



Balance Performance of Professional Footballers with Long-term Lower Limb Musculoskeletal Injury

Ogwumike O.O., Tijani A.

Department of Physiotherapy, College of Medicine, University of Ibadan

Correspondence

Ogwumike, Omoyemi O., Department of Physiotherapy, College of Medicine, University of Ibadan, Nigeria • Email: yemfide@yahoo.com

SUMMARY

Lower limb musculoskeletal injury (LLMI) is a common occurrence in athletes. Balance impairments have been implicated as contributory to poor balance performance following LLMI. It is usually expected that once the initial rehabilitation period is over, subsequent recovery should continue until the pre-injury state is reached. Some studies on certain physically-active individuals and amateur athletes have reported that this is usually not the case. This study therefore investigated balance performance (BPf) in professional footballers with long-term LLMI, the effect of limb dominance on BPf and comparison of BPf in injured footballers with their uninjured counterparts.

A sample of 115 professional footballers – 104 males and 11 females, participated in the study and they consisted of two groups - injured group of participants (IGP) and uninjured group of participants (UGP). Balance performance (BPf) was assessed using the Stork balance stand test. The time in seconds for which the participant is able to stand on the ball of the foot of one leg is indicative of the BPf for that lower limb.

The results indicated that poor balance performance was observed in the injured limb compared to the uninjured limb in IGP ($P=0.000$). BPf was poorer in the dominant limb of IGP compared with the dominant limb of UGP ($P=0.000$). Time lapse since injury did not have any effect on BPf ($P=0.868$).

It was concluded that balance problems persist in professional footballers with LLMI irrespective of time lapse since injury.

KEY WORDS: footballers, lower limb, injuries, balance, dominance

INTRODUCTION

Balance or postural control is a dynamic process by which the body is maintained in equilibrium (Kisner and Colby, 2007). At any point in time the body can either be in a state of rest (static equilibrium) or that of steady-state motion (dynamic equilibrium). Balance performance (BPf) is a complex motor control task involving the detection and integration of sensory information to assess the position and motion of the body in space and the performance of appropriate musculoskeletal reactions to regulate body position within the context of the environment and performance task (Kisner and Colby, 2007). Thus, BPf requires the interaction of the nervous and musculoskeletal

systems. Balance deficits have been implicated as contributing to poor balance performance following lower limb musculoskeletal injury (Lentell, 1990).

Lower limb musculoskeletal injuries (LLMI) are a common occurrence especially in persons who exercise regularly and patients are frequently referred either directly or indirectly for physiotherapy. In the initial rehabilitation period of a few weeks or months, substantial improvements in pain relief, joint mobility, muscle strength and function are made (Holder-Powell and Rutherford, 1999). It is frequently assumed, after the formal period of rehabilitation is completed that as the patient becomes more active, recovery will continue until the pre-injury

state is reached. However, this assumption may not always be the case (Holder-Powell and Rutherford, 1999).

Professional athletes such as footballers perform a lot of lower limb weight bearing functional activities that require a degree of muscle strength, coordination and balance. This sport tasks involve repeated impulsive contacts between the lower limbs and the support surface and when these contacts are poorly controlled, the cumulative effects of exercise vertical impact loading have been implicated as major factors contributing to lower limb injury in footballers (Chu 1998). Just as in other lower limb injuries, impaired balance have been implicated in LLMI and improvement is expected in balance performance subsequent to rehabilitation perhaps to the pre-injury level.

Previous studies have reported impaired balance after ankle sprains (Bullock–Saxton, 1995) and anterior cruciate ligament injury (Friden, et al, 1990; Gauffin, et al, 1990). Holder-Powell and Rutherford (2000) reported impaired balance in some physically active individuals and amateur athletes after a long-term LLMI. This study was designed to investigate:

- (i) BPf in professional footballers;
- (ii) Compare BPf in professional footballers with long-term LLMI with uninjured footballers; and
- (iii) The effect of limb dominance on BPf in this group of participants.

METHODS

Participants

A purposive sampling technique was used to select 115 professional footballers receiving training at the National Stadium, Surulere and the Teslim Balogun Stadium, Lagos Nigeria. The participants consisted of two groups:

1. Seventy-three professional footballers who had long-term LLMI were the injured group of participants (IGP).
2. Forty-three professional footballers who did not have any LLMI formed the uninjured group of participants (UGP) or the control group.

They were selected based on each participant's satisfaction of the inclusion criteria for the study which consisted:

1. At least six-month time lapse since occurrence of LLMI before the commencement of the study
2. Absence of pain at the site of the injury
3. Absence of neurological symptoms consequent to the LLMI
4. Lack of any LLMI in the control group (UGP)

Procedure

Ethical approval for the study was obtained from the UI/UCH Ethical Review Committee and an informed

consent form was signed by all the participants after explaining the nature and purpose of the study by the researcher. The participants' weight and height were assessed using the standard methods and recorded. Information about the time, site and nature of injury as well as limb dominance was also obtained and recorded.

Physical Examination

In a supine lying position, each participant was asked to carry out active movements of the lower limb joints including knee flexion and extension, ankle dorsiflexion and plantarflexion as well as foot inversion and eversion. These movements in one lower limb were compared with those of the other in order to rule out pain and joint range limitation and to ensure that each participant met the inclusion criteria for the study.

The Stork Balance Stand Test

Balance performance of the participants was assessed with the aid of the Stork balance stand test (Torpend Sports, 2009). This test measures the ability of the participant to balance on the ball of the foot with hands placed on the hips while positioning the non-supporting foot against the inside knee of the supporting leg. Using a stopwatch, the amount of time in seconds that the participant is able to stand on the ball of the foot of one leg is indicative of his BPf. The timing is stopped if:

- (i) The supporting foot swivels or moves (hops) in any direction
- (ii) The non-supporting foot loses contact with the knee
- (iii) The heel of the supporting foot touches the floor.

For each participant, the overall score was the best of three attempts. The same procedure was carried out for both lower limbs.

Treatment of data

Descriptive statistics of mean and standard deviation were used to summarize the demographic variables of participants while student paired t-test was used to compare differences in BPf in the injured and uninjured limb of the injured group of participants (IGP). Independent t-test was used to compare differences in BPf between: the dominant injured limb of injured participants and the dominant limb in the control group, and the non-dominant injured limb of injured participants and the non-dominant limb of un-injured participants. Analysis of variance (ANOVA) was used to compare time lapse since injury and balance performance in IGP. The significance level was set at $\alpha = 0.05$.

RESULTS

There were 115 participants in this study: 104 (90.4%) male and 11 (9.6%) female professional footballers. Their ages ranged between 17 and 43 years. The 17 to 25 years age group comprised the largest percentage of the participants. The male participants were generally taller and heavier than their female counterparts. Table 1 shows the demographic characteristics of the participants.

The student's paired t-test showed significant differences in mean BPf scores of injured and uninjured limbs of IGP ($P<0.05$) (table 2). The independent t-test revealed significant differences in the mean BPf scores of the DL of IGP when compared with the DL of UGP ($P<0.05$) (table 3). A further comparison of the mean BPf scores in NDIL of IGP and that of NDL of UGP revealed significant differences in the two groups ($P<0.05$) (Table 4), with better mean BPf scores being observed in the UGP. An analysis of the mean BPf scores as related to different injuries in the participants was made using analysis of variance (ANOVA). It was observed that ankle injuries were the most predominant and it was the injured part of the lower limb for which the least mean BPf was recorded in the participants (fig. 1). A consideration of the time lapse since the injury and the mean BPf scores showed that no significant difference ($P= 0.87$) was observed in the BPf and time lapse since the injury (table 5).

Table 1. Demographic characteristics of participants

Variables	IGP		UGP	
	n	%	n	%
Sex				
Male	62	84.9	41	97.6
Female	11	15.1	1	2.4
Age Group (yrs)				
17-25		78.1		69.1
26-34		19.2		26.2
35-43		2.7		4.8
Height (m)	$\bar{x} \pm S.D$		$\bar{x} \pm S.D$	
Male	1.69 ± 0.08		1.68 ± 0.06	
Female	1.64 ± 0.06		1.64 ± 0.00	
Weight (kg)	$\bar{x} \pm S.D$		$\bar{x} \pm S.D$	
Male	63.9 ± 7.20		69.50 ± 7.60	
Female	1.64 ± 0.06		66.00 ± 0.00	
BMI (kg/m^2)	$\bar{x} \pm S.D$		$\bar{x} \pm S.D$	
Male	22.37 ± 3.15		20.91 ± 2.71	
Female	23.54 ± 3.84		21.45 ± 0.00	

Key: IGP: Injured group of participants
UGP: Uninjured group of participants
BMI: Body mass index
 $\bar{x}$: Mean value

Table 2. Comparison of balance performance in injured and uninjured limb of IGP

Group	BPf(s); $\bar{x} \pm S.D$	t-value	P
Inj L	19.92 ± 13.28	- 6.97	0.000*
Unj L	26.34 ± 14.23		

Key: Inj L: Injured limb
Unj L: Uninjured limb
BPf: Balance performance
*: Significant value
s: seconds

Table 3. Balance Performance in Injured Limb of IGP Compared with BPf in Dominant Limb of UGP

Group	BPf(s); $\bar{x} \pm S.D$	t-value	P
DIL	20.93 ± 15.28	- 6.22	0.000*
DL	37.34 ± 11.36		

Key: DIL: Dominant injured limb
DL: Dominant limb
BPf: Balance performance
*: Significant value
 $\bar{x}$: Mean value
s: seconds

Table 4. Balance Performance in Non-Dominant Injured Limb of IGP Compared with BPf in Non-Dominant Injured Limb of UGP

Group	BPf(s); $\bar{x} \pm S.D$	t-value	P
NDIL	25.56 ± 12.95	- 7.24	0.000*
NDL	44.23 ± 13.94		

Key: NDIL: Non-dominant injured limb
NDL: Non-dominant limb (control)
BPf: Balance Performance
*: Significant value
s: seconds

Table 5. Time since Injury and Balance Performance

Group	BPf(s); $\bar{x} \pm S.D$	t-value	P
<12	19.35 ± 13.1	4.15	0.868
12-36	19.91 ± 13.7		
37-60	22.54 ± 14.5		
>61	16.5 ± 11.6		

Key: BPf: Balance Performance
 $\bar{x}$: Mean value
s: seconds

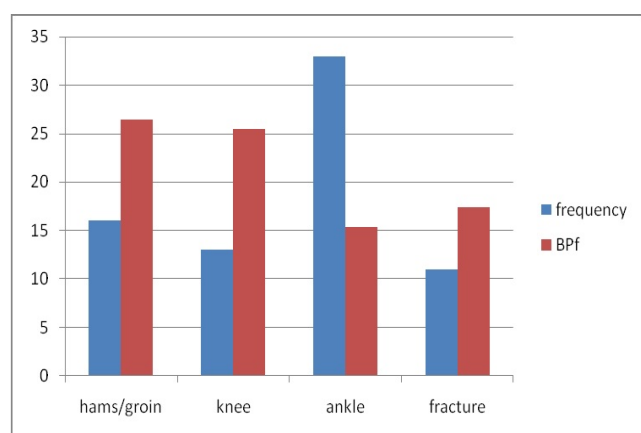


Figure 1. Frequency of Site of Injury Occurrence and Balance Performance in Injured Group of Participants

DISCUSSION

A majority of the participants in this study were male. This is probably because football is usually a male-preferred sport. They were aged between 17 and 43 years, with the highest percentages in the 17 to 25 years age groups. This may not be out of place because this latter age group belonged to an age of peak performance in young individuals with strong muscles and optimal physiological capability of the heart and the lungs which effectively equip the body for exercise (Montenegro, 2010).

The observed poor balance performance in the injured limbs compared with the uninjured limbs in this study is in line with the observation in previous studies which reported balance impairments following LLMI (Holder-Powell and Rutherford, 1999, Evans et al, 2004). In a study by Evans et al (2004) of the injured and uninjured limbs of individuals after unilateral lower limb sprains, balance deficits were identified to be present in both limbs and balance impairments seen in the injured limbs were greater than those observed in the uninjured limbs. The result of this study is in agreement with that of Evans et al (2004).

In this study, the mean balance performance scores in the DIL and NDIL were significantly lower than that of the DL and NDL of the UGP. This is not an unusual observation because a number of previous researchers such as Hertel et al (2001) reported that balance performance is clearly impaired after lower limb injuries with deficits identified in both the dominant and non-dominant limbs compared with control groups. Freeman (1965) opined that balance impairments after lower limb sprains were possibly due to damaged ligamentous and articular mechanoreceptors in the injured ligaments. Bullock Saxton et al. (1994) and Bullock Saxton (1995) found alterations in hip extensor activity in both the injured and uninjured

limbs after severe unilateral ankle sprains. Beckman and Buchanan, (1995) declared that deficits in balance performance may indicate a larger motor control deficit and that alterations in muscles proximal to the ankle have been identified in those with a history of ankle sprain. These proximal alterations may be related to kinetic and kinematic changes noted in single limb drop landings (Caulfield et al, 2004). It is however noteworthy that the specific mechanism involved in impaired balance in the injured footballers in this study cannot be straightforwardly explained because they were involved in multiple forms of injuries to the lower limbs.

A lower mean balance performance score observed in DIL in this study compared with the DL of the UGP is not an unusual finding. This is due to the fact that several previous studies have reported that the dominant leg is usually at an increased risk of injury because it is preferentially used for kicking, pushing off or landing while the non-dominant limb serves for support and that it provides more proprioceptive input for weight bearing (Harrison et al, 1994). Furthermore, the implication of limb dominance as a risk factor for lower extremity injury cannot be overemphasized. This is because it has been observed that since most athletes place a greater demand on their DL, they therefore produce increased frequency and magnitude of movements about the knee and ankle particularly during high demand activities that place the knee and ankle at risk (Beynon et al, 2002). In addition, Ekstrand and Gillquist (1983) noted that the dominant leg sustained significantly more ankle injuries in male soccer players, with 92% of ankle injuries affecting the dominant leg.

A consideration of the site of occurrence of injuries in relation to BPF in this study showed that the ankle was the most commonly injured site of the lower limb and it is also the injured aspect of the lower limb where the least BPF was recorded. This finding is in order with previous observations that soccer athletes are at an increased risk of ankle injuries (Ekstrand and Gillquist, 1983, 1990).

In this study, the least duration of injury occurred 6 months prior to the involvement of the participants in the study while the longest duration was over 96 months. A consideration of these time ranges in relation to balance performance revealed no significant effect. This possibly showed that local rehabilitation strategies that focussed only on restoring range of motion and strength of muscles surrounding the injured lower limb site may not have been adequate to restore optimal balance performance in this group of participants (Bahr and Bahr, 1997, Rozzi et al, 1999).

CONCLUSION AND RECOMMENDATION

It was concluded that balance problems persist in professional footballers with LLMI irrespective of the time lapse since injury.

Orthopedic and sports physiotherapists are strongly advised that, in addition to local rehabilitation strategies, they should pay particular attention to balance retraining in patients with LLMI even after the acute rehabilitation phase of the injury is over.

References

- Bahr, R. and Bahr I.A. 1997. A twofold reduction in the incidence of acute ankle sprains in volleyball after the introduction of an injury prevention programme: A prospective study of injury mechanisms and risk factors. *Scandinavian Journal of Medical Science and Sports* 7(3): 172-177.
- Beckman, S.M. and Buchanan J.S. 1995. Ankle inversion injury and hypermobility: Effect on hip and ankle muscle electromyography onset latency. *Archives of Physical Medicine and Rehabilitation* 76(12): 1138-1143.
- Beynnon, B., D. Murphy and Alosa D. 2002. Predictive factors for lateral ankle sprains: A literature review. *Journal of Athletic Training* Oct-Dec 37 (4): 376-380.
- Bullock-Saxton, J.E. (1995) Sensory changes associated with severe ankle sprain. *Scandinavian Journal of Rehabilitation and Medicine* 27: 161-166.
- Bullock-Saxton, J.E., Janda U. and Bullock M.I. 1994. The influence of ankle sprain injury on muscle activation during hip extension. *International Journal of Sports Medicine* 15 (6): 330-334.
- Caulfield B. and Garrett M. 2004. Changes in ground reaction force during jump landing in subjects with functional instability of the ankle joint. *Clinical Biomechanics* (Bristol, Avon) 19(6): 617-621.
- Chu, E.T. (1998) Balance in orthopedic injuries: Assessment and treatment. <http://resource.onbalance.com>
- Ekstrand, J. and Gillquist J. 1983. Soccer injuries and their mechanisms: A prospective study. *Medicine and science in Sports and Exercise* 15: 267-270.
- Evans, T., Hertel J. and Sebastianelli W. 2004. Bilateral deficits in postural control following lateral ankle sprain. *Foot Ankle International* 25 (11): 838-839.
- Freeman, M.A.R. 1965. Instability of the foot after injuries to the lateral ligament of the ankle. *Journal of Bone and Joint Surgery* 47: 669-77.
- Friden T., Zatterstrom R., Lindstrand A. and Moritz U. 1990. Disability in anterior cruciate ligament insufficiency. *Acta Orthopedics Scandinavia* 61: 131-5.
- Gauffin, H., Pettersson G., Tegner Y. and Tropp H. 1990. Functional testing in the patient with old rupture of the anterior cruciate ligament. *International Journal of Sports Medicine* 11: 73-7.
- Harrison, E.L., Duenkell N., Dunlop R. and Russell G. 1994. Evaluation of single-leg stance following anterior cruciate ligament surgery and rehabilitation. *Physical Therapy* 74:245-52.
- Hertel J., Bleckely W.E. and Deneger C.R. 2001. Serial testing of postural control after acute lateral ankle sprain. *Journal of Athletic Training* 36 (4): 363-368.
- Holder-Powell, H.M. and Rutherford O.M.. 1999. Unilateral lower-limb injury: Its long-term effects on quadriceps, hamstring and plantarflexors muscle strength. *Archives of Physical Medicine and Rehabilitation* 80:717-720.
- Holder-Powell, H.M. and Rutherford O.M. 1999. Unilateral lower-limb musculoskeletal injury: Its long- term effect on balance. *Archives of Physical Medicine and Rehabilitation* 81:265-8.
- Kisner, C. and Colby L.A. 2007. Exercise for impaired balance. Chap 8: 678-679. In *Therapeutic exercise: Foundation and Techniques*. Philadelphia: F.A. Davis Co.
- Lentell, R. 1990. The relationship between muscle function and ankle stability. *Journal of Orthopedic Sports and Physical Therapy* 11: 605-611.
- Montenegro, M. 2010. Age in Sports... is it just a number? www.evolvingwellness.com/posts/1273/age-in-sports-is-it-just-a-number.
- Rozzi, S.L., Lephart S.M., Sterner R. and Kuligowski L. 1999. Balance training for persons with functionally-unstable ankles. *Journal of Orthopedics and Sports Physical Therapy* 29 (8): 478-486.
- Torpend Sports. 2009. Fitness testing. Stork balance Stand Test. In Johnson B.L. and J.K. Nelson. 1979. *Practical Measurements for Evaluation in Physical Education*. 4th edition. Minneapolis: Burgess.