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Impact of Differing Instability Devices on Postural Sway Parameters

Kacey M. Wallace [1,2], Michael R. Brown [2], William C. Pannell [2], Jacob B. Daniels [2], Juliana C. Moore [1], Ayden K. McInnis [1], Paul T. Donahue [1,*] and John C. Garner [2]

1 School of Kinesiology and Nutrition, University of Southern Mississippi, Hattiesburg, MS 39406, USA; kacey.wallace@usm.edu (K.M.W.); juliana.moore@usm.edu (J.C.M.); ayden.mcinnis@usm.edu (A.K.M.)
2 Department of Physical Therapy, University of Mississippi Medical Center, Jackson, MS 39216, USA; mbrown23@umc.edu (M.R.B.); jbdaniels@umc.edu (J.B.D.); jgarner@umc.edu (J.C.G.)
* Correspondence: paul.donahue@usm.edu

Abstract: Single-limb balance training is integral to preventing and rehabilitating lower extremity injuries. Previous investigations have shown that when using instability devices, differences may or may not exist in the postural sway parameters during use, depending on the specific devices being assessed. Thus, this investigation sought to examine the differences between a commonly used foam pad and a novel instability device (block) in postural sway measures. Twenty-two healthy individuals with no history of lower extremity injury or neurological disorders participated in this investigation. The participants performed three single-limb static balance exercises on a force platform sampling at 120 Hz. Each condition contained three 10-s trials separated by thirty seconds. The mean CoP values of the three trials in each condition were then compared using a within-subjects repeated-measures analysis of variance. Statistically significant differences were seen in the sway area between conditions ($p = 0.009$), the CoP path length ($p = 0.007$), the peak medial–lateral CoP displacement ($p = 0.004$), and the average sway velocity ($p = 0.007$). All variables displayed similar trends whereby the control condition showed significantly lower values than both instability devices, with no differences between devices. This investigation provides supporting evidence that different instability devices may deliver similar changes to postural sway parameters compared to control conditions. The novel block instability device used in this investigation may be used similarly to the traditional foam pad in prevention and rehabilitation settings based on the absence of differences between the two devices.

Keywords: postural sway; instability device; balance training

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1. Introduction

Balance is described as the contradicting actions between internal and external forces that create natural postural sway [1,2]. Neuromuscular control is a complex interaction between the systems of the body to execute proper movement strategies when one is attempting to maintain balance [3]. Human postural control is believed to be modulated based on the neural integration of three sensory systems: vestibular, somatosensory, and visual [4]. This results in the use of two different control strategies to maintain balance, which originate from either the ankle or the hip [4]. While these strategies are commonly assessed using postural perturbations, they also are present during a static stance [5]. Assessments of postural control are commonly used to understand an individual's ability to execute neuromuscular control. During these assessments, individual biological systems are tested using different challenging conditions. One such condition is to execute a static posture on an unstable surface [6–9]. Standing on an unstable surface not only alters the body orientation but also influences the function of the joint receptors and the cutaneous mechanoreceptors within the foot itself [10,11].

As has been stated throughout the literature pertaining to injury, the primary predictor of future injury is current/past injury [12,13]. Thus, the importance of creating not only rehabilitation but injury prevention programs centered on the improvement of balance parameters is paramount to reducing not only the number of injuries that occur but also the long-term effects of these injuries. Many times, an instability device is used in these training programs to create this unstable surface condition and provide a progressive overload in the training. Previous research has found that training on unstable surfaces can improve both static and dynamic balance, as well as perceptual outcomes [14–18]. A common issue with this training is the variability between the degrees of instability experienced across differing instability devices. Therefore, assessing the differences between commonly used instability devices is essential. Boonsinsukh et al. [7] reported no differences in the postural sway parameters between two different foam pad conditions in groups of faller and non-faller older adults. Patel et al. [11] found that foam pads of a similar size but different densities had statistically different impacts on anterior–posterior (AP) torque variance during a bilateral stance with eyes closed. However, no differences were observed between medium- and soft-density foams and a solid surface under eyes-open conditions. Lastly, they observed differences in the medial–lateral (ML) direction torque variance across all conditions (visual and surface). During a single-limb stance, Stanek et al. [6] also found differences in the ML direction among instability devices commonly used by practitioners. Specifically, they found that a half-foam roller had significantly less mediolateral displacement than a BOSU ball. Additionally, the BOSU ball had a significantly greater sway area and average sway velocity than the other three devices. However, no statistical differences were observed between the half-foam roller and foam pad conditions across any variables. The lack of consistent findings across studies regarding the instability devices creating changes in postural sway points to the need for further investigation to better design training programs in the future.

Since unstable surfaces challenge the somatosensory systems responsible for postural stability, they can be used to assess postural sway and are frequently implemented during balance training interventions to introduce a progressive overload during rehabilitation [14–18]. Rehabilitation professionals (physical therapists, athletic trainers, and strength and conditioning coaches) often use unstable surfaces such as foam pads, wobble boards, and BOSU trainers to create instability during training sessions. This is largely done to train neuromuscular qualities to prevent future injuries. Clark and Burden [14] found that a 4-week intervention using a wobble board exercise program improved the perception of functional stability in a sample of individuals with chronic ankle instability (CAI). Similarly, Wright et al. [17] reported that a four-week wobble board training program provided positive outcomes in both clinical and patient-oriented settings. Cruz-Diaz et al. [18] found that the use of a multi-station training program using several instability devices (exercise mats, Dynair, BOSU, mini trampoline, and foam roller) over six weeks improved patient perception and dynamic stability in a sample of athletes with CAI. Lastly, studies have considered the use of foam pads during unilateral balance training programs. Schlenstedt et al. [19] found there to be reductions in AP sway parameters (range and mean velocity) after completing a 4-week training program. This points to the effectiveness of using instability devices to improve patient outcomes. However, there are conflicting recommendations within the literature as to the implementation of instability devices in rehabilitation settings or during research [6,7,9]. This is largely dependent upon the particular devices being used within the investigation itself and points to the continued expansion of the available data as new products become commercially available.

Thus, as these new products become available to practitioners, it is essential to identify where they fall within this continuum of devices that are currently available and how they may be implemented in training sessions. This can be accomplished through cross-sectional evaluations of postural stability using established instability devices, such as a foam pad. Previous investigations comparing instability devices have also only used the instability device themselves and not compared the changes in postural sway to those on a firm surface [6,8,9]. Therefore, this investigation aims to examine the parameters of postural sway between the traditional foam pad (Airex) used in practice, a novel instability device (SlackBlock), and a firm surface (control).

2. Materials and Methods

A within-subject randomized crossover research design was used to observe the differences in sway parameters across three conditions (two experimental and one control). The static balance of the dominant leg was measured on different instability devices during a single session lasting approximately thirty minutes. Each participant completed three conditions: a control, block (The Slack Block, Slackbow LLC, Birmingham, AL USA), and foam (AirEX Balance-Pad, AirEX, Sins, Switzerland).

2.1. Participants

Twenty-two (11 male, 11 female; height 167.07 ± 10.7 cm, body mass 67.76 ± 13.45 kg, age 21.67 ± 0.75 years) participants were recruited as volunteers for this investigation. The exclusion criteria for this investigation consisted of neurological disorders and lower extremity injuries over the previous 12 months. Participants were instructed to refrain from exercise involving the lower extremities for 12 h prior to their experimental session. This was confirmed verbally by each participant upon arrival. Lastly, the participants completed a physical activity readiness questionnaire (PAR-Q) to determine their current health status and provided informed written consent before testing. All procedures were approved by the University of Southern Mississippi institutional review board.

2.2. Protocol

All testing was performed using an in-ground force platform (AMTI, Watertown, MA, USA). Participants were instructed to perform trials barefoot on their dominant leg. The participant's dominant leg was established by lightly pushing the participant on the back, with the leg used to step forward being deemed their dominant leg. Participants were instructed to keep their upper extremities down by their side and away from the body throughout each trial. Participants were also instructed to maintain visual contact with the wall located in front of them.

Prior to the beginning of each condition, a member of the research team ensured that the block or foam pad was placed in the center of the force platform and, if necessary, repositioned after a trial was completed. Additionally, prior to the start of each trial, a member of the research team ensured that the participant's foot was centered on the force platform. Each trial began when the subject raised their nondominant leg off the ground. Three trials were performed in each of the three conditions. One trial lasted 10 s, followed by a 10-s rest period. A rest period lasting five minutes was given between each condition. If participants stepped off the instability device, the nondominant foot touched the ground, or the hands touched the body, the trial was deemed unsuccessful and repeated until three successful trials were completed. If the individual could not complete three successful trials after five attempts, the subject was instructed to take a 5-min break from testing to account for fatigue.

2.3. Data Analysis

The center of pressure (CoP) was collected at 120 Hz. CoP data were both collected and analyzed using the Balance Clinic Software (AMTI, Watertown, MA, USA). CoP data were used to calculate the following variables: maximal AP and ML sway displacements (Equation (1)), peak AP and ML sway velocity (Equation (2)), and average sway velocity (Equation (3)). Lastly, the total CoP path length (Equation (4)) and 95% ellipse area (Equation (5)) were calculated. The AP direction was defined as the x plane and the y plane as the ML plane based on the local coordinate system of the laboratory.

$$x_{max} = \max\left(x_i - x_{avg}\right) \quad (1)$$

$$V_{x\,max} = \max\left(\frac{(x_i - x_{i-1})}{dt}\right) \quad (2)$$

$$l_{unit} = \frac{l_{path}}{t} \quad (3)$$

$$L_{path} = \sum\nolimits_{i=2}^{n} \sqrt{(x_i - x_{i-1})^2 + (y_i - y_{i-1})^2} \quad (4)$$

$$A = \pi * \sqrt{F * (x_{sd}^2 + y_{sd}^2 + D)} * \sqrt{F * (x_{sd}^2 + y_{sd}^2 - D)} \quad (5)$$

2.4. Statistical Analysis

The mean data of the three successful trials were used in all statistical analyses. All data were first evaluated for normality using a Shapiro–Wilk test. A one-way repeated-measures analysis of variance was conducted for each variable of interest to compare the means across the three conditions. Fisher's least significant differences post hoc comparisons were used in determining where statistical differences were present between conditions. Significance for all tests was set at $p < 0.05$. Eta-squared effect sizes were calculated for each variable and interpreted as small = 0.01, moderate = 0.06, and large = 0.14. All statistical analyses were performed using SPSS (v25.0, SPSS., Chicago, IL, USA).

3. Results

All variables' means and standard deviations are presented in Table 1. All data were normally distributed. Statistically significant differences were seen in the sway area between conditions ($f(2,42) = 5.28$, $p = 0.009$, $\eta^2 = 0.18$). The result for the control condition (9.64 ± 4.53 cm^2) was significantly lower than those for both the foam pad (13.05 ± 4.25 cm^2, $p = 0.009$) and block (12.33 ± 3.37 cm^2, $p = 0.046$). No differences were seen between the foam pad and block conditions ($p = 0.395$). Similarly, statistically significant differences were seen in the CoP path length between conditions ($f(2,42) = 5.52$, $p = 0.007$, $\eta^2 = 0.21$), with the result for the control (67.51 ± 9.49 cm) being significantly lower than those for both the foam pad (74.36 cm $\pm$ 9.76 cm, $p = 0.018$) and block (76.38 ± 14.84 cm, $p = 0.005$). No differences were seen between the foam pad and block conditions ($p = 0.442$) for the CoP path length. The maximal medial–lateral CoP displacements were significantly different between conditions ($f(2,42) = 6.24$, $p = 0.004$, $\eta^2 = 0.23$). Lower displacements were seen in the control (1.39 ± 0.20 cm), which was statistically different from both the foam pad (1.59 ± 0.24 cm, $p = 0.002$) and block (1.53 ± 0.25 cm, $p = 0.03$). Again, no differences were present between the foam pad and block conditions. The average sway velocity displayed statistically significant differences between conditions ($f(2,42) = 5.53$, $p = 0.007$, $\eta^2 = 0.21$). The control condition displayed the lowest average sway velocity (6.75 ± 0.95 cm/s), which was statistically different from those of both the foam pad (7.44 ± 0.98 cm/s, $p = 0.005$) and block (7.64 ± 1.48 cm/s, $p = 0.018$). The maximal anterior–posterior CoP displacements were not significantly different between conditions ($f(2,42) = 1.50$, $p = 0.23$, $\eta^2 = 0.07$). The peak anterior–posterior sway velocity was not significantly different between conditions ($f(2,42) = 1.75$, $p = 0.186$, $\eta^2 = 0.08$). Lastly, the peak medial–lateral sway velocity was not significantly different between conditions ($f(2,42) = 2.16$, $p = 0.13$, $\eta^2 = 0.09$).

Table 1. Sway parameter comparisons (mean ± SD).

	Control	Foam Pad	Block	p	η^2
Peak AP Displacement (cm)	2.05 ± 0.56	2.31 ± 0.62	2.23 ± 0.58	0.23	0.07
Peak ML Displacement (cm)	1.39 ± 0.20	1.59 ± 0.24 *	1.53 ± 0.25 *	<0.01	0.23
Peak AP Sway Velocity (cm/s)	26.66 ± 6.03	28.94 ± 7.45	29.88 ± 6.91	0.19	0.08
Peak ML Sway Velocity (cm/s)	26.35 ± 6.85	28.58 ± 5.81	29.62 ± 5.88	0.13	0.09
Average Sway Velocity (cm/s)	6.75 ± 0.95	7.44 ± 0.98 *	7.64 ± 1.48 *	<0.01	0.21
Path Length (cm)	67.51 ± 9.49	74.36 ± 9.76 *	76.38 ± 14.84 *	<0.01	0.21
Sway Area (cm^2)	9.65 ± 4.53	13.04 ± 4.25 *	12.33 ± 3.37 *	<0.01	0.18

AP = anterior–posterior; ML = medial–lateral; * = significantly different from control condition.

4. Discussion

This study aimed to compare the sway parameters between instability devices using block and foam conditions. Our results indicated no significant differences in the sway parameters between the foam and block conditions. However, there was a significant difference in the sway parameters between the control and both of the instability devices. This supports previous investigations where no differences were seen between foam pad conditions on measures of postural stability [7,9]. While the instability device challenges one's ability to maintain postural control, it also raises the CoM above that of the control condition. When one increases the height of the CoM, postural control will decrease. This could partially explain the differences between the experimental and control conditions within the current investigation. Previous research has explored the effects of altering the location of the CoM on postural sway. Using two instability devices, Simeonow and Hsiao [20] observed the postural sway differences in construction workers. There was a significant increase in postural sway as the heights of the instability devices increased. Ojie et al. [21] used the angle of hanging mass and the projected sway to observe the relationship between the sway and the height of the CoM. It was found that the height of the CoM was directly correlated to the projected sway. They found that as the height increased from 50 cm to 100 cm, the mean of the CoM displacement continually increased. A potential explanation for the lack of differences between the foam and block conditions may be that the height differences between the devices were not large enough (block 8.89 cm vs. pad 6.51 cm). The results of the current investigation showed no significant differences between the two devices; the height difference was not sufficient to induce an increase in postural sway for the block condition. Furthermore, the block was constructed with a top layer made of wood. Thus, differences in the direct feedback to the somatosensory system may have occurred, which offset any differences in the height of the two devices [9,10].

As for other differences between the two experimental devices, the block was narrower than the foam pad. However, no differences between the block and foam conditions regarding the mediolateral displacement or peak sway velocity were present. The finding of no differences with the narrower block in the ML direction is supported by Stanek et al. [6], where no differences were seen between the half-foam roller and the foam pad. This could potentially be due to the block, while narrower, still being greater than the width of the foot itself for both the current investigation and many of the instability devices used in previous investigations. Additionally, it is of interest when examining the foam pad in the amount of surface area that is in contact with the foot. Previous investigations have shown that softer foam conditions produce lower postural sway velocities than firmer and more dense foams [8,11]. Within the present study, the construction of the block could again potentially explain why no differences were seen. The wooden upper layer of the block again could provide a differing feedback response from the bottom of the foot compared to the foam pad, thus creating a similar response through differing mechanisms. While the density of the two experimental conditions in the present study was not explored, further investigation is warranted as to whether a firmer foam pad would elicit greater sway than a block.

Our data show no significant differences in the sway parameters between the foam and block conditions. Lin et al. [9] found similar results when observing the differences between two foams commonly used by both practitioners and researchers. They concluded that there were no significant differences between the instability devices, which could be used interchangeably in a clinical setting. Boonsinsukh et al. [7] also found similar results, as both foam pad conditions produced similar sway parameters. The findings of this investigation support previous recommendations indicating that foam pads can be used interchangeably to induce increased postural instability, as no statistically significant differences were found between the two devices. In contrast, the current results differ from those of Stanek et al. [5], who found statistically significant differences between instability devices. They evaluated the differences between a BOSU ball, an Airex foam pad, a half-foam roller, and a Dyna Disc. Notably, differences were seen between the BOSU ball and all other conditions. The BOSU ball elevated the CoM of the participants to a much greater height than the other three devices used. This could explain why Stanek et al. [5] found a significantly greater center of pressure area and sway velocity for the BOSU ball conditions. Based on these findings, Stanek et al. [4] recommended that clinicians and practitioners implementing balance training protocols be aware of patients' position in the rehabilitation process when selecting unstable devices. For example, since the BOSU ball produces a higher sway velocity, a patient should not train on a BOSU ball at the beginning of a rehabilitation program. However, when looking at the two foam conditions in Stanek et al. [5], the results support the findings of the current investigation. No differences were seen between the foam pad and half-foam roller conditions. This points to the need for further investigation into the materials used in the construction of the instability device and when a given device should be implemented in a training protocol. While no significant differences were found between the foam pad and block, the variability was greater in the block for both the path length and average sway velocity. As the average sway velocity was calculated as the path length over time, any increase in path length variability would also be present in the average sway velocity. Lin et al. [9] showed that when using a similar foam pad to the one used in this investigation, the path length displayed fair to excellent reliability (ICC 0.41–0.81). As a rather large range of reliability has previously been reported, it is an important consideration in the interpretation of the results. Within the current study, the use of the randomized crossover study design limited the order effect that could have occurred. Future investigations should examine order effects when using instability devices as this could create potentially greater between-subject variability.

It Is of interest to note that no statistically significant differences were found between the conditions for the peak AP displacement, peak AP sway velocity, and peak ML sway velocity, although moderate effect sizes were present. Across all three of these variables, the instability devices demonstrated greater values. This is similar to the variables that did reach statistical significance, where the control condition had lower postural sway. While the lack of differences in AP displacement could intuitively be explained by the unilateral stance, both instability conditions had greater displacement. This could potentially be explained by changes in the ML direction not being strictly in the frontal plane but across both sagittal and frontal planes. This also would explain the differences seen in the 95% sway area. Interestingly, previous investigations that have used unilateral balance training interventions found changes in the AP direction post training [17]. This would support the findings of the current investigation that, during a unilateral stance, there are still changes in the AP direction, athough it has a greater base of support than the ML direction.

Previous investigations have shown differences in patient perception and clinically relevant outcomes after short-term training programs using various instability devices [13,17,18,22]. However, there is a gap in the evidence when examining training outcomes across different devices. Cross-sectional examinations such as the current and previously mentioned investigation display no differences in foam-based instability devices and conclude that foam pads can be used interchangeably. A potentially more clinically relevant investigation would examine longitudinal training outcomes using the different devices both independently and as a part of a systematic progression. Previous investigations examining the effect of unilateral balance training interventions have used built-in systematic progressions, such as the inclusion of additional motor/cognitive tasks to make the training more complex. It would be of interest to explore whether adding additional cognitive and/or motor tasks would impact the longitudinal results using the devices within this investigation. This would be of benefit for both healthy populations as part of a preventive training intervention and with clinical populations during rehabilitation, such as those with CAI and/or anterior cruciate ligament reconstruction.

The novel block device that was used within this investigation also is worth further exploration on its own. The block itself comes in several sizes that are dependent upon the body weight of the individual. All participants in this investigation used the size 13 block, which is to be used with individuals under 86.36 kg (190 lbs) based on the manufacturer recommendations. It would be of interest to examine whether the use of a larger block with the same demographics as the current investigation has an impact. Moreover, the block had five removable inserts within the foam. All five inserts were left in place during this investigation. However, removing these inserts may influence the way that the foam deforms and thus change the CoP parameters. As discussed earlier, future investigations should examine the longitudinal effects of training with different instability devices. The block that was used within this study may have the ability to add additional overload stresses over time placed on the removable inserts. Thus, examining these effects would be of interest to practitioners who use the device but also to researchers who aim to develop training protocols to be used across different population groups.

This study is not without limitations. The participants were not given specific instructions on positioning the nondominant leg during testing. Previous studies have instructed subjects to flex the nondominant knee at 90 degrees [23]. However, other studies have also not used specific instructions as to the location of the contralateral limb when trying to replicate clinical settings. As the present study aimed to have a level of ecological validity, it was believed that not providing specific instructions on the location of the contralateral limb was appropriate [23]. Instructing subjects to keep the nondominant leg at 90 degrees could have led to lower ecological validity. A second limitation of this study was the visual field. The visual target on the wall was not at eye level, which could have increased the postural sway due to the head's orientation [24]. As all participants used the same visual target across all conditions, any impact would have been the same in each condition. Lastly, during data collection, this investigation was performed on a sample of healthy young adults free of neuromuscular disorders and injury-free. Thus, the generalizability across injured populations commonly using single-limb balance training is limited. However, balance training protocols are not limited to those individuals who are currently injured and can be used in an injury mitigation capacity. Thus, the use of a healthy, college-aged population does provide a level of informative data to be used in the design of future training interventions.

5. Conclusions

In conclusion, this study found no statistically significant differences in sway parameters between the block and foam pad. The results from this study support the previous findings in that the foam-based instability devices can be used interchangeably for acute balance training (<10 s) in healthy college-aged individuals, since they do not demonstrate a significant difference in postural instability. However, the long-term training outcomes when using different instability devices need further investigation.

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References

1. Winter, D. Human Balance and Posture Control during Standing and Walking. *Gait Posture* **1995**, *3*, 193–214. [CrossRef]
2. Pollock, A.S.; Durward, B.R.; Rowe, P.J.; Paul, J.P. What Is Balance? *Clin. Rehabil.* **2000**, *14*, 402–406. [CrossRef] [PubMed]

3. Mancini, M.; Horak, F.B. The Relevance of Clinical Balance Assessment Tools to Differentiate Balance Deficits. *Eur. J. Phys. Rehabil. Med.* **2010**, *46*, 239–248. [PubMed]
4. Nasher, L.M.; Wiillacott, M.; Tuma, G. Organization of Rapid Responses to postural and locomotor-like perturbations of standing man. *Exp. Brain Res.* **1972**, *36*, 463–476. [CrossRef]
5. Tropp, H.; Odenrick, P. Postural control in single-limb stance. *J. Orthop. Res.* **1988**, *6*, 833–839. [CrossRef] [PubMed]
6. Stanek, J.M.; Meyer, J.; Lynall, R. Single-Limb-Balance Difficulty on 4 Commonly Used Rehabilitation Devices. *J. Sport Rehabil.* **2013**, *22*, 288–295. [CrossRef] [PubMed]
7. Boonsinsukh, R.; Khumnonchai, B.; Saengsirisuwan, V.; Chaikeeree, N. The Effect of the Type of Foam Pad Used in the Modified Clinical Test of Sensory Interaction and Balance (mCTSIB) on the Accuracy in Identifying Older Adults with Fall History. *Hong Kong Physiother. J.* **2020**, *40*, 133–143. [CrossRef] [PubMed]
8. Gosselin, G.; Fagan, M. Foam Pads Properties and Their Effects on Posturography in Participants of Different Weight. *Chiropr. Man. Ther.* **2015**, *23*, 2. [CrossRef] [PubMed]
9. Lin, C.-C.; Roche, J.L.; Steed, D.P.; Musolino, M.C.; Marchetti, G.F.; Furman, G.R.; Redfern, M.S.; Whitney, S.L. Test-Retest Reliability of Postural Stability on Two Different Foam Pads. *J. Nat. Sci.* **2015**, *1*, e43.
10. Wu, G.; Chiang, J.H. The Significance of Somatosensory Stimulations to the Human Foot in the Control of Postural Reflexes. *Exp. Brain Res.* **1997**, *114*, 163–169. [CrossRef]
11. Patel, M.; Fransson, P.A.; Lush, D.; Gomez, S. The Effect of Foam Surface Properties on Postural Stability Assessment While Standing. *Gait Posture* **2008**, *28*, 649–656. [CrossRef] [PubMed]
12. Hägglund, M.; Waldén, M.; Ekstrand, J. Previous injury as a risk factor for injury in elite football: A prospective study over two consecutive seasons. *Br. J. Sports Med.* **2006**, *40*, 767–772. [CrossRef] [PubMed]
13. Wikstrom, E.A.; Cain, M.S.; Chandran, A.; Song, K.; Regan, T.; Migel, K.; Kerr, Z.Y. Lateral Ankle Sprain and Subsequent Ankle Sprain Risk: A Systematic Review. *J. Athl. Train.* **2021**, *56*, 578–585. [CrossRef] [PubMed]
14. Clark, V.M.; Burden, A.M. A 4-Week Wobble Board Exercise Programme Improved Muscle Onset Latency and Perceived Stability in Individuals with a Functionally Unstable Ankle. *Phys. Ther. Sport* **2005**, *6*, 181–187. [CrossRef]
15. Taghavi Asl, A.; Shojaedin, S.S.; Hadadnezhad, M. Comparison of Effect of Wobble Board Training with and without Cognitive Intervention on Balance, Ankle Proprioception and Jump Landing Kinetic Parameters of Men with Chronic Ankle Instability: A Randomized Control Trial. *BMC Musculoskelet. Disord.* **2022**, *23*, 888. [CrossRef] [PubMed]
16. McKeon, P.O.; Ingersoll, C.D.; Kerrigan, D.C.; Saliba, E.; Bennett, B.C.; Hertel, J. Balance Training Improves Function and Postural Control in Those with Chronic Ankle Instability. *Med. Sci. Sports Exerc.* **2008**, *40*, 1810–1819. [CrossRef] [PubMed]
17. Wright, C.J.; Linens, S.W.; Cain, M.S. A Randomized Controlled Trial Comparing Rehabilitation Efficacy in Chronic Ankle Instability. *J. Sport Rehabil.* **2017**, *26*, 238–249. [CrossRef]
18. Cruz-Diaz, D.; Lomas-Vega, R.; Osuna-Pérez, M.C.; Contreras, F.H.; Martínez-Amat, A. Effects of 6 Weeks of Balance Training on Chronic Ankle Instability in Athletes: A Randomized Controlled Trial. *Int. J. Sports Med.* **2015**, *36*, 754–760. [CrossRef]
19. Schlenstedt, C.; Arnold, M.; Mancini, M.; Deuschl, G.; Weisser, B. The effect of unilateral balance training on postural control of the contralateral limb. *J. Sport Sci.* **2017**, *35*, 2265–2271. [CrossRef]
20. Simeonov, P.; Hsiao, H. Height, surface firmness, and visual reference effects on balance control. *Inj. Prev.* **2001**, *7*, i50–i53. [CrossRef]
21. Ojie, O.O.D.; Saatchi, R.; Saatchi, M. Demonstration of the Effect of Centre of Mass Height on Postural Sway Using Accelerometry for Balance Analysis. *Technologies* **2020**, *8*, 20. [CrossRef]
22. Hirase, T.; Inokuchi, S.; Matsusaka, N.; Okita, M. Effects of a Balance Training Program Using a Foam Rubber Pad in Community-Based Older Adults: A Randomized Controlled Trial. *J. Geriatr. Phys. Ther.* **2015**, *38*, 62–70. [CrossRef] [PubMed]
23. Ageberg, E.; Roberts, D.; Holmström, E.; Fridén, T. Balance in Single-Limb Stance in Patients with Anterior Cruciate Ligament Injury. *Am. J. Sports Med.* **2005**, *33*, 1527–1537. [CrossRef] [PubMed]
24. Redfern, M.S.; Yardley, L.; Bronstein, A.M. Visual Influences on Balance. *J. Anxiety Disord.* **2001**, *15*, 81–94. [CrossRef]