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P2-S-58 Artificial Intelligence Based Muscle Activity and Muscle Monitoring Tracker with Wireless Sensor System

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BACKGROUND: The shoulder, the most mobile joint in the body, is prone to injury, dislocation, and degenerative diseases. A growing number of patients undergo surgical procedures and require prolonged rehabilitation to regain their range of motion (ROM) and function (Khoschnau, et al., 2020). We propose an artificial intelligence (AI)-based wearable device which is temporarily attached to the joints for tracking kinematics and electromyogram (EMG) activity of patients after shoulder surgery. The device can lower medical costs through remote sharing of real-time joint ROM and muscle activity data, reduce the need for in-person hospital/physical-therapy visits and increase patient engagement through goal-oriented recovery feedback. The outcome of surgical interventions is commonly measured by improvement in shoulder pain, ROM, strength, and patient-reported outcome measures. These outcomes still rely on physical examination, which is highly variable and inaccurate. Also, timely assessment of ROM and appropriate interventions by physical therapists are critical to avoid stiffness and development of postoperative complications. MATERIALS/ METHODS: We used a prototype sensor-based wearable joint ROM and muscle activity monitor to assess two subject's shoulder joint function.

The subjects were an 82-year-old right-handed healthy man with no history of shoulder girdle muscle or joint disease or surgery, and a 74-year-old right-handed man with right shoulder stiffness due to right rotator cuff injury-related shoulder surgery. The subjects performed motions using their shoulder joints with the wearable device attached to their shoulder. RESULTS: Fig. 1 shows the ROM of subjects during shoulder abduction and external rotation, and elbow flexion (top); and EMG RMS (bottom). Each plot is one combination of handedness (left, right) and task (flexion, abduction, external rotation), as labeled. The injured subject had lower ROM than the healthy subject for all three movements. In flexion movement, a deltoid muscle contribution calculation in the injured subject was 6.53%, while in the healthy subject it was 16.1%. The maximum flexion angle in the affected right shoulder of the injured subject was 110°, compared to 146° in the same shoulder of the healthy subject. CONCLUSIONS: Our powered adjustable brace aims to reduce recovery time by giving real-time feedback to the user during postoperative rehabilitation, improve ROM and optimize pain control. Measurements from the device's four surface EMG sensors and the triaxial accelerometer-gyroscope can be transmitted wirelessly to healthcare cloud/storage for further processing. In the healthcare cloud, an AI-based algorithm will estimate the impairment of individual shoulder girdle muscles. This technology can be used for remote at-home telemedicine delivery of rehabilitation services while tracing tele-visit sessions in compliance with billing standards as in-person visits.

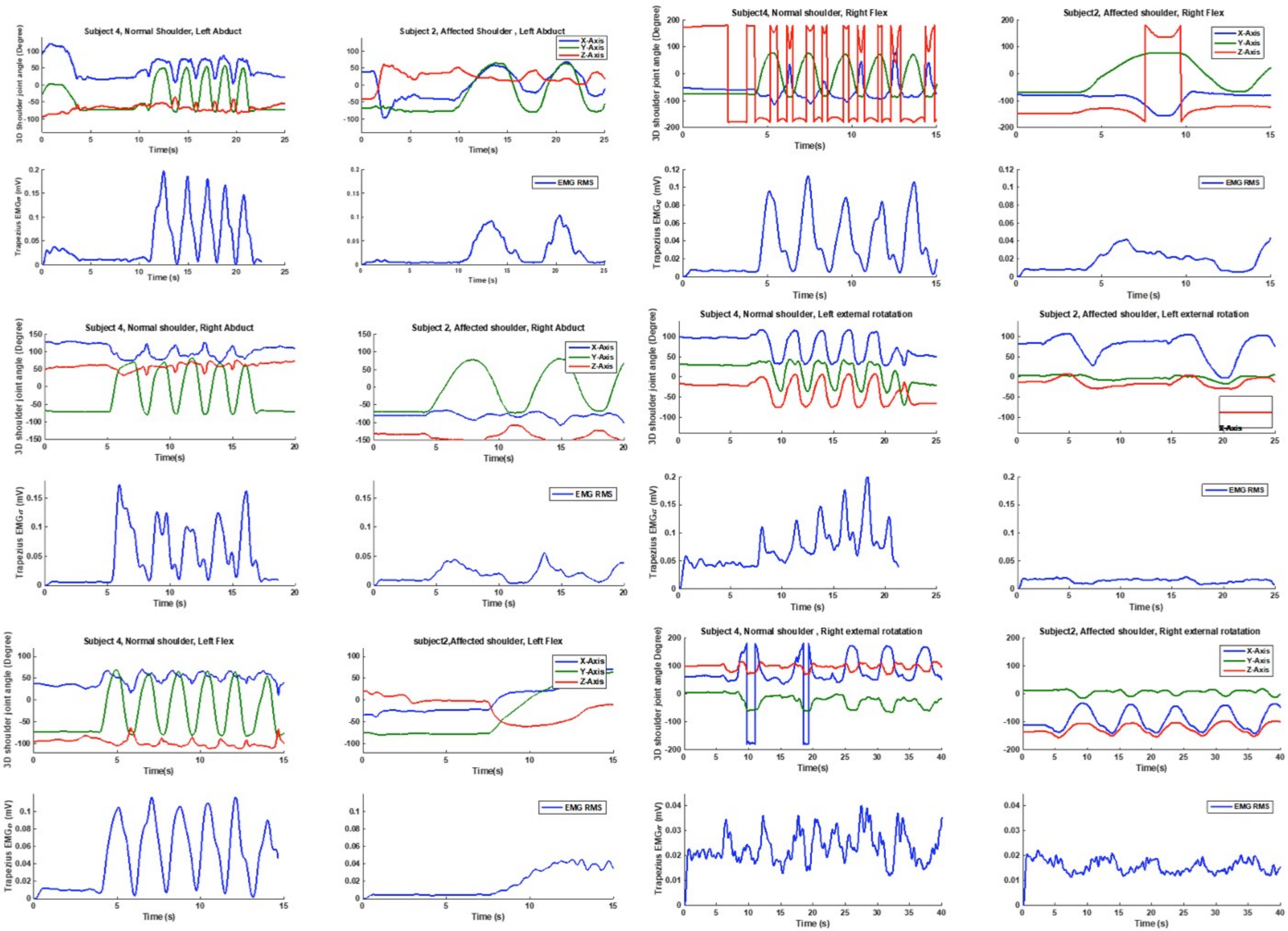

Figure 1. Comparison of ROM of both shoulders (flexion, abduction, and external rotation movement) of healthy subject 4 (or ii) to subject 2 (or i) (with affected right shoulder).