

Forearm Muscle Activation Patterns of Baseball Pitching Grips Contributing to Valgus Stability

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Disclosures

No relevant disclosures

Background

- Muscle and joint load in baseball pitchers has been a well-researched field due to interest in both injury prevention and onfield performance optimization.
- Limited research has been done on the forearm muscle activation pattern in healthy young adults while holding different baseball pitching grips.
- Previous research has shown the forearm flexor pronator mass contributes to valgus elbow stability.

Objective

The objective of this study is to evaluate the contribution of forearm muscles in various pitching grips in order to highlight the importance of specific muscle conditioning in order to avoid elbow injury.

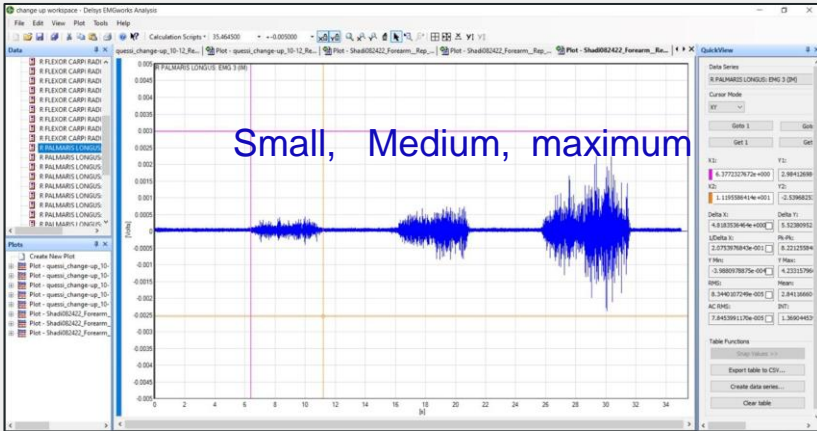
Materials

- Delsys EMG Sensors with Tekscan thin film sensors to measure forearm muscle activation

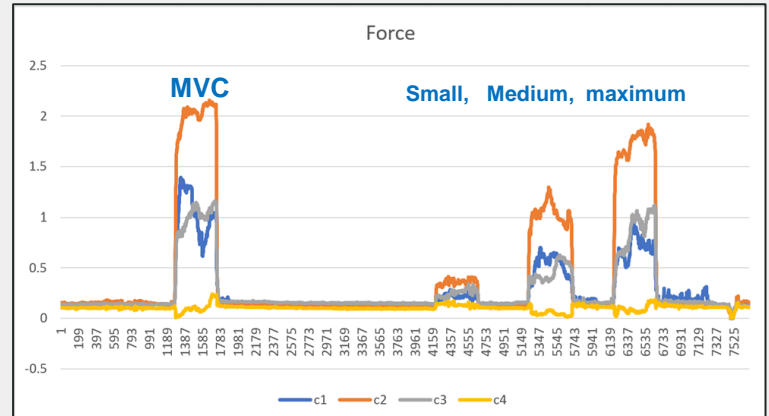


Methods

- N= 7 healthy subjects each squeezed a baseball at three different exertion levels (mild, medium, and maximum).



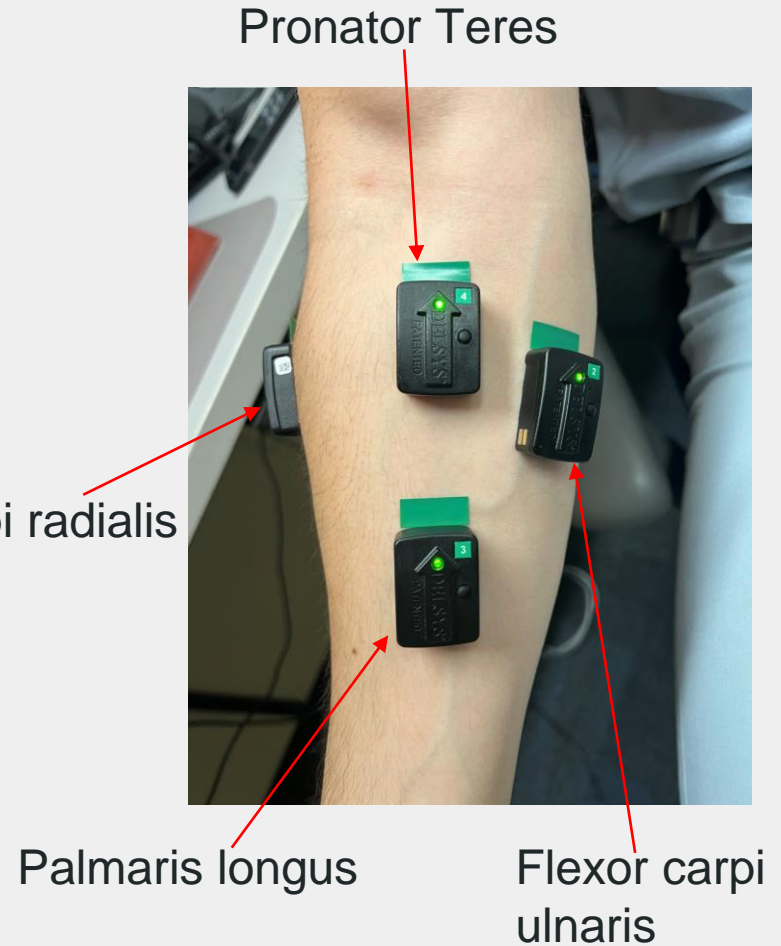
Raw EMG signals of FCU muscle in response to small, medium, and maximum gripping forces



Force graph in response to small, medium, and maximum gripping forces

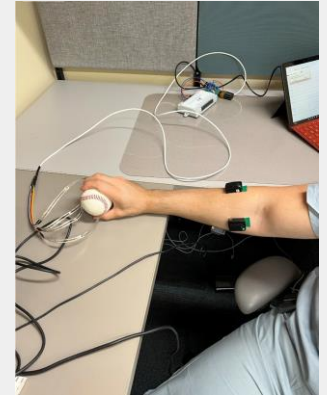
Methods

- Electromyography (EMG) was used to measure forearm activation levels of the following muscles while holding a baseball:
 - Pronator teres
 - Flexor carpi ulnaris
 - Palmaris longus
 - Extensor carpi radialis



Methods

- Each subject squeezed ball with the following pitching grips:
 - Fastball
 - Curveball
 - Change-up



Four Tekscan thin film sensors were placed between fingers and ball surface

Data Collection

- Delsys EMGworks software was used to measure muscle contraction levels, and conventional analysis was used to determine bivariate correlation using IBM SPSS software (version 28) between normalized force (%) and maximum voluntary contraction (MVC).

Results

- The Pearson correlation coefficient between normalized force (%) vs. MVC showed:
 - Extensor carpi radialis muscle contributed most significantly to force of contraction in both the fastball and changeup grips

Normalized Force (%) vs. Maximum Voluntary Contraction (MVC) Correlation Coefficients

	Fastball	Curveball	Changeup
Pronator Teres	0.775	0.858	0.672
Flexor Carpi Ulnaris	0.702	0.556	0.579
Palmaris Longus	0.576	0.510	0.569
Extensor Carpi Radialis	0.780	0.600	0.754

Results

- The Pearson correlation coefficient between normalized force (%) vs. MVC showed:
 - Pronator teres had the most significant contribution to the force of contraction when using the curveball pitching grip

Normalized Force (%) vs. Maximum Voluntary Contraction (MVC) Correlation Coefficients

	Fastball	Curveball	Changeup
Pronator Teres	0.775	0.858	0.672
Flexor Carpi Ulnaris	0.702	0.556	0.579
Palmaris Longus	0.576	0.510	0.569
Extensor Carpi Radialis	0.780	0.600	0.754

Results

- The Pearson correlation coefficient between normalized force (%) vs. MVC showed:
 - Flexor carpi ulnaris contributed least to the force of contraction in the curveball grip compared to the other two pitching grips

Normalized Force (%) vs. Maximum Voluntary Contraction (MVC) Correlation Coefficients

	Fastball	Curveball	Changeup
Pronator Teres	0.775	0.858	0.672
Flexor Carpi Ulnaris	0.702	0.556	0.579
Palmaris Longus	0.576	0.510	0.569
Extensor Carpi Radialis	0.780	0.600	0.754

Results

- All normalized force (%) vs. maximum voluntary contraction (MVC) correlation p-values <0.001 for forearm muscle contributing most significantly to each pitching grip

Normalized Force (%) vs. Maximum Voluntary Contraction (MVC) Correlation P-values			
	Fastball	Curveball	Changeup
Pronator Teres	<0.001	<0.001	<0.001
Flexor Carpi Ulnaris	<0.001	0.009	0.006
Palmaris Longus	0.006	0.018	0.007
Extensor Carpi Radialis	<0.001	0.004	<0.001

Conclusion

- The individual forearm muscle contributing most to the contraction force varies among the pitching grip tested.
- The extensor carpi radialis muscle is most significant in the fastball and changeup grips, while the pronator teres is most significant in the curveball grip.

Significance of Findings

- Active pronator teres and flexor carpi ulnaris contraction are known to contribute to valgus elbow stability.
- Therefore, our study highlights the importance of pitching conditioning in curveball pitchers due to the increased activation of the PT during curveball pitches- the muscle which is most vital to valgus stability of the elbow joint.

Acknowledgements

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This study was approved by our institutional review board (IRB protocol # IRB-22-02-4364).

Thank you!

Any Questions?

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