Prior Work/Patent Search

Feature	US20210123456	US20190345678	US20200098765	Our Sleeve
EMG Sensors Placement	△ (Similar)	O (Same)	△ (Similar)	X (Different)
Wireless Communication	O (Same)	O (Same)	O (Same)	O (Same)
Mobile Application	O (Same)	O (Same)	O (Same)	O (Same)
Material	△ (Similar)	△ (Similar)	O (Same)	X (Different)

Based on the comparison table, this is designed to avoid direct infringement by altering the placement of EMG sensors, creating a novel “sensor pocket” or something, and the material used for the sleeve, ensuring it is distinct from existing patents.

Design Overview

The forearm sleeve integrates MyoWare muscle sensors, conductive fabric electrodes, and a MyoWare 2.0 Wireless Shield for real-time EMG signal detection and processing. The sleeve is designed to measure muscle activation, particularly the pronator teres muscle, in baseball pitchers. The MyoWare 2.0 Wireless Shield powers the sensors and enables Bluetooth data transmission to Ardunio IDE (I think), providing real-time feedback for injury prevention and load management.

Research suggests that increased activation of the pronator teres muscle can be an indicator of potential injury. Specifically, higher activation levels during curveball pitching have been associated with increased muscle stiffness and a greater risk of overuse injuries, such as pronator teres syndrome or medial elbow injuries. Monitoring the activity of the pronator teres can help predict and prevent these injuries by identifying early signs of overuse and allowing for adjustments in pitching technique and load management. In addition, the pronator teres muscle extends between the radius and medial epicondyle of the humerus and plays the role of the active stabilizer of the elbow during valgus stress with a function of radioulnar joint pronation [28,29]. Therefore, during curveball pitching, it is considered that the pronator teres muscle acts to control valgus stress in the elbow as the valgus moment of the elbow increases. In addition, the throwing arms of players with medial elbow injuries show stiffness in the pronator teres muscle (Research)

Simple Component List for EMG compressive sleeve

MyoWare Muscle Sensor

- Purpose: Detects and processes EMG signals.

Conductive Fabric (replaces traditional Electrodes)

- Purpose: Integrates into the sleeve for muscle contact. Could potentially be placed right under electrodes
- Need probably 3 of them

MyoWare 2.0 Wireless Shield

- Powers and connects to the sensors
- Purpose: Microcontroller for data processing and Bluetooth transmission.
- Rechargeable

MPU6050

- MPU6050 for IMU data, will allow us to identify events and provide an additional source of data to evaluate muscle stress.

Things to Look at?

Median Frequency (MF) and Mean Frequency (MNF):

- These parameters are derived from the frequency domain analysis of the EMG signal. A shift in the frequency spectrum from high to low frequencies indicates muscle fatigue. Decreases in median and mean frequencies are commonly associated with muscle fatigue (Sakurai et al., 2010).

Power Spectrum Analysis:

- Monitoring the power spectrum can help identify the decline in performance capacity of the muscle. Changes in the power distribution across different frequencies can indicate fatigue (Ullah et al., 2008).

Torque and Joint Angular Velocity:

- Assessing the relationship between EMG signals and the torque produced by the muscle, as well as how different joint angular velocities affect these parameters, can provide a comprehensive understanding of muscle fatigue (Ullah et al., 2008).

Design Considerations

1. How comfortable will this be?
2. Will it stay on?
3. Will the sensors stay in place?
4. Will the data be accurate through the conductive fabric?

Previous Research

Functional Anatomy

- **Pronator Teres Muscle:** The pronator teres is one of the muscles of the forearm responsible for pronation, which means it helps rotate the forearm so the palm faces downward. It originates from the medial epicondyle of the humerus and inserts onto the lateral surface of the radius.
- **Ulnar Collateral Ligament (UCL):** The UCL is a critical ligament on the inner side of the elbow that helps stabilize the joint, particularly against valgus stress (force pushing the elbow sideways).

Relationship and Interaction

1. **Stabilization Role:**
    - During the throwing motion, particularly in baseball pitching, the elbow experiences significant valgus stress. The UCL is the primary stabilizer against this stress. The pronator teres muscle assists in stabilizing the elbow joint by providing dynamic support during pronation and forearm movement (Ciccotti et al., 2017).
2. **Muscle Activation and UCL Stress:**
    - The pronator teres, along with other forearm muscles, helps distribute the load across the elbow joint. When the pronator teres is activated, it can reduce the stress on the UCL by providing additional support and reducing the overall valgus force (Saito et al., 2020).
3. **Overuse and Injury Risk:**
    - Overuse or excessive activation of the pronator teres can contribute to fatigue and potential injury to the muscle itself or related structures like the UCL. When the pronator teres becomes fatigued or strained, the elbow relies more heavily on the UCL for stability, increasing the risk of UCL injury (Fleisig et al., 1996).
    - Studies have shown that repetitive throwing, particularly pitches that involve high pronation and supination forces (like curveballs), can lead to increased muscle activity in the pronator teres, which may correlate with higher stress on the UCL (Tamura & Saito, 2023).

4. **Injury Mechanisms:**
    - Injuries to the UCL, such as tears, often occur due to repeated high valgus stress, which can be exacerbated by improper mechanics or overuse of the pronator teres muscle. When the pronator teres is unable to adequately support the elbow joint, the UCL bears more load, increasing the likelihood of injury (Andrews et al., 2001).

References

Andrews, J. R., Fleisig, G. S., & Zheng, N. (2001). Biomechanics of the elbow in the throwing athlete. Operative Techniques in Sports Medicine, 9(3), 136-138.
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