**Tennis Elbow: Implications for an Evidence-Based Treatment**

+1Alizadehkhaiyat, O; 2Fisher, AC; 1Kemp, GJ; 3Vishwanathan, K; 1Frostick, SP

1University of Liverpool, Liverpool, UK, 2; 3Royal Liverpool University Hospital, Liverpool, UK, 4Countess of Chester NHS Hospital, Chester, UK

**ABSTRACT INTRODUCTION**
Lateral elbow tendinopathy or tennis elbow (TE) is the commonest elbow problem in athletes which involves the common wrist extensor origin, particularly the origin of extensor carpi radialis (ECR). At least 40 conservative treatments have been described but the optimal treatment is unknown due to unknown etiology. Muscle imbalance, an unhealthy functional relationship among the periaricular muscles, particularly between agonist and antagonist groups, has become an important topic in the etiology of painful musculoskeletal disorders. We aimed to investigate strength, fatigability, and activity of forearm upper limb musculature to elucidate the role of muscle imbalance in the pathophysiology of TE.

**METHODS**
Sixteen patients clinically diagnosed with TE were compared with sixteen control (C) subjects with no history of upper limb problem. Maximum isometric strength was measured for metacarpophalangeal (MCP), grip, wrist, and shoulder on both sides. Three consecutive strength trials were performed according to standard criteria and the mean values recorded as maximum voluntary contraction (MVC). Furthermore, total upper limb strength (the sum of wrist, grip and shoulder strength) on the affected side was calculated as the sum of MVC, wrist, grip and shoulder strength measurements in order to assess the impact of TE on whole-upper extremity performance. Electromyographic activity (RMS amplitude) and fatigue characteristics (median frequency slope) of wrist extensor and flexor muscles including Extensor Carpi Radialis (ECR), Extensor Digitorum Communis (EDC), Flexor carpi Ulnaris (FCU), and Flexor Digitorum Superficialis (FDS) were measured during isometric contraction at 50% MVC. Validated questionnaires: Patient-Rated Tennis Elbow Questionnaire, Disabilities of the Arm, Shoulder, and Hand and Patient-Rated Wrist Evaluation Questionnaire were used for assessing pain level and functional disability. Hospital Anxiety and Depression Scale (HADS) was used to register psychological status. This study was approved by the Local Research Ethics Committee, and all participants gave their written, informed consent.

**RESULTS SECTION**
All strength measurements showed dominance difference in C (11% for grip, 12% for wrist, and 10–15% for shoulder), but none in TE. In TE group, grip (25%), wrist (30%) and shoulder (25–35%) strength were significantly (p<0.05) weaker than those in C group (Fig1). Total Upper Limb strength was significantly higher in C group (1215±99N) on the affected side compared to the TE group (860±76N) (Fig2). Analysis of frequency spectrum showed no difference in both groups, the activity of ECR was markedly reduced (p<0.05) in TE group. Although for most forearm muscles RMS increased with time in indicated of functional disability and poor psychological status in TE affected side compared to the TE group (860±76N) Scores strongly (p<0.05) reduction in the activity of ECR muscle in TE group compared to C group.

**DISCUSSION**
Considering the importance of kinetic chain principles, we integrated strength measures in multiple segments of the upper limb. A global upper limb weakness was found which needs to be addressed in prevention and treatment strategies for TE suggesting that whole upper limb should be included in TE rehabilitation. We were also able to identify a muscle activation imbalance (in ECR) in TE that, if not corrected, would change the activation pattern of neighbouring muscles as a compensatory mechanism leading to a widespread imbalance. This suggests that restoration of normal ECR activity should be a treatment goal in the rehabilitation of TE to avoid further muscular imbalances and strength deficits. Although numerous exercises are proposed for wrist extensor and flexor muscles, future work should address which exercises best restore muscle balance rather than muscle strength per se. Significantly elevated levels of depression and anxiety in TE group indicates that behavioural assessment and early cognitive-behavioural intervention should be included in rehabilitation programs. Future work should focus on concepts of fear-avoidance ad pain-related fear to investigate the role of these mechanisms in chronic TE.

**REFERENCES**