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Expert Opinion Article

Comprative Study Between Two Rehabilitation Methods (Hydrotherapy & Landbased) Of Acute And Chronic Ankle Sprain Injury Of Amateur Cricketers

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Abstract

The main aim of study is to investigate the comparison between rehabilitation procedures, Aquatherapy & landbased exercises protocol A tota1of 143 amateur cricketers of age, 16-36 years armature creekers which belong to the 4 cities of Punjab (Lahore, Sialkot, Gujranwala & Faisalabad) selected by Cumberland Ankle Instability tool and executed Star Excursion Balance Test (SEBT) & Single Leg Balance Test (SLB) for baseline measurements. The sample was selected through snowball sampling technique with 40 normal control subjects selected for further comparison as well. Both groups were under 8 weeks exercise plan protocols, pre and post test battery has been executed for initial data. The pre and post exercise of control group values showed significant increase ($p<0.01$) in lateral direction reach and posterior medial direction ($p<0.05$), furthermore, the remaining showed non-significant. The rehabilitation groups showed improvement in distance (cm) and percentage (%), of non-injured and injured legs. The improvement percentage of hydrotherapy is less than landbased rehab plan which showed significant improvement of non injured and injured leg (closed & open eyes) in seconds through SLB test. The comparative analysis showed that the hydrotherapy rehabilitation is more valuable for mobilization (injury). The landbased exercises rehabilitation beneficial in power of respective trauma. The position sense enhanced of both the rehabilitation protocols execution. Shapiro-Wilk test is used for normality. The result concluded that aqua rehab has more efficient in range of motion (ROM) while strength showed better in landbased exercise rehab plan. The landbase training showed best results in recurrence of trauma (12.5%) than Aqua (15%) while control group showed 18% recurrence rate.

Keywords: Aquatherapy, Star Excursion Balance Test (SEBT), Single Leg Balance Test (SLB) and Recurrence.

INTRODUCTION

Overstretching of ligaments is an ordinary musculoskeletal trauma in sports and normal lifestyle persons. The overstretching ankle ligament athletes having great difficulty in mobilization, walking and event in balance the body posture in normal position. Proper rehabilitation program, regain of flexibility, Strength, and implementation of therapatic modalities not only fasten the recovery process but also pause the injury to further extension (Tallet, Gill & Zain, 2018; Gill, Noor & Eqra, 2019; Ali et al., 2021). Usually athletes with this trauma did not take it serious and ignore it, as a result leading to chronic pain, dysfunctions and high risk of recurrence overstretch of ankle ligaments occurred (Doherty et al., 2017). Similarly, ankle chronic instability is that if the overstretching ankle ligaments occur in the ligaments again or the ankle joint twisted another time (Delahunt et al., 2010; Sausa, Laite, Costa & Sentos, 2017). The Schiftan et al. (2015) research concluded that re-injury of over stretching of ankle ligaments again and again and treated not properly, ankle sprain might lead to chronic ankle instability, proper execution & implementation of isometric and isotonic exercises get rid from this trauma (Sausa, Laite, Costa & Sentos, 2017). The combination of both Hydro and landbased therapy exercises produces the best results of trauma and also help in reduction of ankle sprain injury for some extent. Proper stretching

(dynamic & static) plan on regular basis also develop range of motion (ROM) which decrease the chances of reinjry (Tallet, Gill & Arshad, 2018; Gill, Noor & Iqra, 2019; Gill, Bilal & Maqsood, 2023) but still external factors are always played major contributions in re trauma (e.g. surface, temperature and shoes) (Gill et al., 2022; Gill, Ayub & Qazi., 2023). The process of rehabilitation procedure has great importance in sports era and "Come Back To Play" has enormous significance (Wade, 2020), which not only reinstate athletes but risk free activity for the betterment of sports and players as well (Wade, 2020; Gill et al., 2023). The athletes executed diverse conservative methods to prevent from injuries, if they had not properly rehabilitate after acute and chronic trauma, elite athletes stop or leave the sports and major cause is overstretching of ligaments, syndrome and frequent injuries (Gill, Ayub & Qazi. 2023).

OBJECTIVE

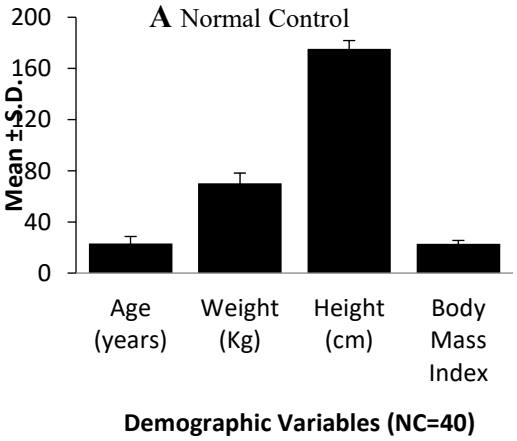
- ✓ To ensure between two methods (Aqua & Landbased) rehabilitation that which procedure produces best results..
- ✓ To check which protocol is measured and effective for long time.
- ✓ To check the recurrence rate of both rehabilitation methods.

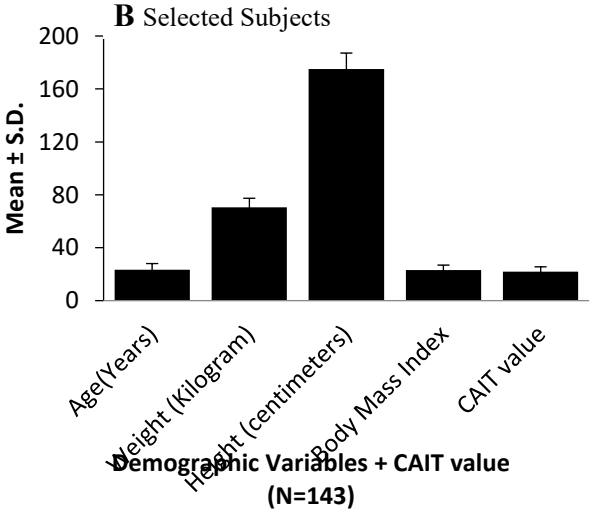
HYPOTHESIS

- ✓ The study hypothesized between Aqua and landbased rehab procedure which is more effective in rehabilitation of over stretching of ankle ligaments among cricket players and less recurrence rate.

METHODOLOGY

This experimental research comprised study having 143 selected subjects through CAIT. The cross sectional study with age limit is (16-36, years) with confirmed acute and chronic over stretching of ligaments passed through the R.I.C.E procedure to dispose of early soreness & pain (if required). The research utilized the snowball sampling technique and information gathered as of 4 main cities of Punjab having appropriate cricket conveniences. The cross sectional study also contain demographic variables and CAIT used for the identifying the athletes for injury grades. Selected participants dispersed into three major groups (a) Normal group (n=40), Control group (n=49) and Intervention groups n=94 (Aqua and Landbased) respectively. The study utilized Star Excursion Balance Test (SEBT) & Single Leg Balance Test (SLB) for data collection and comparison. The test calculated average of 3 measurements from every subject to get the best value as were calculated by other researchers (Gribble et al., 2012; Cain et al., 2020). The aqua and landbased training executed in Punjab University ground & swimming pool along with respective cities, clubs, gymnasiums & swimming pool. The normalization process was adopted through dividing by respective height and distance researched by the subjects (Gribble & Hertel, 2003) and checked through





SPSS-26 with Shapiro-Wilk test, confirmed it as normally distributed. The athletes were given 6 tests as recommended by Gribble and Hertel (2004). The test executed with the help of star grid on a flat surface. The framework was sketch out through protactor, type and measuring scale with 8 outlines noticed out from the center at 45° and the 8 direction names as according to the reach distance from the standing leg direction (Anterior, Anterolateral, Lateral, Posterolateral, Posterior, Posteromedial, Medial, Anteromedial) of non-injured and injured legs as shown in Figure 2. In the post-test protolcols 8, 9 and 6 subjects were absent due to their personal problem of control injured, Aqua and landbased groups. The grid finally consist a square of 182.9cm x 182.9cm. The SLB tested by standing near a support and time has been noted in seconds. The test was redundant if the athlete did not stabilize his weight in performing the test and both test performed 3 times with average of three values calculated to avoid any discrepancies (Gribble et al., 2012). The following Figure 1A & Figure 1B showed demographic variables of all subjects.

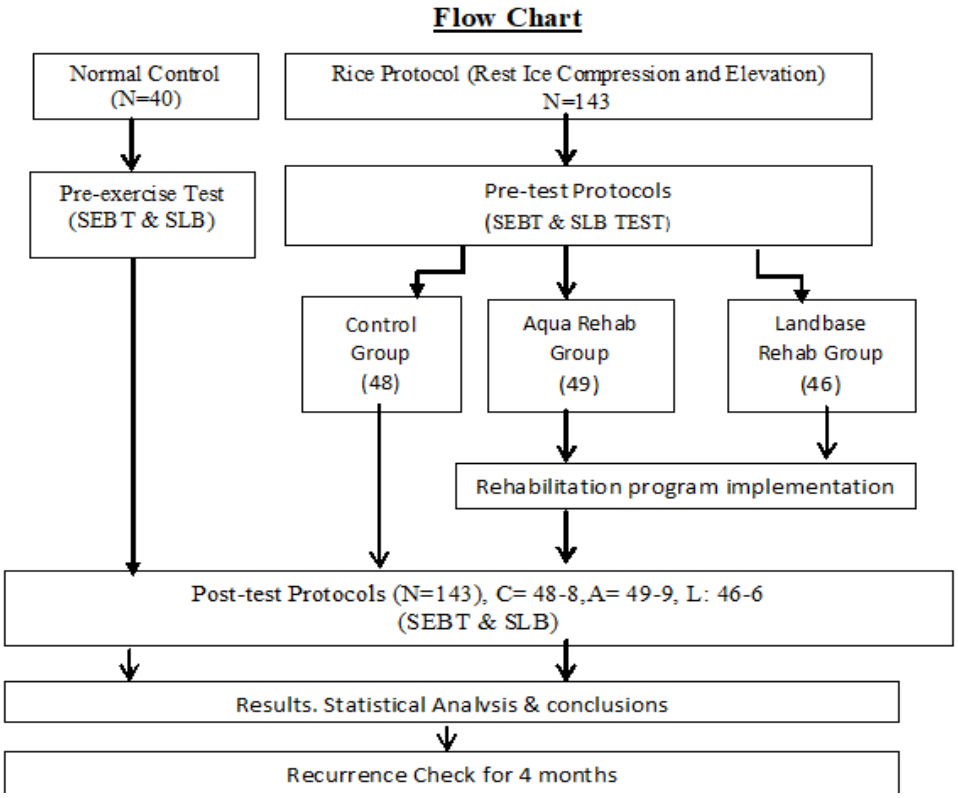


Figure 1. Shows Mean ± S.D. values of demographic variable of 183 subjects divided into Normal, Control and intervention group which represented it separately as shown in Figure 1. A and B. The activity flow chart of this cross sectional study is shown in the following chart.

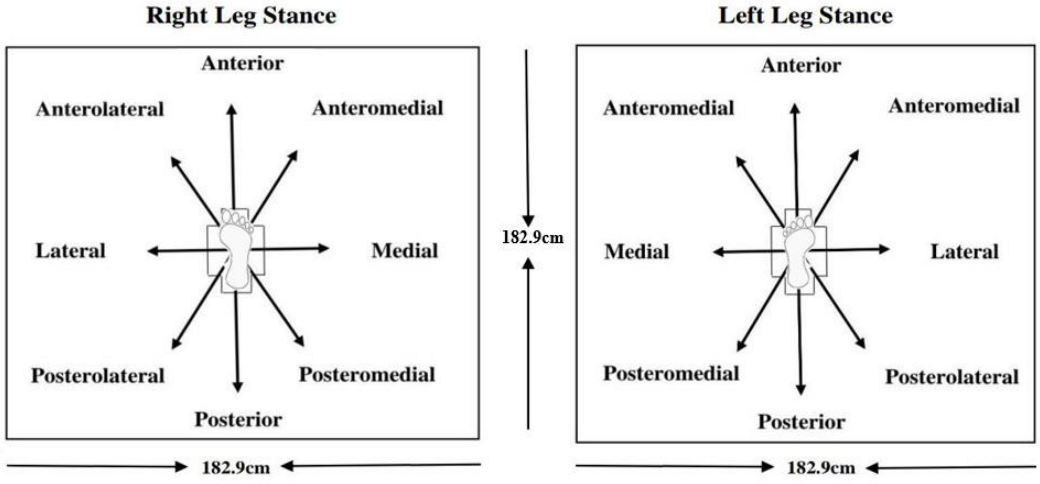


Figure.3. Showing all directions of Star Excursion Balance Test of Right/Left Legs.

The protocol was executed on control and intervention groups. Suitable rest has been taken to execute next test. The recovery session were also executed after test procedure. The test was discarded as the athlete did not perform according to the protocols. The SEBT grid has been shown in following Figure 3.

Star Excursion Balance Test

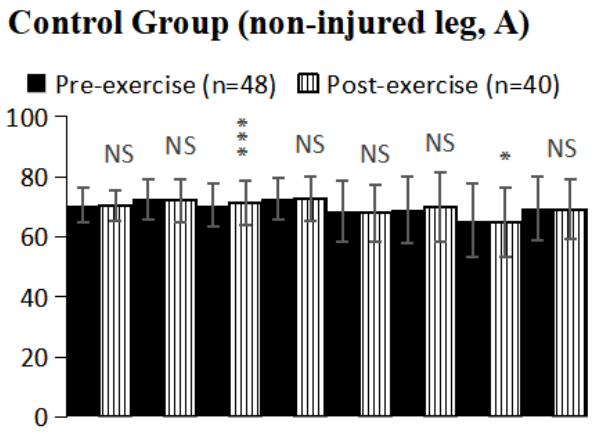
The control group participants did not do any sort of exercise and their pre and post exercise test of all directions were observed. The collected data was analyzed by paired sample t-test and found statistically significant for lateral ($p<0.001$) and medial and posterior medial ($p<0.05$), other directions values were found non-significant for remaining directions.

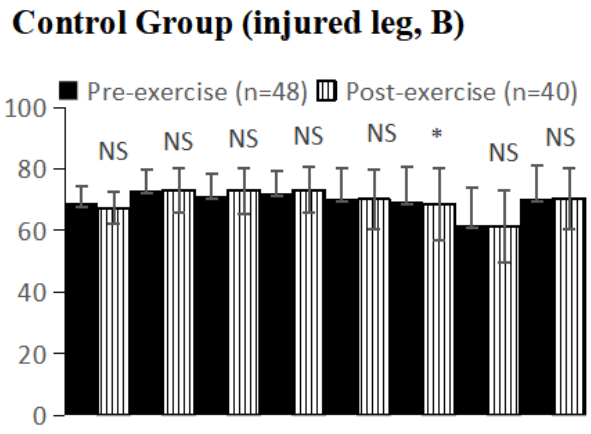
Table 1. Shows post-exercise values (cm) of 80 subjects in 8 directions evaluated by Star Excursion Balance Test (SEBT) of Aqua rehab group and Landbased rehab group, (non-injured and injured legs).

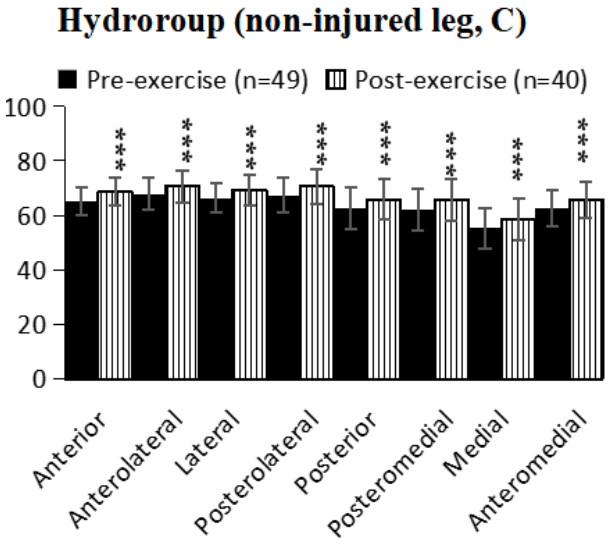
Star Excursion Balance Test (SEBT), Mean ± S.D.					
Directions (cm)	Control Injured (I) Non injured & Injured	Aqua Rehab Group		Landbased Rehab Group	
		(non-injured leg, II)	(injured leg, III)	(non-injured leg, IV)	(injured leg, V)
	Pre Post Diffp-value 40 40 (%) t-value	Pre Post Diff p-value 49 40 (%) t-value	Pre Post Diff p-value 49 40 (%) t-value	Pre Post Diff p-value 46 40 (%) t-value	Pre Post Diff p-value 46 40 (%) t-value
Anterior	67.2 67.4 NS ± ± 0.2 p = 0.4 6.1 6.2 (0.3) t = -1	65.4 68.6 *** ± ± 3.2 p = 0.001 5.1 5.1 (4.9) t = -13.9	67.7 70.6 *** ± ± 2.9 p = 0.001 5.1 5.4 (4.3) t =- 4.8	66.3 71.0 *** ± ± 4.7 p = 0.001 5.8 5.8 (7.1) t = -33.3	66.9 71.4 *** ± ± 4.5 p = 0.001 5.1 4.8 (6.8) t = -4.2
Antero-lateral	72.2 72.2 NS ± ± 0 p = 1 8.1 8.4 (0.0) t = 0.0	67.8 70.7 *** ± ± 2.9 p = 0.001 5.8 5.8 (4.3) t = -9.6	72.4 74.9 *** ± ± 2.6 p = 0.001 5.2 5.0 (3.5) t = -9.7	70.3 75.1 *** ± ± 4.8 p = 0.001 8.0 7.9 (6.8) t = -31.1	69.1 73.5 *** ± ± 4.4 p = 0.001 5.8 5.7 (6.3) t = -4.1
Lateral	71.5 71.1 * ± ± -0.4 p = 0.05 6.2 6.2 (0.6) t = 2.10	66.3 69.3 *** ± ± 3.0 p = 0.001 5.3 5.6 (4.5) t = -12.9	70.8 72.1 *** ± ± 1.3 p = 0.001 5.1 5.1 (1.8) t =-8.0	69.2 74.1 *** ± ± 4.8 p = 0.001 6.5 6.2 (7) t = -17.6	67.4 72.9 *** ± ± 5.5 p = 0.001 6.1 6.1 (8.2) t = -4.5
Poster-lateral	72.3 72.3 NS ± ± 0 p = 0.85 7.6 7.5 (0.0) t = 0.20	67.4 70.6 *** ± ± 3.2 p = 0.001 6.5 6.5 (4.7) t = -11.6	71.5 73.6 *** ± ± 2.1 p = 0.001 5.9 6.0 (3.0) t = -6.1	70 74.6 *** ± ± 4.6 p = 0.001 7.6 7.5 (6.5) t = -21.8	68.5 73.3 *** ± ± 4.8 p = 0.001 6.2 6.2 (7.0) t = -3.9
Posterior	66.5 67.3 NS ± ± 0.8 p = 0.056 9.5 9.5 (1.2) t= -6.9	62.6 65.9 *** ± ± 3.3 p = 0.001 7.6 7.6 (5.3) t = -14.9	65.9 68.1 *** ± ± 2.2 p = 0.001 6.5 7.1 (3.3) t = -8.7	65.3 69 *** ± ± 3.7 p = 0.001 8.6 8.3 (5.7) t = -34.7	64.0 68.8 *** ± ± 4.8 p = 0.001 6.7 6.8 (7.5) t = -3.5
Postero Medial	68.4 69.2 *** ± ± 0.8 p = 0.001 9.8 9.8 (1.2) t = -4	62.2 65.7 *** ± ± 3.5 p = 0.001 7.6 7.5 (5.6) t = -10.2	64.9 67.2 *** ± ± 2.3 p = 0.001 7.3 7.2 (3.5) t = -17.1	64 68 *** ± ± 4 p = 0.001 7.8 7.5 (6.3) t = -24.3	63.0 68.2 *** ± ± 5.2 p = 0.001 7.7 7.7 (8.3) t = -3.5
Medial	60.7 61.3 NS ± ± 0.6 p = 0.234 9.7 9.4 (0.9) t = -4	55.3 58.5 *** ± ± 3.2 p = 0.001 6.8 6.6 (5.8) t = -14.5	65.4 68.6 *** ± ± 3.2 p = 0.001 6.4 6.4 (4.9) t = -7.5	56.6 60.5 *** ± ± 3.9 p = 0.001 8.3 8.2 (6.9) t = -19.7	56.6 62 *** ± ± 5.4 p = 0.001 4 3.6 (9.6) t = -7.5
Antero Medial	67.2 67.4 NS ± ± 0.2 p = 0.7 9.2 8.6 (0.3) t = -1.8	62.7 65.8 *** ± ± 3.1 p = 0.001 5.2 5.3 (5.0) t = -19.9	64.5 66.9 *** ± ± 2.4 p = 0.001 4.6 4.6 (3.7) t = -7.4	63.3 67.3 *** ± ± 4 p = 0.001 6.4 6.2 (6.3) t = -15.9	64.4 68.8 *** ± ± 4.4 p = 0.001 4.5 4.2 (6.8) t = -4.7

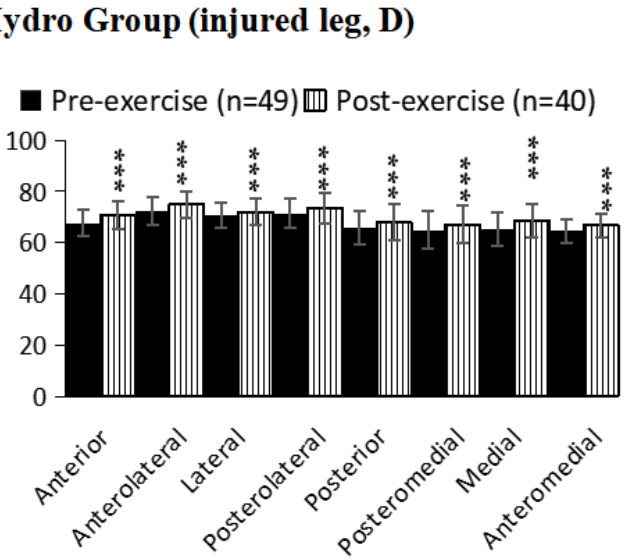
The data utilized paired sample t-test for further comparison among Control, Aqua and landbased rehab group.

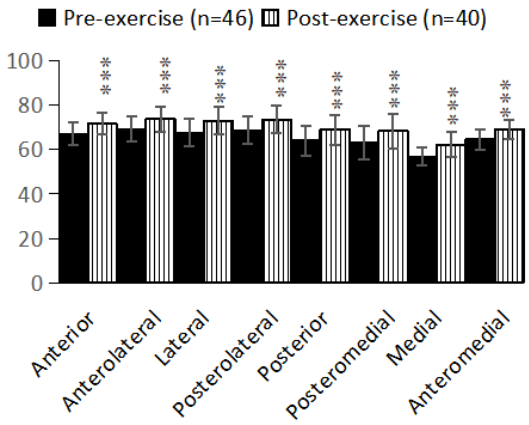
Test (Start Excursion Balance Test)

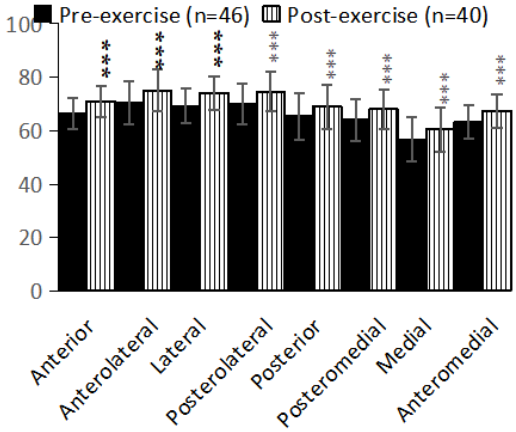












Landbased Group (non-injured leg, E) Directions (cm)

Landbased Group (injured leg, F) Directions (cm)

Figure 4: Shows the values of pre and post test of SEBT, significant and non significant data of Control injured and intervention groups (Hydro and landbased) rehab group in all directions.

Test (Single Leg Balance Test)

Single Leg Balance Test (SLB), Mean ± S.D.						
Positions (seconds)	Control Injured (I)	Aqual Injured Group (non-injured leg, II)	Aqual Injured Group (injured leg, III)	Landbased Rehab Group (non-injured leg, IV)	Landbased Rehab Group (injured leg, V)	
	Pre Post Diff p-value 40 40 (%) t-value	Pre Post Diff p-value 49 40 (%) t-value	Pre Post Diff p-value 49 40 (%) t-value	Pre Post Diff p-value 46 40 (%) t-value	Pre Post Diff p-value 46 40 (%) t-value	
Close eye	21.3 22.3 * ± ± 1 p = 0.4 1.1 1 (4.7) t = -1	32 34.3 *** ± ± 2.3 p = 0.001 2.2 1.5 (7.2) t = -8.9	35.5 36.7 *** ± ± 1.2 p = 0.001 1.5 1.5 (3.4) t = -18.1	20.7 30 *** ± ± 9.3 p = 0.001 2.3 2.1 (44.9) t = -20	28.6 32.2 *** ± ± 3.6 p = 0.001 1.4 2.1 (12.7) t = -7.6	
Open eye	41.7 42.7 ** ± ± 1 p = 0.04 1.3 1.6 (2.4) t = -2.4	17.3 24.1 *** ± ± 6.8 p = 0.001 3.4 4.1 (39) t = -8.4	25.2 31.3 *** ± ± 6.1 p = 0.001 3.0 2.9 (24.3) t = -12.9	16.6 29.1 *** ± ± 12.6 p = 0.001 2.7 2.7 (75.3) t = -21	20.7 31.4 *** ± ± 10.7 p = 0.001 5 1.9 (51.6) t = -13.1	

Table 2: Showed SLB test (pre and post-exercise values) of both positions of all the groups. The data presented in Mean ± S.D. along with their difference values of selected athletes.

Pre and post exercise test results of Normal Control Group (n=40), Control group and Rehab group were showed values significant or non-significant which has been shown in Table 2 and Figure 5 respectively along with their values.

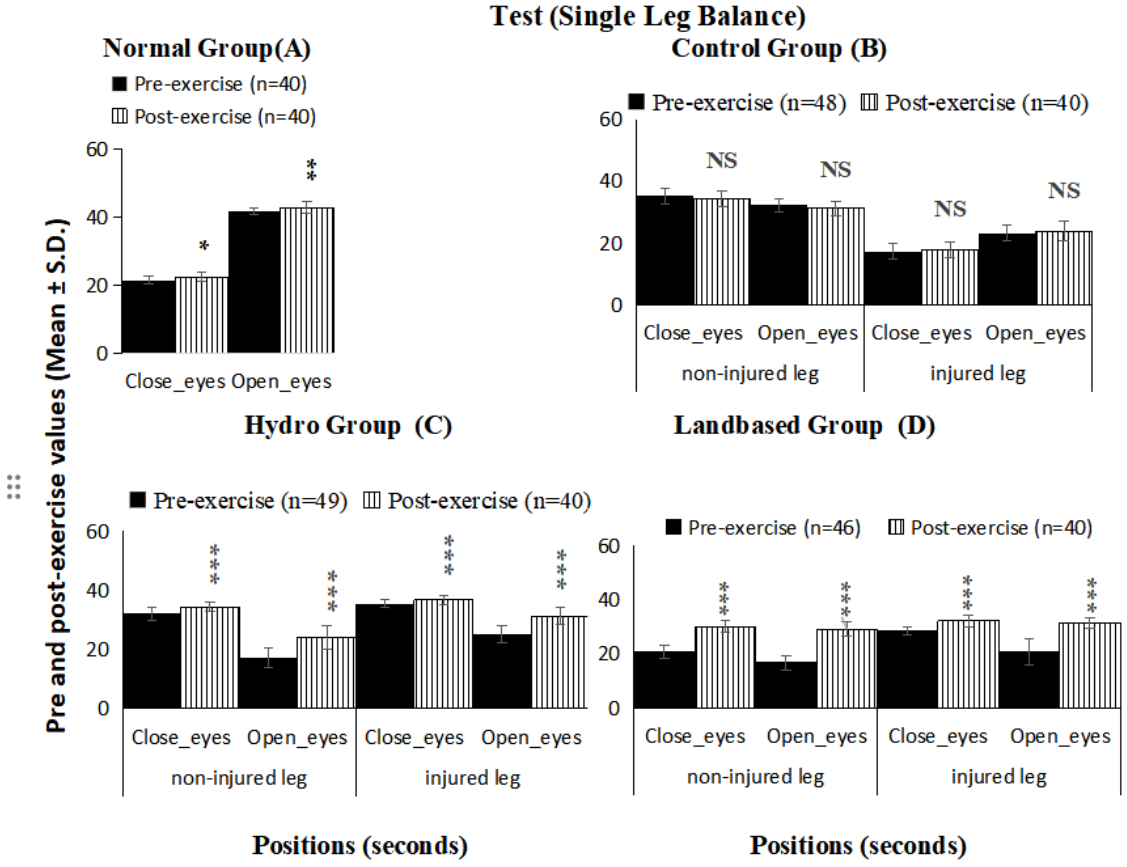


Figure 5: Shows values of two positions balance with (closed and open eyes) of Single Leg Balance Test of subjects in Normal Control (A) Control Injured (B), Aqua Rehab (C) & landbased Group (D). The subjects were selected from four major cities of Punjab from December 2016 to December 2018.

Group comparison of Ankle Sprain by (Both Rehab Methods).

120 athletes present in this research activity with post exercise results of Single Balance Test (SLB). Aqua and land based exercises post test showed different results with improvement results and landbased rehab showed 22.2% more improvement.

Analysis of Variance Between Groups (Anova Between groups)

The comparables between 3 groups (control, Aqua & landbased) were calculated through ANOVA and we found that the mean difference between 3 means were not same for groups. The independent comparison between ANOVA of close eyes among 2 exercises methods yielded statistically significant effect at ($p<0.05$), F (2, 117) = 189.5, p = 0.000, n^2 = .78. Similarly, the independent group between ANOVA of open eyes among 2 exercises methods yielded statistically significant effect F (2, 117) = 103.04, p = 0.000, n^2= 0.64. To check the comparison between the groups (Control group, Aqua, and Landbased) conducted multiple comparison test.

Close & Open	Groups	Sum of Squares	Df	Mean Square	F	Significant Value.
Injured leg with close eyes	Between Groups Within Groups Total	4350.05 1342.75 5692.80	2 117 119	2175.03 11.47	189.52	*** 0.000
Injured leg with open eyes	Between Groups Within Groups Total	1163.82 660.78 1824.59	2 117 119	581.91 5.65	103.035	*** 0.000

Table 3. Showing the comparative analysis among injured leg of three groups through Analysis of Variance (ANOVA) and found statistically significant ($p<0.000$) at both positions (close and open eyes), selected from four major cities.

*** Significant ($p<0.001$)

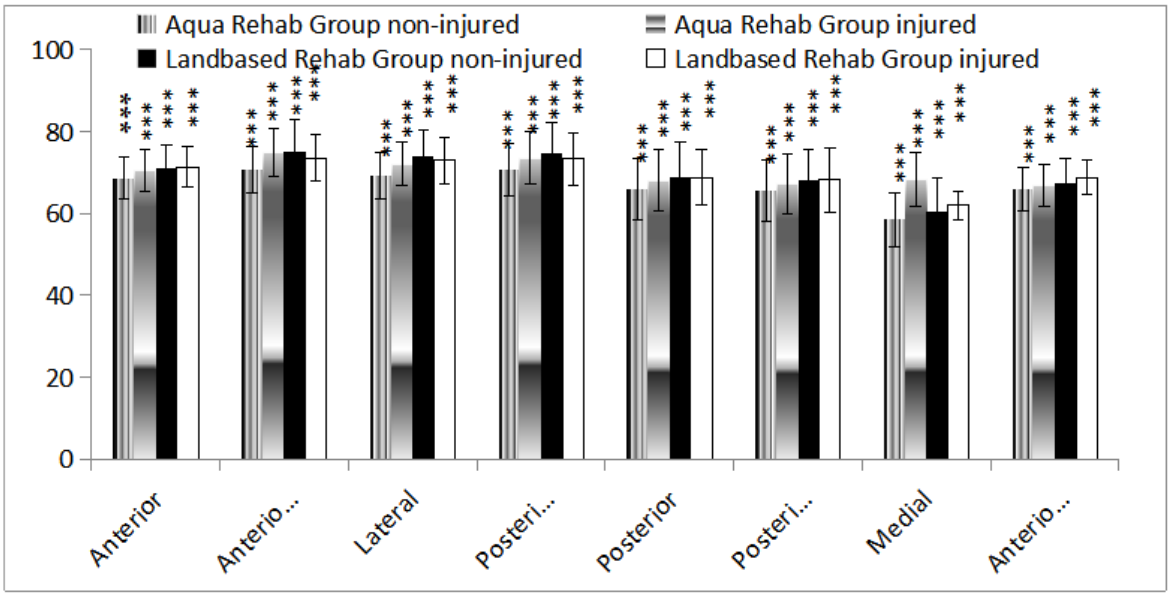


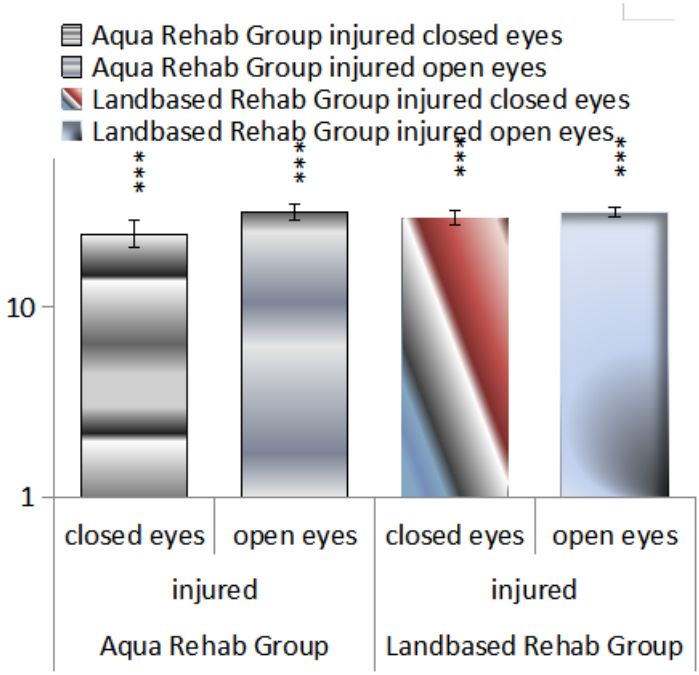
Figure 6. Showing Mean ± S.D. of after-exercise test values (cm) of all the participants of all directions of SEBT (non-injured and injured) groups of Hydro and landbased groups. The data was analyzed through SPSS-26.

Analysis of Variance of Ankle Sprain Exercises Methods SLB (close and open eyes)

The data was associated with the injured leg as it showed through numerical values and as the less mean value of injured leg with close and open eyes was 24.1 and 31.4. Similarly, the land base values were 12.7 and 51.6 respectively.

Table 5 : Showing the post test values of Hydro and landbased (non-injured and injured legs) with closed and open eyes values of athletes with acute and chronic ankle sprain

S. N	Rehab Groups	Post-exercise values of Means ± S.D. SLB (sec) (N=120)		
1	Aqua rehab (n=40)	non-injured	closed eyes	34.3 ± 1.5
			open eyes	24.1 ± 4.1
		Injured	closed eyes	36.7 ± 1.5
			open eyes	31.3 ± 2.9
2	Landbased (N=40)	non-injured	closed eyes	30.0 ± 2.1
			open eyes	29.1 ± 2.1
		Injured	closed eyes	32.2 ± 2.7
			open eyes	31.4 ± 1.9



The above figure 7 showed the Graphical representation of post test values of Single Leg Balance Test protocols after implementation of rehab program,

The above Table 5 and Figures 7 showed the post exercise values of SLB test of both legs with close and open eye positions. The post test values showed significant ($p<0.001$) & its pictorial presentation of the results clearly.

Multiple Comparison

For all three methods (Control group, Aqua, and Landbased) have significant effect on both the variables (close and open eyes) at 1% significance level. To evaluate the nature of the difference between the means further the statistically significant ANOVA was followed up with three Fisher's LSD Post Hoc tests (Hayter, 1986). Additionally, the multiple

comparison was conducted among three methods to check the effects between them, using Fisher's LSD (Least Significant Difference) test. The difference between the Aqua exercises rehab and the Landbased rehab group was statistically significant, t(117)= -6.5, p=0.000, d= -9.5. The effects sized associated with the statistically significant effect are considered large based on Cohan's (1992) guidelines. A visual depiction of the means and 99% confidence interval is presented in Figure 8a (close eyes). Furthermore, the difference between the Aqua exercises rehab and the Headway rehab group was statistically significant, t(117) = -1.1, p = 0.291, d = -0.57. The multiple comparison indicated that the 2 groups had significant difference (p<0.000) between Aqua rehab and landbased. A visual depiction of the means and 99% confidence interval is presented in Figure 8B(open eyes). The result indicated that both the directions of injured leg were statistically significant and on the basis of their mean it can be concluded that the maximum mean valued method was considered to be the best method. Post Hoc test (Fishers LSD) suggested that Landbased (rahab exercise group) effects showed significant difference as compared with other Aqua and control rehab group. Fisher's test suggested that Landbased method has a significant effect of rehabilitation exercises on subjects as compared to other methods (Aqua and control) in both (close and open eyes) positions of Single Leg Balance Test. The following Figure 8a & 8b showed that injured leg comparison of both close and open eyes

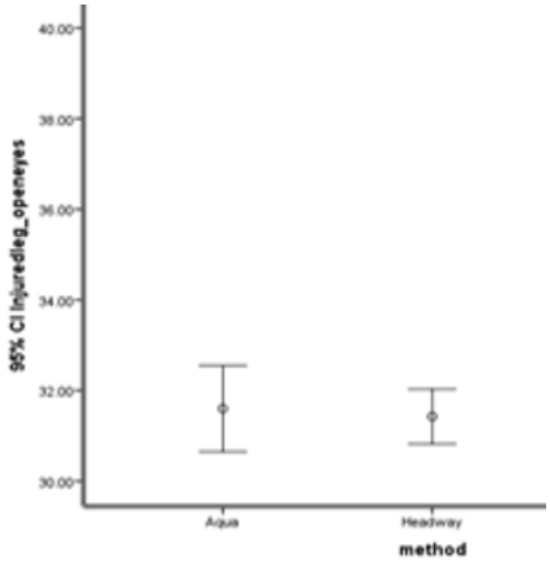


Figure 8A (Non-injured Leg)

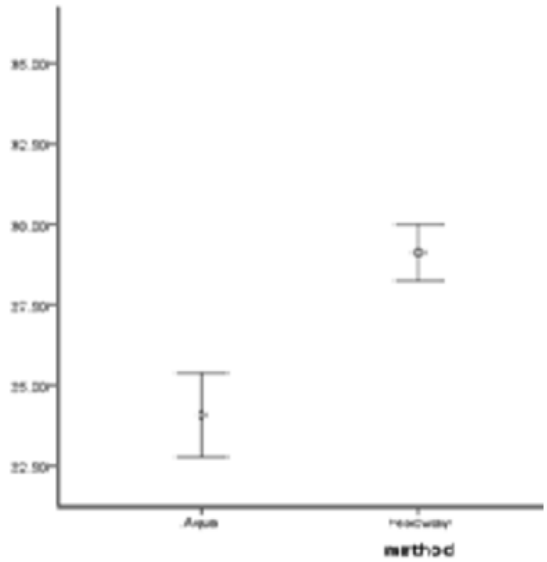


Figure 8B (Injured Leg)

Figure 8A showing the values of Aqua which is slightly better in close eyes while Figure 8B showing improvement in landbased procedure after 8 weeks rehabilitation program implementation of open eyes respectively.

DISCUSSION

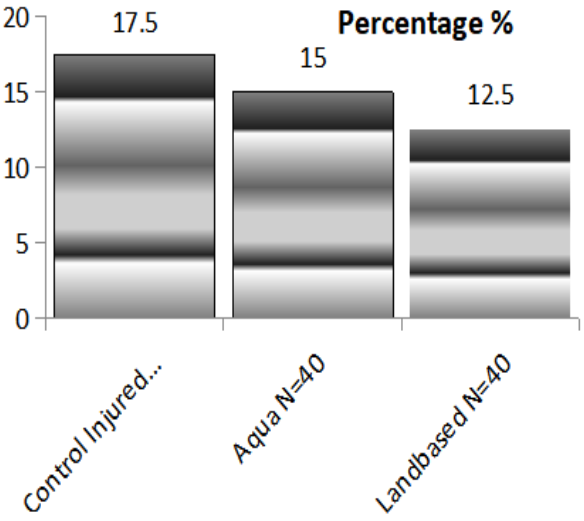
The implementation of two exercises methods showed significant results in their respected groups as pre post values showed significant (p<0.001) differences among them. The study analyzed that hydro exercises are more beneficial as we are considering the Range of motion increase along with strength. The SEBT test showed improvement in the reach directions, balance and proprioception the result are familiar with the Gerber et al., 1998; Gribble et al., 2012 and Doherty et al., 2017 as a vital improvement in proprioception reduces the recurrent rate. Similarly, the range of motion and regain strength cut down the injury risk to some extent. As, surface and unexpected trauma always a threat for an athlete to be-aware of this reinjury of ankle problem. Once you are in this trauma you have a psychological pressure of ankle problems. As compared with the other treatment of ankle sprain with landbased exercises the ROM increases with significant improvement (p<0.0001) the results are familiar with Mascaro & Swanson (1994) & whitehead (2017). Moreover, the SEBT showed improvement in balance strength and proprioception as compared with the hydro group results. the land based exercises improvement force and power in ankle gait muscles

which not only support ankle but also help in balance, stability and re install proprioception, the result compared with (Fong et al., 2007); Andrews Harrelson and Wilk, 2012; Gribblr et al., 2013). The trauma resulted loss of proprioception in ankle & dysfunction sometimes pain failure of motion, in general cut down the blood flow to some extent in usual cases at that point. In the study both the protocols of exercises work effectively and produced efficient results which are similar with (Shifton, Ross & Hahna, 2013; Sausa, Laite, Costa & Sentos, 2017; Whitehead, 2017). The regain proprioception is an indication to have best process of exercises and return to proper functionality as familiar with (Shifton, Ross & Hahna (2013). The result of comparison of both the implemented methods concluded that combination of both the methods resulted in better improvement and also cut down the risk of re trauma. The result was familiar with the (Gill et al., 2022; Gill, Ayub & Qazi. 2023). Similarly the regain ROM and strength also improved chronic and acute problems in balance stability proprioception and strength as well, the hydrostatic and landbased exercises not only help athletes for safe their future sports but also increases the life sprain of athletes participated mobilization sports like running, sprinting and explosive sports activates (Anderson, Harmon, and Rubin (2002).

RECURRENCE

The following Table 6 and Figure 9 showed recurrence subjects of control injured group, Aqua and landbased injured group

Time (Weeks)	Control group N=40	Aqua roup N=40	Landbased group N=40
1-2	1	1	--------
3-4	-------	-------	--------
5-6	-------	1	2
7-8	2	2	--------
9-10	-------	1	1
11-12	2	-------	------
13-14	-------	------	1
15-16	1	1	1
Total	7	6	5
Recurrence (%)	17.5	15	12.5



The above Figure 9 showed the recurrence rate of injury of ankle sprain subjects. The value of recurrence of control group percentage was (17.5) which was higher than aqua (15) and landbased (12.5) rehabilitation protocols. The final result showed that landbased has better recurrence as compared with Hydro and control group respectively.

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