PROPOSITION OF STANDARDS FOR POSTUROGRAPHIC PLATFORM AFP 40/16

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1 Introduction

The screening of abnormalities of the posture at the not painful stage seems essential in sports medicine, which is above all a prevention medicine (Measure S and al. 2001).

The posturography introduced the measure into the observation of the phenomena of orthostatic posture control. The publishing of the standards «standards 85 ", allowed the clinician to say if their patient was situated in a range of normality. Problem: today the posturography platforms recommended by AFP (French society of posturology) are with a frequency of acquisition in 40Hz and a coding 16 bits (said AFP40 / 16). The problem is that the standards 85 were validated with platform in 5Hz. There is today thus no standard for these news platform recommended.

The first objective of this work was to compare the values of the standards 85 with those obtained by a platform AFP40 / 16 to a group of 45 sportsmen subjects.
The second objective was to make a preliminary study of disentangling. The idea was, in a first time, to identify "sectors" to be dug to know new parameters for medical prevention.

We have in this led purpose a forward-looking study by making a series of posturographics measures to sports subjects of good and high level by a AFP40 / 16 platform.

2 MATERIAL AND METHOD

2.1 MATERIAL

2.1.1 SUBJECTS

It is about a group of confirmed sportsmen practising military varied sports, which participated in these measures.

The average of age of the subjects is:

	Age
Moy.	25,5
Dév. Std	6,3
Minimum	7,0
Maximum	55,0

The anthropometric characteristics of these subjects are:

taille(en m)	
Moy.	1,76
Dév. Std	,06
Minimum	1,63
Maximum	1,87

Poids(en Kg)	
Moy.	73,1
Dév. Std	8,8
Minimum	55,0
Maximum	93,5

Pointure	
Moy.	42,4
Dév. Std	2,0
Minimum	36,0
Maximum	46,0

Longueur M.I. (en cm)	
Moy.	91,4
Dév. Std	4,6
Minimum	81,0
Maximum	101,0

Duration of the sports practice:

Activité Physique et Sportive (Heures/semaine)	
Moy.	22,1
Dév. Std	8,7
Minimum	0,0
Maximum	30,0
Médiane	25,0

We do have to note that the declared duration corresponds in the time of presence on playing field and that we can consider that there is an intense practice for half of the declared time.

The population of military sportsmen practises varied sports. We classified them to identify the type of the main sport.

Type of the main Sport :
- Pivot (Example: tennis, volleyball): 11
- Pivots-contacts (Example: football, basketball(sneaker), handball): 15
- On-line (Example: running, swimming, cycling): 19

2.1.2 POSTUROGRAPHY PLATFORM
It is about a posturography platform of type SATEL ®.
The dimensions are 480X480X65 mm. The weight of 12 kg.
The used sensors are of type beam at the constant moment
The capacity of load by each sensor is 100 kg, with a sensibility in 0.017 %

The peculiarity is that the sampling frequency is in 40Hz with coding in 16 bits

2.2   METHOD

2.2.1   PROTOCOL OF EXAMINATION
The subjects were examined:
- At first to collect an anamnesis: as it is about military subjects, some of examinations are realized every year with the aim of a medical follow-up. We leaned on the results of these

annual medical examinations besides the interview with the subjects to complete the elements of anamnesis necessities.
- Secondly to measure the anthropometric parameters before every posturography measure.

2.2.1.1 Collection of the anamnesis
- Identification of the subject:
    - o name, first name, sex
    - o Rank and unit of affectation
    - o Date of birth, age

Are indispensable to be able to classify the data and if necessary contact again the subjects if necessary.

- Sports activity
    - o Number of hours for a week
    - o Type of activity: on-line / pivot / pivot-contact

The idea is to look for a correlation between the sports activity, on a quantitative and qualitative plan and the posturography parameters of performance.

- Traumatic histories
    - o Knees and peg
    - o Reabilitation

The idea is to compare the subjects having suffered from traumatism which can intervene in the neuro-driving control with the other unhurt subjects. This should allow us to look for criteria of functional recovery on the postural plan.

- Vision
    - o visual Acuteness
    - o Feel chromatic
    - o Vision of the relief

The question was to observe if these parameters of the vision intervened in the postural control.

- Coefficient of chewing

The question was to observe if this parameter measuring globally the dental occlusion intervened in the postural control.
All these parameters of the anamnesis was collected by means of a form.

2.2.1.2 Collection of the anthropometric parameters

- Weight and size

The measure of the weight was made at every sportsman's systematically on the same balance before the meal and in underwear.
The measure of the size was made removed the shoes by means of a height gauge

- The length of lower limbs

The measure of the length of lower limbs was made by means of a metre-ribbon by taking the vertical line enter the big trochanter and the ground by way of the lateral malleolus.

- Dominant side

Was determined by a test for the eye and by an interrogation for the members

2.2.1.3   posturographics measures

We realized measures in static condition, opened then closed eyes, on hard then soft ground.
We shall note that the distance with the target to be fixed was 75 cms. We chose a target point and not a thread not to give a visual information of verticality to the subject

2.2.2   DATA PROCESSING

Our attention is in a work of disentangling essentially concentrated on the data of performance in static condition: the average surface, the position X and Y and LFS

2.2.2.1   Définitions

The surface corresponds to the area of the reliable ellipse which contains 90 % of the positions sampled by the center of pressure. It is considered as the most rigorous statistical measure of the dispersal of these positions (Takagi and al 1985).
A surface beyond the superior limit of normality means that there is an abnormality - statistics - of the precision of the control of the posturales oscillations

The average position X corresponds to the average of the values of the abscissas of the center of pressure on the reference table of the statokinésigramme. She is named X-mean.
The average position X (right-left) of the centre of gravity shows a symmetry of the postural tonus. When this parameter goes out of its limits - very narrow - of normality, we can be sure that exists a frank abnormality of a symmetry of this tonus, any evident orthopaedic cause having been eliminated.

The average position Y corresponds to the average of the values of the orderly of the center of pressure on the reference table of the statokinésigramme. it is named Y-mean.

The LFS corresponds to the road which the center of pressure goes through by surface unit. The LFS has no unit. A strictly normal road is represented by a LFS equal to the unit. If the LFS is upper to the unit it means that the road gone through by surface unit is upper to the normal; conversely a parameter LFS lower than the unit, means that the road gone through by surface unit is lower than the normal.
It is necessary to know that the value of the posturogramm length depends on the frequency of sampling. The standards of the parameters which use the length, as the LFS, can be thus used only if the signal processing was realized on the data of a realized recording, or reduced, in a cadence of sampling of 5 Hz

2.2.2.2   Methodology

We realized at first a descriptive analysis of the data of posturographics performances of our 45 subjects by calculating for each of them the average, the distance-type and the distribution of the values. Then secondly we made a study more detailed of the cases «abnormal subjects 85 ", to allow a discussion of the "profile" of these subjects.
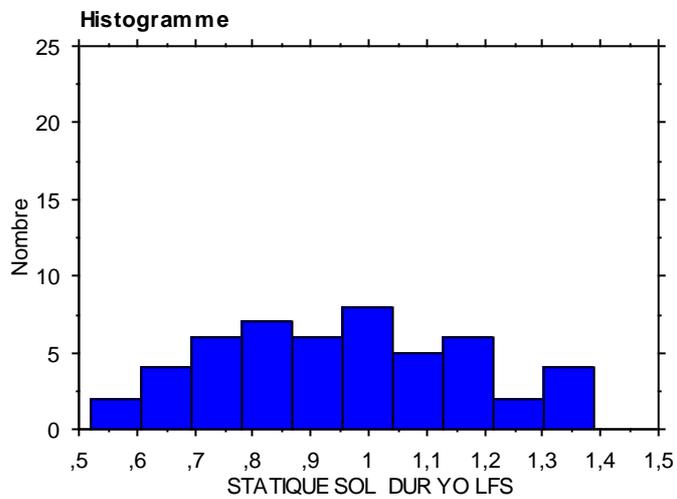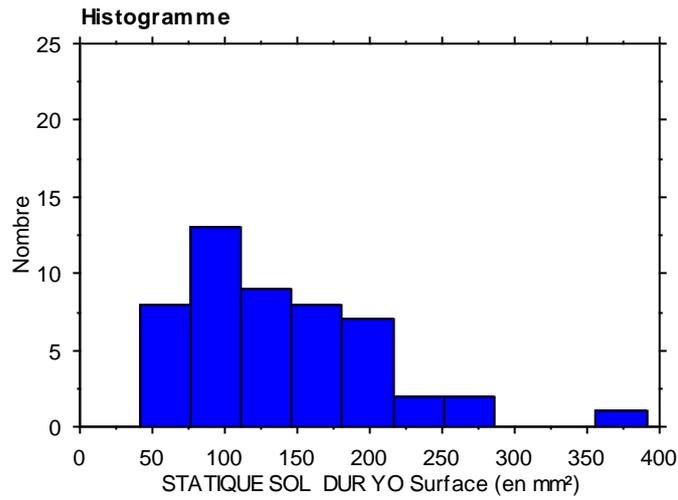
3   RESULTS

3.1   DESCRIPTIVE ANALYSIS

3.1.1   VALUES OPENED EYES (YO) ON HARD GROUND (SD)
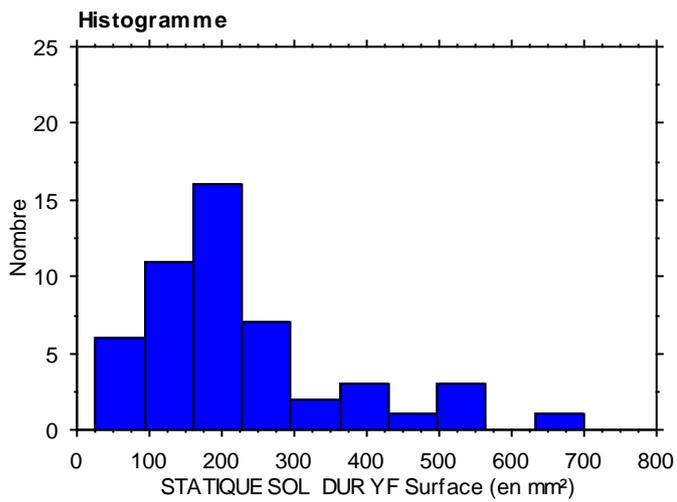
	Moy.	Dév. Std	Minimum	Maximum	Médiane
STATIQUE SOL DUR YO X-Moyen (en mm)	-1,11	6,37	-19,40	11,50	-1,55
STATIQUE SOL DUR YO Y-Moyen (en mm)	-39,07	22,87	-75,30	80,10	-41,45
STATIQUE SOL DUR YO Surface (en mm²)	137,22	66,55	41,00	391,00	123,50
STATIQUE SOL DUR YO LFS	,96	,22	,52	1,39	,96

Histogramme

Histogramme

Histogramme

Nombre

STATIQUE SOL DUR YO Surface (en mm²)

Histogramme

Nombre

STATIQUE SOL DUR YO LFS
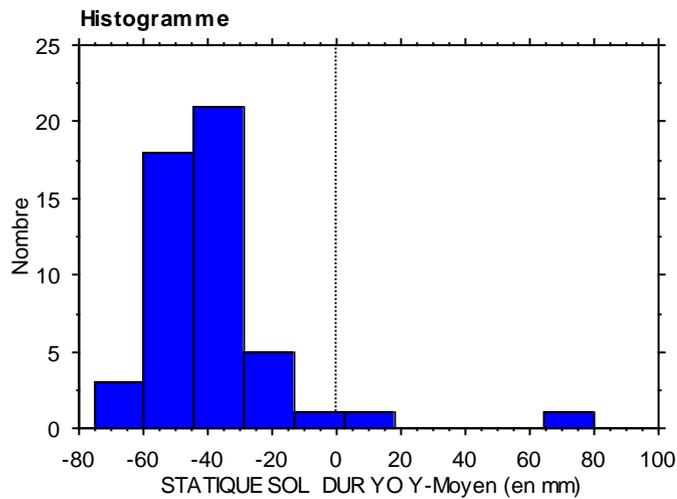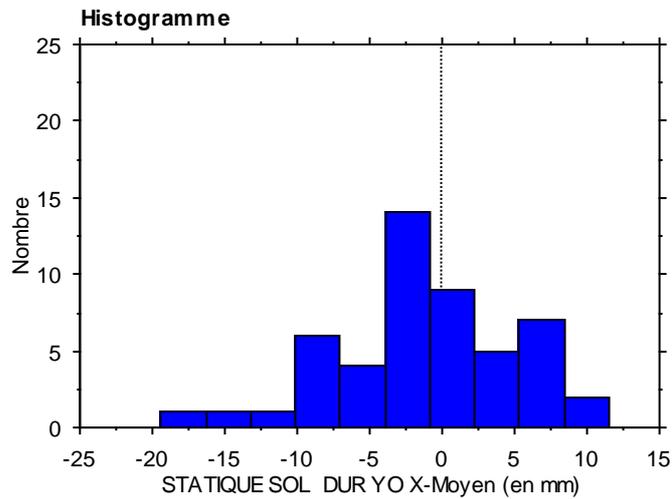
3.1.2 VALUES CLOSED EYES (YF) ON HARD GROUND (SD)

	Moy.	Dév. Std	Minimum	Maximum	Médiane
STATIQUE SOL DUR YF X-Moyen (en mm)	-,028	7,620	-19,400	13,800	-,100
STATIQUE SOL DUR YF Y-Moyen (en mm)	-36,940	21,303	-74,100	74,100	-41,150
STATIQUE SOL DUR YF Surface (en mm²)	225,880	138,274	26,000	700,000	197,500
STATIQUE SOL DUR YF LFS	1,103	,342	,570	2,020	1,045

Histogramme

STATIQUE SOL DUR YF X-Moyen (en mm)

Histogramme

STATIQUE SOL DUR YF Y-Moyen (en mm)

Histogramme

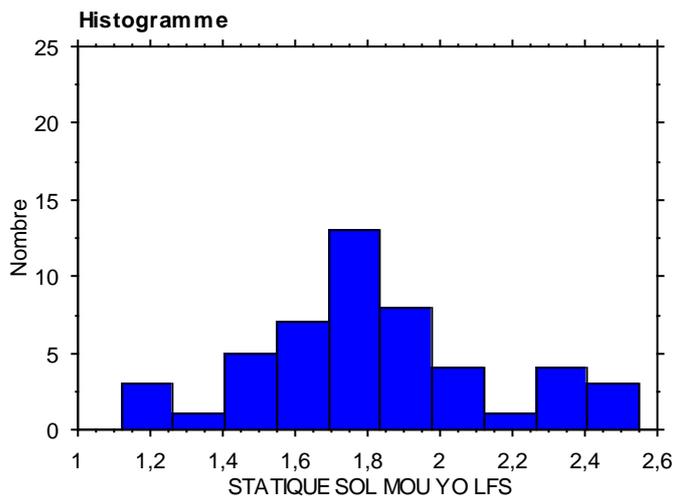STATIQUE SOL DUR YF Surface (en mm²)

Histogramme

STATIQUE SOL DUR Y F LFS
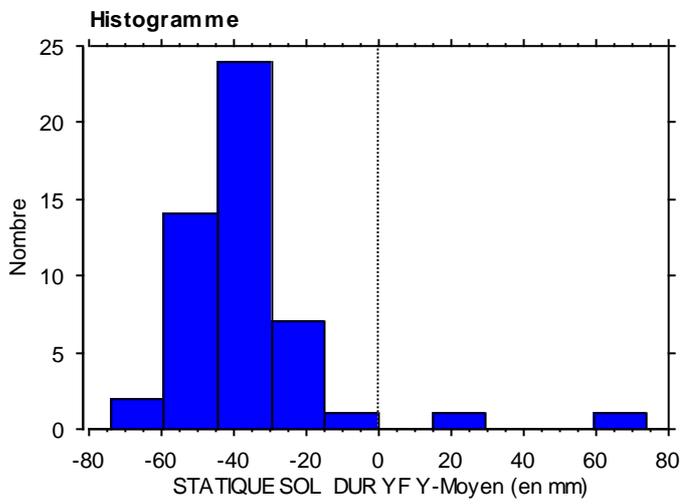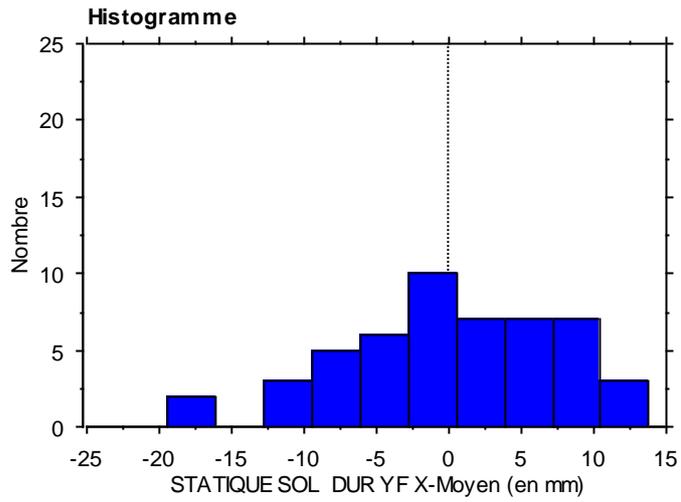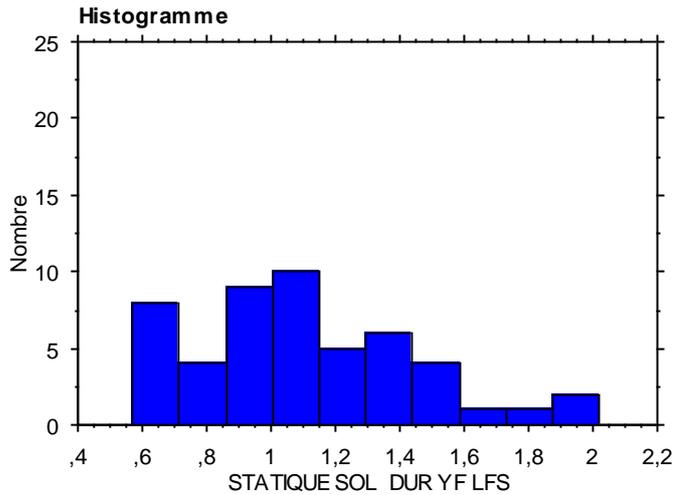
3.1.3 VALUES OPENED EYES (YO) ON SOFT GROUND (SM)

	Moy.	Dév. Std	Minimum	Maximum	Médiane
STATIQUE SOL MOU YO X-Moyen (en mm)	-2,64	9,16	-25,20	16,80	-1,40
STATIQUE SOL MOU YO Y-Moyen (en mm)	-9,69	22,68	-55,30	83,70	-10,40
STATIQUE SOL MOU YO Surface (en mm²)	458,78	164,42	204,00	999,00	419,00
STATIQUE SOL MOU YO LFS	1,82	,33	1,12	2,55	1,80

Histogramme

STATIQUE SOL MOU YO X-Moyen (en mm)

Histogramme

STATIQUE SOL MOU YO Y-Moyen (en mm)

Histogramme

STATIQUE SOL MOU YO Surface (en mm²)

Histogramme

STATIQUE SOL MOU YO LFS
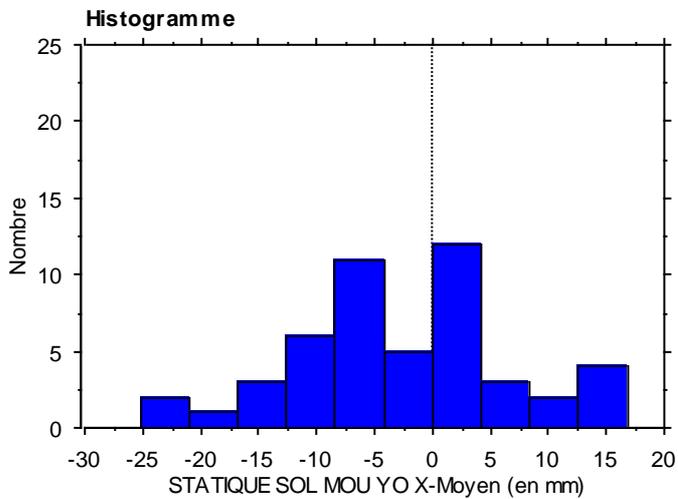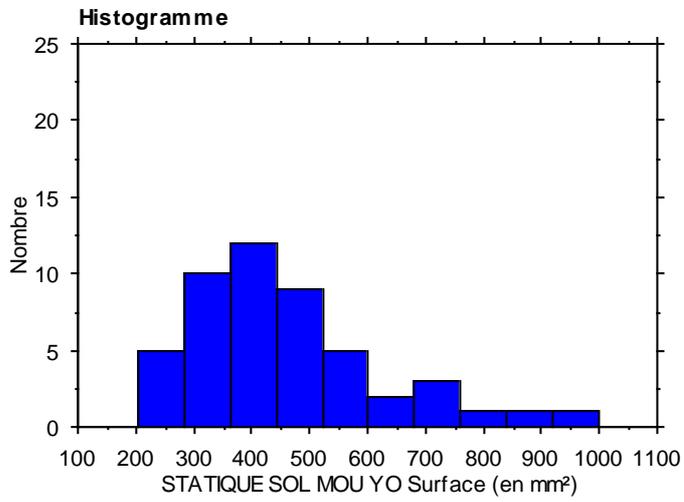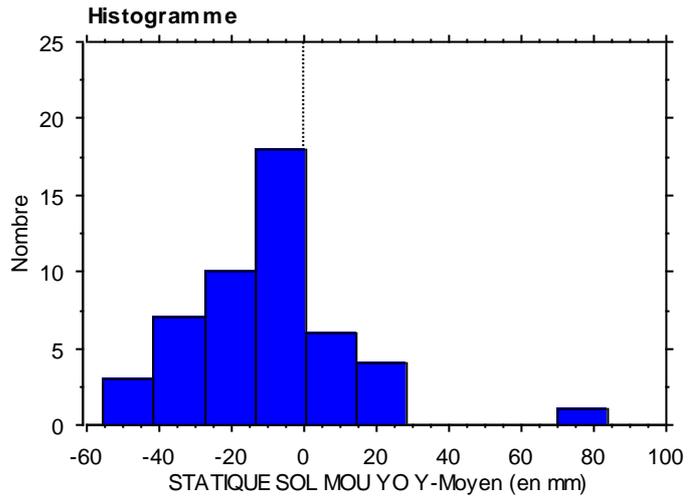
3.1.4   VALUES CLOSED EYES (YF) ON SOFT GROUND (SM)

	Moy.	Dév. Std	Minimum	Maximum	Médiane
STATIQUE SOL MOU YF X-Moyen (en mm)	-1,11	9,79	-20,90	16,60	-1,00
STATIQUE SOL MOU YF Y-Moyen (en mm)	-4,60	22,66	-51,70	87,00	-4,20
STATIQUE SOL MOU YF Surface (en mm²)	1723,80	668,41	820,00	3776,00	1509,00
STATIQUE SOL MOU YF LFS	1,30	,47	,30	2,20	1,40

Histogramme

STATIQUE SOL MOU YF X-Moyen (en mm)

Histogramme

STATIQUE SOL MOU YF Y-Moyen (en mm)

Histogramme

STATIQUE SOL MOU YF Surface (en mm²)

Histogramme

STATIQUE SOL MOU YF LFS
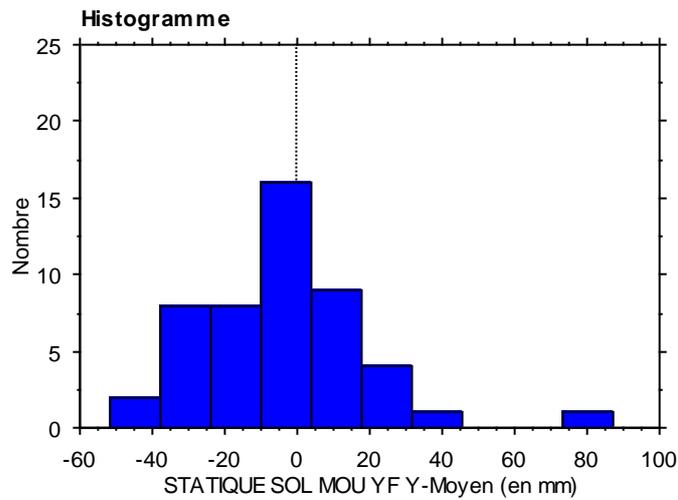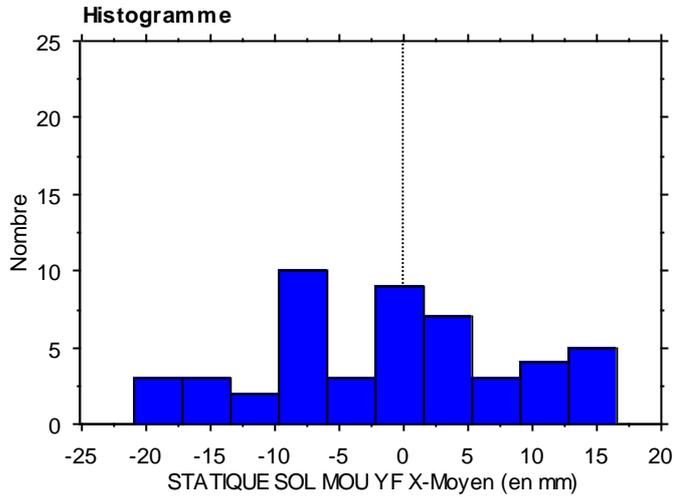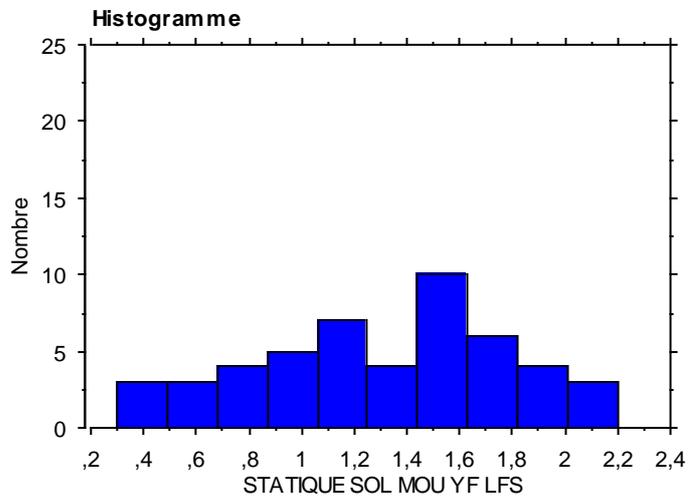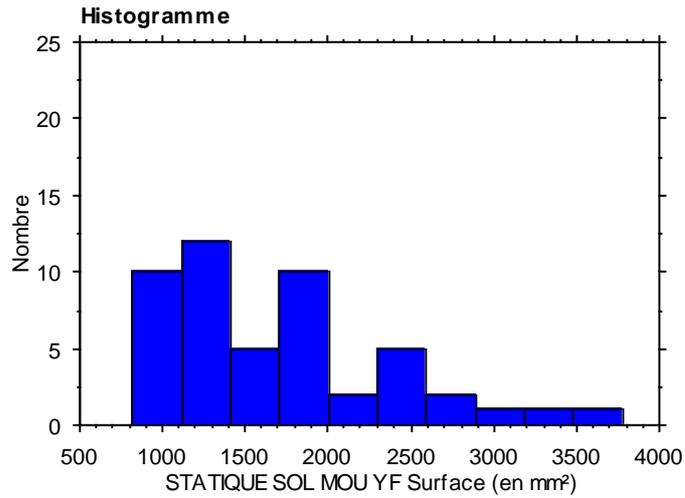
3.2   ABNORMAL SUBJECTS FOR THE STANDARDS 85

The standards exist for the measures on hard ground only, eyes opened and closed. We present the cases of subjects having exceptional values the opened eyes and present their results opened and closed eyes.

3.2.1   X MEAN

The Standard 85 gives a interval going from 9.6 to 11.7 mm.

3.2.1.1   Subjects above the interval

No subject >11.7 mm

3.2.1.2   Subjects below the interval

3 subjects < -9.6 mm

	Moy.	Dév. Std	Minimum	Maximum
STATIQUE SOL DUR YO X-Moyen (en m...	-15,200	4,015	-19,400	-11,400
STATIQUE SOL DUR YO Y-Moyen (en m...	-24,100	17,930	-34,800	-3,400
STATIQUE SOL DUR YO Surface (en m...	106,000	28,618	88,000	139,000
STATIQUE SOL DUR YO LFS	,853	,084	,800	,950
STATIQUE SOL DUR YF X-Moyen (en mm)	-16,200	5,116	-19,400	-10,300
STATIQUE SOL DUR YF Y-Moyen (en m...	-24,733	17,454	-35,600	-4,600
STATIQUE SOL DUR YF Surface (en mm²)	161,667	24,214	134,000	179,000
STATIQUE SOL DUR YF LFS	1,157	,102	1,040	1,230
STATIQUE SOL DUR Quotient de ROMB...	157,000	34,117	129,000	195,000

The subjects having Xmean to the left remain diverted to the left blindly.
We do not note with this abnormality any other abnormality on Ymean, surface or LFS.

3.2.2 Y MEAN

The Standard 85 gives a interval going from -1.5 to -57mm.

3.2.2.1   Subjects above the interval

1 subject > -1.5 mm

	Moy.	Dév. Std	Minimum	Maximum
STATIQUE SOL DUR YO X-Moyen (en mm)	,800	•	,800	,800
STATIQUE SOL DUR YO Y-Moyen (en mm)	80,100	•	80,100	80,100
STATIQUE SOL DUR YO Surface (en mm²)	391,000	•	391,000	391,000
STATIQUE SOL DUR YO LFS	1,120	•	1,120	1,120
STATIQUE SOL DUR YF X-Moyen (en mm)	5,700	•	5,700	5,700
STATIQUE SOL DUR YF Y-Moyen (en mm)	74,100	•	74,100	74,100
STATIQUE SOL DUR YF Surface (en mm²)	700,000	•	700,000	700,000
STATIQUE SOL DUR YF LFS	,930	•	,930	,930

We notice by this subject that besides having a very previous position, it presents an increased surface. It is a high-level crossman sportsman to whom we calculated besides an energy cost in the running very high.

3.2.2.2   Subjects below the interval

7 subjects < -57mm

	Moy.	Dév. Std	Minimum	Maximum
STATIQUE SOL DUR YO X-Moyen (en mm)	-1,443	8,373	-9,000	11,500
STATIQUE SOL DUR YO Y-Moyen (en mm)	-62,614	6,263	-75,300	-57,700
STATIQUE SOL DUR YO Surface (en mm²)	139,571	47,141	71,000	214,000
STATIQUE SOL DUR YO LFS	1,113	,099	,940	1,230
STATIQUE SOL DUR YF X-Moyen (en mm)	1,143	10,326	-12,200	13,000
STATIQUE SOL DUR YF Y-Moyen (en mm)	-55,243	10,315	-74,100	-44,100
STATIQUE SOL DUR YF Surface (en mm²)	216,714	86,506	151,000	372,000
STATIQUE SOL DUR YF LFS	1,360	,351	,850	2,020

Subjects having Ymean in back stay in back blindly, nevertheless we note a tendency to refocus.
We dont note any abnormality in Xmoyen, surface or LFS.

3.2.3 Surface

The Standard 85 gives a interval going from 39 to 210 mm²

3.2.3.1 Subjects above the interval

6 subjects > à 210 mm²

	Moy.	Dév. Std	Minimum	Maximum
STATIQUE SOL DUR YO X-Moyen (en mm)	-1,167	4,769	-8,600	4,500
STATIQUE SOL DUR YO Y-Moyen (en mm)	-27,133	54,035	-66,400	80,100
STATIQUE SOL DUR YO Surface (en mm²)	262,667	65,817	214,000	391,000
STATIQUE SOL DUR YO LFS	1,012	,257	,700	1,320
STATIQUE SOL DUR YF X-Moyen (en mm)	-,700	6,679	-8,900	8,000
STATIQUE SOL DUR YF Y-Moyen (en mm)	-21,000	47,168	-49,500	74,100
STATIQUE SOL DUR YF Surface (en mm²)	425,500	197,664	225,000	700,000
STATIQUE SOL DUR YF LFS	1,008	,358	,670	1,560

We note that the subjects having an increased surface tend to normalize blindly.
The only one of 6 subjects stays with a surface increased blindly, was the same who had a very previous position.

3.2.3.2 Subjects below the interval

No subject < à 39 mm²

3.2.4 LFS

The Standard 85 gives a interval going from 0.72 to 1.39

3.2.4.1 Subjects above the interval

No subject > 1.39

3.2.4.2 Subjects below the interval

4 subjects < 0.72

	Moy.	Dév. Std	Minimum	Maximum
STATIQUE SOL DUR YO X-Moyen (en mm)	1,700	5,646	-3,900	9,300
STATIQUE SOL DUR YO Y-Moyen (en mm)	-36,550	9,738	-48,400	-27,300
STATIQUE SOL DUR YO Surface (en mm²)	118,750	88,917	41,000	238,000
STATIQUE SOL DUR YO LFS	,645	,054	,570	,700
STATIQUE SOL DUR YF X-Moyen (en mm)	,625	3,884	-4,300	5,200
STATIQUE SOL DUR YF Y-Moyen (en mm)	-40,800	8,668	-49,500	-28,800
STATIQUE SOL DUR YF Surface (en mm²)	110,500	93,443	26,000	244,000
STATIQUE SOL DUR YF LFS	,637	,078	,570	,710

We find that on 4 subjects which have a low LFS with opened eyes, 2 keep it low blindly.
There is for none of the subjects of abnormality associated by the other criteria of performance: surface, X and Y means.

4   DISCUSSION

4.1   ABNORMAL SUBJECTS

Generally speaking, We note that there are few "abnormal" subjects:

- Is it Necessary to refine the standards for the sports population? Indeed we can consider that the sports population is not identical to the general population.
- Considering the stressed driving constraints, we can expect from the sports population of the values of performance for stabilométrique superior to the general population.
- These more restricted standards would so allow us to identify insufficient postural recoveries, particulary after rehabilitation.

We notice that the abnormalities of the criteria of posturography performances of our subjects were always isolated, except a case where we observed at the same time a very previous position and a high surface.

4 subjects having a left abnormality of Xmean, and presented disorders of the eye motricity confirmed by an orthoptic Measure. We can discuss the interest of the use of a posturography platform for screening of disorders of the eye motricity having for consequence an postural asymmetry (Measure S and collar(pass). 2001).

4.2   VALUES ON HARD GROUND

If we compare our values observed to those of the standards 85 (Gagey and collar(pass) 1995):

Measured parameter	Standard 85 YO	YO	Standard 85 YF	YF
X-mean	1.1 (-9.6/11.7)	**-1.1 (-13.9/11.7)**	0.3 (-10.5/11.1)	**-0.03 (-15.2/15.2)**
Y-mean	-29.2 (-1.5/-57)	**-39.1 (6.5/-84.7)**	-27.5 (-3.6/-51.4)	**-36.9 (5.7/-79.5)**
Surface	91 (39/210)	**137 (5/269)**	225 (79/638)	**225 (0/501)**
LFS	1 (0.82/1.39)	**0.96 (0.52/1.4)**	1 (0.70/1.44)	**1.1 (0.5/1.7)**

We find that the reliable intervals of our measures are more important, what comes probably from the fact:

- Of the smallest number of subjects included in our study;
- Of the presence of possible subject (s) abnormal because as we saw him(it), certain parameters were exceptional 85.

However this comparison would tend to consider that the standards 85 are valid for the posturography platform AFP40 / 16.

4.3   VALUES ON SOFT GROUND

Measured parameter	YO	YF
X-mean	**-2.6 (-20.9/15.7)**	**-1.1 (-20.7/18.5)**
Y-mean	**-9.7 (-55.1/35.7)**	**-4.6 (-50/40.8)**
Surface	**458 (130/786)**	**1723 (387/3059)**
LFS	**1.8 (1.2/2.4)**	**1.3 (03/2.3)**

We note that surfaces and LFS are very increased eyes opened and closed with regard to the hard ground. These measures seem logical because there is a disturbance of the information proprioceptive.

Besides, we note that the coefficient of Romberg is more important on soft ground (376) than on hard ground (288). This goes to the directionof the rise of the role of mink when the proprioceptives

information is perturbed. There would be a variable "weight" of the role of sensorial entries to the postural control.

5   CONCLUSIONS

The study of the posture in the field of the sports medicine seems to be an important field of investigation.
The introduction of a technique of measure seems indispensable to try to study and to report most objectively possible our observations.

It seems that Normes85 remains valid for the posturography platform AFP40 / 16, but a more pushed study remains necessary, in particular at the sportswomen.
It is necessary to discuss the interest of smaller limits of standards for our sports population.

The posturography associated with the postural clinical examination seems to be a method allowing to detect oculo-driving disorders having a postural echo

It seems necessary to treat more widely all the data which we raised. In particular fréquentielles analyses and dynamic measures

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