Front Squat Verse Back Squat: Comparison of the Activation of Core Musculature

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Introduction

Chronic low back pain is very prevalent, as more than 50% of people in the United States are affected.[1] It has been found that core strength training can decrease pain in patients with chronic low back pain.[1] Additionally, squat exercises are a functional movement commonly performed in daily activities requiring proper core activation to avoid acute back injury or pain.

Literature has analyzed electromyography (EMG) activity of lower extremity muscles during front and back squats. However, it has failed to examine core muscle activity between the various squats. The primary muscles that stabilize the spine are the transversus abdominis (TrA), lumbar multifidus (LM), and erector spinae (ES).[1]

Objectives

The purpose of this study is to compare muscle activation of the transversus abdominis, lumbar multifidus, and erector spinae during a 6-repetition maximum (6RM) front and back squat. The hypothesis states that the 6-RM front squat will have a significantly greater EMG activity in the specific core muscles that are associated with chronic low back pain when compared to the 6-RM back squat.

Future research in this topic could determine a preventative squat program for athletes who are at risk for chronic low back pain.

Methods

The purpose of this study is to compare muscle activation of the transversus abdominis, lumbar multifidus, and erector spinae during a 6-repetition maximum (RM) front and back squat. A within-subject, comparative study design, with a convenience sampling method was conducted. Thirty healthy experienced college aged weight-lifters (13 males, 17 females) over the age of 18 from a University were gathered. Participants performed a warm-up protocol and 1 set of front and back squats at their 6-repetition maximum for 6 repetitions. The electromyography (EMG) activity of transversus abdominis, lumbar erector spinae, and multifidus were assessed using the last repetition for comparison to ensure proper muscle fiber recruitment.

Results

Electromyography muscle activity of transversus abdominis was normally distributed therefore a dependent t-test was utilized to compare data. The EMG data measuring erector spinae and lumbar multifidus was not normally distributed therefore, the Wilcoxon signed rank test was used to analyze the data using SPSS. P values of <0.05 were considered statistically significant.

The p-vale of front versus back squat of left transversus abdominis was (0.330) whereas right transversus abdominis was (0.827). The p-value for front versus back squat of left erector spinae was (0.094) and (0.530) for right erector spinae. Lastly, a p-value of (0.813) resulted from the front versus back squat of left lumbar multifidus and a p-value of (0.441) resulted for right lumbar multifidus muscle activity. No significant differences were found comparing muscle activity between front versus back squat noted by all p-values > 0.05.

A small effect size resulted from this study indicated by Cohen's d values of L TrA muscle activity during front versus back squat (-0.181) and R TrA muscle activity during front versus back squat (-0.040). Consistent with those findings, Hedges correction values for L TrA (-0.179) and R TrA (-0.040) also indicated a small effect size. Since data was collected from more participants than the targeted sample size, a power analysis using G*Power 3.1 software was performed. A new power of 0.86 was generated for comparing TrA muscle activity and a new power of 0.98 resulted for comparing ES and LM muscle activity between the two squat forms.

Based on the results of this study, the researches failed to reject the null hypothesis stating, "The 6-RM front squat will have a significantly greater EMG activity in the specific core muscles that are associated with chronic low back pain when compared to the 6-RM back squat."

Table 5. Paired Samples Test

		df	Sig. (2-tailed)
Pair 1	F TrA L - B TrA L	29	.330
Pair 2	F TrA R - B TrA R	29	.827

Table 7. Erector L - Test of Normality

	Kolmogorov-Smirnov[a]			Shapiro-wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
F erec L	.289	30	.000	.682	30	.000
B erec L	.254	30	.000	.819	30	.000

A. Lillieofrs Significance Correction

Table 8. Erector R- Test of Normality

	Kolmogorov-Smirnov[a]			Shapiro-wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
F erec L	.234	30	.000	.719	30	.000
B erec L	.181	30	.014	.739	30	.000

A. Lillieofrs Significance Correction

Table 9. Multifidus R- Test of Normality

	Kolmogorov-Smirnov[a]			Shapiro-wilk		
	Statistic	df	Sig.	Statistic	df	.Sig
F mult R	.237	30	.000	.784	30	.000
B mult R	.134	30	.181	.908	30	.013

A. Lillieofrs Significance Correction

Table 10. Multifidus L- Test of Normality

	Kolmogorov-Smirnov[a]			Shapiro-wilk		
	Statistic	df	Sig.	Statistic	df	.Sig
F mult R	.245	30	.000	.815	30	.000
B mult R	.278	30	.000	.803	30	.000

B. Lillieofrs Significance Correction

*F = front squat

B = back squat

R = right

L =

Data Analysis

A power analysis for this study was conducted with an alpha value of .05, confidence interval of 95% and a 0.8 effect size indicating 26 participants.[13] The raw EMG data was normalized to the participants' corresponding MVC using smoothing, rectification, and amplitude normalization.[14]

Descriptive statistics such as participant characteristics, means, Cohen's d values, Hedge's corrections, p-values, effect sizes and 95% confidence intervals were used to analyze the data.[13] To determine the magnitude of the effect sizes, Cohen's categories was used.[13] This study used paired t-tests to compare the EMG measurements between front and back squats using SPSS 27.0.

Discussion

No significant differences were found as indicated by p-values > 0.05. Therefore, the researchers failed to reject the null hypothesis. These results can be beneficial for clinicians who utilize any squat form to engage and strengthen the core since both forms recruited transversus abdominis, erector spinae and lumbar multifidus comparably.

Limitations

- Small sample size from the same University
- Uncontrolled variables existed during squat performance: varying squat mechanics, increased lordosis due to butt wink and not all participants reached parallel at the final recorded repetition
- An intensive warm-up protocol was utilized that may have resulted in muscle fatigue skewing the final repetition recorded and utilized for data comparison
- Maximal loading may have recruited all muscles instead of allowing strong muscles to compensate for the weaker ones during lighter loads.[15]

Conclusions

No significant differences were found between TrA, ES and LM muscle activity when performing a 6RM front versus back squat. It is uncertain whether the results are accurate and recruit all musculature similarly regardless of the squat type or if the data is flawed due to limitations of this study. Future research is necessary to investigate this topic further.

References: See Handout with Reference List