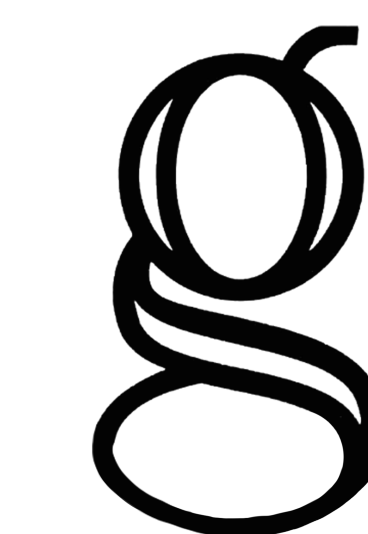




# Examining Biomechanical Correlates to Playing-Related Musculoskeletal Disorders in Professional Guitarists

Team METR

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**Research questions:** Is there a relationship between the biomechanics of playing technique and the presence of PRMD symptoms? Do biomechanical variables associated with playing technique relate to the higher prevalence rates of PRMDs in biological females?

## Playing Related Musculoskeletal Disorders (PRMDs)

- PRMDs are painful conditions that hinder a musician's ability to play their instrument, impacting musicians financially and emotionally, in addition to causing physical impairments [1].
- Despite PRMDs impacting 64-90% of guitarists, there is a significant lack of research investigating the biomechanical correlates of PRMDs among this population [2,3].
- We will use a modified Nordic Musculoskeletal Questionnaire to assess the presence of PRMD symptoms.

## Gender Disparity

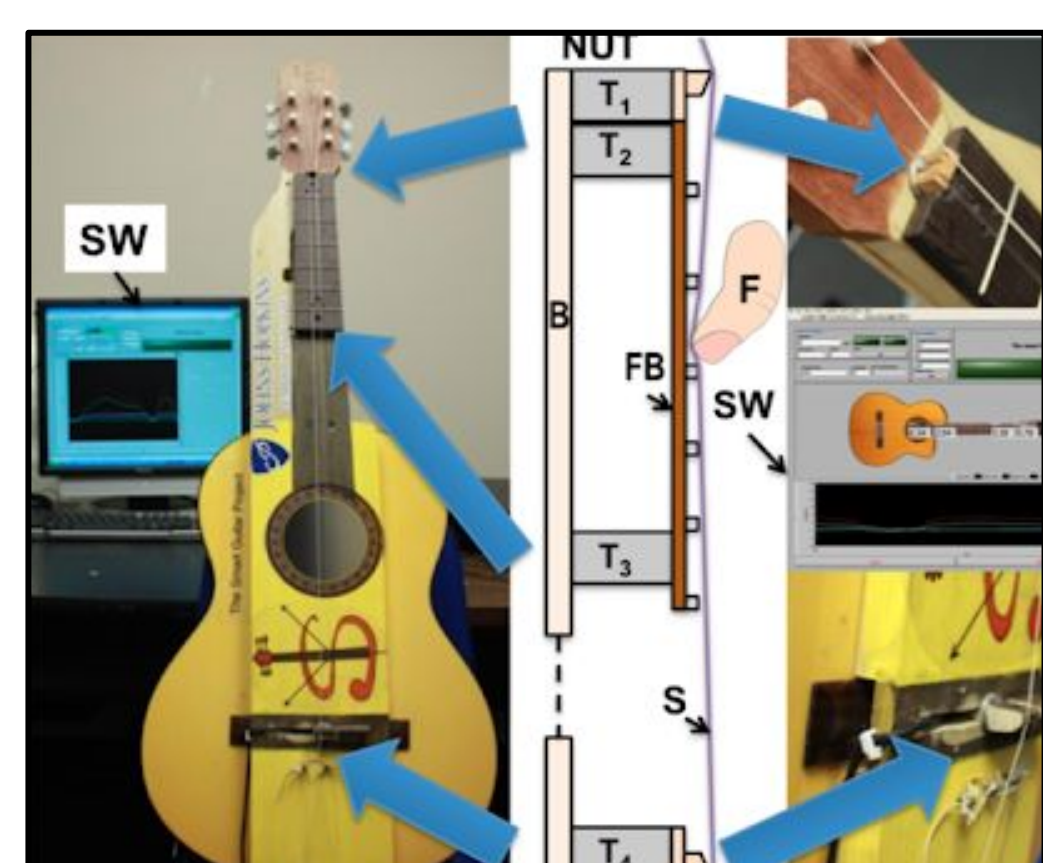
- Prior research has found that PRMDs are significantly more prevalent among biological females than biological males [4,5].
- There is no conclusive research on why this sex-based disparity exists.

## Methodology

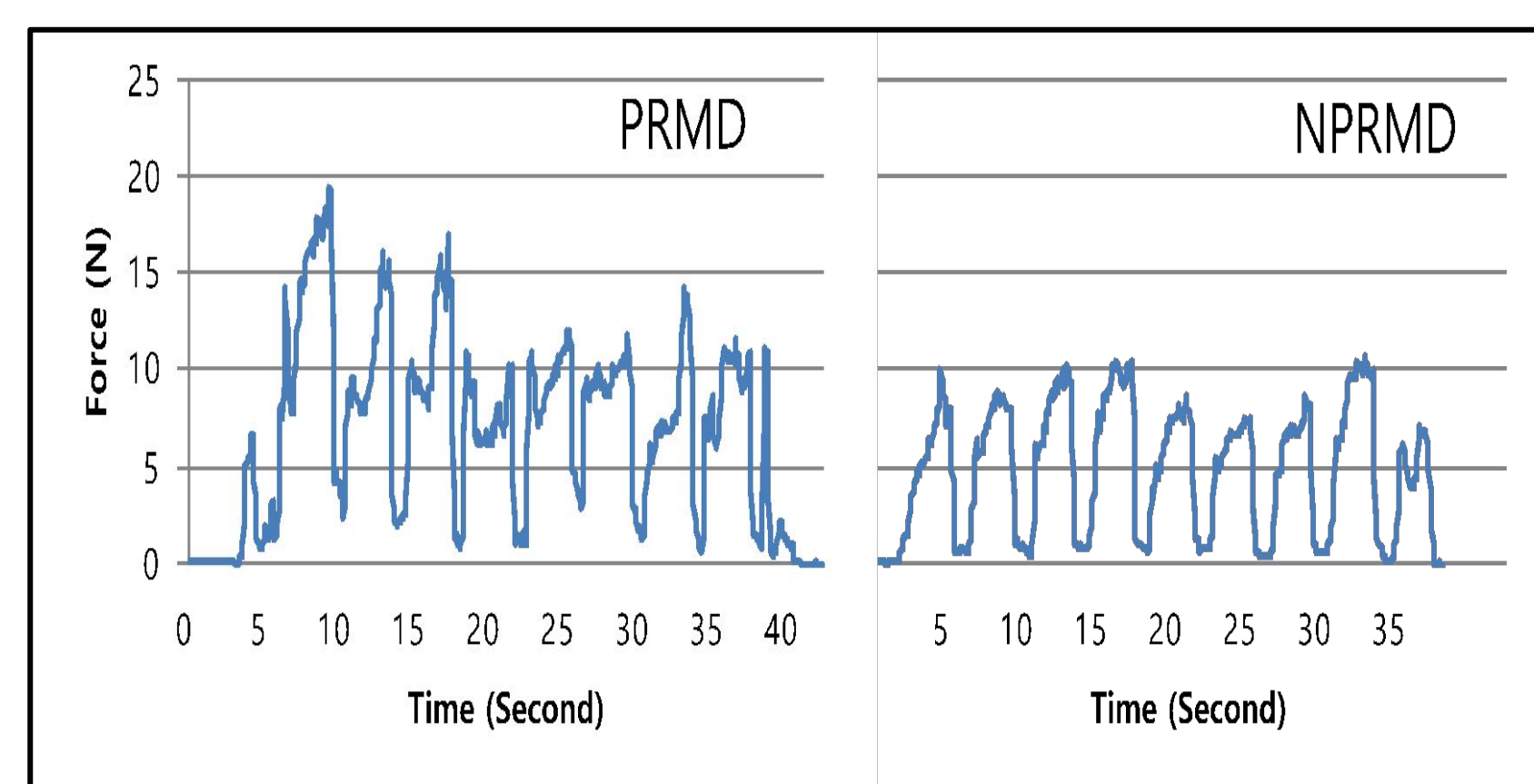
### Smart Guitar

**We modified a classical guitar by embedding force-measuring sensors in the fretboard and bridge.**

- Participants will play 20 trials of standardized excerpts
- Sensors will record three-dimensional finger forces and torques



**Figure 1.** SmartGuitar with sensors at the bridge and fretboard.



**Figure 2.** Preliminary data on finger forces in participants with (left) and without (right) PRMDs.

**We predict that those with PRMDs and females will:**

- Show greater finger forces and torque using the left (fretting) hand
- Show smaller variability in finger force and joint torque

### Electromyography

**EMG will measure the regular and antagonist forces generated by the forearm muscles while participants play a standardized scale.**

- Sensors will be placed on flexor and extensor of left forearm
- EMG Logger software will be used to compare action potentials generated by forearm muscles when playing
- Comparison of normalized muscular force exertion



**Figure 3.** Graph of voltage from action potentials measured by EMG sensor with repeated muscle contractions

**We predict that those with PRMDs and females will:**

- Show greater muscular co-activation of the flexors and extensors
- Show smaller variability in muscular activation

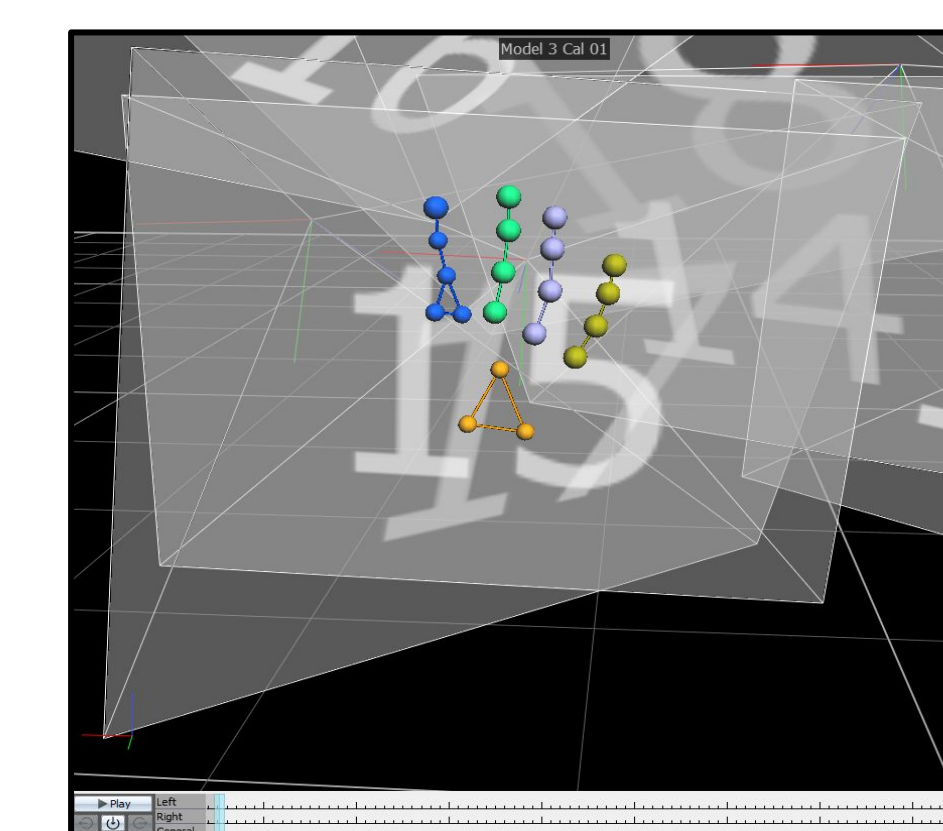
### Motion Capture

**Motion capture cameras will be used to analyze finger and hand positioning and to quantify joint torques in anatomically natural and unnatural postures.**

- Reflective markers will be placed on segments of fingers and hand
- Infrared motion capture cameras and Vicon software will record movement of markers on the fretting hand
- Visual3D software will analyze Vicon data



**Figure 4.** Reflective sensor placement on fretting hand



**Figure 5.** Image of hand in Vicon software

**We predict that those with PRMDs and females will:**

- Show greater joint torques in anatomically unnatural postures, specifically interphalangeal joint torques in ab/adduction direction

## Acknowledgments

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Reference List:



## Future Steps

- **Methods:** Full study will be conducted using
  - compiled EMG, motion capture, force sensor data
  - anthropometric measurements to control for hand and forearm size
- **Findings:** We predict that those with PRMDs and females will display
  - greater finger forces and torques
  - greater muscular co-contraction
  - joint torques in unnatural positions
  - less variability in muscular activation, finger force, and joint torque development
- **Applications:** Findings will be applied to
  - gain further physiological understanding of PRMDs
  - inform preventative measures used in music pedagogy to decrease PRMD prevalence