ANALYSIS OF POSTURE AND ITS IMPACT ON PERFORMANCE IN WOMEN'S WATER POLO

Salvatore Napolitano, Antonio Ascione and Davide Di Palma

Parthenope University, Naples, Italy

Original scientific paper

Abstract

Purpose. The study examines the postural effects on the wellness and the performance of fourteen professional female water polo athletes. There are no written studies on water polo, probably because it is assumed that there is no pain because Archimedes's formula opposes the force of gravity. Currently athletes carry out exercises to compensate and to avoid any eventual pain that then disappears when they are out of the water according to motor control and learning theory. The aim is to understand the phenomenon in professional athletes using a tridimensional analysis of the surface of the torso and the baropodometric platform. Methods. This consists in examining the "3D" surface of the torso of fourteen professional water polo athletes, participants in the Italian Championship in the A1 series, and the data of the baropodometric platform. This data highlights curves that will then be considered with regards to athletic performance and well being. The data of performance and well being of the athletes is collected by a trainer for each single athlete. The study was carried out at the specialized center CORPORA of Gricignano (CE) with the following apparatus: "Formetric Spinometer". This allows the morphological 3D image of the torso, with extreme accuracy (error below 0,2 mm), speed, and safety thanks to the radiation free equipment. The postural Formetric check-up supplies a series of indicators which together give a detailed evaluation of the subject's posture. For each athlete a synthesis chart was elaborated, showing a 3D reconstruction of the surface of the torso and the individualization of specific postural parameters with the data collected by the trainers on the athlete's performance and well being. This data was elaborated using a statistic model of linear regression. Results. The evaluation of the data shoes no existent correlation between cases with pseudo pathological curves and their state of well being and performance. While athletes with a near perfect exam often complained about occasional pain. Conclusions. There is a paradox regarding affection, performance and pain; in some cases it is low, while in some cases, it is the opposite. The results of the Archimedes's principle and the force of gravity probably produce physiological adjustments in water.

Key words: *Spinometria Formetric, posture, performances.*

Introduction

This study has analyzed the effects of postural aspects on the state of well being and performance of 14 high level water polo athletes (Teczely&Ángyán,2006). The tri dimensional analysis of the surface torso and the baropodometric platform supplied specific data collection that was useful to better understand the effects that posture has in sports performance, and especially on the capability of the athlete's body to modify and correct posture in order to compensate the presence of any eventual pseudo pathological curves. The Formetric data collecting method is the most widespread in the world, offering a tridimensional optic system screening of the spinal cord and posture. Data on morphological appearance of the athletes were detected thanks to Spinometro Formetric Diers, an optical analysis system of the spine, designed in Germany thanks to a project of the European Community (for screening and the study of scoliosis in children to prevent risks related to 'high number of exposures to x-rays), and spread throughout the world in major centers dedicated to spinal pathologies. It 'the first system designed to perform the analysis of posture and three-dimensional morphology of the back method with Non-Invasive and Non-ionizing. The Foremtric system offers a non invasive screening system and an extensive optical scan of the vertebrae (for a static image screening, with a time of 40 milliseconds to exclude the effects caused by spontaneous postural variations), with the possibility to graphically represent numerous problems of clinical nature inherent to objective analysis and in quality of corporal statics and posture, scoliosis and of all the possible alterations of the spinal cord. The morphological screening system of the spinal cord, automatically collects the points (C7, sacrum, lumbar), the meridian line and the rotation of the vertebrae. The result is the creation of a tri dimensional model of the spinal cord, or rachis, in its entirety, representing morphological rotation and positioning of the pelvis. Thanks to numerous possible uses, the spinometer is particularly useful to:

- Screening programs for children;
- Analysis and monitoring of scoliosis patients, with the advantage of avoiding radiological exams as a first means of testing;
- Measuring, analysis and monitoring of patients affected by lordosis;
- Planning and verifying medical supplies, such as conventional prosthesis, insoles for proprioceptive correction, dental braces;

- Therapeutic support and intervention and control of results obtained;
- Control, quality verification and documentation in rehabilitation;
- Legal medicine evaluation, for example, cervical distortion trauma.

The functional principles of Formetrics is based on triangularization. The active triangularization techniques allow the collection of the surface of a specific object through a luminous source, illuminated at a determined angle, and a video camera which captures the light reflected from it. Considering a point, the three lines constituted by the congruent illuminated line source video camera, the ray of light of the object and light source, and from the rays of light reflected by the object and video camera, a triangle is derived (hence the origin of the name of the technique). When we know the direction of light and the distance of the video camera light source it is possible to calculate the distance separating the object (pt) from the video camera. Carrying out such a procedure through projection of parallel light bands (raster image), it is possible to carry out 3D superficial data with great precision (up to 0, 01 mm). Such a technique is defined topometric projection of bands or video raster stereography. As a result we individualize the coordinates of the relative pixels to each point of the object's surface "hit" by a band of light; the density of the scan results directly proportional to the density of the luminous bands. Still, if they are too elevated problems may occur during elaboration of data (Hughes & Franks, 2005; Napolitano & Tursi, 2013; Napolitano, 2014).

Results are available in the form of 3D coordinates in which the values depend on the casual position of the patient with respect to the system of image acquisition, with points distributed on the skin's surface in a regular way. The reference points allow various measures and unvaried corporal comparison, rather independently from the position of the subject with respect to image acquisition. Such anatomical points are VII cervical vertebrae, right and left lumbar and the symmetrical line. The symmetrical line of the subject with ideal posture coincides with the median line of the body and the saggital median plane, and can be considered coincidental with the spinal process line (Raiola, Parisi & Napolitano, 2012). Given the existing correlation among the superficial reference points and the bone structure, it is possible to build a highly precise tridimensional model and derive reliable evaluation parameters. The morphological evaluation passes through the following phases: automatic localization of spinal cord process line through calculation of symmetrical line; measurement of the superficial rotation with respect to the spinal process lines and vertebral rotation measurement; localization of the center of the vertebrae through evaluation of the anatomical dimensions (Napolitano et al, 2012). Few seconds after the measurements are taken the examiner will have the following information:

- Saggital profile of the dorsal structure and the spinal cord;
- Lateral frontal deviation of the spinal cord;
- Transversal superficial and vertebral rotation;
- Complex tridimensional view of the spinal cord.

Other instruments that aid in postural examination are the baropodometric platform and stabilometry. The baropodometric platform is surely a cutting edge instrument in the study of the foot. It consists in a platform with applied sensors which are connected to a computer system. What the system measures are the reactions on the ground, in an exact position and in motion. The findings and measurements collected during the exam are printed with color "photographs" in which an automatic analysis of the pressure values and their comparison to normal parameters. Through the barapodometric exam, various parameters are seen. The correct interpretation of this data allows you to precisely evaluate the general attitude of toned posture in the subject with respect to measurements collected in the norm (Ding & Fan, 2007). The collection of data is precise, instantaneous, repeatable, non invasive and allows the reduction of radiological exams. The stabilometric analysis (posturography) can be carried out be the same baropodometric platform because it is able to function as a stabilizer and measure the postural movements in static position.

Methods

The research method experimented in evaluating the 3D data collection is that of the torso of 14 water polo athletes who participated in the Italian Championships in the A1 series. Such evaluation had the goal to reveal the state of their spinal cord and highlight any eventual pathological curves and their consequences on both their athletic ability and their health. The exam was carried out at the CORPORA Center of Gricignano (CE) with "Formetric Spinometry" equipment. "Formetric Spinometry" allows you to carry out tridimensional morphological data collection of the torso with extreme accuracy (with a margin of error inferior to 0,02 mm), speed (few minutes per procedure) and safety (does not imply ionized radiation like traditional radiological exams) (Tursi et al, 2012). The Formetric postural check up supplies a series of indicators which together allow you to obtain a detailed evaluation of the subject's posture and complete the clinical examination with various elements. It was possible to carry out such research tank to the cooperation of the CORPORA center (which provided the equipment) and the Volturno S.C. Society (who provided the athletes).

Results

For each athlete a Formetric Postural Check Up was charted. This includes a 3D reconstruction of the surface torso and the individualization of specific postural parameters.

Table 1: Summary of the collected data. Source: Our Elaboration.

SURNAME	KYPHOSIS ANGLE	LORDOSIS ANGLE	PELVIC INCLINATION right (mm)	PELVIC INCLINATION left (mm)	ANTERO-POSTERIOR BENDING(°)	LATERAL DEVIATION (mm)	LATERAL BENDING right (mm)	LATERAL BENDING left (mm)	SURFACE ROTATION (°)
VALKAI	**47,50**	46,80	0,00	0,00	1,30	6,40	4,50		2,80
PELLEGRINO	48,20	**26,60**	3,00		5,30	3,20		4,50	2,70
MASCIANDA RO	49,50	45,70	1,50		1,00	2,60		12,00	**6,10**
CIAMPICHET TI	52,80	29,10	0,00	0,00	4,50	1,60		7,50	1,80
STARACE	59,20	42,00	0,00	0,00	3,80	3,00	8,20		3,30
ANASTASIO	55,00	55,80	0,00	0,00	2,00	4,70		4,50	1,40
CICCARIELL O	57,80	46,10	0,00	0,00	0,40	5,90	1,80		4,00
GIULIANI	60,40	47,50		9,00	4,40	3,50		12,00	4,10
GUILLET	**61,00**	41,10		12,00	**5,80**	**10,70**	9,00		3,60
DE SIMONE	53,40	**64,00**		3,00	1,90	4,50	1,50		3,00
STELLATO	56,60	44,50		11,80	4,00	2,10	2,50		1,80
VENTRIGLIA	58,50	52,10		3,00	0,70	6,90		**19,50**	2,90
DI MONACO	53,40	49,60	3,00		2,50	7,50		13,50	2,10

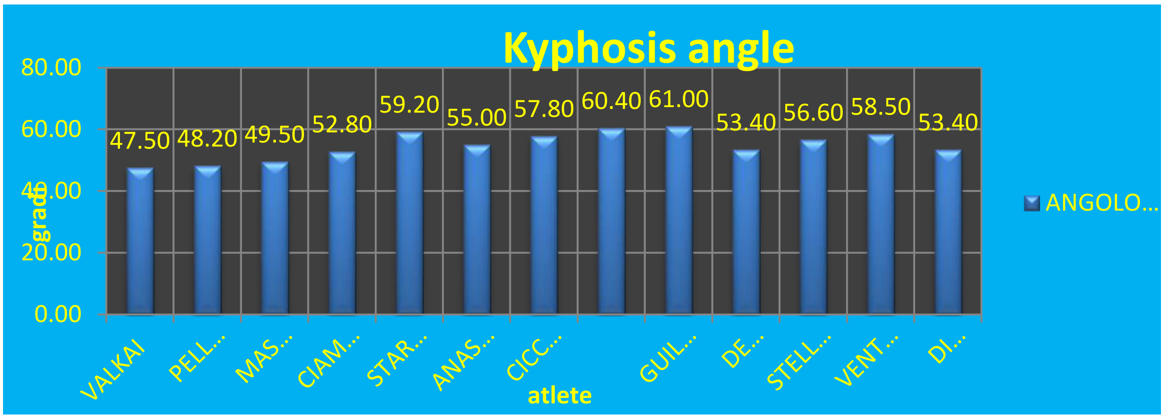


Figure 1. Kyphosis angle. Source: Our Elaboration.

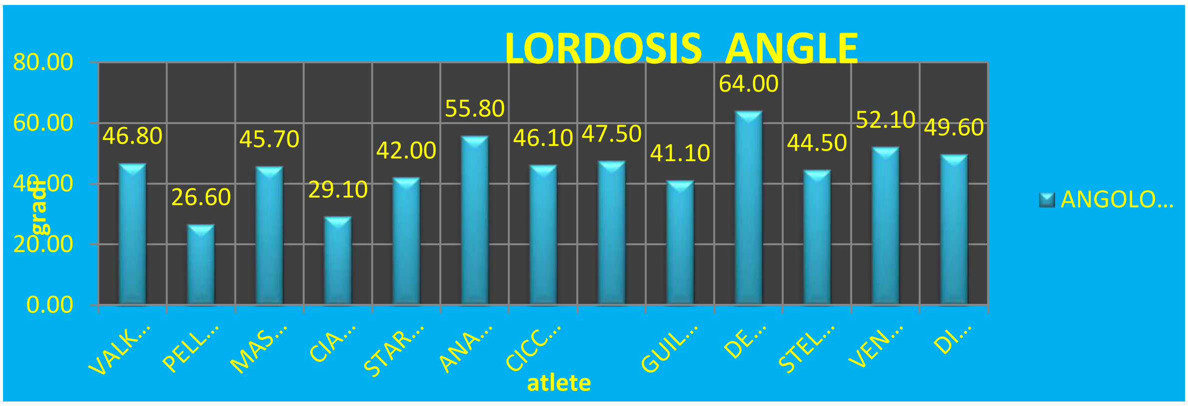


Figure 2. Lordosis Angle. Source: Our Elaboration.

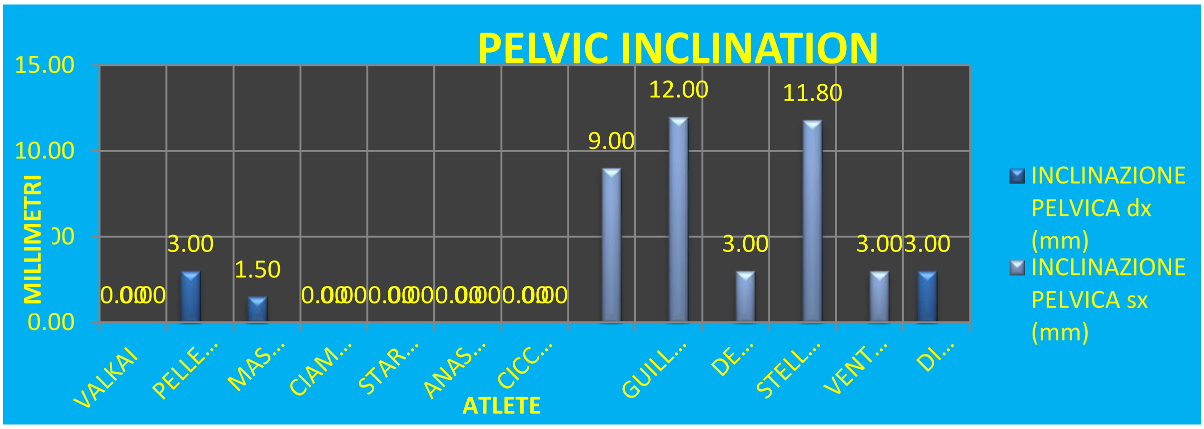


Figure 3. Pelvic inclination. Source: Our Elaboration.

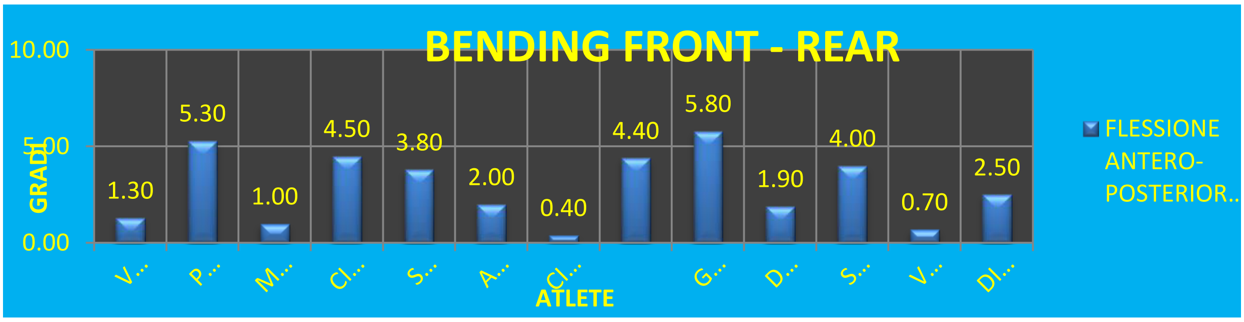


Figure 4. Bending front – rear. Source: Our Elaboration.

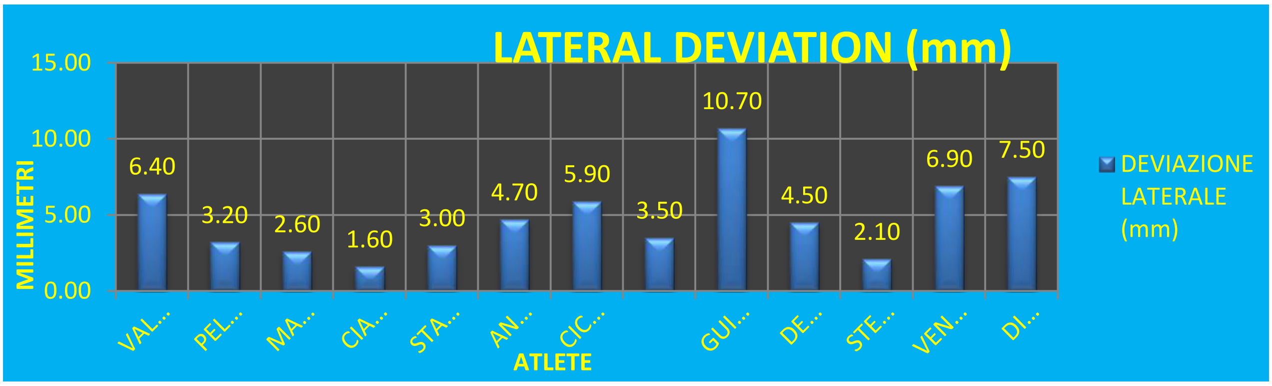


Figure 5. Lateral deviation. Source: Our Elaboration.

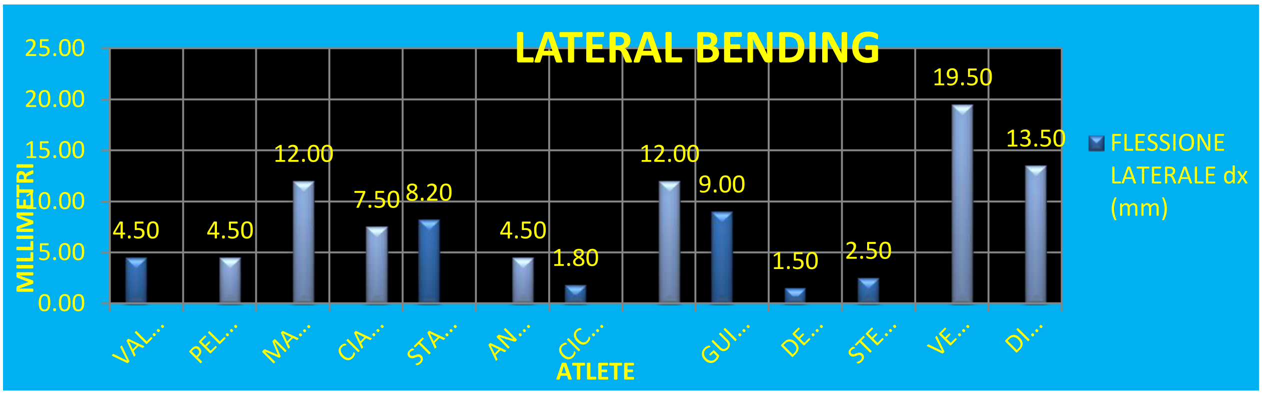
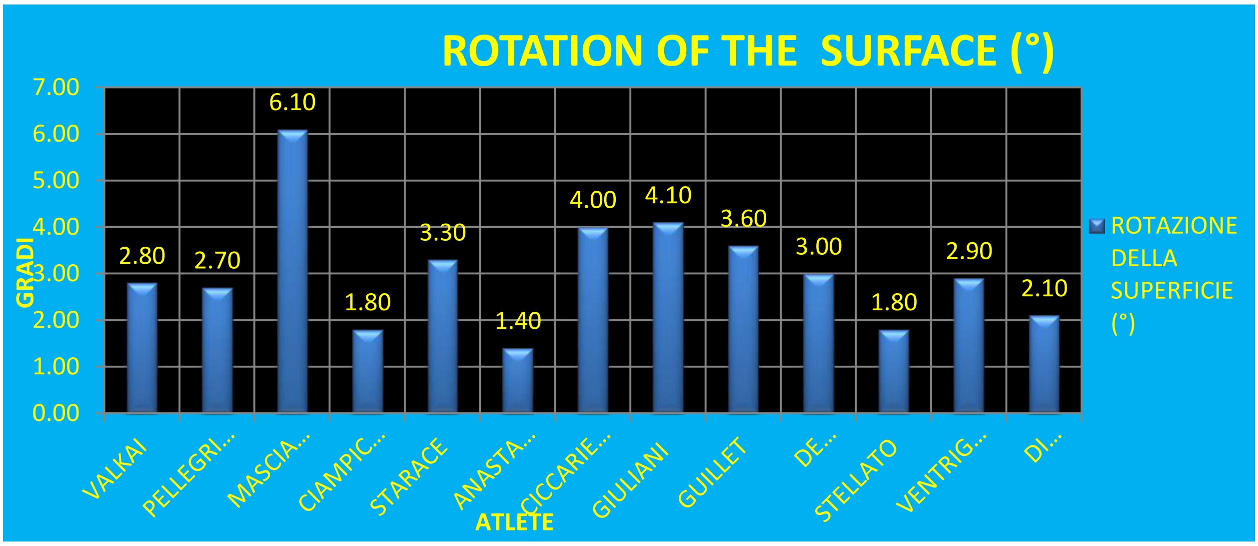


Figure 6. Lateral bending. Source: Our Elaboration.



Graphic 7: Rotation of the surface. Source: Our Elaboration.

Table 2. Linear regression.

COGNOME	ETA	ANGOLO CIFOSI	XY	X2	Y2	Y'	e	e^2	(Y-M)^2
VALKAI	33	**47,50**	1567,5	1089	2256,25	407,0805	- 359,58	129298,1	54,30556
PELLEGRINO	18	48,20	867,6	324	2323,24	222,0439	- 173,84	30221,7	44,47864
MASCIANDARO	25	49,50	1237,5	625	2450,25	308,3943	- 258,89	67026,27	28,82864
CIAMPICHETTI	20	52,80	1056	400	2787,84	246,7155	- 193,92	37603,2	4,281716
STARACE	31	59,20	1835,2	961	3504,64	382,409	- 323,21	104464	18,75556
ANASTASIO	24	55,00	1320	576	3025,00	296,0585	- 241,06	58109,22	0,017101
CICCARIELLO	24	57,80	1387,2	576	3340,84	296,0585	- 238,26	56767,13	8,589408
GIULIANI	32	60,40	1932,8	1024	3648,16	394,7447	- 334,34	111786,4	30,58941
GUILLET	28	**61,00**	1708	784	3721,00	345,4016	- 284,40	80884,29	37,58633
DE SIMONE	24	53,40	1281,6	576	2851,56	296,0585	- 242,66	58883,17	2,158639
STELLATO	22	56,60	1245,2	484	3203,56	271,387	- 214,79	46133,45	2,995562
VENTRIGLIA	23	58,50	1345,5	529	3422,25	283,7228	- 225,22	50725,3	13,18249
DI MONACO	17	53,40	907,8	289	2851,56	209,7081	- 156,31	24432,23	2,158639
SOMMA	321	713,30	17691,9	8237	39386,15			856334,5	247,9277
MEDIA	24,69230769	54,8692308							

B	**0,25381188**
A	48,6020297

XY	PRODUCT OF VARIABLES
X2	SQUARE OF VARIABLE X
Y2	SQUARE OF VARIABLE Y
Y'	STATE OF X
e	DIFF. BETWEEN OUR VALUED YARN AND WHICH WAS RECOMMENDED WITH REGRESSION PARAMETERS Y '
e^2	Sum of square errors
(Y-M)^2	PROPORTION OF SPARE PARTS
	Slope = b = 0.25381188
	Intercept = a = 48.6020297

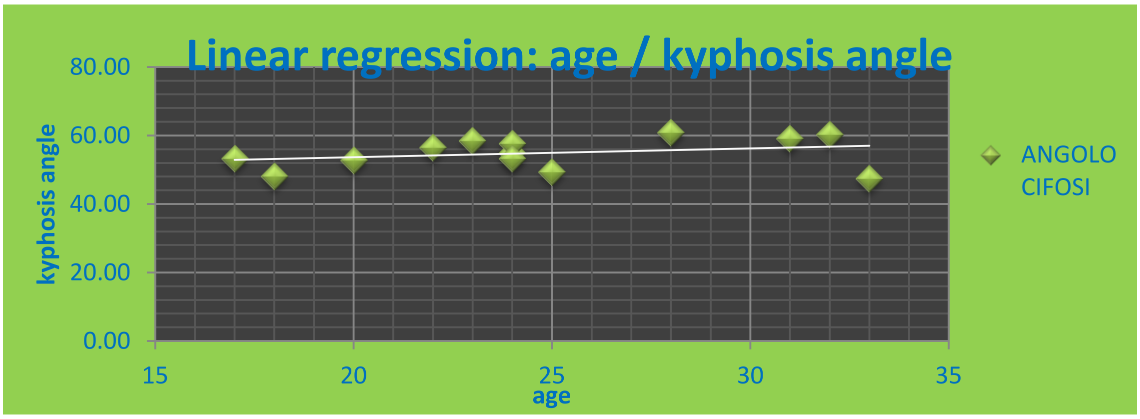


Figure 8. Linear regression. Source: Our Elaboration.

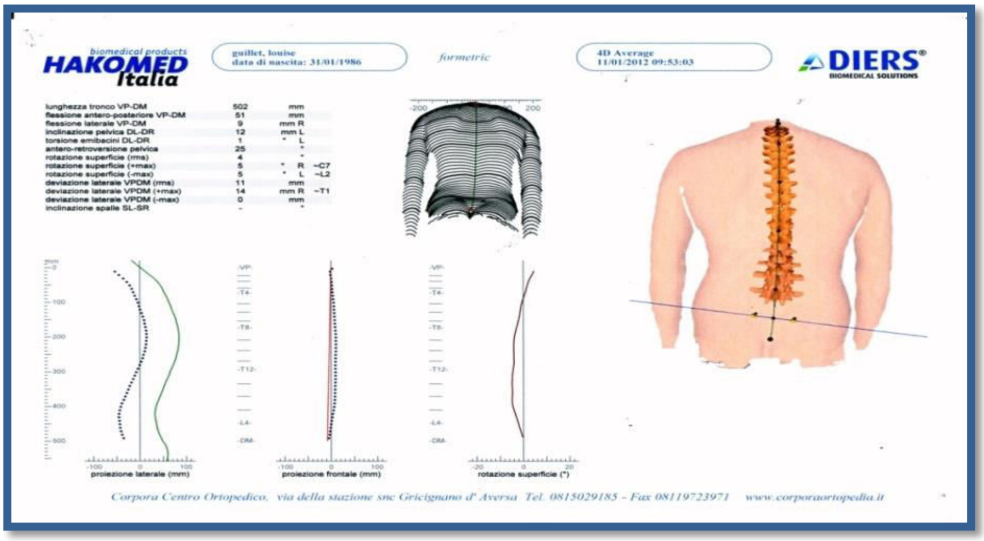


Figure 9. Postural Scheme

Discussion and conclusion

From a detailed analysis on the observed data it can be noticeable that the values of the kyphotic curve for the athlete Guillet are much higher than the normal (they should be less than 40°), with an alteration (in red) of the pelvic tilt, of the anteroposterior flexion, with the lateral deviation and left-side lateral flexion. This athlete, after an analysis of her pain measurement form, has claimed that she does not feel rachis pain. Moreover, her performances are steadily at average/good levels. Considering the data collected for the other athletes, we can say that the values are covered by the standard (Tursi, Napolitano & Raiola, 2013). For example Valkay feels pain. As we can see in the table, she does not show irregular values, except for a slighty marked kyphotic curve. After an accurate evaluation of the observed data we can claim that there is no direct connection between pains, performances and wrong posture. We have also to underline that this sport is practiced in the water so the up thrust, that is equal to the force of gravity, facilitates the support of the body (Alesi et al, 2014; Napolitano et al, 2012; Best, 2010). The human body can adapt in a morpho-functional and compensatory way but we cannot deny that a prolonged wrong posture can damage the good health of the athletes especially at the end of their sport career.

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Received: September 3, 2018
Accepted: September 15, 2018
Correspondence to:
Davide Di Palma
Parthenope University,
Naples, Italy
E-mail: davide.dipalma@uniparthenope.it