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Tolal Hip Femoral Stem Design Concept that Aids in Fine Tuning the Restoration of Joint Mechanics in THA

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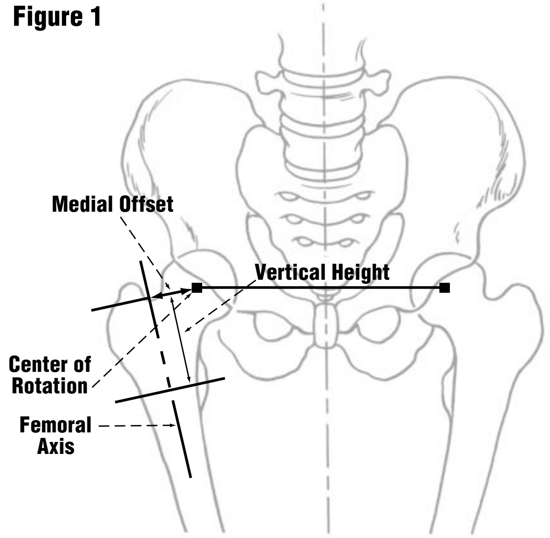
Restoration of the hip joint mechanics is critical to a long-term successful outcome for total hip arthroplasty.[1] Two important angles need to be considered: the neck shaft angle and the angle of anteversion. In addition to these two angles, femoral head offset affects the joint reaction force.[2]

Figure 1



Replacement of the normal position of the femoral head is essential for correction of mechanical balance between abductor forces.[3] If vertical height is too short, joint stability is a problem. If too long, patients are very unhappy. Incorrect version angle can result in reduced range of motion and possible toeing in. Short medial offset will cause shortening of the abductor moments resulting in increased resultant force across the hip joint, and increasing the tendency to limp. Offset too great increases torsional and bending forces on the femoral component. (Fig. 1)

"Technique, technique, technique" as quoted by David Hungerford, M.D. is more important than design or material. With that said, we feel design features can aid in correcting technique related problems.

Surgical approach and technique not only affects soft tissue laxity but also can have a significant influence on component position. The most common surgical errors relate to malpositioning the acetabular component, however, malposition of the femoral component can contribute to increase component impingement and dislocation (Fig. 2).[4,5]

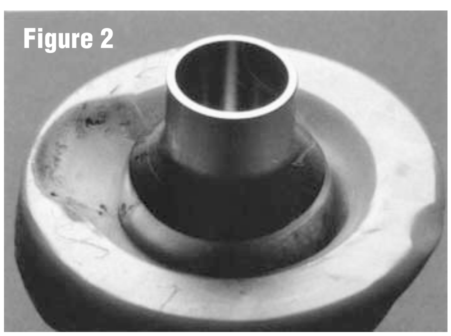


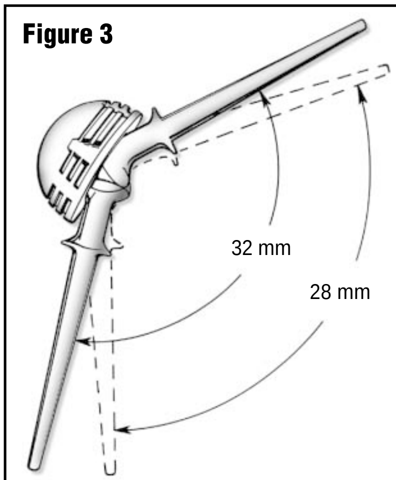
Figure 2

Malpositioning of a cemented stem not only can result in impingement, compromise of cement mantle thickness and dislocation but can significantly impact bone loss by requiring revision of the femoral stem. In addition, malposition can contribute to bone lysis by the increase of articulation wear debris.[6]

Two factors that can affect range of motion are component positioning and component geometry.[4] Although physiological range of motion vary for each patient an average of 114º of flexion is required for sitting. There is no question that increased range of motion results in better clinical results.

Head diameter, neck shape and skirts on femoral heads can all affect hip range of motion (Fig. 3)[1]

Figure 3

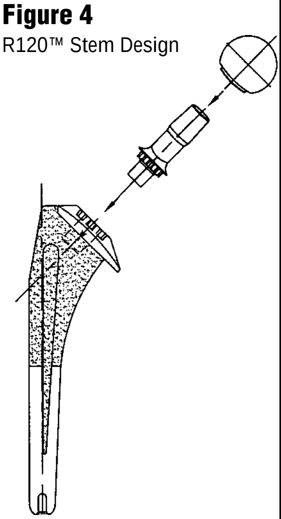


The following stem design approach is recommended in an attempt to aid in restoration of joint mechanics and to allow the surgeon a final opportunity to correct for malpostioning of implants due to technique, and /or bony deformity.

R120™ Modular Indexable Neck Cemented Stem

The stem is designed to use standard conventional cementing techniques. The shape of the stem is trapezoidal and along with a proportionally designed collar provides for optimal impaction and compression of bone cement. In addition, a teardrop shaped recess on the anterior and posterior portion of the implant increases the cement to prosthesis interface therefore increasing resistances to axial and torsional forces (Fig. 4)

Figure 4
R120™ Stem Design



The proximal stem features a matte surface, which enhances fixation of the implant to the PMMA cement, while the distal portion is polished allowing for ease of retrieval if necessary.

An optional distal PMMA stem centralizer is available depending on each individual's philosophy.

Proximally, R120 stems are designed in five (5) cross sections with three (3) interchangeable modular neck lengths of 32mm, 35mm, and 38mm and two angle variations of 8º and 12º. The proximal stem collar is made with a cavity where a self-locking taper and a positive indexing mechanism are employed to ensure the proper head, length, version and offsets are obtained. (Fig. 5)

Figure 5

This unique design features twelve (12) self-locking positions providing several combinations of neck length version and offset for closer match to restoring hip joint mechanics.

This innovative approach provides the surgeon with the opportunity to intervene at the last possible surgical moment and fine tune the hip joint mechanics without disruption of the implant-cement-bone interface. In addition, it should provide for increased opportunity to surgically intervene for certain post-op complications, like component malposition, leg length discrepancy, dislocations and replacement of bearing surfaces, with minimal disruption of bony interfaces.

These are just some examples of the flexibility of using this unique Modular Indexable R120™ Neck System(Fig. 6).

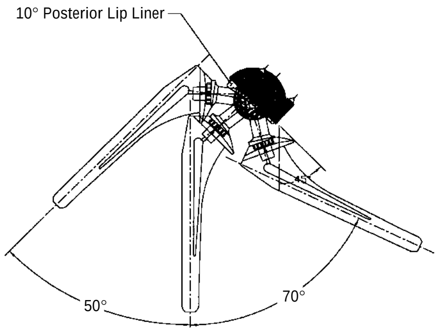
The references for the pro and con use of modular couplings have been well documented and are too many to list here. We suggest the basic decision-making be left to the operating surgeon as to the advantages offered by modularity. In addition, we suggest each modular site needs to be evaluated on its own merits.

Modular necks have been used in titanium cementless stems in Europe successfully for years (Fig. 7). Both mechanical and clinical results have demonstrated the design approach to be safe and effective.[7,8,9] However, the authors here feel, for cemented application, cobalt chrome molybdenum alloy is preferable both for interfacing with cement and for providing less risk of fretting and/or corrosion at the modular stem neck junction.[10,11] The availability of modular necks and heads allow for unprecedented flexibility in restoring hip joint mechanics.

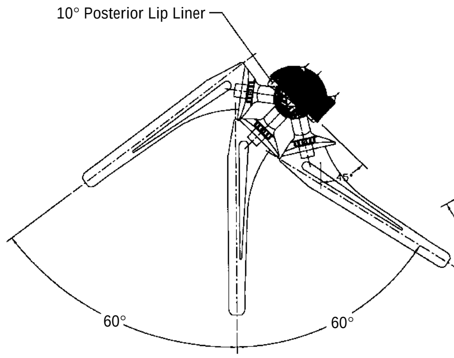
Figure 7

Only long-term outcome data will clearly demonstrate the viability of this modular neck design, however, basic mechanical principals and attention to the design features presented should aid the surgeon in fine-tuning and restoring normal mechanics to the reconstructed hip.

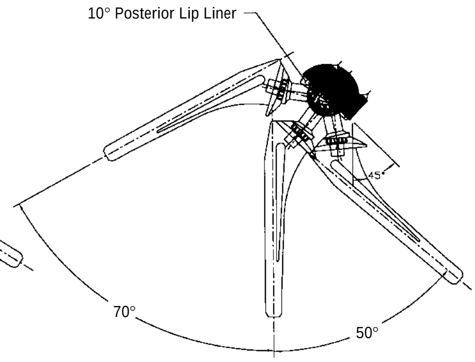
Figure 6



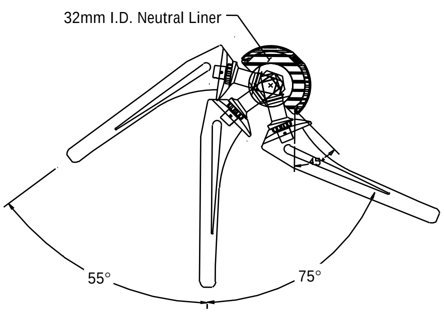
R120 Stem w / 28mm 0 Head
Shown with 10° lip liner
Indexable Neck position #0
Neck Angle 127°



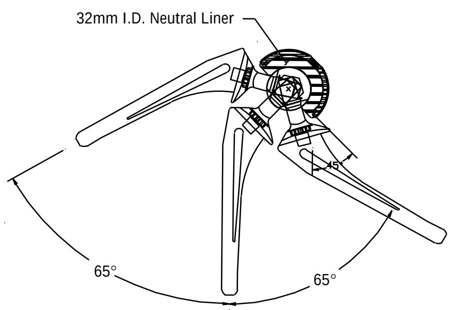
R120 Stem w / 28mm 0 Head
Shown with 10° lip liner
Indexable Neck position #3 or #9
Neck Angle 135°



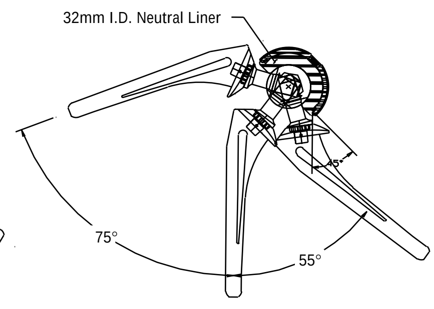
R-120 Stem w / 28mm 0 Head
Shown with 10° lip liner
Indexable Neck Position #6
Neck Angle 142°



R120 Stem w / 32mm 0 Head
Shown with 0° lip liner
Indexable Neck Position #0
Neck Angle 127°



R120 stem w / 32mm 0 Head
Shown with 0° lip liner
Indexable Neck Position #3 or #9
Neck Angle 135°



R120 Stem w / 32mm 0 Head
Shown with 0° lip liner
Indexable Neck Position #6
Neck Angle 142°

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