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The Effect of Femoral Head and Neck Cross Section on Range of Motion

The AcuMatch® Integrated Hip System, which includes the C, P and M-Series family of stems, was designed to maximize range of motion through its innovative neck design (Figure 1). The precisely designed and machined neck flats feature a cross section of 8mm, one of the smallest cross sections in the industry. The result of the design effort includes impressive head-neck ratios for both 28mm and 32mm femoral heads (see table below) which may ultimately lead to a reduction in post-operative dislocation.[1, 2, 3]

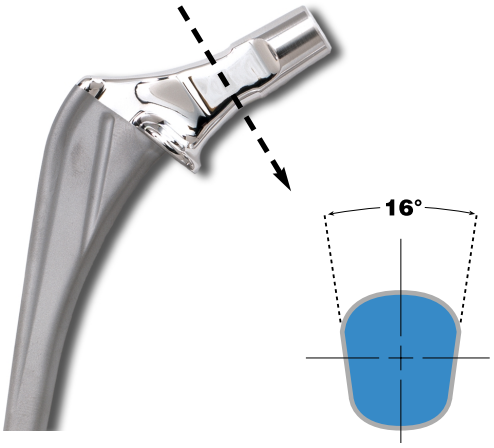

Figure 1. The AcuMatch neck is machined to minimize the medial dimension and overall cross section while also maintaining overall strength.

Important Facts About Head-Neck Ratio

Head-neck ratio is the result of dividing the femoral head diameter by the cross sectional dimension of the femoral neck. Here are two examples using the 8mm cross section of the AcuMatch femoral stems coupled with 28mm and 32mm femoral heads:

28mm/8mm = head-neck ratio of 3.5

32mm/8mm = head-neck ratio of 4

Why is head-neck ratio important?

Higher head-neck ratios increase range of motion (Figure 2). Increased range of motion may reduce the occurrence of post-operative dislocation, one of the leading post-operative complications associated with both primary and revision total hip arthroplasty.[4]

Increasing the head-neck ratio is why many manufacturers are incorporating larger diameter heads into their product lines. By increasing the femoral head diameter, the head-neck ratio will be greater and the chance of post-operative dislocation may be decreased.

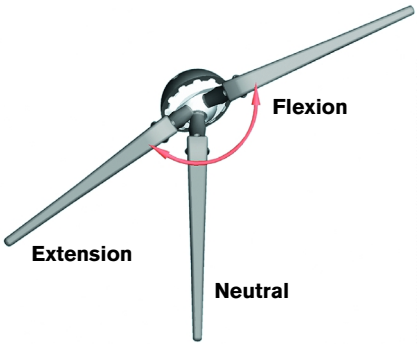

Figure 2. Range of motion is measured by the amount of flexion and extension that can be achieved following a total hip replacement. Greater range of motion may decrease the chance of post-operative dislocation.

Competitive Head-Neck Ratio Comparison:

	28mm	32mm	36mm
AcuMatch	3.5	4.0	4.5
Summit	3.0	3.4	3.85

The higher the head-neck ratio, the greater range of motion achievable.

What About the Issue of Strength?

The AcuMatch neck was designed to maximize its strength. The neck flats are angled at 16°, resulting in more material on the lateral aspect of the stem (where applied forces produce greater tensile stress) and less material on the medial aspect of the stem (where the first point of impingement occurs).[5] The result is excellent range of motion without sacrificing stem strength.[6]

Potential issues when using larger diameter heads:

- Limited to acetabula that can accept a large shell
- Minimizes polyethylene thickness

References:

1. Amstutz HC, Lodwig, RM Schurman, DJ Hodgson AG. Range of motion studies for total hip replacements. *Clin Orthop*. 1975;111:124-130.
2. Krushell RJ, Burke DW, Harris WH: Range of motion in contemporary total hip arthroplasty. *J Arthroplasty*. 1991;(6): 97-101.
3. Robinson RP, Simonian PT, Gradisar IM, Ching RP: Joint motion and surface contact area related to component position in total hip arthroplasty. *J Bone Joint Surg.* 1997;17-B(1) 140-146.
4. Vaughn BK. Management of dislocation in total hip arthroplasty. Oper Techniques. 1995; (5) 4:341-348.
5. Yamaguchi M, Bauer TW, Hashimoto Y, The spatial location of impingement in total hip arthroplasty. Sixty-fourth annual meeting, AAOS, San Francisco, CA, 1997.
6. Exactech data on file.

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