ANKLE MORPHOMETRY ON 3D-CT IMAGES

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INTRODUCTION:
For anatomic implant design of total ankle replacement (TAR), morphometric evaluation in vivo in the current patient population is essential. Such information in a specific individual is also helpful for preoperative selection of proper implant-size and for designing custom implants. For these purposes, 3D-CT measurement, which permits direct exploration of 3D morphology, is thought to have an advantage over radiographic measurement. This study hypothesized that the topographical features of the talar dome can be described by morphometric evaluation on 3D-CT images.

METHODS:
Three-dimensional ankle CT images were collected from a total of twenty-one patients (11 males, 10 females; average age 40 ± 10 years) who suffered from unilateral ankle osteoarthritis, under institutional IRB approval. In this study, the images of only the unaffected ankles were utilized.

The CT images were subjected to morphometric evaluation of the superior talar dome surface, with use of image visualization software (Vitrea® Version 2, Vital Images Inc., Minneapolis, MN). For reproducible measurement, local reference planes based on anatomical landmarks of the talus (“anatomical” sagittal, coronal, and transverse planes) were first established (Fig. 1).

The width of talar dome was measured on the mid-coronal slice (the anatomical coronal slice passing through the approximate center of the talar dome), as well as on the slices rotated 30 degrees anteriorly or posteriorly about the talar-dome center. On each slice, two lines were drawn in alignment with the medial and lateral talus sides, and a line connecting the two peaks on the superior talar surface was drawn to intersect the two vertical lines (Fig. 2, left). Talar width was then measured as a distance between these intersections.

The radius of talar dome was measured on the mid-sagittal section image. Three surface points at anterior, middle, and posterior positions along the dome were digitized, and the radius of the arc passing through these three points was calculated (Fig. 3, right).

RESULTS:
The width of talar dome, averaging 29.9 ± 2.6 mm at the anterior part (all subjects, Fig. 3), decreased linearly from anterior to posterior (p < 0.001, single factor ANOVA). The dome radius averaged 20.7 ± 2.6 mm. Gender difference was demonstrated in both width and radius (p-values < 0.05, unpaired t-test), except the width at the middle (p = 0.07).

DISCUSSION/CONCLUSION:
The average data of both width and radius are equivalent to those in previous radiographic studies [1,2]. The results further demonstrate the wedging shape of the talar dome and a gender difference; neither was demonstrated in previous radiographic studies. The 3D-CT image approach for assessing ankle geometry appears to have a potential to provide information useful for designing TAR implants or for choosing the optimum size of implant.

REFERENCES:

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