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To Compare the Effect of Land and Water Based Balance Training in Functional Ankle Instability

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Abstract
Background: *With increasing amount of leisure time and the current emphasis on the physical fitness, the incidence of sports injuries has increased dramatically. Ankle is one of the most common parts of the body to get injured during sports activities. Functional ankle instability is defined as recurrent or subjective feeling of giving way. The studies have shown that Functional Ankle Instability results in decreased ability to maintain balance & a decrease in joint position sense.*
Aims & Objective: *The primary aim of the study is to determine the effect of water & land-based balance training in Functional Ankle Instability.*
Methods: *30 subjects with Functional Ankle Instability were selected for the study fulfilling the inclusion criteria. Each subject in both the groups underwent similar balance training protocol for 4 weeks (thrice a week) with at least 1 day rest between 2 training sessions. The pre & post-test readings were collected using Star Excursion Balance Test dynamic balance & One Leg Stance Test for static balance.*
Result: *The result of the study showed that there is significant difference between water & land-based balance training.*
Conclusion: *The water-based balance training has better effect of functional ankle instability.*
Keywords: *functional ankle instability, static balance, dynamic balance, SEBT, OLST.*

Introduction

With increasing amounts of leisure time and the current emphasis on physical fitness the incidence of sports injuries has increased dramatically. One of the body parts injured most frequently has been the ankle joint with most common injury occurring in this joint being the ankle sprain. It has been estimated that ankle injuries occur everyday per 10,000 of the population.

Ankle sprains occur in all the sports but particularly prevalent in Sports such as basketball and Soccer with ankle sprains representing approximately 50% of all basketball injuries and 30% of all soccer injuries. Chronic ankle instability is a frequent consequence after lateral ankle sprain and it is estimated that approximately 40% on the individuals suffering and initial ankle sprain will develop long standing ankle dysfunction. These chronic symptoms are most often due to functional instability and less frequently due to mechanical stability.

Mechanical ankle instability refers to objective measurement of ligament laxity whereas functional ankle instability is defined as the recurrent or the subjective feeling of giving way. The stabilizing elements of the normal ankle are the capsule and ligamentous structures, the musculotendinous units and the anatomical alignment of the joint. Stability of the ankle joint during functional activities such as standing walking and running exist in the presence of intact neural input from proprioceptors in the joint capsule, ligaments, tendon and skin. It has been suggested that diminished sensory input from the damaged articular mechanoreceptors at the ankle in turn may promote decreased motor control (Balance) leading to clinical concern of functional instability.

Balance is defined as the ability to maintain the center of body mass within stability limit determined by base of support. Balance is often classified as being either static or dynamic. The test used for assessing balance is one leg stance test (OLST) for static balance and star excursion balance test (SEBT) for dynamic balance. Studies have shown that functional ankle instability results in decreased ability to maintain balance and the decrease in joint position sense. The visual, somatosensory and vestibular Systems all contribute for maintenance of the balance.

The use of water for rehabilitation spans centuries. Weather it is a sports injury or severe weakness, hydrotherapy help to regain the freedom of movement without pain. The water provides a wonderful environment for helping patient restore balance, strength and range of motion.

Aims & Objective

The primary purpose of the study is to determine which training medium(land vs water) is better when training for functional ankle instability.

Hypothesis

Experimental Hypothesis

1. There will be significant difference between the water training group and the land training group in improvement with regard to OLST.
2. There will be a significant difference between the water training group and the land training group in improvement with regard to reach distances in all 8 directions of SEBT.

Null Hypothesis

1. There will be no significant difference between the water training group and the land training group in improvement with regard to OLST.
2. There will be a significant difference between the water training group and the land training group in improvement with regard to reach distances in all 8 directions of SEBT.

Dependent Variables

1. Normalised reaching distance value to the height (in centimeters) in 8 directions of star excursion balance test (SEBT) – Anterior (A), Anteromedial (AM), Medial (M), Posteromedial (PM), Posterior (P), Posterolateral (PL), Lateral(L) & Anterolateral(AL)
2. Total reach distance (in centimeters) of star excursion balance test (SEBT)
3. Reading of OLST in hundredth of second.

Independent Variables

1. Balance Training
2. SEBT
3. OLST

Review of Literature

The term ankle specifically refers to the talocrural joint that is the articulation between the talus and the mortise created by distal tibia, fibula and two malleoli.

The capsule of the ankle joint is fairly thin and weak anteriorly and posteriorly. Therefore, the passive stability of the ankle is the responsibility of the ligaments and Bony constraints of the ankle joint while the active stability depends on the muscular support.

The ligaments of the ankle can be divided into the lateral group, medical group and the ligaments of syndesmosis. These ligaments are responsible for about 87% of the resistance to the inversion of the talus when the ankle is non weight bearing.

Ligament	Distal Attachment	Proximal Attachment	Function
Anterior Talofibular	Neck of the talus	Lateral malleolus	Primary restraint against plantar flexion & internal rotation of foot & inversion
Calcaneofibular	Lateral surface of the calcaneus	Tip of lateral malleolus	Prevents inversion
Post. Talofibular	Lateral tubercle of the talus	Lateral malleolar fossa	Prevents inversion
Lateral talocalcaneal	Posterolateral calcaneus	Posterolateral talus	Prevents excessive inversion & supination
Cervical	Cervical tubercle of the calcaneus	Neck of the talus	Assist in prevention of inversion
Anterior Tibiotalar	Superior posterior portion of the navicular	Inferior medial malleolus	Prevention of eversion
Tibionavicular	Sustentaculum tali of calcaneus & navicular bone	Inferior medial malleolus	Prevention of eversion
Tibiocalcaneal	Sustentaculum tali of calcaneus	Inferior medial malleolus	Prevention of eversion
Posterior Tibiotalar	Medial tubercle of talus& Sustentaculum tali of calcaneus	Inferior medial malleolus	Prevention of eversion

Lateral ankle sprains are one of the most common injuries among athletes and other young active adults. The incidence of lateral ankle sprain is approximately1 per 10,000 people per day.

Classification of Ankle Sprain

Table 1
Classification of Ankle Sprains

Severity	Physical Examination Findings	Impairment	Pathophysiology	Typical Treatment*
Grade 1	Minimal tenderness and swelling	Minimal	Microscopic tearing of collagen fibers	Weight bearing as tolerated No splinting/casting Isometric exercises Full range-of-motion and stretching/strengthening exercises as tolerated
Grade 2	Moderate tenderness and swelling Decreased range of motion Possible instability	Moderate	Complete tears of some but not all collagen fibers in the ligament	Immobilization with air splint Physical therapy with range-of-motion and stretching/strengthening exercises
Grade 3	Significant swelling and tenderness Instability	Severe	Complete tear/rupture of ligament	Immobilization Physical therapy similar to that for grade 2 sprains but over a longer period Possible surgical reconstruction

*Patients must receive treatment that is tailored to their individual needs. This table outlines common treatment protocols.

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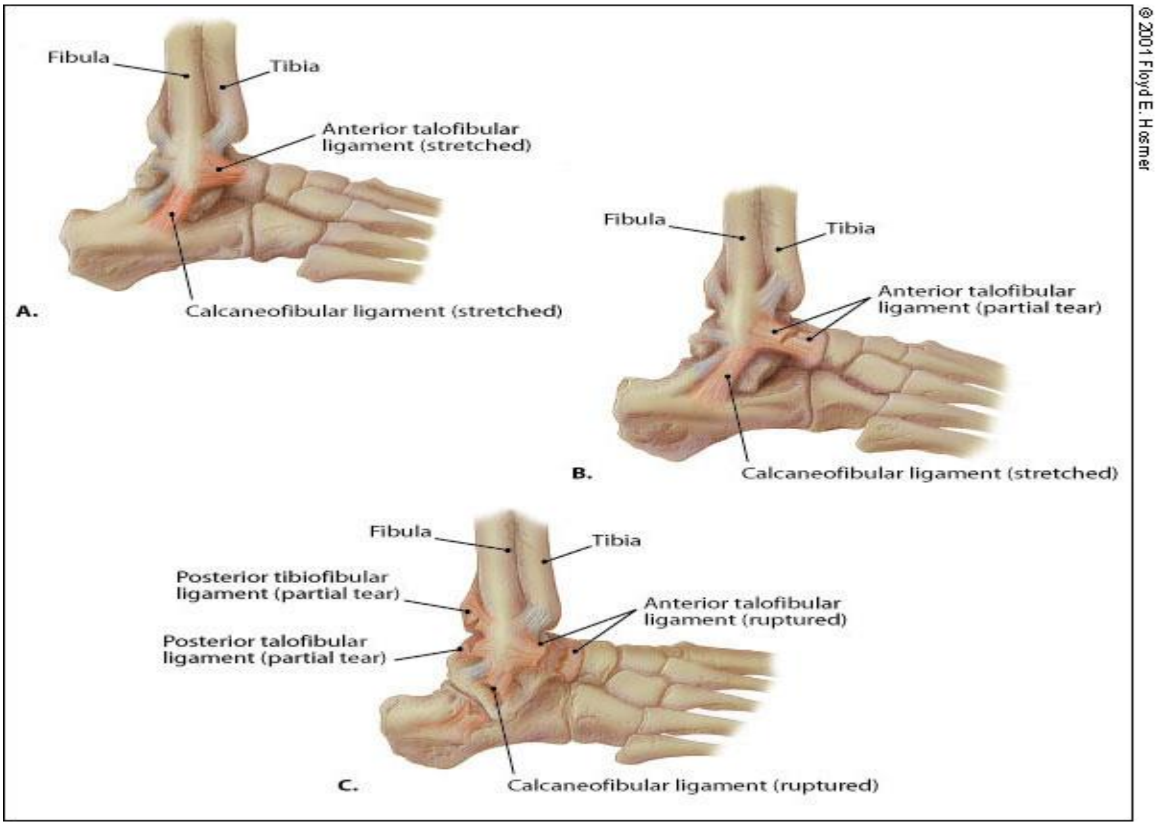


Figure: Grading of Ankle Sprain

Patho-anatomy & Mechanism of Injury

The most common mechanism of injury in ankle sprains is a combination of plantar flexion and inversion. The lateral stabilizing ligaments which include the anterior talo-fibular, calcaneofibular and posterior Talo-fibular ligaments are most often damaged. The anterior talofibular ligament is the most easily injured. concomitant injury to this ligament and the calcaneofibular ligament can result in appreciable instability. The posterior Talo-fibular ligament is the strongest of little complex and rarely injured in an inversion sprain.

Functional Ankle Instability

Chronic ankle instability is a common problem after acute ankle sprain manifested by recurring injuries that often limits sports participation. Traditionally, chronic ankle instability has been attributed to 2 potential causes: mechanical instability and functional instability. More recent definition of functional instability is the occurrence of recurrent ankle instability and the sensation of joint instability due to contribution of proprioceptive and neuromuscular deficits.

Functional Ankle Instability

Injury to the lateral ligaments of the ankle results inadverse changes to the neuromuscular system that provides dynamics support to the ankle. Freeman et al first described the concept of functional instability in 1965. Over the past two decades functional insufficiencies among the individuals with other acute ankle sprains or chronic ankle instability have been demonstrated by quantifying deficits in ankle proprioception cutaneous sensation nerve conduction velocities neuromuscular response time postal control and strength.

Proprioception at ankle is impaired in the individuals prone to repetitive ankle sprains on measure of kinesthesia and active replication of o0joint angles.

Impaired cutaneous sensation and slow nerve conduction velocity have been reported as indicators of common peroneal nerve palsy after acute lateral ankle sprain but no evidence exist that such improvement are present in patients with chronic ankle instability.

A neuromuscular recruitment patterns have been demonstrated in individuals with history of repetitive lateral ankle sprain.

Impaired postural control during single leg stance has been demonstrated frequently in individuals after acute ankle sprain and in those with the history of repetitive ankle sprains. Non instrumented assessment of the modified Romberg test has been performed by having subjects stand as motionless as possible on one leg for a period of usuallyranging from 10 to 30 seconds. The task was performed while standing on the involved limb and then the uninvolved limb first with open and then with eyes closed.

Strength deficits have been reported among the individuals with chronic ankle instability. Diminished strength has been reported for both eversion & inversion, although reports of no strength deficit also exist.

Clinical symptoms of chronic lateral instability of the ankle

It is manifested by recurrent injuries but pain, tenderness and sometimes bruising over the lateral ligaments. Many, approximately30% may be asymptomatic between the events whereas others may manifest with chronic ankle pain, tenderness, swelling or induration with great difficulties in Sports and daily activities. A history of insecurity, instability and giving way is far more important in diagnosis than the physical examination claimed in general to be unreliable in acute and recurrent sprains.

Radiological Assessment

Diagnosis of instability may be supported by a forced inversion film accompanied by a lateral film with the foot pulled forward. A talar tilt of more than 5 degrees difference to the contralateral non-injured ankle is usually considered pathological though others claim a minimum of 10 degrees.

A forward subluxation of over 6mm is usually considered pathological. However wide variations of up to 19 degrees have been found to be present in about 5% of populations. These finding suggest that radiological diagnosis of lateral and stability is highly unreliable. This becomes even more evidence as it has been shown that only 40% of patients demonstrating radiological stability will have symptoms unstable ankle.

Balance & its Physiology

Balance is defined as the ability to maintain the center of body mass stability limits largely determined by base of support. Stability limits are boundaries of an area of the space in which the body can maintain its position without changing the base of support. Balance is often classified as being either static or dynamic. Static balance is said to exist when an adopted position is maintained for the period of time while the dynamic balance is the maintenance of balance when on the move. A white variety of external and internal forces challenge the body by altering its center of gravity. To maintain balance a person must sense these forces and execute muscle response that offset them, skill that is achieved by the coordinator affords of sensory and motor systems. The components that contribute to maintenance of balance are visual, vestibular and somatosensory system.

Visual System: The visual system is a major contributor to balance, providing information about the environment, the body's location within that environment, and the direction and the speed of the movement within that environment. When visual information is reduced (eg. by closing Eyes) in younger adults, postural sway increases. Conversely, stance is steadied when the eyes are open and fixed on a point of reference. As individual grow old, people tend to lose their ability to use Visual cues to control static balance. This may lead to decline in visual field, contrast sensitivity and death perception that typically occurs during the aging process.

Vestibular System: The vestibular system located in the inner ear and consisting of otoliths and semicircular canals, the vestibular system provides information about head movement independent of visual cues. As the head moves, movement of the fluid in the canal triggers receptors and information regarding head orientation is sent to the brain. After the age of 40 the number and size of vestibular neurons often decreases and it is estimated that 40% of an individual's vestibular sensory cells no longer function by age of 70.

Somatosensory System: A sub component of comprehensive motor control system for upright postural control. It deals with three of the four body senses.

1. Touch- sensing the physical properties of the surface in contact with the skin.
2. Proprioception- sensing the position of body parts.
3. Kinesthesia- sensing the movement of the body parts.

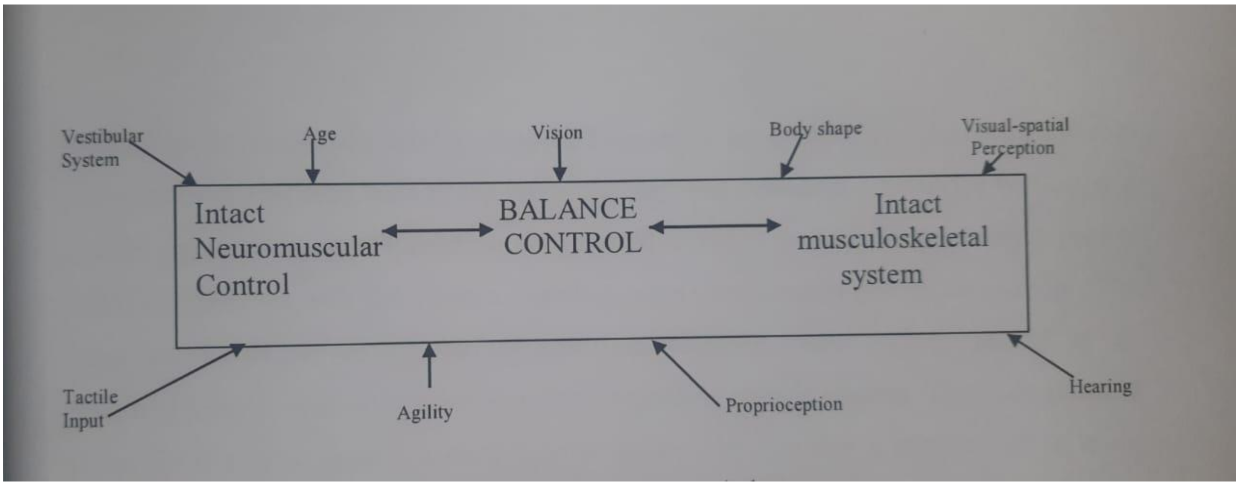


Figure: factors affecting balance

Sources of Proprioceptive Input

Mechanoreceptors are specialized neuroepithelial structures found and skin, ligaments, muscles and tendons that surrounds joint. The receive and send information about the functional and mechanical deformation to the central nervous system. The types of mechanoreceptors are as follows:

1. Cutaneous Mechanoreceptors:

Type of Mechanoreceptor	Location	Sensory Information	Adaptation Rate
Pacinian Corpuscles	Deep dermis or hypodermis	Deep cutaneous pressure, vibration, & proprioception	Rapid
Meissner's Corpuscles	Dermal papillae of hairless skin	Touch, pressure, & slow vibrations	Rapid
Ruffini Ends	Dermis	Continuous touch or pressure & depression or stretch of skin	Slow
Hair Follicles	Along the axis of strands of hair	Light touch & bending of hair	Rapid

2. Muscle Mechanoreceptors:

Type of Mechanoreceptor	Location	Sensory Information	Adaptation Rate
Muscle Spindles	Muscle belly enclosed in connective tissue capsules	Sense changes in muscle length or rate of muscle length change and send that afferent information to the CNS	Slow
Golgi Tendon Organs	Tendons near musculotendinous junction	Sense changes in muscle tension or rate of musculotendinous tension change	Slow

3. Joint Mechanoreceptors:

Type of Mechanoreceptor	Location	Sensory Information	Adaptation Rate
Type I	In stratum of joint capsule	Very slight movements & tension on the capsule	Slow
Type II	In synovial membrane & fibrous layers of joint capsule & fat pad	Very slight movements & tension on the capsule (at the end ranges of motion)	Rapid
Type III	In ligaments	Larger movements (at the end ranges of motion)	Slow
Type VI	Within joint	Noxious stimulus	Rapid

Assessment of Balance:

Quantification of balance or postural control is often necessary to assess the level of injury or ability to function in order to initiate and appropriate plan of care. Measurement of Postural control is an important tool in the assessment of Athletic population for established level of neuromuscular function for the purposes of injury prevention and rehabilitation. Postural control is often described as being static or dynamic.

Static Postural Control: Static postural control is commonly assessed by having an individual attempt to maintain a stationary position while standing on either one or both feet. A common clinical example of static postural control assessment tool is one leg stance test (OLST).

One Leg Stance Test: This test evaluates ability to balance while standing on one leg. Patients are given specific instructions to stand on one leg for 30 seconds, in one of two conditions, with eyes open or eyes closed.

Dynamic Postural Control: Dynamic posture control often involves completion of a functional task without compromising one’s base of support. dynamic postural control tests such as excursion & functional reach tests are superior to basic single leg stance tests. The star excursion balance test (SEBT) is one such test that provides a significant challenge to an athlete’s postural control system.

Star Excursion Balance Test: The star excursion balance test is a functional balance test that uses a unilateral stance on the center of a star and the maximal reached down each of the star’s 8 lines. The star excursion balance test has been reported to have high the reliability for testing dynamic postal control of those with and without functional ankle instability.

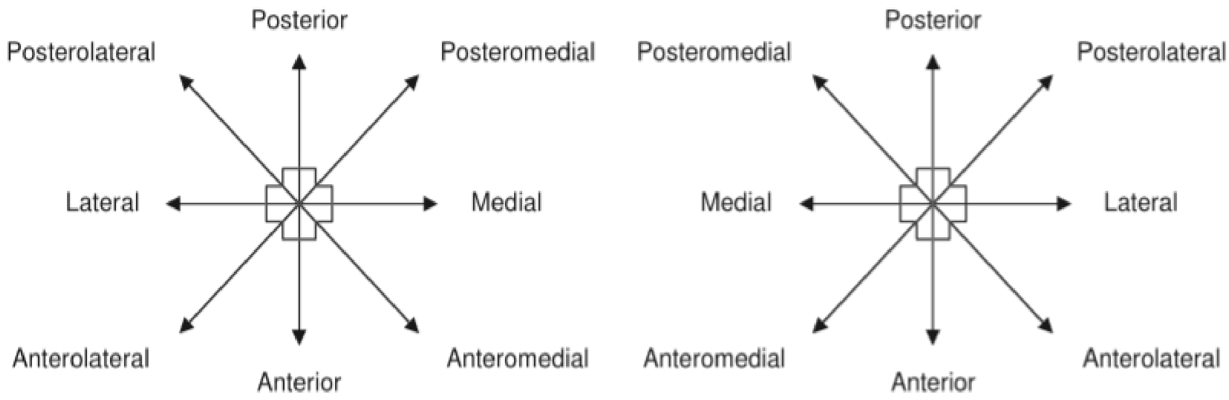


Figure: star excursion balance test for both limbs.

Water & its use in Balance Training: Research has shown that three weeks of inactivity can lead to a significant loss of cardiovascular fitness and 6 weeks of rest can lead to a decrease of as much as 14 to 16% in maximal oxygen consumption. Because of these losses, athlete may seek an alternative training medium and many athletes have found water-based program to be beneficial during their recovery. The physical properties of water are the basis of its Creative use in rehabilitation.

Buoyancy: Archimedes' principal of buoyancy states that a body partially or completely immersed in a fluid experience an upward thrust equal to the weight of the fluid that was displaced. buoyancy can be used in rehabilitation as assistance, support or resistance.

Hydrostatic Pressure: Pascal's law state that at any given depth, the pressure from the liquid is exerted equally on the all surfaces of the immersed object. As the density and depth of the liquid increases so does the volume of liquid overhead and therefore the hydrostatic pressure thus it may be used in rehabilitation to reduce effusion or to allow the athlete to exercise the injured extremity without increasing the effusion.

Viscosity: Viscosity is defined as the friction occurring between individual molecules in a liquid, which causes resistance to flow. Because water is more viscous than air Movement in the water is resisted regardless of buoyancy. Viscosity provides the most common form of resistance training.

Fluid Dynamics: Two different types of water flow exist; laminar flow and turbulent flow. Laminar flow is defined as the smooth flow of water molecules carries the least amount of resistance because the water molecules are travelling the same direction and speed while the turbulent flow is interrupted flow causing water molecules to rebound in all directions.

Intense training of athletes should take place in water between 27 degrees Celsius to 28 degrees Celsius to prevent any heat related complication. However, for simple rehabilitation exercises that are not cardiovascular demanding, athletes can safely exercise at 33 to 34 degrees Celsius.

Table: Rehabilitation Articles on Acute and Chronic Ankle Instability

Matsusaka et al (2001)[77]	‘‘Effect of ankle disk training combined with tactile stimulation to the leg and foot on functional instability of the ankle’’	Balance training Single-leg stance on ankle disc, remaining upright for as long as possible, 10 min/d, 5X/wk for 10 wk; one group taped from the lateral malleolus to the sole of the foot, other group untaped.	Improved postural sway in all subjects who trained using ankle disk; taped subjects improved 2 weeks earlier, perhaps due to increased afferent input.
Osborne et al (2001)77	‘‘The effect of ankle disk training on muscle reaction time in subjects with a history of ankle sprain’’	Balance training Ankle-disk training X 15 min/d for 8 week, injured side only	Ankle-disk training (8 wk) decreased anterior tibialis muscle latency in both trained and untrained extremities, suggesting a proprioceptive crossover effect.
Rozzi S. et al (1999)49	Balance Training for Persons with Functionally Unstable Ankles	Subjects in both groups participated in a 4-week, 3days-per-week single-leg balance training program on the Biodex Stability System. Balance training protocol used is given in Table 2.	Significant improvement from pre-test scores to post-test scores.

Methodology

Study design: comparative study

Sample size: 30

Sampling method: convenient sampling

Source of data collection: Rajiv Gandhi Stadium Rohtak

Sampling Criteria

Inclusion Criteria

1. Subjects with history of minimum of two inversion ankle sprain to unilateral ankle in past 1 year out of which one episode required protected weight bearing and/or mobilization.
2. Subjects with subjective feeling of “giving way” during sports activity.
3. subjects who were pain free at the time of study.
4. Subjects with age 18-30 years.

Exclusion Criteria

1. Subjects with history of cerebral concussion, vestibular disorder and lower extremity injuries for 3 months before study.
2. Subjects with history of ear infection, upper respiratory tract infection at the time of study.
3. Subjects with history of fracture in either of the lower extremity.
4. Subject with history of ligament laxity in knee or hip

Variables:

Independent variable: balance training exercises

Dependent variables: Balance

Instruments used:

1. Stop watch
2. Measuring tape
3. 3 inches wide adhesive tape
4. Protractor
5. Ball
6. Air squabs
7. OHP marker
8. Theraband (Red)

Material used in study- air squab (blue), ball (orange) & theraband (red)

Protocol: 30 subjects were included in the study after approval from the ethical committee. Pre-training assessment was done. One group performed the balance training on land while other group performed their training in water. Post-training assessment was done at the end of 2nd week & 4th week.

Procedure:

Star Excursion Balance Test (Pre test):

Initially a verbal and visual demonstration of the testing procedure was given to each subject. they took 6 practice trials in each direction for each leg were given to become familiarize with the task. To minimize learning effect subjects were asked to randomly select 3 chits with different directions mentioned in it to determine the starting excursion direction, right/left leg and clockwise/ counterclockwise directions. To perform the SEBT, the subject maintained a single leg stance on injured leg/uninjured leg and with contralateral leg reach as far as possible. The subject was asked to lightly touch the furthermost point on the line with the most distal part of the reach foot in any way possible to achieve maximum reach distance without moving the support foot. Then return reaching leg back to starting position (for at least 10 seconds) without allowing contact to affect the base of support. The reaches were performed in either clockwise directions or counterclockwise directions. The same procedure was performed with the other leg after rest of 30 minutes in all the 8 directions while standing at the center of the grid. The examiner then manually measured the distance from center of the grid to the touch point with tape measure in centimeters.

Balance training protocol:

The following balance training was performed in both the groups:

- Group 1- performed the below mentioned set of exercises in water.
- Group 2- performed the below mentioned set of exercises on land.

It was performed after 15 minutes of the performance of OLST. Each training session lasted for around for 20-30 minutes. Initially a verbal and visual demonstration of the exercises was given to each subject

Exercise protocol that was used is as follows:

(A) Following exercises were performed 3 times each:

1. Walking backwards 11m
2. Tandem walking 11m
3. Walking on toes 11m
4. Walking on heels 11m

(B) Following exercises were performed 15 times each:

1. Toe raises/heel raises (for both the legs).
2. Shallow knee bends
3. Standing on injured/uninjured leg and catching and throwing the ball.
4. Theraband exercises (hip flexion/extension, hip abduction/adduction) while standing on single leg (for both the legs).

(C) Standing on air squab for 5 minutes and tries and maintains balance.

Frequency of Training:

The training was carried for 3 sessions a week for a period of 4 weeks.

Data Analysis

Data was analyzed using statistical tests, which were performed using SPSS version 28 with excel 2019. Demographic data of patients including age, height, and body mass index, involved and dominant leg were descriptively summarized to project the results. The dependent variables for statistical analysis were analyzed using parametric tests like 2 X 3 ANOVA and independent t-test/paired t-test.

Result

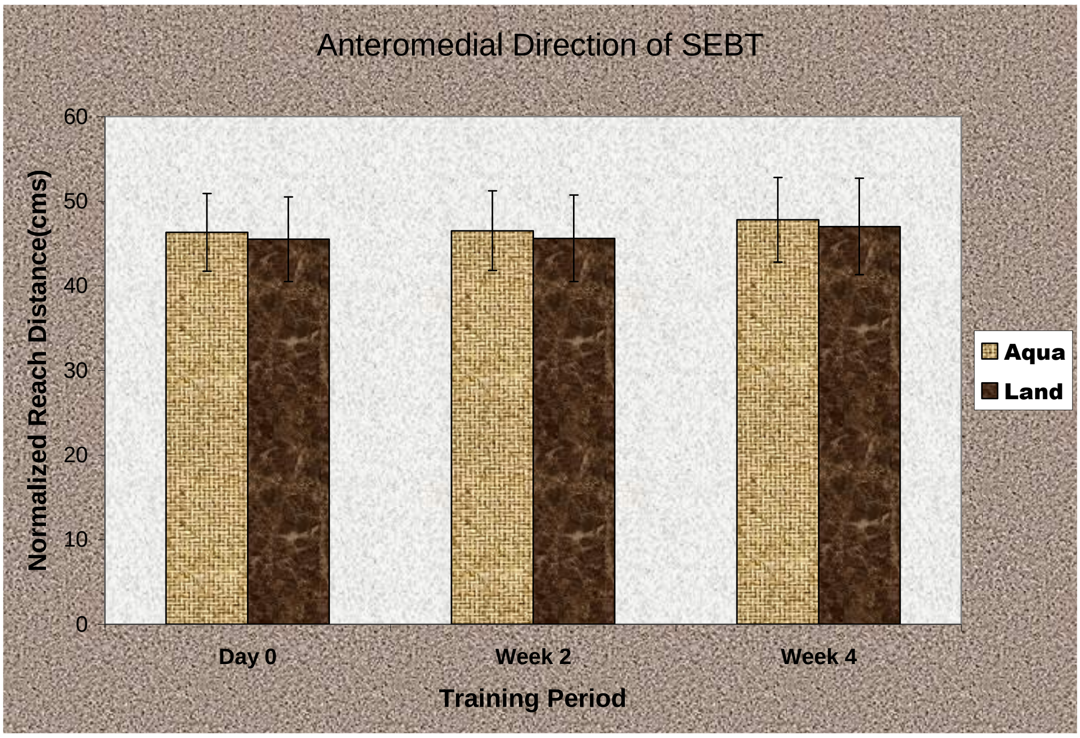
Table 5.1 Baseline Characteristics

Variable	Group 1 N=15 M±SD	Group 2 N=15 M±SD	t value	p value
Age(in years)	25.1±3.0	23.7±2.4	1.418	0.167
Height(in cms)	175.4±8.4	176.9±5.4	-0.575	0.570
Weight(in Kgs)	70.7±2.4	71.4+3.0	-0.683	0.500
BMI(Kg/m^2)	22.8±2.0	22.9±1.3	-0.040	0.961
AI0	44.8 ± 4.3	43.6 ± 4.9	0.736	0.468
AMI0	46.3 ± 4.6	45.5 ± 5.0	0.438	0.665
MI0	50.2 ± 4.9	47.5 ± 4.7	1.562	0.129
PMI0	54.1 ± 4.4	51.7 ± 4.9	1.403	0.171
PI0	53.3 ± 4.4	51.3 ± 5.5	1.068	0.295
PLI0	49.1 ± 3.7	48.8 ± 3.7	0.262	0.795
LI0	33.7 ± 2.7	31.9 ± 3.3	1.602	0.120
ALI0	37.5 ± 3.0	35.8 ± 3.3	1.522	0.139
TRI0	369.0 ± 27.1	356.1 ± 27.7	1.295	0.206
OLSTI0	12.4 ± 5.2	14.0 ± 5.1	-0.857	0.399

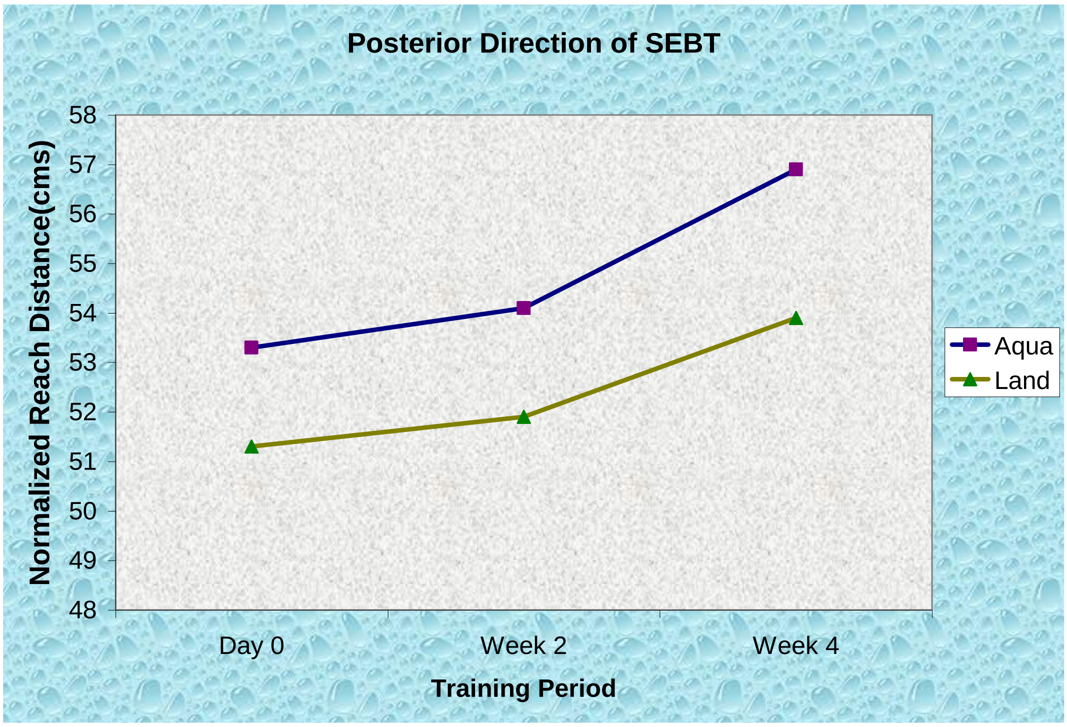
Table 5.2 Nominal Data

Variable	Group 1(Water Training)	Group 2(Land Training)
Right dominant injured	11	10
Left dominant injured	3	2
Right nondominant injured	Nil	nil
Left nondominant injured	1	3

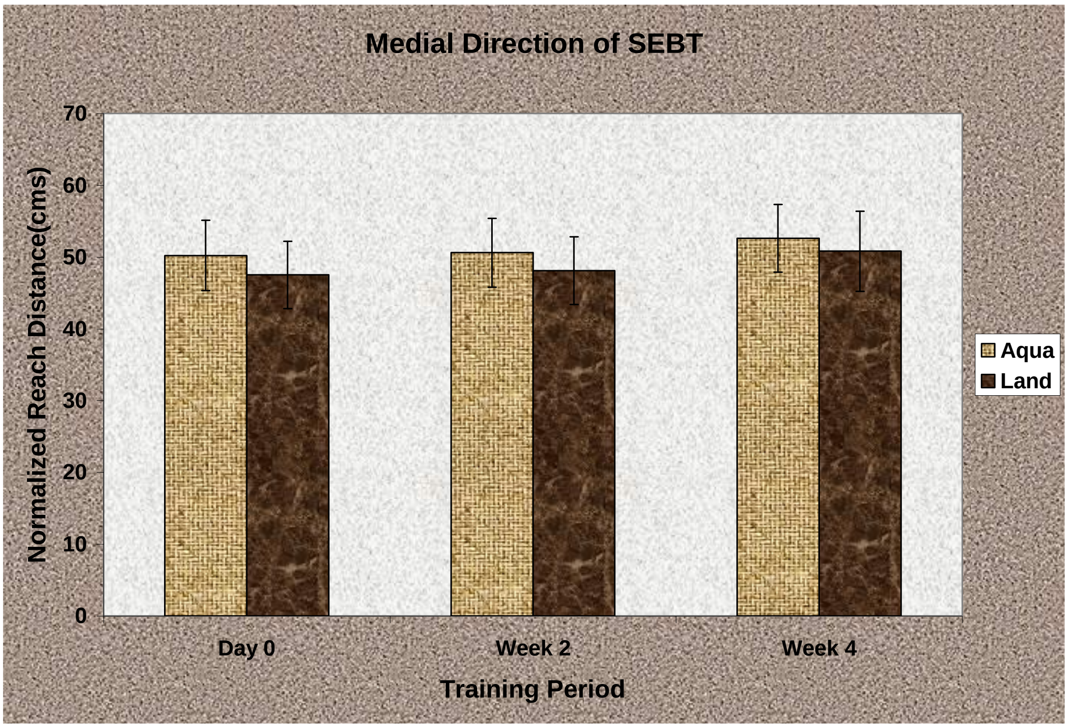
Variable	Group 1 (Water Training) Mean ± SD	Group 2 (Land Training) Mean ± SD
AI4	45.8±4.0	43.4 ± 4.1
AMI4	47.8 ± 5.0	47.0 ± 5.7
MI4	52.6 ± 4.7	50.8 ± 5.6
PMI4	58.6 ± 4.3	54.3 ± 5.5
PI4	56.9 ± 4.0	53.9 ± 5.8
PLI4	50.5 ± 4.2	49.4 ± 4.4
LI4	34.2 ± 2.8	33.0 ± 3.5
ALI4	38.2 ± 3.0	37.8 ± 3.5
TRI4	384.6 ± 25.8	369.5 ± 29.3
OLSTI4	22.7 ± 6.6	26.8 ± 4.3



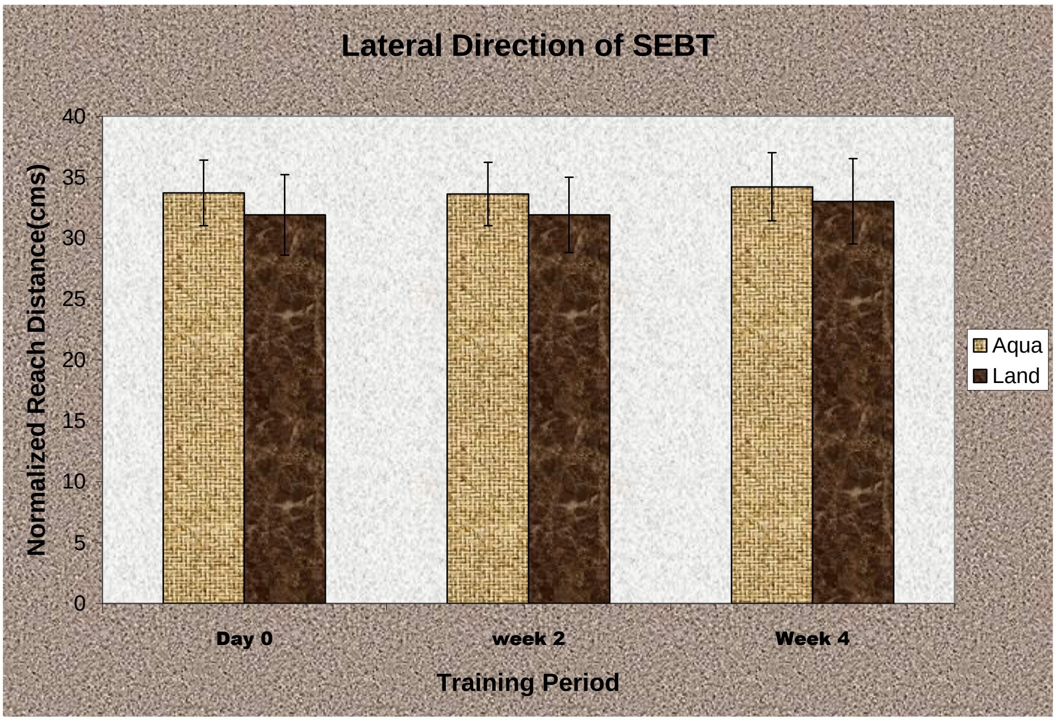
Comparison of Normalized Reach Distance (Anteromedial Direction of SEBT) of 2 groups from day 0 to week 4.



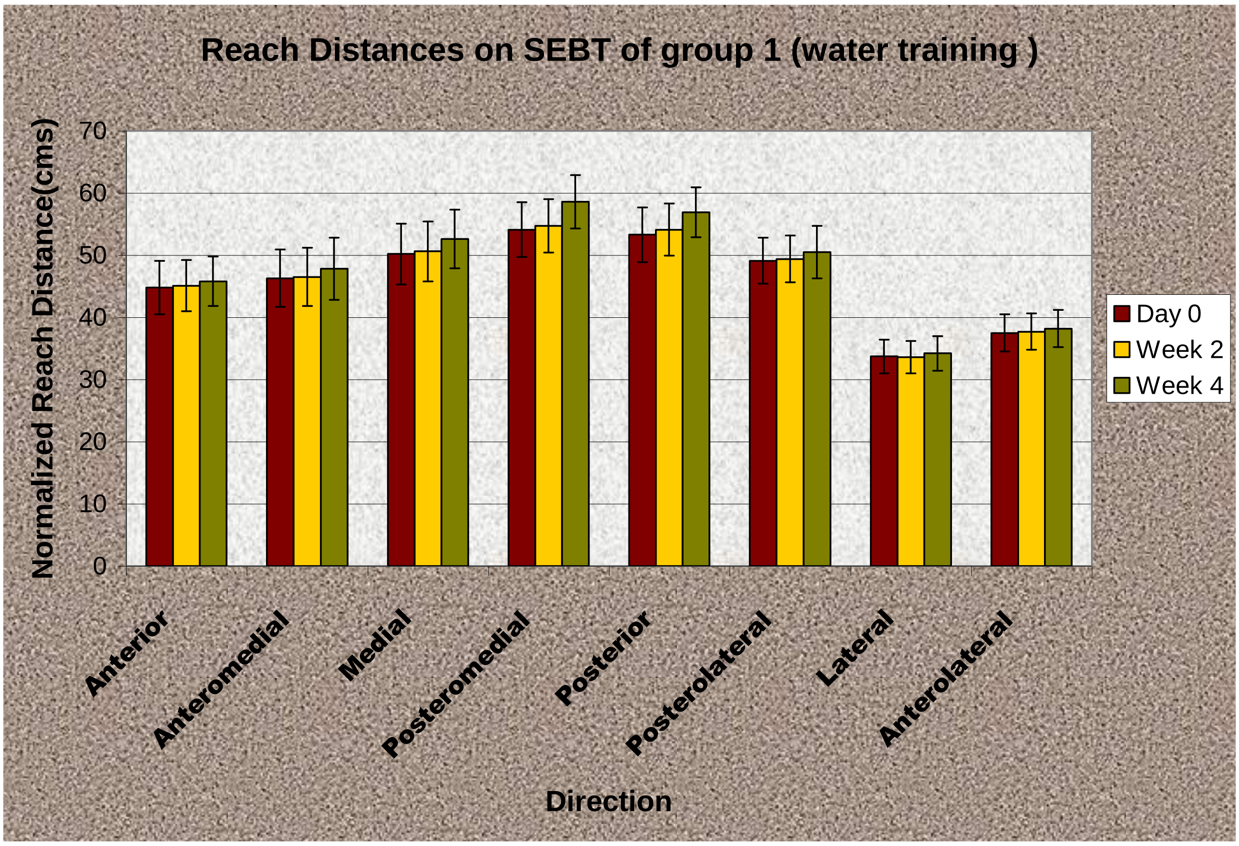
Comparison of Normalized Reach Distance (Posterior Direction of SEBT) of 2 groups from day 0 to week 4



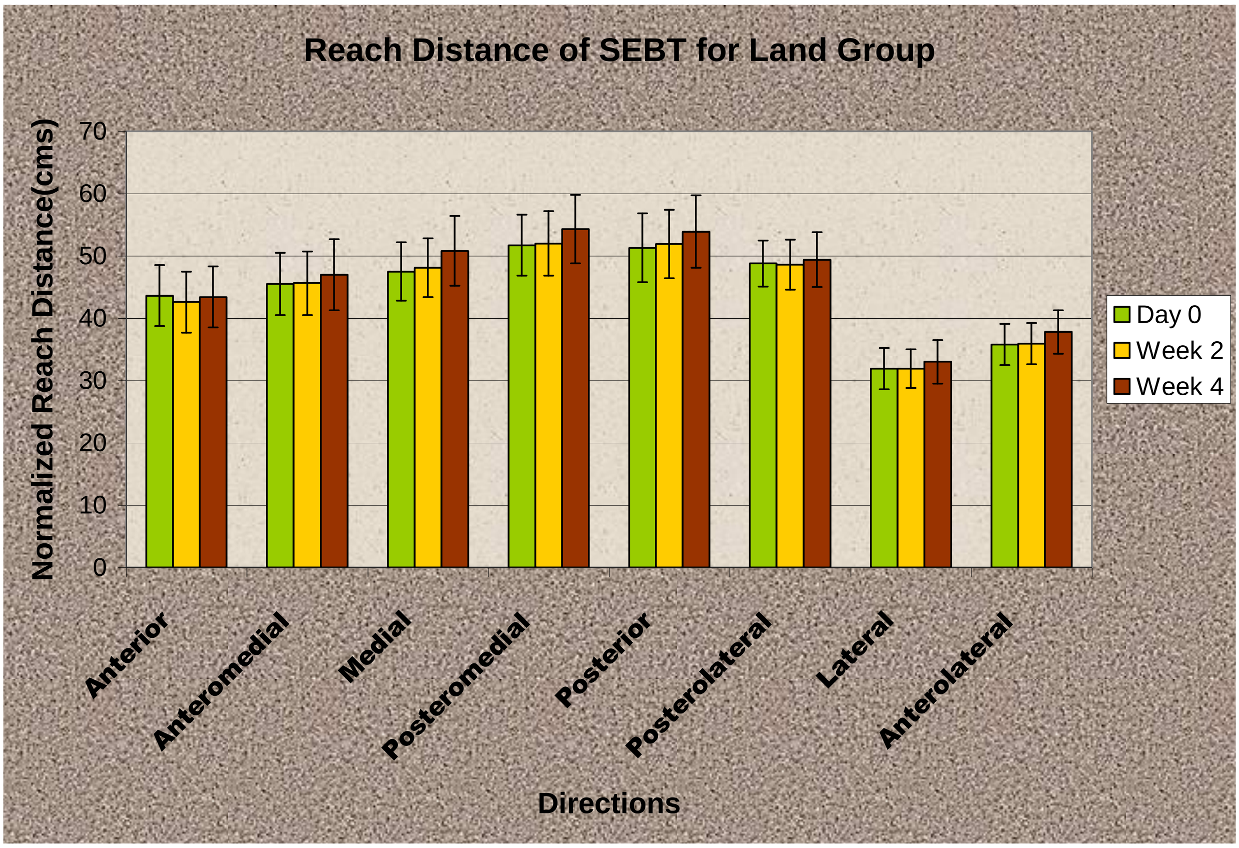
Comparison of Normalized Reach Distance (Medial Direction of SEBT) of 2 groups from day 0 to week 4 .



Comparison of Normalized Reach Distance (Lateral Direction of SEBT) of 2 groups from day 0 to week 4.



Comparison of means of group1 (water training) among all the 8 directions from day 0 to week 4.



Comparison of means of group 2 (land training) among all the 8 directions from day 0 to week 4.

Discussion

The results of this study demonstrate that regardless of training medium (water versus land); significant improvements in balance were achieved by both the groups.

Weight bearing exercises will stimulate joint mechanoreceptors leading to improved proprioceptive inputs. The above explained phenomenon can be related to the reasons of improvement in both the groups from day 0 to week 4.

The main findings of this study were in somewhat accordance with work done by Peter Douris et. al[87] and case study by A.G. Beneka and P.C. Malliou. [93] Peter Douris et.al[87] concluded that regardless of treatment medium significant improvements were evidenced on Berg Balance Scale between pretest and posttest. The utilization of lower body exercises, whether on land or in water, was accompanied by improved balance.

Limitations

- Larger sample size would have brought in more clarity in observed trends.
- Results cannot be generalized to female population.

Future Scope

- Generalisabilty of the results should be increased by carrying the study on female subjects.
- Studies should be carried on a larger sample size.
- Studies should be carried for longer durations (8 to 12 weeks), to make the picture of results more clear.

Conclusion

The primary purpose of this study was to determine whether training medium (water versus land) has an effect when training balance for functional ankle instability. The overall results of the study show that both the mediums of training are equally effective when training balance for functional ankle instability. The results are summarized as:

- There was marginally better improvement in dynamic balance when training in water as compared to land training as assessed on anterior, posteromedial, posterior and anterolateral direction of Star Excursion Balance test.
- However, there were no differences in improvement in dynamic balance whether training in water or on land as assessed on anteromedial, medial, posterolateral and lateral direction of Star Excursion Balance test.
- There was no difference in improvement pattern for static balance whether training in water or on land as assessed on One Leg Stance Test.
- However both the groups improved significantly from day 0 to week 4.
- Overall water proved to be an effective medium when training dynamic balance in subjects with functional ankle instability in our study.
- Though statistically nonsignificant but water group registered better improvement from day 0 to week 2, so it can be used as a training medium for early rehabilitative phase.

References

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