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ASSESMENT FOR PROFESSIONAL FOOTBALL PLAYERS TO AVOID INJURIES, USING HUBER® 360

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ABSTRACT. The motor behavior of six football players aged 21 to 25 is investigated in this research. We examined the players using the HUBER® 360 platform and several functional tests such as the Stability test, Unipodal test, Stability limit test, Mobility restrictions test, and Upper and lower limb coordination test to obtain the information needed to avoid injuries while participating in performance sports. This study is relevant to footballers because injuries have a short-term detrimental impact on the health of the enhancers if they are discovered in time and a long-term negative impact if they are not detected. The preliminary testing on the HUBER® 360 equipment is specialized in defining the performance capacities of footballers and not only, by recognizing specific characteristics of the athletes, it is possible to correct them and thus improve sports performances.The data taken on such a group of football players are significant to the sport practiced as a professional, and so can be used to develop training methods and techniques for the sportsmen in question. Among those researched, it is discovered that corrective training sessions must be utilized, but it is also possible to specify which directions, positions, and speeds of movement must be avoided or used with caution.

Keywords: *football, balance, HUBER® 360, football injuries*

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REZUMAT. Evaluarea jucătorilor profesioniști de fotbal cu HUBER® 360 pentru evitarea accidentărilor. Acest studiu a investigat comportamentul motor a șase jucători de fotbal cu vârsta cuprinsă între 21 și 25 de ani. Jucătorii au fost examinați cu ajutorul platformei HUBER® 360 și a bateriei de teste funcționale, care conține testul de stabilitate, testul unipodal, testul limită de stabilitate, testul restricțiilor de mobilitate și testul de coordonare a membrelor superioare și inferioare pentru a obține informațiile necesare evitării accidentărilor din timpul practicări sportului. Această cercetare este relevantă pentru jucătorii de fotbal, deoarece accidentările pot avea efecte negative de lungă durată dacă carențele de instabilitate nu sunt detectate la timp. Testarea preliminară cu ajutorul dispozitivului HUBER® 360 specializat în definirea capacităților de performanță ale fotbaliștilor și nu numai, prin recunoașterea caracteristicilor specifice sportivilor, este posibilă corectarea acestora și astfel îmbunătățirea performanțelor sportive. Datele colectate asupra unui astfel de grup de jucători de fotbal au implicații importante pentru acest sport și, prin urmare, pot fi folosite pentru a dezvolta metode și tehnici de antrenament pentru jucătorii implicați. Printre cei cercetați, se constată că trebuie utilizate sesiuni de antrenament care să corecteze și să scadă riscul de accidentări, dar este de asemenea posibil să se precizeze în ce direcții, poziții și ce viteze de mișcare trebuie evitate sau utilizate cu prudență.

Cuvinte cheie: *fotbal, echilibru, HUBER® 360, accidentări fotbal*

Introduction

Football is one of the most popular sports, with a worldwide estimation of 200 million players' participation (Brophy et al., 2007). Football players pose an inherent risk of injury and are among the highest of all sports, particularly for adult male players (Junge et al., 2009). An injury can result in incomplete recovery, residual symptoms, withdrawal from sports, and the long-term degenerative joint process. In competitions, injuries are an important issue for sports clubs, especially in the situation where several athletes are unable to participate with all their team squad due to acute injuries, thus considerably decreasing the club's chance of success. This entails financial losses that increase with the withdrawal from the competition of one or two key athletes due to injuries (Anandacoomarasamy, 2005; Kisser & Bauer, 2010; Valle et al., 2017). There is consistent evidence in the literature to support the use of injury prevention strategies that include pre-season conditioning as well as balance programs that are continued throughout the playing season (Abernethy & Bleakley, 2007).

Material and method

The group of athletes investigated

The assessment with the help of the HUBER® 360 gadget is used for a group of 6 football players to acquire the essential information and to prevent injuries during the practice of football. They were informed about the investigations that are conducted with the specialized device in order to evaluate and build a recovery program using modern investigative techniques.

Table 1 shows the structure of the football group, which includes the specific elements of each subject analyzed, noting with F1 – F6 the football players who are part of the research group.

Table 1. The structure of the group of footballers under investigation

Subject	Sex	Age	Height [cm]	Weight [kg]
F1	Masculine	22	189	100
F2	Masculine	21	181	72
F3	Masculine	25	186	90
F4	Masculine	25	182	80
F5	Masculine	22	179	68
F6	Masculine	25	180	74

Due to the high incidence of injuries such as ankle sprains, investigations must be conducted using specialized equipment such as the HUBER® 360 to account for any potential disruptions or faults in the execution of movements by football players. Such assessments should be conducted at the start of the competitive season to allow for the detection of football players vulnerabilities utilizing safe and reliable methods. (Fabri et al., 2009; Haxhiu et al., 2015)

Motorized platform with multi-axial action

HUBER® 360 was the instrument used in this research. The HUBER® 360 is a device with an oscillating platform and two handles, as well as force sensors situated beneath the motorized platform and at the handle level (Fig. 1.a). You can view all the data recorded from the patient's evaluation on the tablet on which the software HUBER® 360 (Fig. 1.b) is integrated, you can export the evaluation in PDF format that can be transmitted to the subject, allows personalized configuration of recovery programs and tracking their progress. (Chattanooga, 2015, 2022)

a. b.

Fig. 1 a. HUBER® 360 platform with a subject to investigate;
b. the tablet of the device with the subject's data

The gadget safely mobilizes joints in all planes of motion, and the feedback obtained on the screen assists the patient in improving strength and coordination of movements, exercising both superficial and deep muscles during this component of the program. Improved stability and self-confidence during movement execution can be accomplished with the help of balance games suited to the patient's physical condition. In the last stage, dynamic workouts are performed to enhance the tolerance to effort, as well as to improve the cardiovascular system and change the BMI. (Chattanooga, 2015, 2022).

Also with use of this platform, we can objectively assess the patient using a series of seven functional tests: Stability Test; Unipodal test; Stability limit test; Mobility restrictions test; Test of the strength of the hind limbs; Upper and lower limb coordination test.

The examination lasts 15 minutes. Three of the seven functional tests are based on the Romberg and Fukuda tests, and they examine balance, stability, and mobility limits, while the other two focus on quantifying force and assessing the subject's coordination abilities. We shall demonstrate the stability test and the mobility restriction test in this paper for the research of a group of football players.

- The stability test is done bipedally timed (inspired by the Romberg test) with both eyes closed and open, and it measures the position of the center of gravity, allowing you to assess your balance.. (Chattanooga, 2015)
- Test for mobility restrictions. This test will identify the patient's mobility limitations and, as a result, the amplitude of the platform on which the patient will be able to work. (Chattanooga, 2015)

Results and discussions

All six tests were completed on the HUBER® 360 gadget by the six athletes who play football as a performance sport. All of them were considered essential for the inquiry, but significant findings were obtained for the tests of stability and balance, thus the tests that emphasize this behavior of the sportsmen will be reported in this paper.

Test of stability with open eyes

Table 2 shows the results of the open-eyed stability test for the group of athletes, together with the evidential values for each researched subject and the related representations in figures 2 to 6. The minimum values are shown in red, while the highest values are highlighted in blue.

Table 2. Centralization of stability measurements with open eyes for footballers

Subject	Stability – length (eyes open) [mm]	Stability – area (eyes open) [mm^2]	Stability – speed (eyes open) [mm/s]
F1	935.08	535.28	18.70
F2	670.72	196.15	13.41
F3	917.19	390.17	18.34
F4	596.35	70.97	11.93
F5	496.83	253.20	9.94
F6	728.77	212.19	14.58

The stability test with eyes open displays the subject's center of gravity on the moving platform of the HUBER® 360. As the test is performed, the favorable attitude of a participant in comparison to the others for one of the recorded values is displayed in the tables for 15 minutes.

The registration data for sportsmen registrations can be found in Table 2 and Figures 2–7. We can deduce the following from them:

- The subject F5 not only has the shortest length of movement of the center of gravity during the 15-minute test, but also has the slowest speed of movement of the center of gravity.
- The subject F4 has the smallest surface in the movement of the subject's center of gravity, as well as the second smallest length and speed of movement of the subject's center of gravity.
- For all three measurements taken, the subjects F2, F3, and F6 show intermediate results.
- The subject F1 has the highest values for the researched parameters of length, area, and speed.

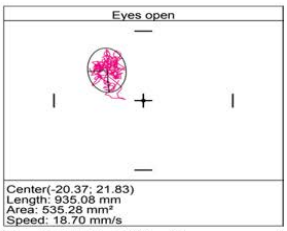

Fig 2. F1 Stability (eyes-open)

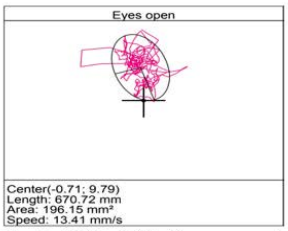

Fig 3. F2 Stability (eyes-open)

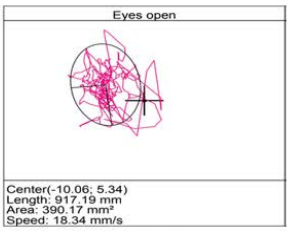

Fig 4. F3 Stability (eyes-open)

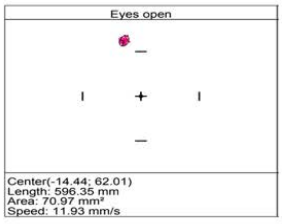

Fig 5. F4 Stability (eyes-open)

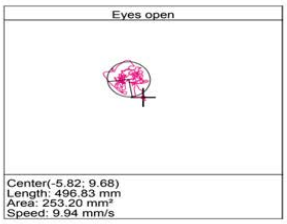

Fig 6. F5 Stability (eyes-open)

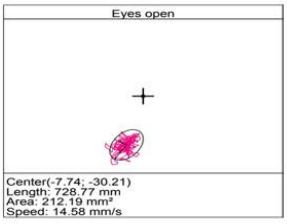

Fig 7. F6 Stability (eyes-open)

Test of stability with closed eyes

The stability test is carried out with the eyes closed, and the findings are displayed in Table 3, with the minimum values in red and the maximum values in blue for each group. The results of the tests are shown in figures 8 to 13 based on the visuals on the tablet.

Table 3. Centralization of stability measurements with closed eyes for footballers

Subject	Stability – length (eyes closed) [mm]	Stability – area (eyes closed) [mm²]	Stability – speed (eyes closed) [mm/s]
F1	1679.74	1085.41	33.59
F2	1293.82	241.66	25.88
F3	1417.79	417.84	28.36
F4	933.25	324.81	18.66
F5	576.25	292.52	11.52
F6	621.06	195.55	12.42

Table 3 and numbers 8 to 13 from the football players' closed-eyed stability test highlight the following points:

- With his eyes closed, subject F1 displays the maximum values of three sizes observed in the stability test, indicating that this player from the analyzed group has significant instability and requires well-directed training to improve this aspect.

- The subject F5 has the shortest length of movement and the slowest speed of movement of the center of gravity, indicating that his centre of mass is robust.
- The subject F4 has the smallest surface in the movement of the subject's center of gravity, as well as the third smallest length of movement and third lowest speed of movement, indicating that he is stable.
- Subjects F2, F3, and F6 exhibit intermediate levels for all three assessments, indicating that they need to improve their steadiness.

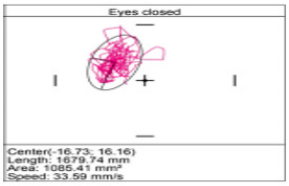

Fig 8. F1 Stability (eyes-closed)

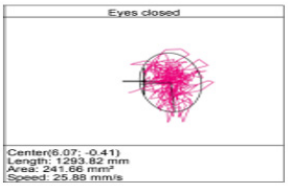

Fig 9. F2 Stability (eyes-closed)

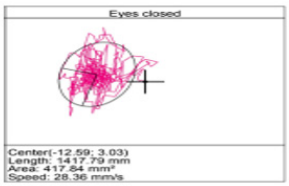

Fig 10. F3 Stability (eyes-closed)

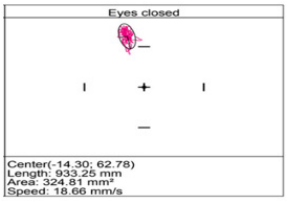

Fig 11. F4 Stability (eyes-closed)

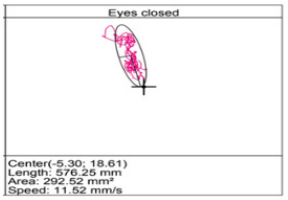

Fig 12. F5 Stability (eyes-closed)

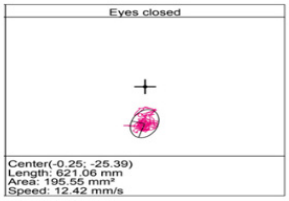

Fig13. F6 Stability (eyes-closed)

Unipodal Test

The unipodal test is performed on the platform with a single leg, and the length of the distance from the equilibrium state, or the area generated by the center of the weights, is measured for 30 seconds. The measurements are taken with both feet on the platform, and the findings are given in Table 4 with illustrations in Figures 14–19.

Table 4. Unipodal Test – left and right

Subject	Unipodal left length [mm]	Unipodal left area [mm²]	Unipodal right length [mm]	Unipodal right area [mm²]
F1	1858.91	1214.99	1291.30	982.95
F2	3211.13	18290.95	3037.24	5489.84
F3	2668.41	707.13	2604.16	1502.60
F4	1899.83	5531.00	1708.12	712.99
F5	1577.26	1931.00	1478.08	2480.49
F6	1688.69	549.90	1716.75	689.84

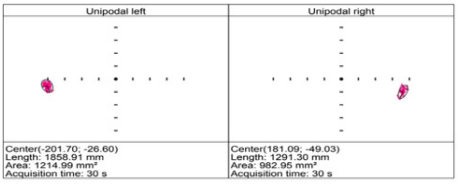

Fig 14. F1 unipodal - left and right

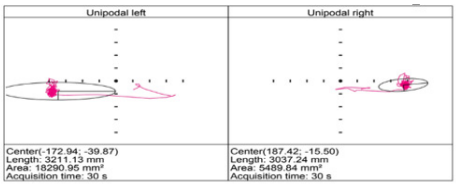

Fig 15. F2 unipodal - left and right

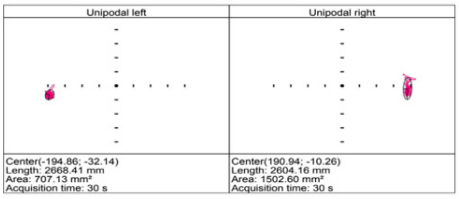

Fig 16. F3 unipodal - left and right

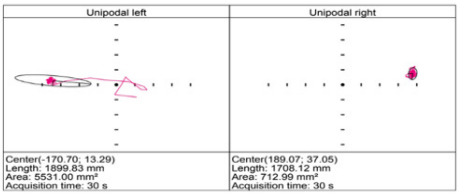

Fig 17. F4 unipodal - left and right

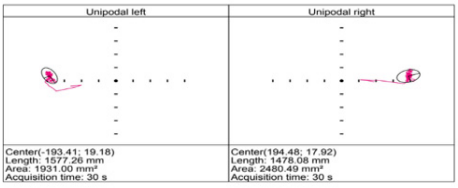

Fig 18. F5 unipodal - left and right

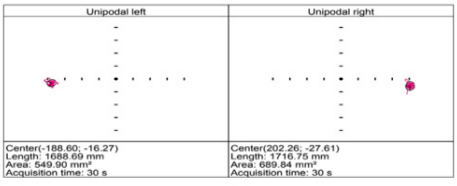

Fig 19. F6 unipodal - left and right

In the unipodal test on the both legs situations given by Table 4 and Figures 14-19, the recommendations are:

- In this test, the F2 football player has the highest values with both legs, therefore it must be cautious with the left leg to avoid injury during the competition.
- F1 shows the lowest value in length on the right foot and intermediate on the left one, so he has good stableness on the right leg.
- F5 shows the smallest value in length on the left foot and intermediate values on the others, so he has good steadiness on the right leg.
- F6 shows the smallest surface in the movement of the center of gravity of the subject on both legs and intermediate on the others parameters, so he has good stable on both legs.
- F3 and F4 subjects show intermediate values for all measurements made, so it is considered that they need to train more to improve their abilities.

Stability limit test

Table 5 shows the results of the stability limit test for the group of footballers, along with the evidential values for each researched subject and the related representations in pictures 20 to 25. The minimum values are shown in red, while the highest values are highlighted in blue.

Table 5. Centralization of stability limit test for footballers

Subject	Limits of stability 1	Limits of stability 2	Limits of stability 3	Limits of stability 4	Limits of stability 5	Limits of stability 6	Limits of stability 7	Limits of stability 8
F1	139	228	263	277	206	267	273	0
F2	88	149	212	190	167	201	215	156
F3	105	167	237	213	206	246	253	266
F4	136	221	233	174	153	188	257	238
F5	142	212	275	179	136	231	257	199
F6	171	242	288	116	125	111	203	219

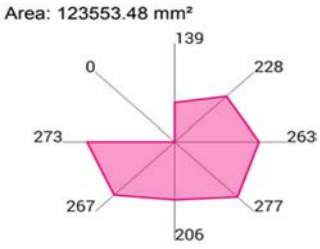

Fig 20. F1 stability limit test

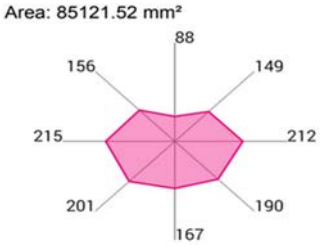

Fig 21. F2 stability limit test

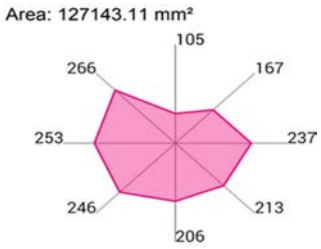

Fig 22. F3 stability limit test

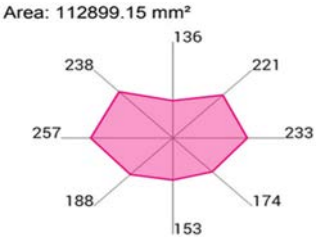

Fig 23. F4 stability limit test

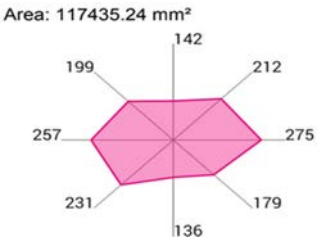

Fig 24. F5 stability limit test

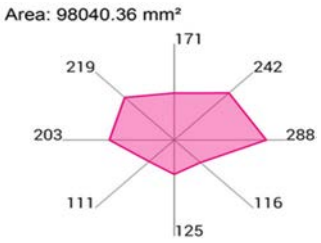

Fig 25. F6 stability limit test

The recordings in the figures corresponding to the stability limit test are made in the front direction – direction 1 – and the sequence is in direct rotation of the clockwise motion, as shown in table 5. As a result of this finding, all components of the footballers group perform as follows:

- F1 footballer has greatear stability for the following directions: rear-right, rear, rear- left and left. Regarding the front-left direction, it can be a device error or an athlete distraction. The rest of the results are in the medium range.
- F2 footballer has the smallest values for front, front-right and right directions and medium for the other directions. These values could be due to the reduces mobility of the talocrural joint.
- F3 footballer has good results for rear and left-rear directions. Considering the results for all the athletes in the group, he can improve the stability for front and fron-right direction.
- F4 and F5 footballers, compared to the other athletes in the group, have medium results.
- F6 footballer has big differences between the front and rear directions, the results from the front direction being greatest and from the rear being lowest; these values could indicate an imbalance between anterior and posterior calf muscles.

Mobility restriction

The amplitude of the platform's movement is explored according to the indications provided by the gadget specialized in testing the subjects on the platform, for which the subject is able to perform. The platform motion is graded on a scale of one to ten. The smallest amplitude of the platform movement is "1," and the largest amplitude is "10," at which the subject can engage while maintaining his balance or doing particular activities that can be highlighted in eight different directions.

The device recordings for subjects F1–F6 will be provided centrally in table 6, and the results recorded by the device will be presented in figures 26–28 for the footballers group tested with mobility restrictions.

Table 6. Centralization of measurements of restrictions on the mobility

Subject	Mobility restriction 1	Mobility restriction 2	Mobility resticion 3	Mobility restriction 4	Mobility restriction 5	Mobility restriction 6	Mobility restriction 7	Mobility restriction 8
F1	10	10	10	10	10	10	10	10
F2	10	10	10	10	10	10	10	10
F3	10	10	10	10	10	10	10	10
F4	10	10	10	10	10	10	10	10
F5	10	10	10	10	10	10	10	3
F6	3	10	3	10	10	6	0	10

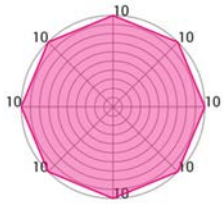

Fig 26. F1,F2,F3,F4 mobility restriction

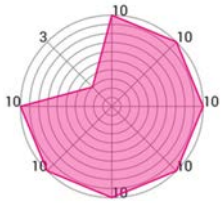

Fig 27. F5 mobility restriction

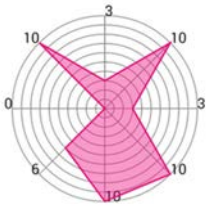

Fig 28. F6 mobility restriction

The status of footballers is relatively straightforward to present based on the analysis of table 6.

- On all eight investigation directions, the subjects F1, F2, F3, and F4 have the best behavior. They act the same way in all eight directions in relation to the support surface, therefore it will not destabilize and will remain stable.
- Subject F5 has one restriction on the front-left direction.
- The subject F6 has 4 restrictions, the most severe in the left direction.

Upper and lower limb coordination test

The subject is positioned on the platform with his hands on the handles, and the footballer must push with the same power on both handles while maintaining his balance on the platform in the upper and lower limb coordination test. Different visuals emerge on the monitor screen, and the person being studied must pay attention to the given commands and carry them out according to the specifications.

This test is particularly crucial for football players because it takes their whole attention in order to react to the opponent's movements and changes of direction - in this case, the screen of the device's display.

This dynamic test was found to be tough for individuals F1, F3, F4, and F6, who were only able to complete the activities for around 30 seconds, achieving level 0 (see figure 29). On the other hand, footballer F5 achieved level 8 and he was able to complete the activities for around 99 seconds, witch shows he has the best coordonation between lower and upper limbs, on the second place is footballer F2 who managed to complete the activities in around 124 seconds achieving level 6.

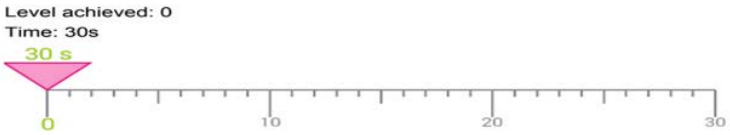

Fig 29. F1, F3, F4, and F6 upper and lower limb coordination test

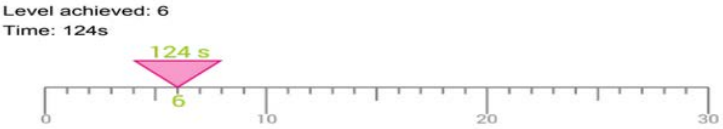

Fig 30. F2 upper and lower limb coordination test

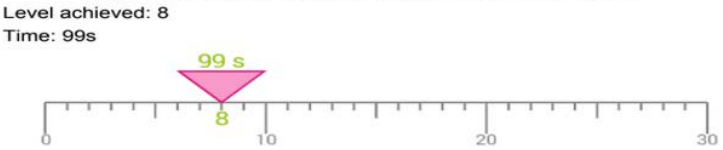

Fig 31. F5 upper and lower limb coordination test

Conclusion

The study describes the results of a preliminary test conducted on six athletes who participate in football as a competitive sport. The testing of performance footballers with the HUBER® 360 platform is particularly important because, by using the device's 6 possible tests, those characteristics of the footballers that make them vulnerable at certain competitive moments and predispose them to accidents, can lead to recovery periods over a long period, or can even take them out of the practice of their favorite sport, which is harmful to both athletes and to the sports clubs they belong.

The premises of the investigation tests of the athletes and the methods of selecting the investigated group are:

- Athletes that participate in competitive football are medically healthy.
- Every subject in this group, from F1 to F6, is fit and healthy and able to play football.
- Each member of the group expresses a desire to participate in performance sports and is eager to enhance his performance.

- Each member of the group agreed to the anticipated testing with the HUBER® 360 equipment to detect their weaknesses and to avert the coming accidents with specific, well-targeted trainings based on the test results.

The following conclusions can be drawn from the tests performed on athletes and described in Chapter 3 of this paper:

- **Stability with open and closed eyes**. There are no significant differences between athletes, but given that subject F5 has the lowest results, it`s recommended to improve its performances, especially the speed of execution, to avoid injury in the future.
- **Unipodal Test.** The differences being significant between F2 and the other participants for this study, will be necessary an improvement of unipodal support for F1, F3, F4, F5 and F6.
- **Stability Limit Test**. It could be recommended, for F2 subject, stretching for posterior calf muscles to increase mobility at the ankle joint.
- The **Mobility Restriction Test** shows that the subject F6 has to improve his mobility of the talocrural joint.
- **Coordination Test.** F1, F3, F4 and F6 need dynamic training to increase the coordination between upper and lower limbs. These workouts will help increase the adaptability to unexpected situations during competitions.

The recommendation would be for atheles to practice training that follows spontaneity during matches for improving the personal and team results.

Authors' Contribution

All authors have equally contributed to this study and should be considered as main authors.

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