THE SCIENCE BEHIND A SHORT CURVED STEM TOTAL HIP REPLACEMENT

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Acknowledgement: Declan Brazil, PhD
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and TSI™ Study Group Members
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Executive Director; McTighe has vested interest in CDD, LLC; J&J; Signature Orthopaedics, Ltd; Omnilife; and has royalty interest in CDD, LLC

Note: JISRF Board Members and Advisors have multiple commercial relationships.

Intent

To make JISRF available as a resource to all within the orthopaedic community.

www.jisrf.org
Past 10 years

Influx of Short Stems

Difficult to compare results

“Lack of Classification System”
The Joint Implant Surgery and Research Foundation (JISRF) has developed and advocated a stem classification system by primary stabilization contact regions to help identify, differentiate, and catalog stems for total hip replacements.

**JISRF Stem Classification System**

1. **Head Stabilized**
   - A. Hip Resurfacing
   - B. Mid-Head Stem

2. **Neck Stabilized**
   - A. Short Curved Stems
   - B. Short Lateral Engaging Stem
   - C. Neck Plugs or Neck Only

3. **Metaphyseal Stabilized**
   - A. Taper Stems
   - B. Bulky/Fit and Fill Stems

4. **Conventional Metaphyseal/Diaphyseal Stabilized**
MODERN-DAY CONSERVATIVE IMPLANT DESIGNS FOR
THA STARTED IN EUROPE WITH THE INTRODUCTION OF
THE THRUST PLATE IN 1978. SIMILAR TO THE PHILIP
WILES HIP REPLACEMENT FROM 1938.

Wiles performed
A total of (6) replacements.
1 explanted stem (1960s) is in
the archives of the BOA on
loan to the Hunterian
Museum at the Royal College
of Surgeons

Thrust Plate 1978
Arnold H. Huggler &
Hilaire A. C. Jacob

Historical Review of THA
Conservative Cementless Implants
João de Azevedo Lage (born December 3rd, 1920 and died in July 25th, 2001)

Lafayette de Azevedo Lage, MD (Son)
Second generation orthopaedic surgeon

“Lage Prosthesis”
1956 as Endo to Bi-Polor to THA
His son Lafayette stopped using the device in May 2001

Many Stems are still functioning today!
Two Significant Designers that impacted and influenced designs of short stem.

Pipino (1979) & Morrey (1982)

Pipino first presented the femoral neck-conserving **Biodynamic™** hip prosthesis for cementless fixation in 1979.

c.c. material with sintered beads

(In Howmedica/Stryker Orthopaedics)

In 1982, B. F. Morrey **Mayo Clinic Stem** designed a short (60 mm), double-tapered titanium alloy short femoral stem with a modular head.

Titanium alloy with proximal fiber mesh pads.

(Zimmer)
The growing interest in the Anterior Approach has also influenced the development of short stem designs.

K. Keggi Experience
40 + years

Dual incision for 30+ years
Helpful with heavy patients for femoral canal preparation and insertion of modular stems.
K. Keggi

All short stems designs including neck preserving can be done with a single anterior incision. J. Keggi (2010)
Potential Advantages of Short Stems

- Preservation of Tissue (Hard & Soft)
- Less Blood Loss
- Reduced Thigh Pain (end of stem)
- Easier Stem Preparation and Insertion
- Reduced OR Time
- Reduced Hospital Time (Now being done as outpatients in selective centers.)
- Reduced Instrumentation (1 pan)
- Reduced Stem Inventory (sizing 6-7 stems)
- Reduced Rehabilitation
- Easier Explanation if Necessary
- Easier Revision (conversion to Primary Stem length)

- Overall Reduction in Health Care cost
  1. OR time reduced ($3,000 per hr.)
  2. Less inventory (neck preserving)
  3. Less instruments (trays cost on average $250-$300 per tray to recycle)
Architectural changes in the proximal femur after THA continues to be a problem.
Neck sparing

Saves bone

Why get rid of it?

Taper Lock style

NECK SPARING STEM VS. CONVENTIONAL STEM

ICJR Australia
February 14-16, 2014
Neck Retention

- Provides better blood flow vs. hip resurfacing (Pipino)
- Provides better axial and torsional stability vs. conventional THA (Freeman & Whiteside)
- Provides for more tissue sparing approaches (Pipino)
- Potential for less blood loss (Pipino)
- Potential for quicker rehab (Pipino)
FEA modeling has demonstrated better potential for bone remodeling for the Short Curved Neck Sparing compared to previous porous coated stems (AML style). McTighe, Brazil, Turnbull, Harrison, et al., AAOS 2008
FEA modeling for short curved neck preserving stem with a proximal novel conical “Flare” has demonstrated better potential for bone remodeling compared to previous short stem “Biodynamic™”.

McTighe, Brazil, Turnbull, Harrison, et al., AAOS 2008
Conical Flair Designs work to offload hoop tension into compressive loads.

Intrinsic™ Stem / Primaloc™

Conical Flare on MSA™/ ARCTM / TSI™

1994 DESIGN CONICAL COLLAR STRAIGHT STEM

MCTIGHE ET AL. PATENT ISSUED 1998 # 5,725,594
Alternative Load Transmission

Removes Bone

Risk of Fx.

Lateral Load Bearing

Natural Load Sharing

Saves Bone

Medial Calcar Loading

Note all short stems are equal in design philosophy or function.
“Why Resect the Neck,” 1986 JBJS

Conventional stem length in both a cementless and cemented style.

Significant advantages in biomechanical benefits: Reduction of both torsional and axial moments. Freeman

Cementless

Cemented
C.F.P.™ by Link, 1996
Longest follow up of short curved neck preserving stems in the literature.

Historical Lage Hip Brazil
1956-2001

Nanos™ Neck Preserving Stem
By Smith & Nephew, International

Corin Mini Hip™
International 2008 & U.S. 2010

Promise Neck Preserving Stem
Permedica Manufacturing (Italy)

MSA™ by Global, Au 2007
ARC™ by Omni, U.S. 2010

TSI™ by Signature Orthopaedics, Ltd. 2004

Short Curved Neck-Stabilized Stems
(JISRF Classification 2a.)
This is the only neck-preserving lateral flare short stem on the market. Most lateral flare stems are metaphyseal stabilized styles.

High neck resection makes stem insertion difficult due to the bulky style of the stem.

Relies on metaphyseal fit and fill for stability.

Short Lateral Flare Engaging Stem (JISRF Classification 2.b)
Several modified neck-sparing designs have recently been introduced that are only inserted into the femoral neck region. These have been referred to as “neck plugs or neck replacement” and are limited to international clinical experience. They appear to be a hybrid design between the short curved neck-sparing stem and the mid-head device by McMinn (BMHR).

Spiron Neck Screw
Haring 56 patients at 5 yrs. = 97%
Luger 28 hips at 3 yrs = 1 aseptic loosening

Primoris™ Trials underway

Haring 1 yr

TSI™ Neck Replacement In Development

Silent Hip

BOA presentation 2009 141 hips
97% at 3 yrs
Waller 15 hips all had ASR Bearings
6 ASR MoM cup revisions

CUT Femoral Neck
Mixed results by different investigators
Sterns 5yr = 98%
Ender 5 yr. = 89%
Ishaque 8 yr = 49.6%

Neck Plugs or Neck Replacement Implants (JISRF Classification 2c)
Three (3) reported cases of high metal ions resulting in pain (pseudo tumors) requiring revision surgery. All three cases had Metal on Metal Bearings.

1 case MSA™ and 2 Cases ARC™
78 CASES / 1 REVISION =1.2%

Design - Curved, short, neck loading femoral stem.

Proximal
- Trapezoidal, taper cross-section
- Proximal titanium/HA porous coating zone in femoral neck
- Torsional stability further enhanced by lateral back
- Proximal conical flare transfers compressive loads to medial calcar

Proximal (Cremascoli taper)
1. Modular neck + head
   - Distal polished implant

Adrian van der Rijt, MD
The revision rate within the study was 17.9%, compared with 1.7% outside the study (and thus 4.8% overall). P. Hannaford
The survival estimate is above 98.6%. This report does not account for non-reporting or competing events that preclude revision such as death. Omnilife science™
The design philosophy of neck retaining implants concerns achieving osseo integration in a very small area of femoral neck, maintaining physiological load, bone stock and function. The preservation and incorporation within the femoral neck should reduce the axial and importantly the torsional load on the implant so there are theoretical and, in my opinion (in practice) real improvements in the mechanical environment of the implant.  

Adrian van der Rijt, MD (February 3, 2014)

Dense new bone growing up to conical flare
78 Australia MSA™ Stems by: Adrian van der Rijt
1 revision (for aseptic loosening) = 1.2% Revision Rate

169 Australia MSA™ Stems total non-study = (3 Revision) = 1.7% Revision Rate
39 Australian Study had 7 Revision = 17.9%
208 Combined total = 4.8% Revision Rate

576 USA ARC™ stems by:
J. Keggi, MD; L. Keppler, MD; R. Kennon, MD; T. Clyburn, MD; E. McPhersom
576 ARC™ stems = 10 revisions
(2 aseptic loosening, 2 infections, 2 chronic dislocations, 1 cup resulting removal of neck/replaced with new neck, 2 aseptic loosening, 1 neck disassociation,) = 1.7% Revision Rate TSI Study Group

2,825 USA ARC™ stems since April 2010. 98.6% survival = 1.4% Revision Omnilife science
Overall World Wide Survival with removal of AU study = 1.5% Revision Rate

Worldwide Survival Rates with AU Study Removed = 98.5%
Short stems can facilitate surgical technique for THA. Specifically, when one is using DAA, the neck-sparing curved design significantly facilitates cases of stem insertion. The curved stem can be introduced anteriorly rather than leaning toward the greater trochanter. Less trochanteric levering reduces the risk of proximal femur fractures. Furthermore, with larger-sized patients, proximal extension of the incision is avoided. When utilizing a posterior hip approach, surgeons must note that a true neck-sparing implant provides a distinct advantage for soft tissue closure. Specifically, the capsular envelope is not extensively removed. This allows for a more robust closure of the posterior hip capsule, which may translate to improved posterior hip stability. Furthermore, since a majority of the femoral neck is preserved, the short external complex is successfully closed in a consistent fashion. This adds an additional soft tissue layer that is protective.

Short stems have a definite role in modern total hip arthroplasty, as greater emphasis is being placed on soft-tissue and bone-sparing techniques and as refinements continue in the understanding of proximal femoral fixation and the biomechanics of head/neck and neck/stem modularity.
Our combined experience with the MSA™ and ARC™ Neck Stabilized stems has been rewarding.

For a first generation new design concept with new developmental instrumentation has provided a safe, effective and reliable construct for our younger more active patients.

Improved bone remodeling has been impressive.

Retaining the femoral neck has significant mechanical advantages and we have not seen the problems associated with other model neck stem designs.

Note: There is a short learning curve but very definitive.

We are encouraged and continue to use and evaluate these devices.