



Design Consideration for Modular Stems

by Timothy McTighe, Dr. H.S. (hc) Executive Director Joint Implant Surgery & Research Foundation Chagrin Falls, Ohio

* Acknowledgement of support from many surgeons over the years that are part of JISRF and our on going clinical/ surgical research.

RLO*: Charleston Joint Replacement Surgery 2010, May 6-7, 2010 Charleston Place Hotel Charleston, South Carolina * Real Life Orthopaedics



Remember the Goals of THA

Eliminate Pain

- New Bearing Surface
- **Restore Function**
- Reproduce Hip Mechanics
- 1. Femoral Offset
- 2. Neck Length
- 3. Combined Version Angle



Difficult to adjust w/ monoblock stem



Challenge: Joint Stability takes precedent over desired leg length

Single Biggest Legal Problem (Cameron)





#1 Dislocation

- Reports from 1-8%
- Higher in Posterior Approach
- Higher in Sm. Dia. Heads 22mm
- Higher in Revisions >20%









- Big Heads
- Navigation
- Constrained Sockets
- Increased Offset stems
 Hard on Hard Bearings





Dr. Amstutz "Despite a number of improvements in femoral stem neck geometry and increasing femoral head sizes up to 36mm, dislocation continues to be a significant problem after THA"

CURRENT DISLOCATION COSTS

Estimating a conservative 2% dislocation rate, there would be a corresponding 6,000 dislocated hips each year.

- Non-operatively treated 4,500 (75%) \$6,000
 Cost: relocation, brace, x-rays, rehabilitation
- Operatively treated 1,500 (25%) \$25,000
 Cost: operation, brace, and rehabilitation

\$6,000 x 4,500 = \$27 million \$25,000 x 1,500 = \$37.5 million

Total cost of dislocations per year in the United States. \$64.5 million





"Wright Medical Web Site"

Modularity of Femoral Components

 Modularity or multi-piece stems are becoming commonplace in THA with virtually all implant companies offering one version or another.











Proximal Modularity

Designed in the 1970's by Bousquet et al. First reference: 39 Annual meeting of the CAOA 1983 Vol. 1, n 2 (15-28) 1985 Journal of Orthopaedic Surgical Techniques

ISTITUTO CHIRURGICO ORTOPEDICO TRAUMATOLOGICO - LATINA (ITALY)

The BSP total hip system: a five year follow-up study

M. PASQUALI-LASAGNI Ph. D. - G. ANANIA M. D. - M. BOSTROM M. D. A. BOTTIGLIA M. D. - G. CASCIA M. D. - A. SCARCHILLI M. D.



AMERICAN ACADEMY OF ORTHOPAEDIC SURGEONS 62nd Annual Meeting - Orlando (Florida) February 16-21, 1995



The Stability[™] & Intrinsic[™] designs were influenced by **European Concepts**





United States Patent [19] McTighe et al.				US005653765A Patent Number: Date of Patent:	5,653,765 Aug. 5, 1997	
			[45]			
			,			
[54]	MODULAR PROSTHESIS		Cook et 497-512	Cook et al., Journal of Biomedical Materials Research, 18, 497-512, (1984).		
[75]	Inventors:	Timothy McTighe, Chagrin Falls, Ohio; Jerry Kee, Palm Beach Gardens, Fia; Bruce Shepherd, Mosman, Australia	Yue et a 1043-10 Zimmer 1974)	Yae et al., Journal of Biomedical Materials Research, 18, 1043–1058, (1984). Zimmer "Implant Metals" product catalog Rev.2A, (Sep. 1974).		
[73]	Assignee:	Ortho Development Corporation, Dramer Urab	"The Fre Gloucest	"The Freeman Total Hip Systems," Corin Medical Limited, Gloucestershire, England, 1985.		
[21]	Appl. No.:	368,040	Freeman Bone an	Freeman, M.A.R., "Why Resect the Neck?". The Journal of Bone and Joint Surgery, vol. 68-B, No. 3, May 1986, pp.		
[22]	Filed:	Jan. 3, 1995	540-349 Erreman	540-549. Froman, et al., in The Young Patient with Degenerative Hin		
	Related U.S. Application Data		Disease, 1986, pp	Disease, Sevastik J. Goldie I (ed.), Stockholm, Sweden, 1986, pp. 281-292.		
[63]	Continuatio	a of Ser. No. 269,935, Jul. 1, 1994, abandoned	Primary	Primary Examiner-David Isabella Attomnes Agent or Firm-Thoms, North & Western I. I. P.		
[52]	U.S. CL .	623/23: 623/18	1671	ABOTDACT	south of western, Lat.P.	
[58]	Field of S	earch 623/16, 18, 19,	[27]	ABSTRACT	lana a a	
[56]		623/20, 22, 23, 66 References Cited	A modu intercha Coronal	A mountar mp seem prostnesss mentaning a separate and interchangeable stem piece and proximal shoulder piece. Coronal and sagittal slots are formed in a rounded distal end		
U.S. PATENT DOCUMENTS			of the sta	of the stem in a substantially right-angle orientation. A neck member extends angularly outward from the shoulder niece		
Re. 23,395 7/1976 Noiles . D. 339,634 9/1993 Hori et al			and is co into the	and is configured to receive a spherical hip ball for insertion into the hip socket. The proximal shoulder piece includes a		
	(L	ist continued on next page.)	cylindric	al projection for insertion in	to an axial bore formed	
FOREIGN PATENT DOCUMENTS			walls de	walls defining the axial bore, and a distal end of the		
	0050533 4 0543099 5 2580171 10 2589001 10 2558446 7 3535158 4 4320086 12 2159416 3	//1912 European Pat. Off. 62323 //1953 European Pat. Off. 62323 //1954 France 62323 //1959 France 62323 //1959 France 62323 //1959 France 62323 //1959 Germany 62323 //1950 Germany 62323 //1954 Germany 62323 //1954 Unised Kingdom 62323	cylindric the bore cylindri formed piece rei securely piece ca changea	cal projection abuts the lip t. Radial teeth are formed cal projection and mate on the annular lip to there movably mountable onto the joins the shoulder piece w in be unilary or made up (ble distal stem piece and m	when it is inserted into on a distal end of the with compatible toeth by render the shouldes e stem. A locking screw with the stem. The stem of a separate and inter- setaphyseal component.	
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Copy provided by USPTO from the CSIR Image Database on 01-04-2002

AAOS 2006 Scientific Exhibit Target Restoration

By: Tom Tkach, MD; Warren Low, MD; George B. Cipolletti, MS; Timothy McTighe, Dr. H.S. (hc)



Instability - What should be done? Trail reduction demonstrates joint instability with slight increased leg length.





(Head center stays the same).

Big Heads! Theoretically, a bigger head is more stable... At the extremes of motion when the neck impinges In this case, intrinisic stability is unchanged



Biomechanical Solution Modular Neck! Add offset for joint stability reduce length for proper gait.

• This proximal modular design permits the independent selection of offset, version and leg length.



Head Center Data

2,000 Proximal modular stems implanted 2001-2005 AAOS 2006 Scientific Exhibit 957 THA's Performed (2001-2005) 842 Primary/115 Revisions Data collected on 800



¹ Noble, Philip C., M.S., Alexander, Jerry W. B.S. et al, "The Anatomic Basis of Femoral Component Design", Clinical Orthopedics and Related Research, Number 235, October, 1988.





Version Position

Typical 15 - 40° more ROM with neck anteverted.



Neutral neck position.



15° anteversion.

Aneterved neck used 18 times in the first 200 cases.



Modular junctions are not equal in design, function and technique

 Many modular designs have come and gone

•Will clinical outcomes

justify the cost













 Femoral **Component Failure** is a Concern Both clinical and Medical/Legal

 The more modular sites the more possible problems



"Within Any Important Issue, There Are Always Aspects No One Wishes To Discuss" - Femoral Component Failure

Kagel, K/, Kagel, J/, Kanner, R/, Tauth, T/, Lew, W/, Fourtish, J/, McTyles, T/, Chool, E/, Cholatt, G/

Investmention And Almo

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Femoral Offset



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(fatigue concern - all devices are subject to failure)

- >Offset effects (reduces) hip reaction forces
- Increased offset increases torsional loads
- Increased offset increases bending moment of implants



Modular junctions are not equal







Intrinsic stability of tapers

Demand vs Load





Extrinsic stability of composite design

Examples of modular junction failures









Being Fair Monoblock stems also fail





All devices are subject to failure!



Femoral Offset Concerns



One way of reducing implant concerns is by Design. Broad surface contact.



Another way is by design Save the neck

The varus-turning moment increases by a factor of 4 when the

neck is resected





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





Save the Architecture









A/P directed resultant force



With the neck resected this force generates significant torsional moment on the device which is resisted by shear at the stem/bone interface.



Which do you think has better torsional stability?









Persevering what we can by design & technique







International Osteoporosis Foundation May 5-8, 20

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IOF World Congress on Osteoporosis May 5-8, 2010 ź Florence, Italy

Poster Exhibit

"Neck Sparing Total Hip Arthroplasty Lessons Learned"

By: T. McTighe¹, I. Woodgate², A. van der Rijt², A. Turnbull², J. Harrison², D. Brazil² L. Keppler², J. Keggi², K.J. Keggi², R. Kennon², S.D. Stulberg², L.E. Rubin²



Prof. K. Keggi, MD Presenting in Florence, Italy



Novel: proximal conical flair loads the medial





Posterior approach

Anterior approach





38 yr old female auto / injured at 16 in 1987 comminuted acetabular fx & femoral shaft fx.





Dr. Charles Bryant trial rasp in place



Anterior Approach



The need and use of modularity example of surgical day for Lou Keppler, MD, Cleveland, Ohio





Modular Designs Small Incisions

 Works for all incisions even small anterior "Keggi" approach







Australian Orthopaedic Association 69th Annual Scientific Meeting - Cairns, Queensland October 2009

Poster Exhibit

By L. Keppler, MD and T. McTighe, Dr. H.S. (hc)

3 Case Report on Proximal Modularity



MoM Cup Spinout









Dual Press™ Modular neck





MoM cup removal





L. Keppler

18 yr old fusion takedown







Technique







Patient is happy and doing well @ 6 months





There is a role for modularity!

AAOS (E) Scientific Exhibit 2006 • Chicago, IL

The Role of Modularity in **Primary THA - Is There One?**

By Louis Keppler, M.D.*, Hugh U. Cameron, MB, ChB, FRCS[§], Timothy McTighe, Ph.D. (hc)[△]





Joint Implant Surgery and **Research Foundation** 17321 Buckthome Drive Chagrin Falls, OH 44023 440-543-0347 • www.jisrf.org

Introduction

Modularity or multi-piece stems are becoming commonplace in hip revision surgery^{6,13,15,17,19,21} with virtually all implant companies offering one version or another. The role of modularity would therefore seem to be firmly established for revision, but what of primary cases?8.11

This study is a follow-up to previous work with a further ten years of cases reviewed. The real



modularity pay higher dividends than the potential risk factors. We believe this review will provide guidance for others surgeons to aid in their decision making process.

For almost two decades the two senior authors have been using a provimally modular stem in primary cases. The S-Rom® stem has

The Role of Modularity in THR

Modular means that the stem has 2 or more parts which can be joined. Does that means any stem with a modular head is a modular stem? Not in today's definition. This exhibit is limited to the femoral side and includes two or more modular parts.7

Modular Stem History

Modular stems have a long history staring with McBride in 1948 that utilized a threaded femoral component publishing his first account in JBJS in 1952. This was followed in 1978 by Bousquet and Bornand with the development of a proximal modular stem that featured a provimal body that





Modularity offers significant benefits but you need to know its limits!

Improved modular designs appears to have addressed many of these concerns but do we know its limits?



Second Generation "Dual press™" design 216 ft-lbs./292.8 Nm Pin larger and stronger





Discussion

- Restoration of normal joint mechanics on a consistent basis is improved with modular designs.
- Provides for intra-operative fine tuning of biomechanics without disruption of implant bone interface.
- Provides for increased exposure to socket in revisions.
- Provides intra-operative options in case of dislocations.
- Significant number of small (10mm/11.5mm) stems required > 45mm offsets.













Conclusion

- The head center data suggest reconstruction benefits from the availability of many head centers for each stem size.
- Proximal modular design allows for restoration of proper soft tissue tension and joint biomechanics without disruption of implant interfaces
- New tissue sparing implant designs are emerging and hold significant promise

We are encouraged and remain enthusiastic about the features and benefits of proximal modularity.



