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Comparison of dynamic balance in older adults having intact balance undergoing lower limb strength training at gym with older adults not undergoing any form of exercise using star excursion balance test: A cross-sectional study

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Abstract
Objective: To compare dynamic balance in older adults having intact balance undergoing lower limb strength training at gym with older adults not undergoing any form of exercises using Star Excursion Balance Test.
Outcome Measure: Star Excursion Balance Test
Method: 25 participants going to gym and those not undergoing any form of exercises and fulfilling the inclusion criteria were assessed for their dynamic balance using star excursion balance test. The maximum distance reached by the subject was noted. Each subject performed same test for three times and an average reading was noted. This average distance reached by the subject was then divided by the leg length of the subject and a relative distance was calculated. Relative distances of each leg in 8 different directions were calculated similarly for every subject and compared.
Result:
- Anterior direction of right and left leg showed no significant difference with p values 0.649421 and 0.571824 respectively.
- Anterolateral direction of right leg showed significant difference whereas, that of left leg showed no significant difference with p values 0.033221 and 0.235153 respectively.
- Lateral direction of right and left leg showed significant difference with p values 0.002401 and 0.001091 respectively.
- Posterior direction of right leg showed significant difference whereas, that of left leg showed no significant difference with p values 0.024842 and 0.412489 respectively.
- Posterolateral direction of right and left leg showed significant difference with p values 0.000046 and 0.000067.
- Posteromedial direction of right leg showed significant difference and that of left leg showed no significant difference with p values 0.0404 and 0.193167 respectively.
- Medial direction of right and left leg showed no significant difference with p value 0.56115 and 0.676702 respectively.
- Anteromedial direction of right and left leg showed no significant difference with p value 0.666065 and 0.712956.

Conclusion: The study concluded that gym going adults on an average had statistically significant dynamic balance compared to adults not undergoing any kind of exercises. Thus, to prevent fall and reduce the risk of fall, all older adults must undergo some form of lower limb strengthening which would improve the quality of life in the forthcoming geriatric age.

Keywords: dynamic balance, older adults, strengthening, gym, star excursion balance test

1. Introduction

Balance is the ability to maintain *centre of gravity* (COG) within *base of support* (BOS). Balance can be classified into:

- Static Balance: it is the ability to maintain the body in some fixed posture. Static balance is the ability to maintain postural stability and orientation with centre of mass over the base of support and body at rest.
- Dynamic Balance: it is the ability to maintain postural stability and orientation with centre of mass over the base of support while the body parts are in motion [1].

The centre of gravity is maintained over the base of support using adequate postural control during both static and dynamic situations. The body should respond to translations of the centre of gravity imposed voluntarily, e.g., intentional movement, and involuntarily or unexpectedly imposed, e.g., slip, trip

Balance is maintained by first continually acquiring information about the body's position and trajectory in space. This is done through the sensory system. Second the body determines in advance effective and timely response (central processing). Third, the body carries out response via the effector system (strength, range of motion, flexibility, endurance) [2].

In response to postural challenge, an individual slows the centre of mass by generating muscle torque at the ankle or hip or simply by taking a step.

Aging dampens this reaction time and muscle strength which impairs the ability to control a fall in some people. In older adults, lateral stability is the key contributor to maintain the balance control. The muscle torque required to maintain balance is greater than the force that can be generated by older muscle. Specifically, weakness of hip abductors compromises the ability to maintain lateral stability during stepping and thus maintain balance. This may have serious implications for those at risk such as fallers who have demonstrated greater lateral sway than

non-fallers. Control of balance may be limited by generation of muscle power. The age-related decline in neural processing may diminish the ability for rapid force development necessary in response to postural challenge.

Gym is a fitness centre which involves a diverse strength training protocol and equipments such as resistance training machines, elastic bands/tubing, free weights, body weights and weighted equipment like dumbbells, barbells, sand bags etc.

Strength training increases the force that a muscle generates in response to loss of balance. In the two studies that have examined this in healthy older adults, improvement in balance was not associated with any gain in strength. Alternatively, other adaptations that was provided by strengthening e.g. increased neural drive to agonist muscles, increased motor unit recruitment and activation, improved cognition, decreased depression, less antagonist muscle co-contraction, and improved force control could also explain the efficacy of strength training on balance [3].

The *Star Excursion Balance Test* (SEBT) is a simple, reliable and cost-effective screening test measuring dynamic balance requiring subjects to balance on one leg and reach as far as possible in eight different directions to determine potential risk of injury. Reach index value of SEBT can be used as an index of dynamic postural control [4].

2. Materials and Methods

Materials

- Consent form
- Pen
- Paper
- Geometric equipment
- Measuring Tape
- Marking Tape
- Calculator
- Flex

Methodology

- Study Design- Cross-sectional study.
- Sample Size- 50.
- Sampling Design –Purposive Sampling.
- Study Setting – various geriatric homes and gyms.
- Duration of Study- 6 months.

2.1 Inclusion and Exclusion Criteria

2.1.1 Inclusion Criteria

Group A

(Undergoing strength training)

1. Age group – 50-74 years of age.
2. Berg Balance Score – 45-55.
3. Lower limb strengthening at gym for more than 6 months.[3]
4. Both males and females.

Group B

(Not undergoing strength training)

1. Age group – 50-74 years of age.
2. Berg Balance Score – 45-55.
3. Not undergoing any form of exercise.
4. Both males and females.

2.1.2Exclusion Criteria

1. Injury to lower limb up to past 6 months
2. Recent surgeries of lower limb.
3. Impaired sensations.

2.2 Outcome Measure

Star Excursion Balance Test (SEBT)

- The SEBT involves having a participant maintain a base of support with one leg while maximally reaching in different directions with the opposite leg, without compromising the base of support of the stance leg.
- Test-retest reliability estimates (ICCs) ranged from 0.91-0.95. for older adults.
- Reach and normalized reach were significantly lower in the geriatric group for each movement ($p<0.001$) [5].

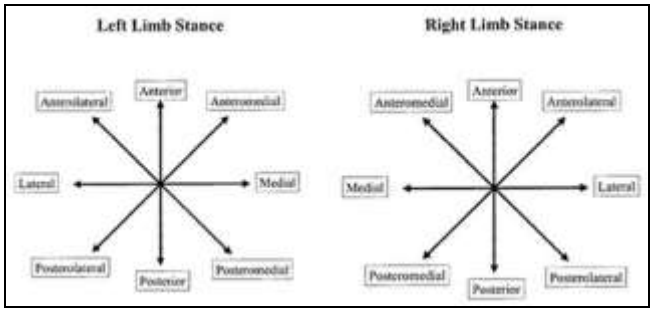


Fig 1: Directions of SEBT

Procedure

- **Equipment required:** A flat, smooth, non-slip surface, measuring tape, marking tape. To prepare for the test, four 120cm lengths of marking tape are placed on to the floor, intersecting in the middle, and with the lines placed at 45-degree angles.
- **Pre-test:** Test procedure was explained to the subjects. Screening of health risks were performed and informed consent was obtained. Basic information such as age, height and gender was recorded.
- **Procedure:** The test was performed prior to exercise. The subject were wearing lightweight and non-restrictive clothing and no footwear. The subject stands on one foot in the centre of the star with their hands on their hips. They then reach with one foot as far as possible in one direction and lightly touch the line before returning back to the starting position. The support foot must stay flat on the ground. This is repeated for a full circuit, touching the line in every reach direction. The spot on the line where the subject was able to reach was marked by the assessor. The test was repeated three times for each foot. The trial was considered invalid if the subject cannot return to the starting position, the foot makes too heavy of a touch, or if the subject loses balance.

Fig 2: Tape Markings for the Test

- **Scoring**: After the test all the reached distances were

recorded to the nearest 0.5cm. *Average distance* in each direction (average of the three measurements) and *Relative (normalised) distance* in each direction (%) (average distance in each direction / leg length * 100) were calculated. These calculations were performed for both the right and left leg in each direction, providing a total of 16 scores per person [4].

2.3 Procedure:

With the permission of ethical committee, the study was started. Various gyms and old age homes were visited in and around city. Subjects were then called on a suitable time to perform the test before any exercise. Informed consent was taken from each subject participating in the study. 50 subjects of 50-74 years of age were included in the study based on the inclusion criteria and exclusion criteria. Group A included individuals undergoing strength training at gym and Group B including individuals not undergoing any form of exercises. Star Excursion Balance Test was performed in both the groups in gym and community settings respectively to assess dynamic balance. Data was collected and analyzed using unpaired T test to compare dynamic balance in older adult population undergoing lower limb strength training at gym with those not undergoing any form of exercises using Star Excursion Balance Test.

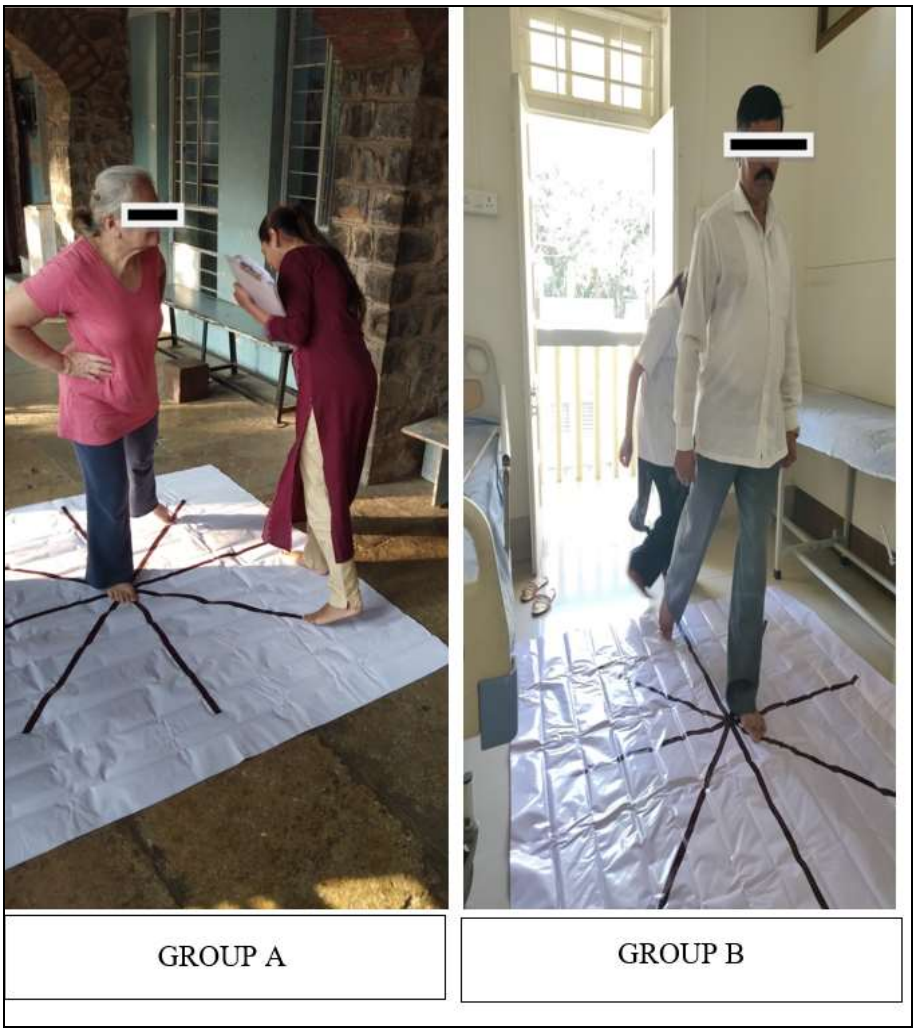
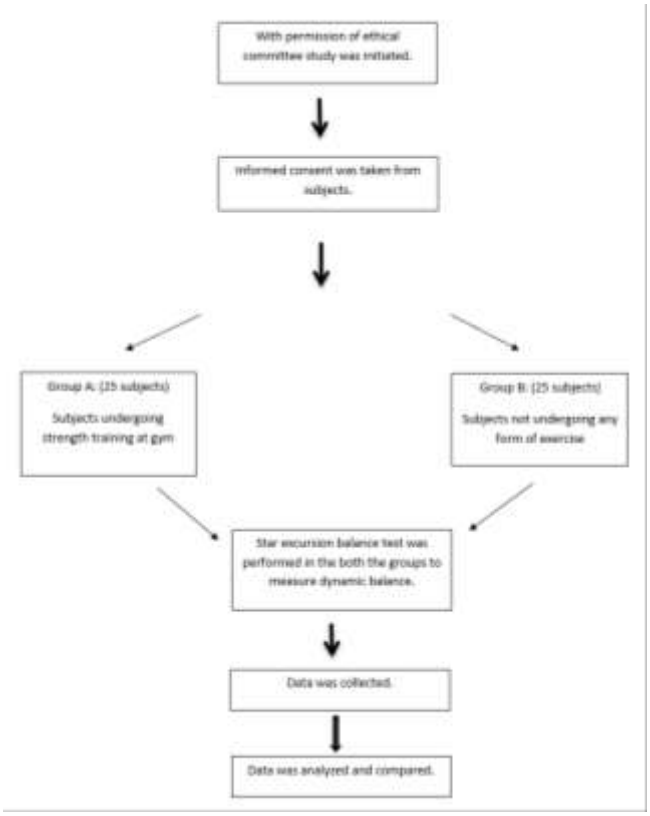


Fig 3: Participants While Performig The Test



Flowchart 1: Procedure

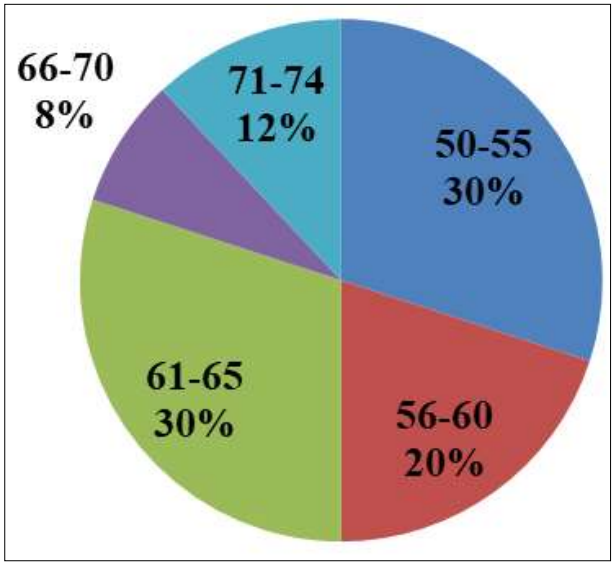
2.4 Data and Statistical Analysis

Dynamic balance in 8 directions was assessed using Star Excursion Balance Test. Relative distances of each leg in 8 directions were noted. Data was entered in Microsoft excel 2010, tabulated and subjected to statistical analysis.

The data passed the normality test when demographic data was analysed.

The relative distances in 8 directions of right leg of Group A with right leg of Group B was compared and analysed using unpaired T test.

Similarly, the relative distances in 8 directions of left leg of Group A with left leg of Group B was compared and analysed using unpaired T test.



Graph 1: Age and Gender Wise Distribution of Demographic Data

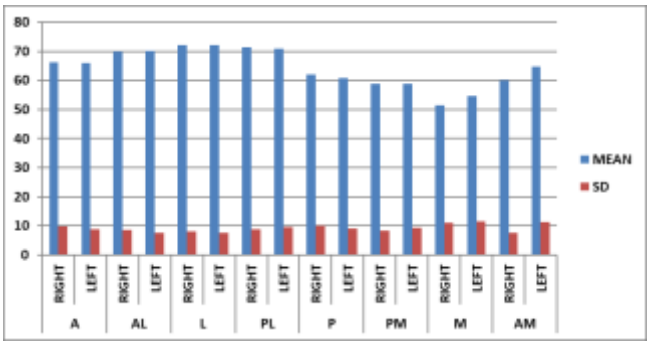
Table 1: Demographic Data

	Group A	Group B
Mean Age	62.68	58.16
No. of Males	16	12
No. of Females	9	13

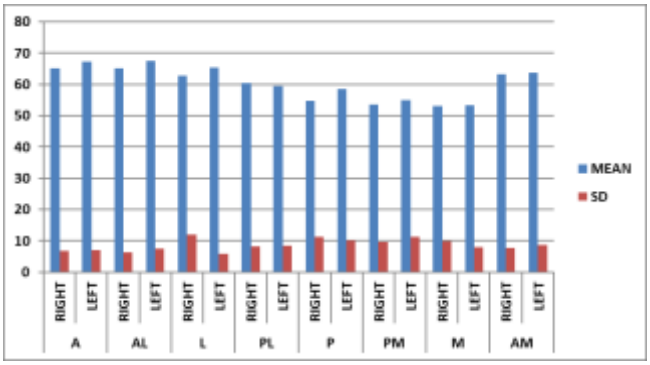
Table 2: Statistics

DIRECTION	GROUP	SIDE	MEAN	SD	T VALUE	P VALUE	SIGNIFICANCE
ANTERIOR (A)	A	RIGHT	66.28	9.8975	2.018082	0.649421	Not Significant
	B	RIGHT	65.16	6.7568			
	A	LEFT	65.96	8.901	2.012896	0.571824	Not Significant
	B	LEFT	67.28	7.0513			
ANTEROLATERAL (AL)	A	RIGHT	69.96	8.5485	2.014103	0.033221	Significant
	B	RIGHT	65.16	6.4416			
	A	LEFT	70.2	7.4726	2.010635	0.235153	Not Significant
	B	LEFT	67.6	7.509			
LATERAL (L)	A	RIGHT	72.2	8.029	2.018082	0.002401	Significant
	B	RIGHT	62.68	11.995			
	A	LEFT	72.12	7.5063	2.014103	0.001091	Significant
	B	LEFT	65.36	5.802			
POSTEROLATERAL (PL)	A	RIGHT	71.32	8.6935	2.010635	0.000046	Significant
	B	RIGHT	60.32	8.3221			
	A	LEFT	70.88	9.450	2.011741	0.000067	Significant
	B	LEFT	59.56	8.438			
POSTERIOR (P)	A	RIGHT	62	10.14	2.011741	0.024842	Significant
	B	RIGHT	54.8	11.341			
	A	LEFT	60.92	9.0550	2.010635	0.412489	Not Significant
	B	LEFT	58.64	10.027			
POSTEROMEDIAL (PM)	A	RIGHT	58.96	8.3545	2.011741	0.0404	Significant
	B	RIGHT	53.48	9.6123			
	A	LEFT	58.8	9.2477	2.012896	0.193167	Not Significant
	B	LEFT	54.88	11.222			
MEDIAL (M)	A	RIGHT	51.4	10.9981	2.011741	0.56115	Not Significant
	B	RIGHT	53.16	9.800			
	A	LEFT	54.6	11.4995	2.016692	0.676702	Not Significant

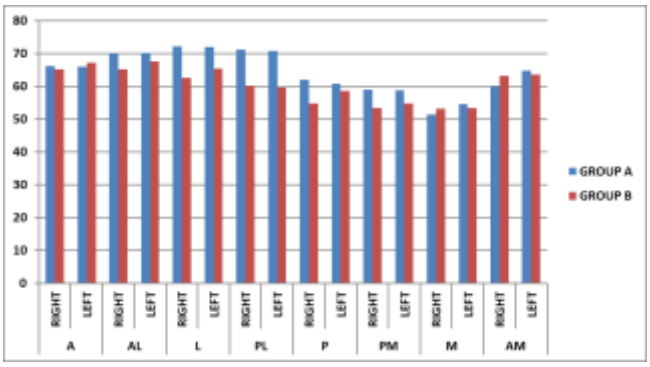
	B	LEFT	53.4	7.989			
ANTEROMEDIAL (AM)	A	RIGHT	59.95	7.5789	2.010635	0.666065	Not Significant
	B	RIGHT	63.24	7.737			
	A	LEFT	64.76	11.3764	2.014103	0.712956	Not Significant
	B	LEFT	63.68	8.6520			



Graph 3: Mean and Standard Deviation Reach Distances of Right and Left Leg of Group A



Graph 4: Mean and Standard Deviation of Reach Distances of Right and Left Leg Og Group B



Graph 4: Comparison of Mean and Standard Deviation Pf Reach Distances of Left and Right Leg of Both the Groups

2.5 Ethical Issues

Entire process of this research project was done by following the guidelines of Maharashtra University of Health Sciences (MUHS). Synopsis proposal including procedure and methodology was approved by the ethical committee of P.E.S. Modern College of Physiotherapy at institution level. The safety of the participant was ensured by the researcher and strict confidentiality was maintained regarding the patient information.

2.6 Informed Consent

The researcher obtained the informed consent of all the participants within the study. All participants were explained about the study and the nature of assessment. They were given the liberty to quit being the part of the study any time while performing the test.

3. Result

- Anterior direction of right and left leg showed no significant difference with p values 0.649421 and 0.571824 respectively.
- Anterolateral direction of right leg showed significant difference whereas, that of left leg showed no significant difference with p values 0.033221 and 0.235153 respectively.
- Lateral direction of right and left leg showed significant difference with p values 0.002401 and 0.001091 respectively.
- Posterior direction of right leg showed significant difference whereas, that of left leg showed no significant difference with p values 0.024842 and 0.412489 respectively.
- Posterolateral direction of right and left leg showed significant difference with p values 0.000046 and 0.000067.
- Posteromedial direction of right leg showed significant difference and that of left leg showed no significant difference with p values 0.0404 and 0.193167 respectively.
- Medial direction of right and left leg showed no significant difference with p value 0.56115 and 0.676702 respectively.
- Anteromedial direction of right and left leg showed no significant difference with p value 0.666065 and 0.712956.

4. Discussion

The objective of this study was to compare dynamic balance in older adults having intact balance undergoing lower limb strength training at gym with those not undergoing any form of exercises using Star Excursion Balance Test.

25 participants going to gym and fulfilling the inclusion criteria were assessed for their dynamic balance using star excursion balance test. Similarly, 25 participants not undergoing any form of lower limb strength training after fulfilling the inclusion criteria were assessed for their dynamic balance using star excursion balance test. The maximum distance reached by the subject was noted. Each subject performed same test for three times and an average reading was noted. This average distance reached by the subject was then divided by the leg length of the subject and a relative distance was calculated. Relative distances of each leg in 8 different directions were calculated similarly for every subject.

The results of the study showed significant difference in dynamic balance between the groups in Anterolateral direction of right leg, Lateral direction of both legs, Posterolateral direction of both the legs, Posterior direction of right leg, Posteromedial direction of right leg. Whereas there was no significant difference in Anterior direction of both legs, Anterolateral direction of left leg, Posterior

direction of left leg, Posteromedial direction of left leg, Medial direction of both the legs and Anteromedial direction of both the legs.

Chang S-HJ, Mercer VS, Giuliani CA, *et al*. suggested an increased rate of force development in hip abductors to maintain balance. Hence, SEBT showed a significant difference in the reach distances of Anterolateral, Lateral, Posterolateral, Posterior and Posteromedial directions owing to increased mediolateral stability in the geriatric population to maintain their COG within the BOS in gym going population.

Insignificant difference was seen between the groups on their non-dominant leg, although no direct evidence supports this contention, but the reason may be less use of non-dominant limb as compared to dominant limb by both the groups

The insignificant result in the aforementioned directions of the test may be due to: inadequate or ineffective dose of the training programme; inadequate compliance with the training programme; variability in the age of the subjects.

5. Limitations

- The sample size was less.
- The study was performed with participants having variable age.
- Any difference in sexes was not considered in the study.
- Any difference between the dominant and non-dominant leg was not considered.
- The study cannot measure any change in the dynamic balance of participants.

6. Future Scope

- The study can be conducted using other age groups.
- A larger sample size can be used for the study.

7. Conclusion

The study concluded that gym going adults on an average had statistically significant dynamic balance compared to adults not undergoing any kind of exercises. Thus, to prevent fall and reduce the risk of fall, all older adults must undergo some form of lower limb strengthening which would improve the quality of life in the forthcoming geriatric age.

8. References

1. contributors p. Balance [Internet]. Physiopedia [cited 24 April 2019]. Available from, 2019. https://www.physio-pedia.com/Balance
2. Guccione A. Geriatric Physical Therapy. 2nd ed. Alexandria, VA: Mosby, 2000.
3. Orr R, Raymond J, Singh M. Efficacy of Progressive Resistance Training on Balance Performance in Older Geriatric population, 2008.
4. Wood R, Star Excursion Balance Test [Internet]. Topend Sports Website. March 2008 [cited 24 April 2019]. Available from: https://www.topendsports.com/testing/tests/balance-star-excursion.htm
5. Stockert B, Barakatt E. Test-Retest Reliabilty of The Star Excursion Balance Test in a Geriatric Population.
6. Endo Y, Sakamoto M. Relationship between Lower Extremity Tightness and Star Excursion Balance Test Performance in Junior High School Baseball Players, 2014.
7. Gribble P, Hertel J. Considerations for Normalizing Measures of the Star Excursion Balance Test