INTRODUCTION:
Since the early 1940’s, there have been many anatomical and histological studies of different joints in both human and animal models. A substantial effort has been made to classify nerve structures and identify their functional importance. In 1967, Freeman and Wyke (F&W) published a classification system after performing a detailed anatomical and histological study of feline knees (3). This system was based on morphological and functional characteristics (Fig 1). This system remains in wide use today. The purpose of this study is to compare the F&W classification system with our results in the capsule-ligament structure of human wrist.

METHODS:
A total of twenty dorsal radiocarpal (DRC) ligaments and twenty long radiolunate (LRL) ligaments, ten short radiolunate (SRL) ligaments and ten radioscaphocapitate (RSC) ligaments were harvested from ten fresh cadavers (1). The demographic data in the cadavers are as follows: DRC and LRL ligaments (5 males, 5 females, average age 75.3 yrs), SRL ligaments (3 females, 2 males, 81.4yrs), RSC ligaments (3 females, 2 males, 74.4yrs). The ligament tissues were fixed, serially sectioned with a cryostat at 50 µm and collected on glass slides, then processed for fluorescence immunohistochemistry using first antibody to protein gene product 9.5(PGP9.5), followed by a secondary antibody conjugated to a fluorescent tag (Alexa Fluor 488(4)). All sections were evaluated with an LSM-510 confocal laser microscope and a Kontron KS 400 image analyzer. Labeled mechanoreceptors were measured and identified by feature. These identified mechanoreceptors were categorized by shape first to see if they fit within the F&W scheme. They were then analyzed by size within each category.

RESULTS:
Mechanoreceptor shapes were characterized as spherical, oval, fusiform, cylindrical, mushroom, rectangular, crescent and conical. Over 50% of mechanoreceptors were oval in shape. 7.4% were unclassifiable in shape (Fig 2). Figure 3 shows the results which fitted our mechanoreceptors in the F&W’s scheme. The spherical and oval shaped receptors matched the F&W Type I category morphologically. The fusiform shapes were F&W Type III. Other shaped: cylindrical and mushroom, etc. receptors which did not match with any F&W categories were labeled as NOTT (Non type One Two Three) (Fig 4). Only one mechanoreceptor of F&W Type II category was found in this study to date since it was impossible to count the exact number of F&W Type IV receptors, we excluded that category in our study. In terms of size, we found that the mechanoreceptors in our study were larger than the size in F&W Type I category and smaller than F&W Type III (Fig 5).

DISCUSSION:
We found significant differences between our results and F&W’s classification. Many mechanoreceptors did not fit exactly into the F&W scheme, therefore were classified as NOTT receptors (13-22%) in shape (2). In addition, we found significant size differences in the mechanoreceptors that are F&W Type I and III categories. All of these mechanoreceptors in the human wrist were discrepant for F&W classification in the morphology and size. High resolution 3-dimensional imaging combined with immunohistochemistry and confocal microscopic technology enabled us to study more accurately the feature and characteristics of mechanoreceptors (Fig 7). It is possible that size differences exist between the human wrist and the feline knee.

CONCLUSION:
Strict conventional classification option of joint mechanoreceptors was not able to classify large numbers of mechanoreceptors found in this current detailed study. Furthermore more precise and detailed information of mechanoreceptor morphologies and dimensions with our new protocol may allow resolution of these discrepancies.

ACKNOWLEDGEMENT:
This work was supported by a grant from NIH/NIAMS AR47806

REFERENCE: