INTRODUCTION: The flexor-pronator mass (FPM) and the extensor supinator mass (ESM) are particularly important for elbow valgus stability in overhead throwing athletes, who place tremendous repetitive valgus moment around the elbow [1-2]. The aim of current study was to identify the relative contribution of each flexor-pronator mass (FPM) - flexor carpi radialis (FCR), flexor carpi ulnaris (FCU), pronator teres (PT), and flexor digitorum superficialis (FDS) – and Extensor Supinator Mass (ESM) – extensor carpi ulnaris (ECU), extensor digitorum communis (EDC), extensor carpi radialis (ECR), and the brachioradialis (BR) – to the valgus stability at two representative throwing postures.

MATERIALS AND METHODS

Specimen Preparation: Eight fresh-frozen elbow specimens (73.8±14.1 yrs) were tested. Specimens included at least 14cm of the humerus, along with the entire forearm and hand. The skin and subcutaneous tissues were removed up to the wrist. All muscles of the forearm were left intact. The specimen was mounted on a customized experimental apparatus (Fig 1).

Experimental Setup (Fig 1): A differential variable reluctance transducer (DVRT) (Microminiature DVRT, MicroStrain Inc., Williston, VT) was mounted on the isometric aspect of the anterior bundle of the medial ulnar collateral ligament (MUCL) to measure the ligament strain corresponding to each muscle loading. A load cell (M31, Honeywell Sensotec, Columbus, OH, USA) was used to measure the pulling force during individual muscle loading.

RESULTS: At 45° and 90° elbow flexion, individual loading of the EDC and ECU caused significant MUCL strain (p<0.05), while the other ES muscles brought no significant change (p>0.05). One-way ANOVA test showed that ECU loading caused the greatest MUCL tension compared with EDC, ECR, or BR loading at both postures (p<0.05). At 90° elbow flexion, all muscles caused no significant MUCL tension (p>0.05). One-way ANOVA test showed that there was no significant difference among the ES muscles. Only ECU loading at 45° elbow flexion provided higher tension of the MUCL strain compared with that at 90° elbow flexion (p<0.05). The relative contributions of the FCU, FDS, FCR, and PT for the valgus instability (varus stability) of the elbow at 45° elbow flexion. These findings also indicated that understanding antagonistic characteristics between the FPM for the valgus stability and the ESM for the valgus instability may be very helpful to restoring more effectively the function of an injured elbow in terms of the valgus stability, particularly in the elbow with the MUCL tear. The study can be helpful to injury prevention, surgical techniques, and rehabilitation in throwing athletes, e.g., the physician should give particular attention to optimizing the function of the FCU, FDS, ECU, and EDC.

DISCUSSIONS: Our findings suggest that the FCU may be a primary dynamic stabilizer for the valgus stability of the elbow incorporating with the MUCL for all throwing postures and the FDS may be functioned as a second dynamics stabilizer at particular throwing postures. On the other hand, the results suggest that the ECU and the EDC may be the primary and secondary dynamic contributors for the valgus instability (varus stability) of the elbow at 45° elbow flexion. These findings also indicated that understanding antagonistic characteristics between the FPM for the valgus stability and the ESM for the valgus instability may be very helpful to restoring more effectively the function of an injured elbow in terms of the valgus stability, particularly in the elbow with the MUCL tear. The study can be helpful to injury prevention, surgical techniques, and rehabilitation in throwing athletes, e.g., the physician should give particular attention to optimizing the function of the FCU, FDS, ECU, and EDC.

Fig 1. Experimental Setup. Fiberglass meshes were sutured to muscles for application of simulated muscle loading through cotton wires and steel eyelets, which guided the loading direction of muscle. DVRT sutured on MUCL is shown in the inset.

Fig 2. Relative contribution (%) of each flexor pronator muscle and each extensor supinator muscle to elbow valgus stability during loading.

CONTRIBUTION OF THE FLEXOR-PRONATOR AND EXTENSOR SUPINATOR MASSES FOR VALGUS STABILITY OF THE ELBOW AT THROWING POSTURES

*Dohyung Lim, ^Sam Perlmutt, }Fang Lin, ^Navjot Kohli, *Jordan W. Nuber, *James Bankard, ^Mohsen Maksous
^SMPP, Rehab. Inst of Chicago, Chicago, IL

m-maksous@northwestern.edu

Poster No: 1149

53rd Annual Meeting of the Orthopaedic Research Society