https://doi.org/10.48047/AFJBS.6.5.2024.6193-6207

African Journal of Biological Sciences

Immediate Effect Of Lumbar Manipulation On Lumbar Range Of Motion And Lower Limb Functional Test In Recreational Football Players: An Experimental Study

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Abstract:

Context: Football is a commonly played sport. Functional impediments in footballers may arise due to decreased spinal mobility, which affects quality of life and performance. Manipulative treatment is a manual therapy techniques which uses a high velocity "thrust" applied to a synovial joint over very short amplitude.

Aims:To evaluate the immediate effect of lumbar manipulation on lumbar range of motion (ROM) and lower limb function in footballers.

Methods and Material:22 male footballers of 18 to 30 years underwent a single session of lumbar manipulation. Modified-modified Schober"s test was used to evaluate changes in lumbar ROM, while Anterior, Postero-lateral and Postero-medial components of Star excursion balance test (SEBT) were used to measure dynamic balance and single leg triple hop distance test for lower limb strength.

Results: Statistical analysis revealed significant differences in outcome measures obtained. Post intervention t-value and p-value for SEBT Anterior (t= 5.583, p= 0.001), SEBT Postero-medial (t=10.376, P=0.001), SEBT Postero-lateral (t=8.495, P=0.001), Lumbar ROM (t=2.569, p=0.018), Triple hop (t=6.492, p=0.001).

Conclusions: Lumbar manipulation has shown to increase lumbar ROM and enhance performance of lower limb functional tests in footballers. Thus this study recommends lumbar manipulation can be applied to enhance the performance of the players.

Keywords: High velocity low amplitude thrust (HVLAT), Lumbar manipulation, Single leg triple hop, Star excursion balance test (SEBT)

Introduction:

Football is one of the most popular contact sports around the world; which requires high demand of aerobic, anaerobic performance and technical and tactile performance. This physiologically demanding sport is characterized by continual intermittent burst of high intensity activity followed by low intensity activity [1, 2, 3]. The worldwide popularity of soccer is that the players need not have extraordinary ability but should possess a reasonable level of ability of all areas. However now, there is a trend towards systematic training and selection process which is influenced by the biometric study of the body of players who compete at the international level. Soccer is not science but science can help improve the performance in soccer players. Improving soccer performance refers to improving techniques and tactics rather than improving mere physical fitness [3.] A minimum requisite of a footballer is to perform skillful movements in limited space, time and also possess the capacity to produce high torque during fast movements. Soccer requires strong and forceful back movements which may cause degenerative changes in lumbar spine which can be visualized on radiography; however the players may seem to be asymptomatic [4].Running for a long time results in raised intra-abdominal pressure leading to further loading of lumbar spine in football players. Spinal flexibility is also reduced as a result of high torsion and compression forces over the lumbar region. Reduction in spinal flexibility is also associated with decrease in disc height and end plate cross sectional area [5].

High velocity low amplitude thrust (HVLAT) is a manual therapy technique which uses a high velocity“impulse”or“thrust” which is applied to a diarthrodial synovial joint over a very short amplitude. Shekelle states that there are four main hypotheses for lesions that respond to HVLAT manipulation: release of entrapped synovial folds or plica, relaxation of hypertonic muscle by sudden stretching, disruption of articular or periarticular adhesions and unbuckling

of motion segments that have undergone disproportionate displacements[6].Spinal manipulation is known to relieve pain, facilitate sensory inputs and restore joint mobility within the spinal segments that is directly correlated to the functions of lower limbs [7, 8].Evidences reveal manipulative technique, commonly used by manual therapists, chiropractors and osteopaths not only to alleviate musculoskeletal complaints but also can enhance the performance and speed up the recovery of players [8].

Functional tests are assessment tools designed to reproduce demands of sports activity thereby assessing the components of sports which include strength, agility and power [9, 10].Lower limb functional test like Star excursion balance test (SEBT) and triple hop test have been found to be reliable and valid tools for assessing dynamic balance and lower limb strength respectively. Functional tests are commonly used by coaches and physiotherapists as they are easy to administer with minimal equipment and require minimum manpower [10]. The additional advantage of functional tests is that individual performance and injury risks which cannot be obtained from conventional evaluation methods can also be identified [11].

Precompetition manipulative treatment is being provided to the world class athletes during Olympic Games and other major international multisport events as it is important for players not only to improve performance but also to prevent injuries associated with the game and the decrease disability following injury and improve quality of life. High performance sports like football require better athletic performance which can be achieved with decreasing recovery time and improving the athletic function. This leads to the study focusing on enhancement in performance[12]. Thus this study aims to find the effect of lumbar manipulation on lumbar range of motion and lower limb functional tests.

Subjects and Methods:

Participants and Study design

The pre post interventional study was registered to the Clinical Trial Registry of India under the registration number CTRI/2019/03/018147. Ethical clearance was obtained from Institutional Ethical Committee with certificate SI No: 255. Twenty two Male recreational football players aged 18-30 years were recruited for the study from the district stadium, RLS ground, Belagavi. A written informed consent was obtained from all subjects willing to participate. Football players who have any pathology that is contraindicated to spinal manipulation and participant who‟s positioning cannot be achieved because of pain or resistance were excluded from the study[13].The data was collected using convenience sampling and a pre- post experimental study design was followed. The intervention was rendered by a manual therapist who has 13 years of experience in the field of manual therapy.

Study Procedures

An assessment of lumbar range of motion, SEBT reach distance and single leg triple hop distance was done prior to and immediately post intervention, followed by comparison and statistical analysis of the values obtained.

Intervention

The participant was made to lie on his non dominant side while the therapist stood facing the participant. The therapist flexed the dominant (upper) lower limb at the hip and knee while the non-dominant (bottom) limb was resting on the manual therapy couch. The foot of the dominant limb was locked behind the popliteal fossa of the non-dominant limb. Further, the participant‟s bottom shoulder was pulled in order to achieve the locking of lumbar spine. The

therapist‟s arm which was towards the participant‟s head was interlocked with the participant‟s upper arm while the therapist‟s other arm pulled the lower trunk towards the therapist until the slack was removed. Once this locked position was achieved the therapist administered an HVLA thrust with arm and body[14].(Figure 1)

Outcome Measures:

Modified Modified Schober‟s Test:Modified-modified Schober‟s test was used to measure the mobility of the lumbar spine. Subjects were asked to stand in upright position with the legs shoulder width apart and arms loosely hanging by the side of the body. Therapist marked the center point of PSIS as a lower reference andthe upper point was marked 15cm from the lower reference. Instructions were given to the subjects to bend forward as much as possible. With the help of measuring tape therapist measured the difference between the two points during flexion[15].

SEBT Reach Distance: Dynamic balance was measured using SEBT which incorporated a stance on one leg with maximum reach of the opposite leg. The SEBT was performed with the subject standing at the center of a grid placed on the floor, the grid was made using the athletic tape of 6-8 feet in length placed in a „Plus‟ shape and other piece of „X‟ shape placed over to form a star shape with 45 degree angulations between all the lines in the grid. The goal of the task was to have the individual establish a stable base of support on the stance limb in the middle of the testing grid and maintain it through a maximal reach excursion in 1 of the prescribed directions such that there was no weight shift on the reaching limb. The therapist noted down the maximal reach excursion in each direction using measuring tape [16, 17]. (Figure 2)

Single Leg Triple Hop Distance Test:Single leg triple hop distance test was used to assess lower limb strength. A standard cloth tape measure was fixed to the ground, perpendicular to a starting line. Participants were made to stand on the dominant leg, with the great toe on the

starting line. They were asked to perform 3 consecutive maximal hops forward on the same (dominant) limb allowing arm swing. The therapist documented the distance hopped from the starting line to the point where the heel struck the ground upon completing the third hop using the measuring tape[18].

Statistical Analysis

Kolmogorov-Smirnov test used to check the normality of the data revealed normal distribution of data hence paired samples *t* test was used for data analysis. Data was processed using the Statistical Package for the Social Sciences software version 23.0(SPSS for windows, Armonk, NY: IBM corp., USA). Height, weight, BMI, SEBT Anterior, SEBT Postero-medial, SEBT Postero-lateral, Lumbar ROM, Triple Hop distance was computed as the study variables. Normality of the quantitative variables was assessed using Kolmogorov-Smirnov test. The analysis of pre and posttest values of outcome measures lumbar range of motion, SEBT reach distance, single leg triple hop distance were done using paired t test. Probability values less than 0.05 were considered statistically significant and probability values less than 0.001 were considered highly significant.

Results:

A total of 22 male recreational football players with mean height of 172.64±6.959, mean weight 66.00±7.940 and mean BMI 21.68±3.358 participated in the study (Table.1). Statistical analysis revealed highly statistical significant difference in the pretest and post test scores of SEBT in all the three directions i.e. anterior (t=5.583, p<0.001), posteromedial (t=10.376, p<0.001) andposterolateral (t=8.495, p<0.001) and triple hop jump distance (t=6.492, p<0.001) while difference in the pretest and post test scores of lumbar range of motion was statistical significant (t=2.569, p<0.05) (Table.2).

Discussion:

This pre post experimental study investigated the immediate effect of lumbar manipulation on lumbar range of motion and lower limb functional test in recreational football players. The result of the study showed a significant improvement in lumbar range of motion and lower limb function after intervention. The study was conducted in healthy, asymptomatic football players in order to obtain additional knowledge of neurophysiological response towards the intervention, so that there is no masking effect of the intervention due to the underlying pathology secondary to injury.

Increase in lumbar range of motion following lumbar manipulation is associated with the cavitation occurring during the manipulation. Synovial fluid which is responsible for movements of a diathrodial joint undergoes high shear rates turning the liquid into brittle solid. During lumbar manipulation, the solid synovial substance breaks and offers little resistance to movement thereby increasing the range of motion. The articular surfaces of zygapophyseal joint or the facet joints get separated leading to the gapping of the respective joints which in turn allows the meniscoids to realign in the joint cavity. This forms the basis of another mechanism for enhanced lumbar range of motion [6].In view of the current study it has been noted that there is an increase of lumbar range of motion following lumbar manipulation. This change in range of motion can be attributed to the mechanism enlisted above.

There are several studies which demonstrated Motor control changes following spinal manipulation similar to our study. Haavik et al conducted a study to investigate whether cervical manipulation improved elbow joint position sense and the study concluded that manipulating the neck of the participants who had a history of neck dysfunction, but who were

not in pain on the day of the experiment, did improve their elbow joint position sense and motor control changes was illustrasted [19].Another study has shown that spinal manipulation improves tibialis anterior (TA) strength, and that this change most likely comes from the supraspinal regions as only very small but significant changes in the H-reflex was observed at low intensities while large changes were shown in the V wave [20].In a randomized clinical trial conducted by Botelho et al in judo players, it was found that cervical manipulation improved the grip strength of the national level judo players compared to sham group [21].

Dong et al in his study among adult females had found improvement in Y balance test is directly correlated to increase in lowerlimb strength [22].Another study identified that an increase in hip and knee flexion of the stance limb are responsible for better SEBT performance in young female athletes and it‟s also associated with increase in muscular activity for postural control caused via trembling component of center of pressure [23 24].

Spinal manipulation has shown to have an effect on both muscle activation and force output in skeletal muscles which can be correlated to the increase in the outcome of the triple hop distance test thereby implying betterment in strength of lower limb. In the lower limb, these effects were largely seen in hip extensors, quadriceps, soleus and gastronemius. Both joint manipulation and mobilization stimulates the sensory receptors (mechanoreceptors, proprioceptors, and free nerve endings) inside and surrounding the joint, thus it has an effect on the spinal cord at a segmental level as well as at the cortical level. This Cortical changes can eventually affect motor neuron pool excitability leading to afferent information from one structure leading to generation of efferent signals to all structures innervated by same nerve[25].In context to the current study it can be concluded that the improvement in the SEBT in all the tested directions was due to above discussed physiology.

Several researches including human participants had identified spinal manipulation produces central neural plastic effects and these plastic effects are seen at the cortical level. In the study, the changes persisted on average for 20min to 30min post-manipulation before returning to baseline levels. Recently, a study using whole head electroencephalography (EEG) and brain electrical source analysis was able to further explore sensorimotor integration after manipulation predominantly happens in the prefrontal complex [26].

Maximum voluntary contractions of muscles and prevention of fatigue is also seen after spinal manipulation which is attributed to descending drive or modulation in afferents.[21] Taken together, these findings recommend that spinal function and/or movement has a critical effect on central cortical processing that improves the accuracy with which the brain is aware of limbposition and alters the way the brain controls upper and lower limb movement patterns. As spinal manipulation is relatively available, affordable, quite safe and secure to use, it could be a good conservative treatment worth trialing before more costly and invasive options are considered, not only for pain syndromes, but also for a variety of conditions that spinal manipulation has not previously been considered for [19, 26].

Limitation of our study was small sample size. Although lumbar manipulation showed improvement in lumbar ROM and lower limb functional test, these cannot be considered as sole predictors of improvement in performance as on-field or during game outcomes were not evaluated.

Conclusion

The present study tested the immediate effect of Lumbar manipulation on lumbar ROM and lower limb functional tests and found that there was an increase in lumbar range of motion and enhancement of dynamic balance and lower limb strength

Acknowledgements:

We are grateful to all the participants for providing time for the study. Sincere gratitude to the Management of Institute of Physiotherapy, Belagavi, Karnataka, for providing infrastructure and facilities to carry out the study.

Source(s) of support: NIL.

Conflicting Interest (If present, give more details): NIL.

Ethical policy and Institutional Review board statement:

Ethical clearance was obtained from Institutional Ethical Committee with certificate SI No: 255

Patient declaration of consent statement:

The authors certify that they have obtained all appropriate patient consent forms. In the form, the legal guardian has given his consent for images and other clinical information to be reported in the journal. The guardian understands that names and initials will not be published and due efforts will be made to conceal identity, but anonymity cannot be guaranteed.

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Table 1. Demographic Data

Particular	Minimum	Maximum	Mean	SD
HEIGHT	160	183	172.63	6.95
WEIGHT	45	83	66.00	7.94
BMI	17	33	21.68	3.35

Table 2. Pre - Post Score of All outcome measures

Variable	Time Frame	Mean± SD	t-value	p-value
SEBT ANT	**Pre-test**	74.04 ±5.01		
	Post-test	78.9 ± 7.02	5.583	0.001*
	Difference	4.86 ± 4.08		
SEBT PM	**Pre-test**	73.3± 9.67		
	Post-test	79.18 ± 11.04	10.376	0.001*
	Difference	5.18 ± 2.63		
SEBT PL	**Pre-test**	78.72± 7.59		
	Pre-test	83.77 ± 8.18	8.495	0.001*
	Difference	5.04± 2.78		
TRIPLE HOP	**Pre-test**	478.63 ± 77.44		
	Post-test	516.00 ± 86.05	6.492	0.001*
	Difference	37.36 ± 26.99		
Lumbar ROM	**Pre-test**	6.81 ± 0.95		
	Post-test	7.31 ± 0.83	2.569	0.018*
	Difference	0.50 ± 0.91		

*Significant at 5% level
All values in absolute form [ignored negative sign for statistical convenience]
SEBT -Star excursion balance test, ANT – Anterior,PM –Posteriomedial,PL-Posteriolateral, ROM – Range of Motion

Figure 1. *LUMBAR THRUST*

Figure 2. *SEBT REACH DISTANCE*