ANALYSIS OF THE MICROARCHITECUTRE OF THE HUMAN FEMORAL HEAD USING MICRO-COMPUTERTOMOGRAPHY

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Introduction

Despite its significance not many things are known regarding microarchitecture of the human femoral head. Understanding the complex structure would lead to advanced knowledge of the pathogenesis of the diseases in femoral head and improved implant survival which lies in the human femoral head [Rothstock et al., 2011]. The purpose of this study was to scan femoral heads from cadaveric donors and investigate the microarchitecture within each femoral head comprehensively.

Methods

Ten proximal femora was harvested from eight human cadaveric donors and these specimens were scanned using micro-computed tomography. Reconstructed batches of images were aligned along the main trabecular direction (MTD) (Fig.1) [Ohman et al., 2007; Perilli et al., 2007; Tassani et al., 2010]. The upper hemisphere of each femoral head was included in the analysis. Femoral neck area was designated as 12 o'clock and 12 identical 30-degree arcs around a same centre were assigned in each image (Fig. 2). Each volume of interest was sub-divided into proximal and distal segment. Morphometric parameters were obtained in each reconstructed 3D volume of interest (VOI).

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Fig 1: The intersection between most lateral and medial trabeculae was assumed to be MTD. Narrow white lines are the most laterally and medially located primary compressive trabeculae while bold white lines are MTD.

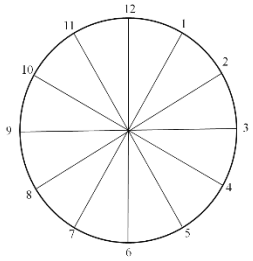

Fig 2: Each slice of reconstructed segmented image was divided into twelve equal sized 30-degree arcs about a same centre point.

Results

In proximal segments structure model index(SMI), trabecular number(Tb. N), trabecular seperation(Tb. Sp), and degree of anisotropy(DA) were statistically different among VOIs.

Bone volume fracture(BV/TV), SMI, Tb. N, Tb. Sp, DA, and connectivity density(Conn. D) were differed among VOIs in distal segments.

In 90-120° area, which is located in posterior area BV-TV was highest and SMI was lowest. In 150-210° and 330-60° area DA was higher than other areas and increased in proximal segment. In 240-300° area trabecular thickness and number tended to be increased only in distal segments. In 0-60° Conn. D was higher in proximal segments..

Discussion

This is the first study to investigate the microarchitecture within each femoral head comprehensively. When the microarchitecture within human femoral head was analysis along the MTD, morphometric parameters were distinctively different among VOIs. These findings are assumed to be mainly due to the morphology and orientation of the primary compressive trabeculae.

References

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Perilli E *et al*, Bone 41: 760-768, 2007

Rothstock S *et al*, J Biomech 44: 1646-1653, 2011

Tassani S *et* al, J Biomech 43: 1160-1166, 2010