The adaptation of human pisiform entheses to compressive forces.

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INTRODUCTION: According to the literature two types of entheses (i.e. tendon / ligament attachment sites), fibrous and fibrocartilaginous can be distinguished[1]. Fibrous entheses transmit tensile stress to bone, while fibrocartilaginous entheses in addition are subject to local compressive stress. Local compressive stress is closely related to the function of the enthesis which is to dissipate shear forces away from the hard/soft tissue interface. Shear forces at the attachment site are caused by the insertional angle change of the tendon / ligament during limb movement. The fibrocartilaginous layer resembles a functional adaptation to the special local mechanical situation[2]. The aim of our study was to test, if there is a correlation between the size of the fibrocartilaginous parts of the entheses and the insertional angle changes of the tendon and ligaments of the human pisiforme complex. The pisiforme as a bony pulley distributes the force of the flexor carpi ulnaris muscle between two ligaments. One of these (pisometacarpal ligament) is running in line with the tendon of flexor carpi ulnaris muscle, while the other (pisohamate ligament) is branching in an angle of 45° [3], which means that both ligamentous entheses are exposed to more or less the same forces, but experience different types of insertional angle change during hand movement.

METHODS: Five human pisiforme complexes were removed within 48h post mortem. The specimens were fixed in methanol, decalcified and cryosectioned at the level of the entheses. Sections were labeled with monoclonal antibodies directed against collagens I and II. The varying sizes of the collagen II positive zones at the entheses were assessed using Axiovision image analysis software (Zeiss).

RESULTS: All attachment sites showed fibrocartilaginous (i.e. collagen II positive) entheses. The fibrocartilaginous zones showed the largest collagen II positive layer at the attachment site of the flexor carpi ulnaris muscle and the smallest at the distal entheses of the pisometacarpal ligament. Furthermore there was a difference between both distal entheses of the pisohamate and the pisometacarpal ligaments.

DISCUSSION & CONCLUSIONS: It is well documented that during hand movement (i.e. during carpal flexion and extension) the major changes of insertional angle occur at the attachment site of M. flexor carpi ulnaris. During radial and ulnar deviation the insertional angle change at the distal entheses of the pisohamate ligament is greater than at the distal entheses of the pisometacarpal ligament. This is due to the specific movement of the pisiforme [4]. Our results on the different sizes of the fibrocartilaginous layer are apparently reflecting the adaptation to the mechanical environment that is created by the average insertional angle changes occurring at either enthesis.

REFERENCES: [1] M. Benjamin et al. (2002): The skeletal attachment of tendons- tendon entheses. *Comparative Biochemestry and Physiology* **133:**931-945. [2] AA Boszczyk et al. (2003): Expression of a wide range of fibrocartilage molecules at the entheses of the alar ligaments – possible antigenic targets for rheumatoid arthritis? *J Rheumat* **30:**1420-1425. [3] T. Pevny et al. (1995): Ligamentous and Tendinosus Support of the Pisiform. *J Hand Surg* **20A:**299-304. [4] T. Moojen et al. (2001): Pisiforme Kinematics In Vivo.*J Hand Surg* **26A:**901-907.

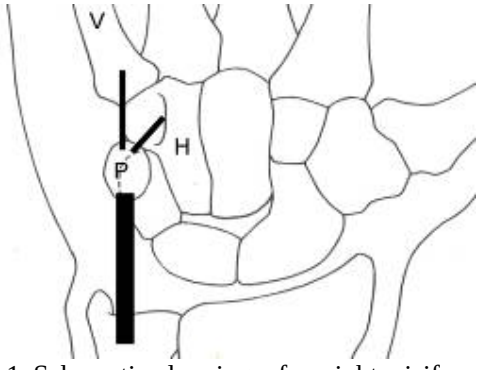

Fig.1 Schematic drawing of a right pisiforme complex.