with regard to bone remodeling “Stress Shielding” of the medial calcar.

• Neck resorbs @ 6-12 months
• Also confirmed by Whiteside with his conventional neck retention stem.
Neck Stabilized Short Curved Stems

Pipino

ARC™ & MSA™ Stems
Licensed TSI™ technology patents pending

Corin
Short Metaphyseal Stabilized Stems
Design Features for a Short Curved Neck Stabilized “ARC™ Stem

Key Design Features

- **Modular Necks**: Manufactured from wrought Cobalt Chrome. The use of modular necks allows intra-operative adjustment of joint stability, leg length, and offset.

- **Lateral T Flange**: This unique feature is designed to provide rotational stability of the stem.

- **Proximal Coating**: Commercially pure titanium plasma spray provides short and long term wear-protective.

- **Proximal Conical Flare**: Designed to provide initial stability of the implant, load the metaphysis, and resist subsidence.

- **Curved Femoral Stem**: Manufactured from forged 4130 steel. The curvature of the femoral stem is designed to engage the cortex medially and avoid inducing the to make it easier to bend.

- **Rigidity**: The polished surface aids in retaining bone to the implant. The stem follows the natural contour of the distal femur. Clinically this may result in retained medial stability and a lower incidence of stem tilting.

- **Lateral Relief**: The lateral edge of the distal stem has an apex that is oriented to the metaphysis to further reduce the chances of knee instability.
Why Save the Neck?

- Neck Resection generates significant increase in torsional and bending moment at the stem/bone interface

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

Neck retention reduces both torsional & bending moments
The Medial Curve

Simple curvature maintaining good bone structure
Curved stem feature

Comes from the pioneering work of Thompson and Muller

Long history of curved devices

➢ Often the stem style and application of use was wrong but the shape of the curve was and is anatomy friendly.
Porous Surface

Pure Titanium Plasma Spray Coating (0.5 mm per side)
95% Pure HA (approximately 50 micros)
applied in secondary application

Proximal 1/3
Porous coated

Distal 2/3
light matte finish

T- 1 mm per side for additional surface area and stability

Distal sagittal slot lateral leg angled in at 11°
Short curved stems don’t seem as sensitive to stem position as standard cementless or cemented stems.
Distal tip angle reduces edge contact

- Distal slot reduces stem stiffness and reduces potential distal load transfer

11° angle
Saggital Distal Slot

Reduces bending stiffness reducing distal load transfer and reduces hoop tension reducing potential distal fx.
Stem Sizes
Addresses +90% of Patients

- Five stem sizes presently

- Definitely add one size down & possible one size up to seven stems

- One tray of instruments
Conical Flare
Designed off Conical Collar of 1993 design

- Transfer of hoop tension into compressive loads
Modular Neck (c.c.) allows for fine-tuning joint mechanics.
Surgeon Decides Bearing Material
Joint Implant Surgery & Research Foundation

FEA Analysis of TSI™ Neck Stabilization Stem

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www.jisrf.org

November 2010
Mini Symposium
Dallas, TX
Objectives

- Compare stresses generated in conventional stem compared to neck stabilization stem when restoring same head centre.
- Compare strain in bone.
- Consider the effect of varus / valgus tilting both stem designs.
Model Setup

**FEA Model**

- Original Femoral head centre restored for each implant.
- 784N Abductor & Tensor fascia
- 710N Vastus lateralis muscle load
- 5340N ISO 7206-8

Bone considered to made up of 2 layers:
- cortical (E=16GPa)
- cancellous (E=450MPa)

Distal femur fixed
Components

Components used to restore head centre

- TSI implant size 1 (range supplied is 1 through to 5),
- 22mm neck with +8mm head.
- Taperloc Stem Size 3, high offset with +8mm head.

Both Stems have Plasma coated proximal bodies and uncoated distally. Both implants were bonded to bone in coated region and frictionless conditions of remaining part of stem.

Implant Materials:
- Neck Stabilization implant
  Titanium Stem, CoCr Neck.
- Conventional Stem,
  Monoblock Titanium
The maximum principal tensile stress in the neck stabilization stem was 35% less than that of the monoblock design.
The effect of Varus tilting Stem was much less for the neck stabilization stem compared to the monoblock design.
Head Center

5 tilt shifts head centre 1.8mm

5 tilt shifts head centre 2.8mm
Stress in Femur

The equivalent stress in the distal femur was similar for both the neck stabilization and the monoblock stem.

Stiffening effect of long stem in femoral canal is equivalent to additional structural support achieved by neck stabilization.

TSI - 52MPa

Taperloc - 48MPa
Conclusions

- Biomechanical advantage of neck stabilization stem produces lower stress in stem compared to monoblock equivalent.
- Stress in bone is comparable for both neck stabilization and monoblock design.
- Effect of varus tilting on monoblock design has more than double effect on stem stress.
Case Examples

One year post-op  John Keggi, MD

Initial post-op slight gap at the conical flair

1 yr post-op gap filled in at the medial conical flair
From Fit & Fill
to a more conservative approach
Broader Application as compared to head stabilized devices

- ADM cup
- Aram
- 17 yr. old McPherson
- Keppler

➤ Type A bone distal slot pinched in

➤ Valgus Modular Neck Position
Stem Sizes

10% need for a smaller stem

Note: 450 stems implanted in past 12 months sizing trend remains the same
Sizes Used

Note: 12° version being added

Necks Used

Note: additional 3.5 mm neck being added
17 year post index surgery
17 year old
Motor cycle accident

McPherson
A few calcar cracks have not been a problem

• Risk has been in small female profile need a smaller stem

• There have been no distal fx.
Subsidence in three cases

Note: Likely unrecognized calcar crack. Stem has subsided – stable - pain free - no treatment planned. Stem went from a slight valgus position to neutral and leg length looks better. Will this hold up?

Note: large male first size 5 stem ever used could have taken a six. Subsided about 8 mm stabilized no additional complications

AU
One +80 year old male patient type C bone subsided 1 cm no symptoms stable and no treatment
First Bilateral

From fit & fill to a more conservative approach
Two Neck Exchanges

Female with a posterior dislocation
Poly exchanged for a 15° and an increase in 4 mm vertical height neck position into max 12° varus position
One major advantage to proximal modularity is improved exposure in the case of revision surgery! Keppler

Note: At the time of surgery a large soft tissue mass was found anteriorly and was thought to be associated with bowstringing of the anterior superior capsule as an unusual consequence of the posterior capsular repair.
One case of disassociation

McPherson

12/14 Euro Taper
ASTM Standard F1636

Note: Truncated skirt on head kept taper from a solid lock

Revised to a standard Mallory/Head primary stem
A New Approach to Stem Design for THA
-Time will tell-
Encouraged at this point in time!
Thank You
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