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Comparative study of the isokinetic profile between footballers of the Akbou football club and man foot ballers

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Abstract: Our objective in this research is to establish an isokinetic muscle profile of a few female footballers playing in the Akbou football club aged 19.33 ± 1 (years); weight: 61.5 ± 9.41 (kg) and height: 163.5 ± 10.32 (cm) and a BMI of 22.96 ± 2 participated in this study using a very high precision technological equipment (isocinetic ergometer CYBEX NORM 2), and this in different angular speeds; which will allow us to appreciate the strength and power of the extensor muscles of the knee in a specific position very close to the technical gesture «ball strike». And to make a comparison and a rapprochement with other isokinetic profiles of footballers in different training schools. (Do not exceed 180 words)

Keywords: Isokinetic, Profile ,football

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1. INTRODUCTION

Football is the most common sport in the world, played by different social strata a trait of union between men, a physical activity that can be defined as a clash between two teams in the sole interest is to keep the ball in other words acquire some possession of the ball throughout a game while respecting the rules of the game. As a result, the practice of this discipline requires physical, technical and strategic requirements, skills and qualities. The qualities required in football are endurance, strength, speed, coordination and flexibility. On the physiological level, the footballer needs a highly developed anaerobic alactic metabolism (strength, speed and relaxation). The different stages of football training are based on improving the qualities involved in the individual and collective motor performance of players.

The performance of a player in football is multifactorial where the intervention and interaction of his tactical, physical, technical and mental abilities several in football relies on the development improvement and stabilization of several qualities, One of its essential qualities is the physical quality which represents one of the elements of this performance which generates the importance of an evaluation according to the energy sectors in order to develop physical profiles allowing us to propose models or appropriate training protocols. The objective of our study is to establish an isocinetic muscle profile of these women footballers, Compared to the profile of certain populations of footballers of an equal average age in order to be able to recommend a type of training and avoid, in particular, certain non-contact injuries which represent 28 to 76% of all football injuries (Dupont G et al., 2010). We chose two types of tests

- The first test a test that has a relationship with our study, the isokinetic test that allows us to calculate the maximum voluntary isometric force (FMIV) and calculate the holding time (TM) at 50% of the FMIV
- the second is the dynamic isocinetic test at different angular velocities, the slow speed that allows us to calculate brute force and fast speed in order to appreciate the power . This type of assessment. of muscle strength at constant speed has become the benchmark for muscle strength assessment (Harrichaux and Medelli 2002).

Since the iso-kinetics is the model that is best suited when resistance is encountered at the end of movement when the limb reaches a high speed especially during bullet strikes. It is with this in mind that we started on these tests isocinetqies and or material and the chosen techniques must be adapted to the different gestures of the ballers



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2. Materials and Methods

2.1. Materials

2.1.1. Population

Six female volunteers aged 19.33 ± 1 (years); weight: 61.5 ± 9.41 (Kg) and height: 163.5 ± 10.32 (Cm) and BMI of 22.96 ± 2 participated in this study. These are the footballers of the Akbou football club who trained regularly with their teams. The isokinetic tests were carried out at the National Technical Centre of Sidi Moussa, with the input of the doctor and physiotherapists of the national team. The subjects did not present any muscle or joint injury that could prevent the tests from being carried out or bias the results. The coaches were asked to conduct these tests. Subsequently, the athletes concerned gave their consent to participate in the study.

2.1.2. Cybex Norm II

2.1.2.1. Technical data

The ergometer allows a significant functional evaluation because it closely respects the physiology of movement. It offers the possibility of maximum muscle work under all amplitudes, it can be done at all speeds, and allows to have data of: strength, power, endurance.

The Cybex allows an accurate, reproducible and comparative evaluation. However, it has some drawbacks because, like any specific equipment, it requires experienced personnel. Likewise, this one being modulable, and it is necessary to adjust it with each use according to the patient. It is through the ergometer that controlled mechanical movements are born; as well as the measurement of the mechanical parameters of the gesture and the reproducibility of the tests.

This device consists of three elements: motor, table (adjustable chair) and a lever arm. The motor generates angular displacements of a given body segment and a sensor chain enables its control. The adjustable table or chair provides support, positioning and restraint of the subject. Finally, the lever arm realizes the subject/machine interface by making the member of the subject integral to the motor. The whole is controlled by a computer type PC compatible IBM. It is from the data of the PC.

The ergometer helps us to check and test the musculature around the knee joint as well as its stabilization and allows us to have correct anatomical positions.

2.1.2.2. Operating principles

- Control of speed: a constant speed is imposed on the movement of the segment, instead of imposing a fixed resistance.
- The servo of resistance: the resistance varies and adapts itself to the movement to be equal to the force developed by the muscle.

2.1.2.3. Fields of application for the Cybex Norm II

- The assessment, evaluation and training of physical fitness.

- The assessment of the maximum voluntary force that allows for pre-operative and post-operative diagnosis, expertise, evaluation of disability deficits.
- Monitoring and validation of rehabilitation protocols for injured members.

2.1.2.4. Cybex Norm II configuration and adjustment

Before the test begins, the device must be zeroed and the engine calibrated, after which the type of test must be determined, followed by the identity of the subject, date of birth, weight and height. The isokinetic ergometer configuration adopted for dynamic and isometric tests is as follows: the reclining seat was at a rotation scale of 40° relative to the position at table orientation (top view) and low relative to the horizontal profile view (high for isometric tests). The back of the seat was at 85° to the vertical, forward-backward rotation at 15° . The contralateral member stabilizer was installed in the seat receiving tube to immobilize the right leg. The dynamometer (engine) was at an inclination scale of 0° from the horizontal axis (profile view), with a height graduated to 8 cm and a rotation position of 40° from the table axis (top view). From this moment, the subject could be installed, and it is necessary to proceed to the restraint of the subject and then to the adjustment of the lever arm

2.1.2.5. Setting up the subject

The Cybex requires special **soin** to the positioning of the subject. The ergometer appearance was necessary before performing the dynamic test. The adjustment of the different elements of the seat of the ergometer was carried out, with the positioning of the rose pulpe and the dynamometer, according to the angular values. The force torque generated by the subject was visualized on the screen of the ergometer. For this purpose, a working file was opened for each subject to enter the anthropometric data and save the test data. Subject was seated with a 15° to 20° angle of the trunk from the vertical. the subject was restrained so that the vrai remained the same throughout the test, with the trunk held by a harness and the thigh by a velcro strap. The subject can be held by the handles on each side. The communauté with adjustable central backrest is positioned so that the center of the assesseur coincides with the axis of the motor and so that the popliteal area is in coudolement with the communauté when the subject is placed at the bottom of this communauté. To adjust the lever arm, the resistive counter-support was placed on the leg segment near the ankle joint (at the tibia anterior tuberosity) or further away beyond the malleolus.

The subject reached a maximum extension that was held for a few seconds, which allowed us to validate the anatomical zero (ZA). In order to define the angular working space, as well as the angular limits for knee extension and flexion, the subject again achieved maximum extension by positioning the leg segment at the same level as the previously established anatomical zero position (ZA), then he made a maximum bending. The safety stops were placed at the defined positions. The joint gravity (muscle tone) was then determined using the computer and in relation to the position of the subject and the arm of the dynamometer. Subject correctly positioned on seat and adjustments made, test could start



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2.2- Methods

2.2.1- Anthropometric measurements

For anthropometric measurements we used a method allowing the calculation of several variables from formulas established and programmed by computer. Essentially the percentage of fat mass (FM), lean mass (LLM), volume of the lower limb (VLL). The most commonly used formulas are those of Durnin and Wormersly (1974) and Jackson et al. (1978).

2.2.2. Isocinetic isometric test.

The Cybex Norm II isocinetic device (M GAYDA et al.2003), at an angle of approximately 60° from the knee joint and 120° from the hip gives us measurements of the maximum voluntary force in the quadriceps .

The subject was attached at the level of the bust and knee in order to respect these angular positions. The measurement of voluntary isometric muscle strength (VIMF) and the 50% retention time (HT) of the VIMF gives us the value of muscular performance

. The subject was given a period of adaptation to the apparatus and movement in order to eliminate the effects of learning. Subject performed 3 sets of 3 tests to develop maximum strength. The tests were separated by 10 sec. Each series was interspersed with a 20 sec recovery phase. The best values of each series were retained and averaged. This average value was considered the VIMF. After 5 minutes of recovery, the subject then performed an extension maintained at 50% of VIMF. A visual landmark corresponding to 50% of the FMIV was placed on the computer screen, the subject matched the path of the generated force with this landmark, so he could better control the intensity of the contraction.

The timer is set just when the subject is holding its contraction for as long as possible. The elapsed time was given regularly (all 15sec) and the subject was encouraged in order to obtain the best possible performance. When the instruction was no longer respected (force trace under visual reference), the test ended and the HT was noted.

2.2.3. Dynamic isokinetic test

Muscle function in concentric mode was measured at the quadriceps and hamstrings on a Cybex Norm II isocinetic device in female footballers. In order to use the ergometer under the best safety conditions, a slight heating of ten (10) minutes on ergo-cycle (Monark, Sweden) with empty load was carried out before the dynamic tests, a minimum of three isometric voluntary contractions were performed to check the alignment of the joint. This phase allowed the choice of the best configuration of the lever arm according to the leg length of each subject. In addition, subjects could become familiar with the device and better cooperate later on the test

We measured the torque developed by the subject during a contraction with shortening of muscle insertions. To do this, the subject operates a lever arm that moves at a constant angular speed of 240°/sec, 180°/sec, 60°/sec, 30°/sec.

The subject initially performed a series of 15 extension-flexion at an angular velocity of 240°/sec in order to feel the movement and adapt to the ergometer. Then the subject performed three (3) sets of 15 extension –flexion at respective angular velocities: 180°/s, 60°/s, 30°/s. Each series was interspersed with a recovery phase of one minute. The number of repetitions was regularly given and the subject was encouraged in order to obtain the best performance, that is to say, go to the end of the three series by respecting the instruction to always go to the end of the movement either in flexion or extension. The ergometer followed the joint movement generated by the muscles

3- Statistical analysis

Means and standard deviations were calculated for anthropometric parameters and isokinetic tests. The strength of the knee extensor and flexor was reported to body weight and antagonistic agonist ratios (IJ/Q) were calculated for 60 and 180°/sec speeds. The data collected was processed on a PC computer using the statistical software Stat View and taking into account the number of the sample studied.

4. Results

4-

1. Anthropometric measurements.

Athlète	LM (Kg)	FM (%)	LLV (l)	LLMV (l)
AS	48.6	24.07	11.79	8.28
BM	51.83	32.69	12.31	8.33
HF	49.49	25.02	12.62	9.10
SE	39	25	8.36	5.46
LS	42.18	24.68	10.83	8.06
DF	39	27.87	10.08	6.72
Moyenne ± écart-type	45 ± 5.65	26.55 ± 3.28	11.04 ± 1.60	7.65 ± 1.32

Table 1: Results of anthropometric measurements:

LM: lean mass. FM: fat mass.

LLV: lower limb volume. LLMV: lower limb muscle volume.

The above table shows anthropometric measurements of our population with a lean mass (MM) of 45 5.65 kg; fat mass of 26.55 ±3.28%; lower limb volume of 11.04 ±1.60 (l), and muscle volume of 7.65 ±1.32 (l).

4.2. Isokinetic tests

4.2.1. Isometric test

4.2.1.1. Maximum Voluntary Isometric Force (FMIV)

The values of the isometric maximum strength of the players, as well as the values reported to the anthropometric data are presented in table 2



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	Level arm (m)	VIMF	VIMF /Weigh	VIMF / LM	VIMF / LLMV:
Average	0.32 ± 0.03	239.66 ± 35	3.94 ± 0.70	5.2 ± 0.49	31.75 ± 4.66
Minimum	0.28	204	3.29	4.56	24.83
Maximum	0.36	296	5.28	6.06	37.36

Table 2: FMIV Results
VIMF: voluntary isometric maximum force.
VIMF /Weight: voluntary isometric maximum force normalized to weight..
VIMF /LM: voluntary isometric maximum force to lean mass.
VIMF /LLMV: voluntary isometric maximum force normalized to lower limb muscle volume.

Table 2 shows the FMIV values, and normalized values for weight, lean mass (FMIV/MM), and muscle volume of the lower limb (FMIV/VMMI). Our population has a VMIF of 239.66 ±35 Nm, a VMIF/weight of 3.94 ±0.70 Nm/kg,

4.2.1.2. Holding time (TM).

The values of the players' hold time are shown in table 3. a VMIF/MM of 5.20± 0.49 Nm/kg and a VMMI/VMIF of 31.75 ±4.66 Nm/l.

Athlète	HT (sec)	HT/Weight	HT/LM:	HT/MVLL
Average ± standard déviation	81.83 ± 16.16	1.35 ± 0.39	1.87 ± 0.53	11.22 ± 3.44
Minimum	63	1.05	1.56	8.68
Maximum	115	2.12	2.94	17.11

Table 3: Hold-time results

HT hold time. HT/Weight: holding time normalized to weight.

HT/LM: holding time normalized to lean mass.

HT/MVLL: holding time normalized to the muscle volume of the lower limb.

Table 3 shows the values of the holding time (HT), and the normalized values in relation to weight, lean mass(TM/MM), and muscle volume of the lower limb(TM/VMMI). Our population presents: a holding time (HT) of 81.83 16.16 sec. As for the standard holding times girls report a: HT/Weight of 1.35 ± 0.39 sec/kg, a TM/ MVLL of 11.22 ± 3.44 sec/l, and a HT/MV of 1.87 ± 0.53 sec/l.

4.2.2. Dynamics isokinetic tests

4.2.2.1. Torque peak and ischium ratio, hamstring/quadriceps

Torque peak (Nm)	60Q	60 IJ	R	180Q	180 IJ	R
average	145.2	99.8	0.67	0.3	66.97	0.84
Standard deviation	23.1	14.6	0.08	25.1	12.66	0.13

Table 4: Results of torque peaks and IJ/Q ratios at. 60 and 180°s.-

60 and 180: Test speed in degrees/sec. - Q: Quadriceps (extension).

- IJ : Hamstring (Flexion). - R : Hamstring/quadriceps ratio

Table 4 summarizes the peak torque values recorded during the dynamic test. The results are expressed as mean value and standard deviation. Our population has 60°/sec torque peaks of 145.22 ± 23.1 Nm on quadriceps, 99.8 ± 14.6 Nm on hamstrings, and there is an hamstrings /quadriceps ratio of 0.67 ± 0.08 . It also has peak torque at 180°/sec of $80. \pm 3$ 25.1 Nm on quadriceps, and 65.97 ± 12.66 Nm, and an hamstring/quadriceps ratio of 0.84 ± 0.15

4.2.2.2. Average power at 60 and 180°/sec

The table below shows the average power values (on quadriceps and hamstrings) expressed by women footballers at 60 and 180°/sec.

Average power (W)	60 Q	60 IJ	180 Q	180 IJ
Average	75.4	58.3	129.9	110.3
Standard déviation	15.6	12.8	22.9	17.5

Table 5: Average power results at 60 and 180°/sec.

-60 and 180: angular velocity of the test. - Q : quadriceps (extension).

- IJ: hamstring (flexion).

Table 5 shows the average power (PM) values recorded during dynamic tests. The results are expressed as a mean value of the standard deviation. Our population has average power at 60°/sec of 75.4 ± 19.7 W on quadriceps, and 58.3 ± 12.8 W on hamstrings. It also has 180° PM/sec of 129.9 ± 22.9 W on quadriceps, and 110.3 ± 17.5 W on hamstrings

4.2.2.3 Peak torque to weight at 60 and 180°/sec

The table below shows the values of peak torque relative to weight (on quadriceps and hamstrings) expressed by footballers at 60 and 180°/sec

Peak torque/weight (Nm/Kg)	60 Q	60 H	180 Q	180 H
Average	2.35	1.62	1.3	1.08
Standard déviation	0.32	0.18	0.21	0.10

Table 6: PC/weight results at 60 and 180°/sec

-60 and 180: angular velocity of the test. -Q: quadriceps (extension).

-H: hamstring (flexion).

Table 6 summarizes the PC/weight values recorded during dynamic tests. Results are expressed as mean value and standard deviation. Our population has 60°/sec Peak Torque/Weight values of 2.35 ± 0.32 Nm/Kg for the quadriceps, and 1.62 ± 0.18 Nm/Kg for the hamstrings. It also shows values of PC/Weight at 180°/sec of 1.3 ± 0.21 Nm/Kg for the quadriceps and 1.08 ± 0.10 Nm/Kg for the hamstring.



5. Discussion

Anthropometric aspect

Anthropometric data show a small difference in height and weight among our population. For the various other parameters, the members of our sample are very homogeneous; the measurements are presented in table 1.

1. Isokinetic aspect

It is noted that the footballers recorded torque peak values at 60 and 180°/sec respectively for quadriceps (Q) and Hamstring (h) of: 145.2 ± 23.1 Nm and 99.8 ± 14.6 Nm, 80.3 ± 25.1 Nm and 66.97 ± 12.66 . These values are significantly lower than those recorded by Amato et al. 2001 on footballers in training at Nice (222.6 ± 41.1 Nm to 60Q, 165.3 ± 26.5 Nm to 60IJ, 133.3 ± 36.1 Nm to 180 Q and 130.3 ± 26.6 Nm to 180 IJ). These differences can be explained by the average weight and size of both populations (74.9 ± 7 kg and 178 ± 6 cm for boys). At equal age, body mass differences justify significant strength differences (Amato et al., 2001). These are directly related to the cross-sectional surface of the muscle. Female footballers reported average power values at 60 and 180°/sec on quadriceps and hamstrings well below the results reported by Amato et coll 2001 and Le Gall 2002. It is certain that the anthropometric characteristics influence the measurements and imply the interest of the expressed in values normalized to weight.

For weight-normalized peak torque values, women's footballers have values of: 2.35 ± 0.32 Nm/kg at 60Q, 1.62 ± 0.18 Nm/kg at 60IJ, and 1.30 ± 0.21 Nm/kg at 180Q, 1.08 ± 0.1 Nm/kg at 180IJ. These values are lower than the values recorded by Dauty on footballers of the same age category who are members of the training centre of the football club of Nantes (3.16 ± 0.39 to 60Q, 2 ± 0.21 to 60IJ and 2.37 ± 0.38 to 180Q). The physiological demands of trainee footballers provide elements of understanding justifying the superiority of trainee footballers over girls. Professional players complete intense physical preparation at the beginning of each season. The objective is to develop each player's aerobic and anaerobic qualities in order to prepare them for competition (Davis et al., 1992). A weight-training program is often associated to develop muscle strength and improve performance. In football, the lower limbs directly serve performance (Chatard 1998, Tumilty 1993).

The quantitative and qualitative association of competitive and related workloads promotes muscular-articular adaptation in favor of lower limbs (Amato et al., 2001). According to Le Gall et al. 1999, while the purely physical aspect is only one of the elements of performance along with technique, mind and tactics, high-level

football practice requires, among other things, important power qualities to the lower limbs. Lower limb power is the most important determinant of agility. The power and muscular explosiveness of the quadriceps appear to be very well correlated with the level of competition. We understand the value of muscle building.

For the 60 and 180°/sec hamstring/quadriceps (H/Q) ratios, women's footballers have values of 0.67 ± 0.08 and 0.84 ± 0.13 respectively. Various studies confirm that footballers have high hamstring/quadriceps ratios. The frequency of use of hamstrings by women footballers explains these values. During training, especially competitions, footballers run an average of 100 short sprints (Chatard 1998, Tumilty 1993, Mambaerts 1992 and Dellal 2006). This type of movement exerts intense pressure on the hamstrings in concentric mode during ground support and eccentrically during knee extension and ball strike (Amato et al. 2001). This contraction controls the concentric activity of the quadriceps and protects the ligamentous structures of the knee joint (Solomonov et al.1987, Barratta et al.1988). In the literature, footballers have values between 0.5 and 0.7 according to age and speed of testing (Morvan 1986, Pochelle 1994); Le Van (2004) reports values between 0.6 and 0.8. Our results are comparable to those found by some authors who studied populations of footballers (Ronchcongar et cool.1998, Zakas et al.1995). By contrast, Amato (2001) recorded hamstring /quadriceps ratios of 0.75 ± 0.05 to 60°/sec and 1.01 ± 0.09 to 180°/sec. This ischio-ischio balanceCalves and quadriceps is important to obtain, as it seems to be the guarantor of good active protection during the various situations of instability that may encounter the knee during football practice. Ekstrand J (2011), also considers it to be a factor in the protection of muscular accidents, so common in this sport. These values reflect the important dynamic role played by hamstrings, which is confirmed by the fact that at high speed, the share taken by hamstrings is greater, with ratios close to 1 (Kerkour et al., 1987).

6. Conclusion

The demands of football activity associated with the growth phenomenon result in an adaptation of muscular characteristics. Our study consists of determining the isokinetic profile of the six players of the football team Ball club akbou who play in the first division of the Algerian women's championship participated in the experiment.

There are no reference standards for women footballers that would have facilitated the interpretation of measurement results of flexor and extensor muscles in lower limbs using isokinetic devices. The reconciliation of the results obtained by women footballers and those obtained by other authors on populations of 38 football players was evaluated in an isokinetic. This population has an average age of 14.74 1.45



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years, an average height of 162.92 12.03 cm and an average weight of 52.95 11.77 kg. We verified that young women footballers express an average value

- Significantly lower peak torque regardless of the test modality.
- Of significantly lower power regardless of the test modality.
- of peak torque to weight significantly lower regardless of the test modality
- A comparable hamstring/quadriceps ratio regardless of the test modality
- Ischial-hamstring/quadriceps ratio that shows a balance between the hamstrings and quadriceps.
- FMIV comparable in slow speed concentric tests at 60°/sec.
- FMIV/Higher weight in slow speed concentric tests (60°/sec).

Isokinetic tests provide the athlete and coach with an objective indication of muscle efficiency. Objective criteria are thus available for an optimization of the training follow-up, a systematic test makes it possible to highlight right/left imbalances or flexors/extensors and to propose, if necessary, a rehabilitation or an adapted muscle building consisting of ten exercises to improve the balance «see article Jérôme Auger masseur et Kinesitherapeute 10 February 2023».

7-Perspectives

In football activity, the lower limbs directly serve performance, a specific work of muscle strengthening hamstrings and quadriceps is there fore recommended for these footballers.

The change of direction according to the strength gains linked to a bodybuilding work can not be evidenced in a study of this kind, For this it would have been desirable to know if the increase in strength of the lower limbs is accompanied by an increase in jumping and sprint performance to really confirm the interest of weight training exercises in the footballer.

The results obtained in this study can be used as a benchmark for muscle building for these women footballers.

From a purely medical point of view, the interest of an annual test with footballers is the detection of possible muscle deficits that must be interpreted and treated. This type of test should also be used as a reference in the context of re-training for effort after injuries

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