Preface

In the present scenario, most of the world's population is suffering from muscle fatigue that affects muscle strength. Muscle fatigue is defined as a state of physical or mental exhaustion that can be triggered by stress, medication, overwork, or mental and physical illness.

The current study deals with the analysis of neck muscle fatigue by using EMG data of various subjects suffering from neck pain recorded via wireless sensors. Neck pain is a common problem which is found in the people of all age group, and it mainly occurs due to poor posture, anxiety, depression, muscle strain, sporting activities, and other stressful situations. The patients suffering from neck pain-related problems are normally prescribed cervical traction therapy by medical experts.

EMG signal contains sufficient information regarding the contraction and fatigue status of the muscle. EMG data for various patients suffering from neck pain with radiculopathy, neck pain without radiculopathy, and spondylosis pain were acquired using wireless EMG sensors during cervical traction therapy and processed for muscle fatigue analysis. The sensors were placed on the neck muscles of the subjects for recording their EMG data. The data were recorded for each subject during their course of traction treatment.

The segmented portion of the recorded EMG data was further used for the extraction of various time and frequency domain features to assess muscle fatigue. The results were evaluated by calculating parameters such as root mean square (RMS), mean absolute value (MAV), Standard deviation (SD), mean frequency (MF), and median frequency (MDF). Muscle fatigue status was analyzed by significant changes in the time and frequency domain features of the EMG signal.

A statistical significance test was also conducted for the extracted features of the EMG data. The results indicated that there are significant variations in muscle activity.

The classification techniques were realized in order to distinguish the fatigue levels for different days. Two different classification techniques i.e., support vector machine (SVM) and decision tree, were implemented using the spectral features of EMG data. The accuracy and the Kappa value of support vector machine were observed higher as compared to complex tree classifiers.

The thesis work is divided into seven chapters, as follows.

Chapter 1 gives a general introduction of muscle fatigue and its types. This chapter briefly describes the problem statements, motivation, objectives, and outcomes of the thesis work.

Chapter 2 describes the background of the preceding, significant, and pertinent investigate research in the domain of analysis of neck muscle fatigue. It gives a brief illustration of neck muscle fatigue. This section describes the available literature review and comparisons for various muscle fatigue determining methods and also explains the respective method of significances.

Chapter 3 presents the muscle fatigue analysis of radiculopathy patients undergoing cervical traction treatment using their EMG data. In this work, two groups of patients, one group having neck pain with radiculopathy and other group having neck pain without radiculopathy patients were taken for recording the EMG data in the sitting position. The subjects were treated with 15 minutes and 7 kg of cervical traction for seven consecutive days. The acquired EMG signals from the subjects were used to extract various features of neck muscle

fatigue. The extracted features were further processed and analyzed to see the significant difference in muscle activity.

Chapter 4 provides information about the efficacy of cervical traction for spondylosis patients using a wireless EMG sensor. In this work, two groups of patients suffering from neck pain and cervical spondylosis were selected for recording their EMG data. The various features in time and frequency domain were extracted from the recorded EMG data to study muscle fatigue during traction therapy.

Further, the determined features were compared for the first day and last day of cervical traction treatment plan.

Chapter 5 establishes a LabVIEW based analyzing system to identify the muscle fatigue status of different neck pain patients undergoing cervical traction treatment. A simple algorithm was implemented in the LabVIEW block diagram showing the fatigue relaxation status on the front panel window from the uploaded pre and post EMG data of the subject. The proposed system here provides a simple and efficient approach for the assessment of muscle fatigue.

Chapter 6 describes the classification of EMG data to assess the fatigue level of different neck pain patients while providing traction treatment over a certain period. The recorded EMG data of day 1, day 3, and day 7 were classified using spectral features. The Complex tree and support vector machine classifier has been utilized to evaluate the classification performance.

Chapter 7 derives the outcomes and the significant findings of this research work with brief conclusions and suggestions for future work.

References: This includes references as a source of information to carry out the entire research work.