

Markerless Motion Analysis of Standard and Arm-Lock Putting Styles by Golfers with Focal Dystonia

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BACKGROUND

Focal dystonia is a neurological condition that often affects distal arm muscles of golfers and can cause involuntary jerks (known as “yips”) that disrupt smooth execution of precise movements such as the putting stroke. We hypothesize that putting performance may be improved by using an **arm-lock putter** and grip (**ALP**) compared to a **standard putter** and grip (**SP**).



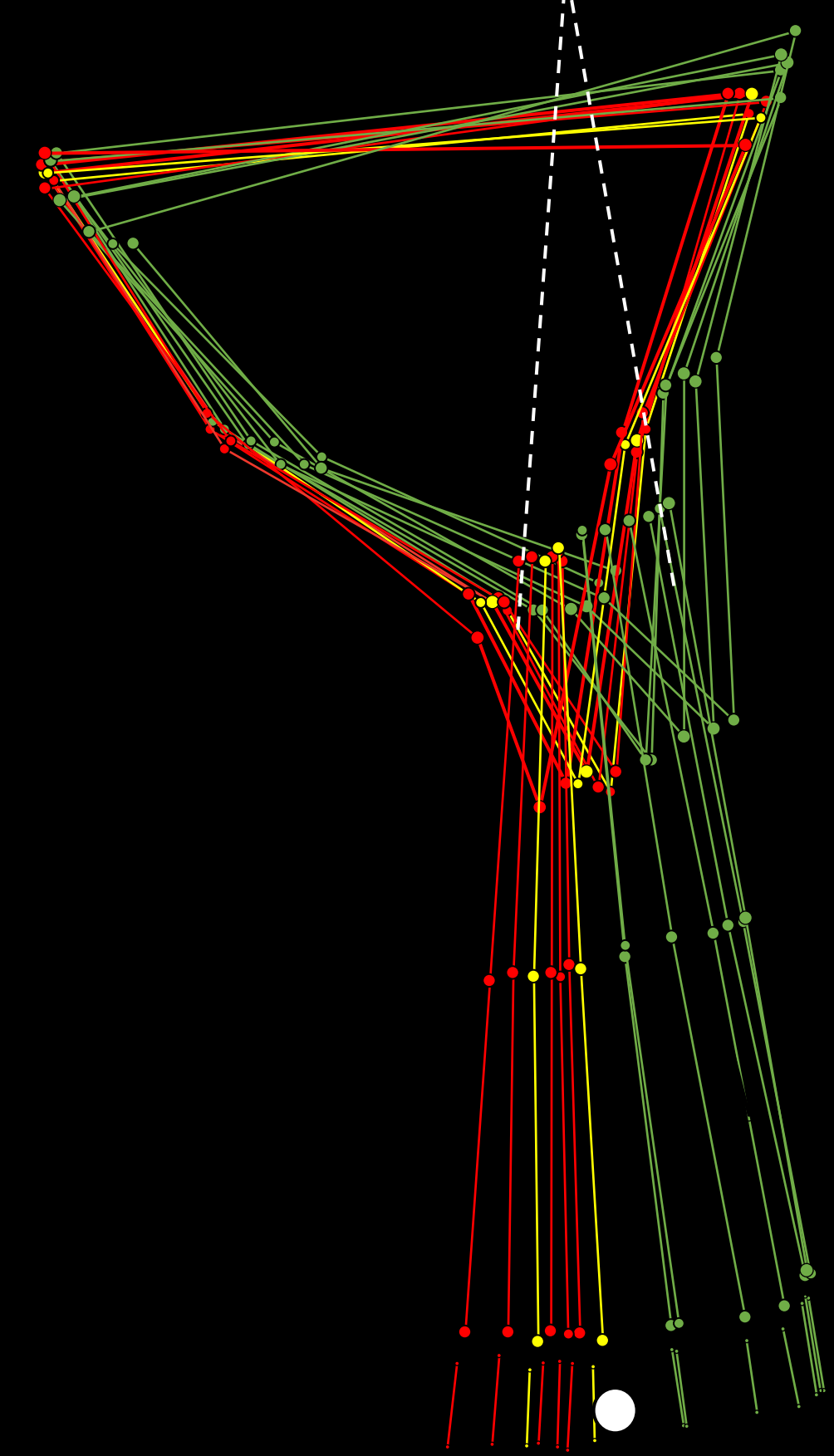
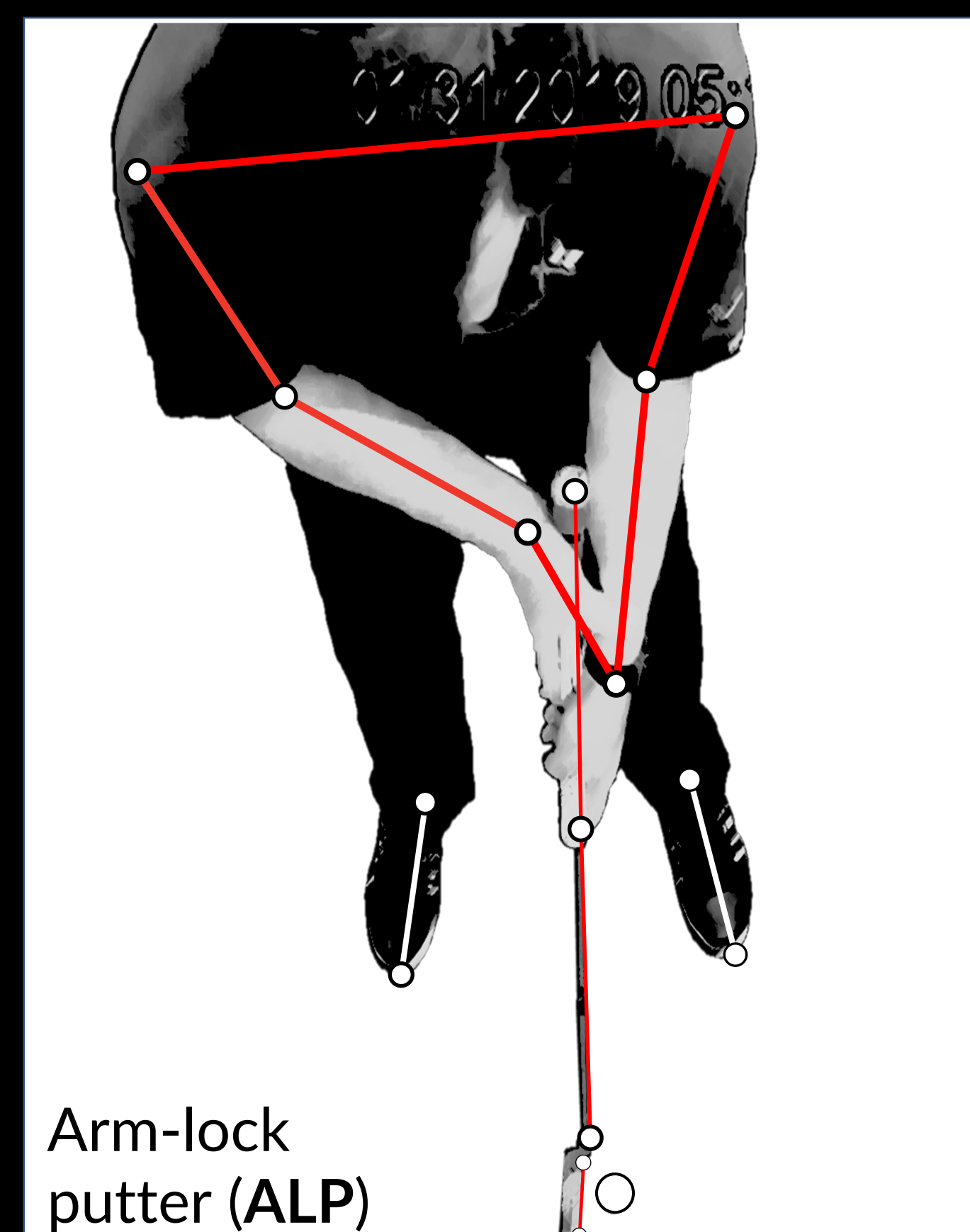
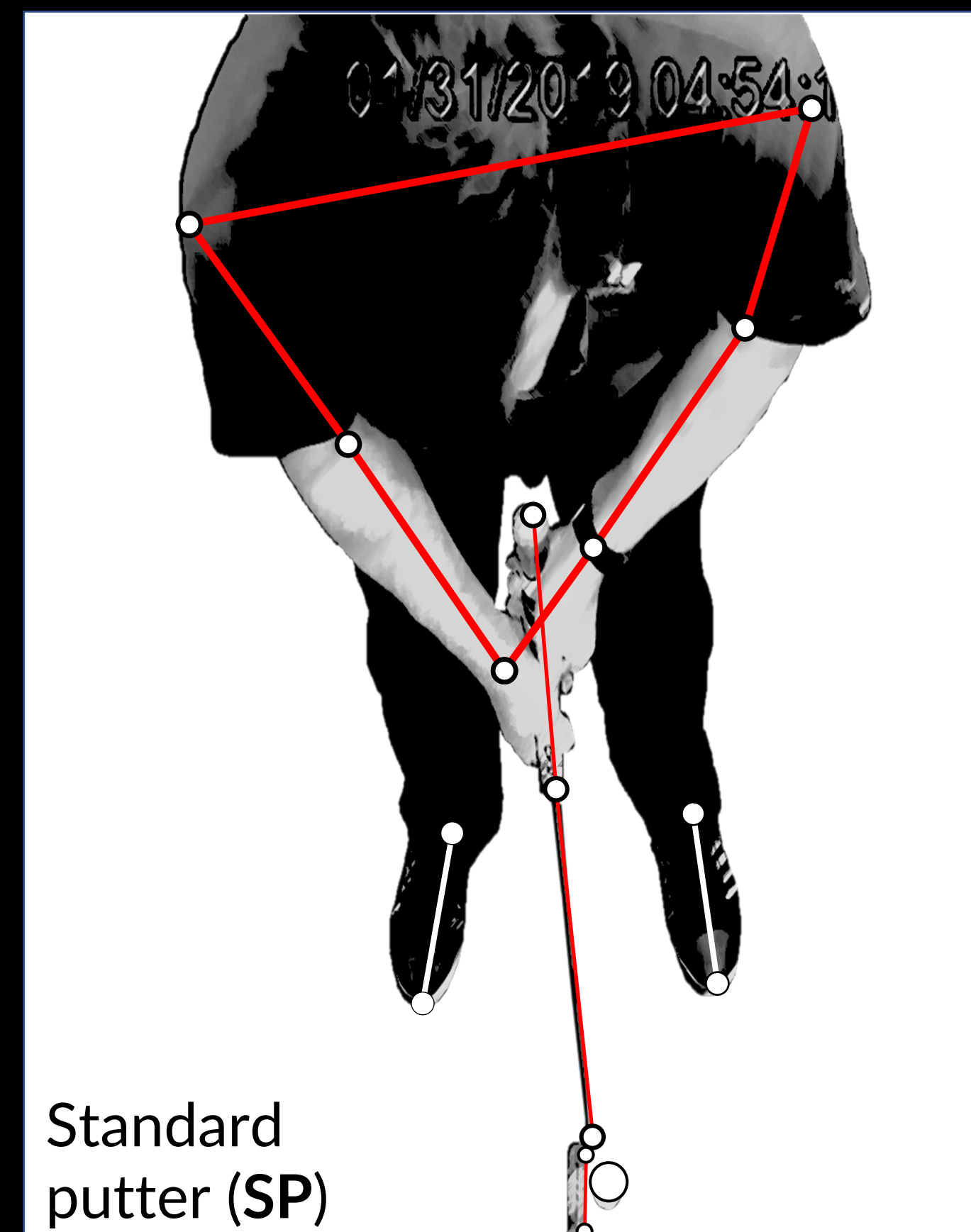
Our team previously studied 106 participants (67M, 39F; ages 19-83) grouped by age, golf experience, and absence vs. presence of tremors or yips. We found that golfers with yips generally achieved better scores when using the **ALP**. Sensors (Blast Motion) attached to the putters revealed lower variability in clubface angles at impact using the **ALP**.

In this study, we are looking for features in the putting motions that may account for the improved performance.

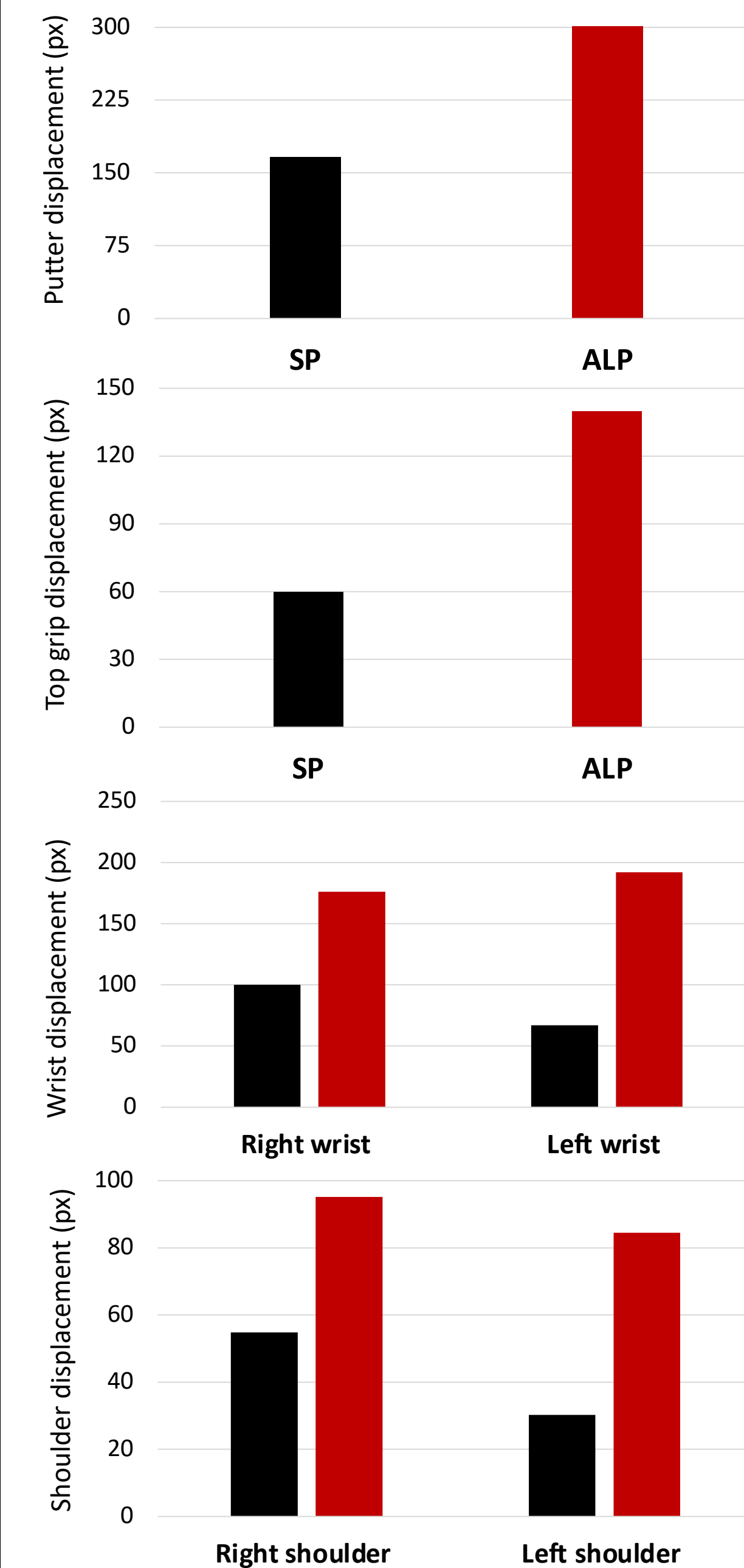
METHODS

- We are using markerless motion capture algorithms (OpenPose and DeepLabCut) to analyze video images collected by 5 cameras (Lorex) in our original study.
- In a training set representing 20 participants, markers will be visually placed on the shoulder, elbow and wrist joints, feet, and putter grip, shaft, heel, and toe.
- Next, we will train a deep neural network to automatically identify and track motions of the body and the putter.
- The deep neural network will be applied to analyze video images from additional participants.

The **arm-lock putting stroke** follows a longer pendular motion that minimizes jerky wrist and hand actions while engaging greater shoulder rotation.



PRELIMINARY RESULTS



- The featured golfer (#58; male, age 76, yipper) demonstrates a longer pendular motion and putter trajectory with the **ALP** than the **SP**.
- With the **ALP**, there is greater shoulder rotation and linear translation of forearms and putter.

DISCUSSION

- With the **ALP**, the shoulders, elbows, wrists and putter move in unison. With the **SP**, the shoulders and arms are relatively immobile, with most of the motion occurring at the wrists.
- With the **ALP**, the pendular motion has a higher center of rotation, located above the shoulders. With the **SP**, the center of rotation is lower, located near the top of the putter grip.
- These **ALP** features help reduce jerky wrist and hand motions.

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