

Evidence matters

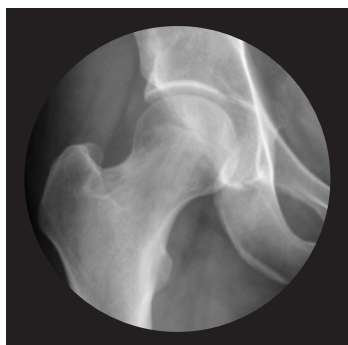
HipCheck software

Top-level summary

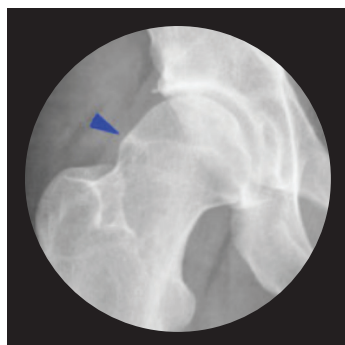
HipCheck software intraoperatively calculates alpha angle with 86% accuracy on good quality images.⁷

The alpha angle measurement technique is used to measure bony deformities that develop on the femoral head-neck junction of the hip during femoroacetabular impingement (FAI) procedures. Literature reports the average alpha angle in patients without symptoms of cam-type FAI is 42 degrees (normal alpha angle range: 38-48 degrees).^{1,2} Whereas, a cam deformity, which can lead to impingement in the hip, is typically diagnosed in patients with increased alpha angles (> 50 degrees).³⁻⁶

A surgeon can arthroscopically access the hip and resect the cam deformity to address impingement—using the alpha angle measurement to help ensure a sufficient amount of the cam is resected.



Normal hip



Hip with cam deformity

Stryker's HipCheck software intraoperatively measures alpha angle during FAI procedures. When the alpha angle is greater than the target angle, it can also display an adjustable resection curve (ARC)—a tool that helps surgeons to visualize the potential final curvature/shape of the femoral head and neck. HipCheck software is able to calculate alpha angles on good quality* images with 86% accuracy, and on average quality images with 80% accuracy.⁷

The ARC is made of two parts. For exospherical hips, it is an arc following the best-fit circle from the alpha angle to the target line and a curve from the target alpha angle down the neck. For endospherical hips, it is a line beginning at the most endospherical point to the target line and a curve from the target alpha angle down the neck. There is no measured or claimed accuracy of mathematical ARC modeling against scientific and/or clinical definitions/claims.

Methods

Acceptable tolerances for the alpha angle were determined through a series of detailed surveys of four orthopedic surgeons. Once tolerance specifications were defined, the accuracy of the alpha angle algorithm was tested against a set of 241 manually tagged good images and 164 manually tagged average images (Figure 1; see guidelines for image quality* on page 2).

Four consultant orthopedic surgeons were surveyed on the acceptability of the ARC and accuracy of alpha angle determined by the software using 29 images from a variety of different hip anatomies depicting both endospherical and exospherical hips. An additional six surgeons were surveyed on the acceptability of the ARC and accuracy of alpha angle during cadaveric evaluation of the HipCheck system.

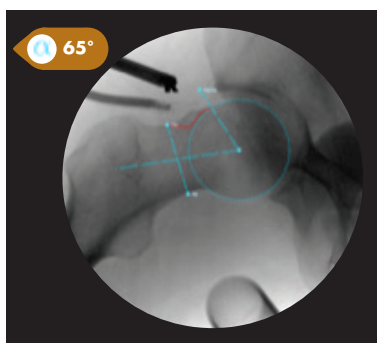


Figure 1a.

Manually tagged "good" quality image of a right hip using Stryker's tagging software; alpha angle measured at 65 degrees.

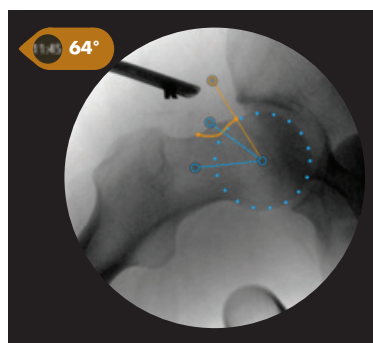


Figure 1b.

Alpha angle algorithm tagged "good" quality image of a right hip using HipCheck software; alpha angle measured at 64 degrees.

Results^{8,9}

- HipCheck software is able to successfully detect the alpha angle. Successful detection is defined as the alpha angle being determined within a tolerance of $+6^{\circ}$ / -4° as measured against manually tagged results.
- HipCheck software is able to calculate the alpha angle on good quality images with 86% accuracy, and on average quality images with 80% accuracy. (Of all good quality images tested, this does not mean that 14% of the images tested failed alpha angle detection. Rather, 14% of the test results were outside the $+6^{\circ}$ / -4° tolerance specifications that were set for the acceptable alpha angle range.)
- Eight out of ten surgeons surveyed felt the length and shape of the ARC was accurate and that the amount of input or interaction from the surgeon was acceptable.
- Nine out of ten surgeons surveyed felt the intraoperative accuracy of alpha angle was acceptable for determining the degree of cam impingement.

Clinical relevance

Residual FAI is considered the most common reason for revision hip arthroscopy, with 80-90% of revisions as a result of residual bony impingement.^{10,11} In addition to under-resection, over-resection of bone lends itself to significant complications including the possibility of femoral neck fracture and avascular necrosis of the femoral head. The surgical approach should be well planned and the amount of resection gauged carefully.¹²

Given current technology, surgeons typically sketch the alpha angle by hand over a pre-operative radiograph or use prior experience to plan their approach. Stryker's HipCheck system will provide a tool for physicians to intraoperatively plan, follow and confirm their cam resection plan.

*Image quality



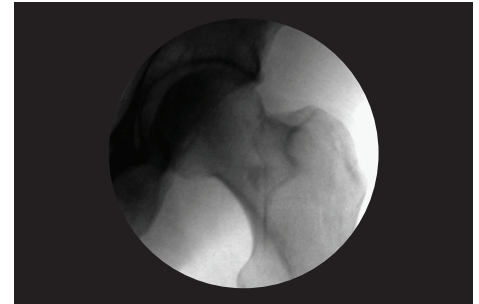
Good quality image

High resolution, not "blurry" and can see a crisp edge around the entirety of the femoral head.



Average quality image

High resolution, very little "blur" and can see a crisp edge around most of the femoral head.



Bad quality image

Lower resolution, "blurry," difficult to make out edges of femoral head and either too dark or too light.

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- ⁸ Stryker TR18366 Rev A 2018 HipCheck Design Validation Test Report.
- ⁹ Stryker TR18373 Rev A 2018 HipCheck AA Test Report.
- ¹⁰ Houcke JV, Khanduja V, Nakano N, Krekel P, Pattyn C, Audenaert E. Accuracy of navigated cam resection in femoroacetabular impingement: a randomized controlled trial. *The International Journal of Medical Robotics and Computer Assisted Surgery* 2017; DOI: 10.1002/rcs.1839.
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- ¹² Guanche CA., Bare AA. Arthroscopic treatment of femoroacetabular impingement. *Arthroscopy* 2006;95-106.

Sports Medicine

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