3D Motion Analysis Of Single Leg Squat With Association To Hip Strength and Ankle Dorsiflexion

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Background

The single leg squat (SLS) is considered a functional movement pattern, involving the kinetic chain, and requires adequate hip strength and knee and ankle range of motion (ROM) to be successful. Previous literature has found correlation between hip strength and ankle ROM deficits; however, limited studies involved the use of a single-camera 3D motion analysis system.

Purpose/Hypothesis

- Purpose: to determine if a correlation exists amongst SLS depth (defined as peak knee flexion during a SLS), hip strength, and ankle dorsiflexion (DF) ROM in a generally healthy population.
- Hypotheses:
  a) positive correlation between hip abductor strength and SLS depth
  b) positive correlation between ankle DF ROM and SLS depth
  c) positive correlation between hip abduction and hip extension strength and ankle DF ROM.

Materials and Methods

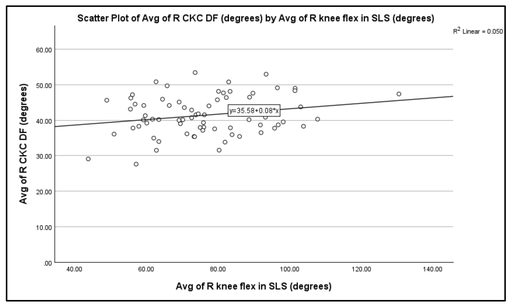
- Exploratory/Correlation, prospective, single trial design
- 72 participants (59.7% female, mean age 22.6 ± 2.79 years)
- Inclusion criteria:
  - 18-40 years old
  - Self-report in good health
  - Physically capable of performing SLS determined by a screen
- Exclusion criteria:
  - Failure of a screen
  - Current or history of LE injury
  - History of LE musculoskeletal surgery
- 4 stations of objective measures (3 trials):
  1) Ankle DF ROM - iPhone iHandy Level Application
  2) Hip Extension Strength – externally-fixated HHD
  3) Hip Abduction Strength – externally-fixated HHD
  4) SLS squat - VSTPro™ by Virtusense Technologies

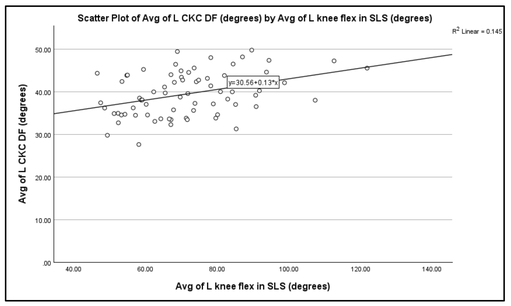
Data Analysis & Results

- Pearson's correlation coefficients were calculated to examine the association between each variable. The coefficient of determination was determined for significant correlations.

Variable 1	Variable 2	Pearson's Correlation	P-value	Confidence Interval
Left Dorsiflexion	**Left Single-Leg Squat**	+0.381	**p<0.001**	0.201-1.000
Right Dorsiflexion	**Right Single-Leg Squat**	+0.223	**p=0.030**	0.029-1.000
Right Dorsiflexion	**Right Hip Abduction**	-0.168	p=0.079	(-1.000) - 0.029
Left Dorsiflexion	**Left Hip Abduction**	-0.140	p=0.120	(-1.000) - 0.057
Right Dorsiflexion	**Right Hip Extension**	-0.152	p=0.101	(-1.000) - 0.045
Left Dorsiflexion	**Left Hip Extension**	+0.037	p=0.379	(-0.160) - 1.000
Right Hip Abduction	**Right Single-Leg Squat**	+0.127	p=0.144	(-0.070) - 1.000
Left Hip Abduction	**Left Single-Leg Squat**	+0.103	p=0.194	(-0.094) - 1.000

- Statistically significant, but weak positive correlations:
  - Right ankle DF ROM to SLS depth (Coefficient of determination: 0.05)
  - Left ankle DF ROM to SLS depth (Coefficient of determination: 0.15)
- Non-significant correlations:
  - Right and left hip abductor strength to SLS depth
  - Right and left ankle DF ROM to hip abductor strength
  - Right and left ankle DF ROM to hip extensor strength





Conclusions

- This study found ankle DF ROM, but not hip strength, to correlate to SLS depth, amongst a generally healthy population.
  - Suggests with increased depth of SLS, there is a need for increased ankle DF.
- Interpretation of the coefficients of determination, however, suggests that 5% and 15% of the variability in R and L SLS depth can be attributed to respective ankle DF ROM.

Clinical Implications

- The result of this study is congruent with previously published literature regarding the biomechanical influence from ankle mobility to SLS depth, however, hip strength does not appear to be a factor in the depth.
- Future studies should examine the same testing measures in those with musculoskeletal injuries to be used for clinical considerations.

Acknowledgments

Doctor of Physical Therapy
College of Health and Human Services
Western Kentucky University

Funding received from WKU College of Human and Health Sciences Quick Turn-Around Grant (QTAG)

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