Monitoring the Status of Functional Recovery in Tendinopathies: Tennis Elbow as an Example

**ABSTRACT**

**INTRODUCTION**

Lateral elbow tendinopathy or tennis elbow (TE) is one of the commonest elbow problems causing pain and thus restricting performance and function. It is commonly considered a degenerative tendinopathy of the origin of extensor carpi radialis (ECR) muscle. The aetiology is likely to be multi-factorial and the optimal treatment remains undefined. Recovery time may vary between 6 months to 2 years. A reliable method is required for monitoring and assessing the status of recovery in TE. We aimed to: (a) investigate changes in muscular strength, fatigue and activity in recovered TE (RTE); (b) assess the appropriateness of EMG and strength measurements in monitoring functional recovery in TE.

**METHODS**

Study included three age-matched female groups of healthy controls (C) with no history of musculoskeletal problems, TE patients with local tenderness at the lateral epicondyle and pain with resisted wrist and middle finger extension, and RTE cases who were asymptomatic for at least 6 months. Measurements included metacarpophalangeal (MCP) (extension and flexion), wrist (extension and flexion), shoulder (internal rotation, external rotation, and abduction) and grip strength, total upper limb strength and EMG measures of muscle fatigue and activity of forearm muscles including wrist extensors and flexors.

For strength measurements three consecutive trials were performed according to standard criteria and the mean values recorded as maximum voluntary contraction (MVC). Furthermore, total upper limb strength on the affected side was calculated as the sum of MCP, 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 (mean 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. This study was approved by the Local Research Ethics Committee, and all participants gave their written, informed consent.

**RESULTS SECTION**

Strength was greater ($p < 0.05$) for all measurements (MCP flexion 18-21%, grip 15-17%, wrist extension 16-19%, wrist flexion 18-21%, and shoulder 14-20%) in C compared to RTE and TE except for MCP extension (Fig 1). The total upper limb strength was significantly higher in C (122±22) than both RTE (78±21) and TE (68±15) on the affected side ($p < 0.05$). There was no difference in any strength measurements between TE and RTE groups. EMG revealed increased activity of ECR in RTE (9±5 %/min) while it was decreased in TE (–12±4 %/min) (Fig 2). There was no difference in the fatigability of muscles (Fig 3).

**DISCUSSION**

The results of this study suggest that regular EMG and strength measurement may provide useful information on recovery progress in the early post-injury stages, when it would be unsafe to return to work or perform sport activities. A global upper limb weakness in RTE compared to the C and that no difference was found for any upper limb strength measurements between RTE and TE indicate that there is sustained muscle dysfunction and weakness in RTE despite substantial pain diminutions, possibly because of inappropriate and insufficient rehabilitation. Increased activity of ECR in RTE may be attributable to relative recovery of the muscle from injury and consequent reduction in the level of pain. Appropriate reconditioning of hand-wrist-forearm shoulder musculature may be essential to achieve full recovery and prevent further tendon overload, degeneration, or relapse of symptoms. It is very important that not only attention is paid to pain reduction, but also to objective outcome targets in muscular strength and functional performance. More research is essential to characterize “full recovery” in both its symptomatic and functional dimensions, in order to establish an appropriate set of outcome criteria and related measures. Future studies should provide evidence in support of further rehabilitation after the pain has disappeared. Further research with large sample sizes should assess the practical reliability of our method in monitoring functional recovery in TE as well as other tendinopathies.

**REFERENCES**


**Figures**

- **Fig 1:** Strength results in C, TE, & RTE groups. Higher strength found for most measurements in C but no difference between TE & RTE. (SH: Shoulder, MPH: Metacarpophalangeal; W: Wrist, EXT: Extension, FLX: Flexion, EXT R: External Rotation INT R=Internal Rotation, AB=Abduction)
- **Fig 2:** Amplitude root mean square (RMS) as measure of muscle activity revealed significantly lower activity of ECR in TE group. Activity of ECR and EDC in RTE tended to be higher than C and TE.
- **Fig 3:** Slope of normalized median frequency %/min (fatigue index) showed no difference in muscle fatigue among C, TE, and RTE groups.

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