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PERFORMANCE POSTURE CORRELATION: A STUDY IN THE WOMEN'S WATER POLO

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ABSTRACT

Purpose

This study analyzed the postural aspect of 14 professional female water polo athletes. There are no studies in the literature dealing with this aspect in water polo.

Usually athletes perform exercises to compensate for pain situations due to a wrong posture.

The purpose of this study is to evaluate, by spinometric examination, any abnormalities in the posture of these athletes and to report them to possible snout situations that may adversely affect their sports performance.

Methods

Each athlete is subjected to a spinometric examination with the "Formetric Spinometer" device at the Corpora di Gricignano, This exam allows to obtain three-dimensional images with a margin of error of less than 0.2 mm. It is a safe system, and in fact, not it emits radiation and can therefore be repeated with a certain frequency, it also provides a series of data that together provide a detailed assessment of the posture of the subject

Results

The results of these examinations provided a series of data on the individual spine's spinal physiological curves and were correlated to sport performance and physical state of fitness.

Conclusions

No such correlation has been established with regard to the generation of these data and the lack of proper posture and as a consequence of poor posture and sports performance

KEYWORDS: Spinometria Formetric, Postura, Performances

INTRODUCTION

This study looked at the incidence of posture aspects of the well-being and performance of 14 high level water polo athletes. The three-dimensional analysis of the trunk surface allowed the collection of specific data, useful to better understand the impact of posture on sports performance, and above all the ability of the athlete's body to produce adjustments that compensate for the presence of any curves pseudo-pathological.

The Formetric Data Collection Method is the most widespread in the world, offering a three-dimensional optical spinal cord and posture screening system.

The morphological aspect of athletes has been identified by the Spinometer Formetric Diers, a spinal optic analysis system designed in Germany thanks to a European Community project (for screening and scoliosis study in children to avoid risks related to the high number of X-ray exposures), and spread all over the world, in the major centers dedicated to spinal pathology.

The 4D + Formetric Spinometry © (Diers) analysis system performs a detailed and extensive (without the use of markers) non-invasive three-dimensional optical detection (without X-ray and without any side-effect), static and dynamic (moving) the entire spine (spine) and the basin by providing accurate quantitative data (error less than 0.2 mm) and repeatable with graphic representations of many postural problems. Therefore, Formetric © spinometry is a reliable system of examinations, particularly suitable for posturology for the detailed, objective and quantitative analysis and evaluation of static and dynamic posture (postural examination).

The numerous indicators provided complement and complement the results of other instrumental exams, such as baropodometry and stabilometry; this results in a complete, in-depth postural check-up in the postural rehabilitation program.

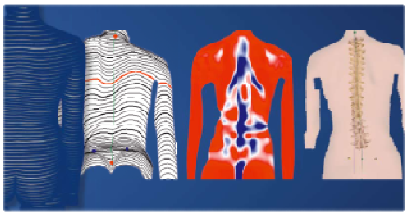


Figure 1

Unlike analysis systems using detection markers (eg BAK), thus detecting only a few points on the skin surface, the 4T + for metric pyrometry exam performs a full morphological survey, volumetric acquisition, by 10,000 measurement points based on the principle of triangulation operation applied to video-raster-stereograph. This can also detect small morphological variations, e.g. following a therapeutic treatment, and to overcome the human error of marker positioning and the detection error due to the movement of the skin during bodily movements.

The process of capturing images is simple, quick and accurate. The geometric spinometric examination is performed in complete comfort and has no contraindication or side effect. The subject is placed standing at a distance of 2 meters from the system projecting, on its rear body surface, halogen light in the form of a special grid with horizontal lines. Thanks to this optical scanning, the for metric system automatically detects anatomic patches (C7 or prominent cervical vertebrae, sacral bone, limber limbs or Michaelis), the median line (symmetry line) of the spine and the rotation of each segment of the same. The result is the creation of a three-dimensional morphological model of the entire vertebral column and the position of the basin, which can be visualized at different angles along with several significant parameters.

The results varied by performing multiple X-rays (X-rays) and BAK (Body Analisys Kapture) and 3D optical on the same subject are significant (poor repeatability of results); this is due to physiological postural changes (respiration, swallowing, emotional state etc.) and operative (upper limb position, feet, etc.). Formetric 4D + technology overcomes this problem by detecting 12 images in 6 seconds (about breath time) by computing and averaging (Averaging). Moreover, thanks to reconstruction and consecutive three-dimensional evaluation, scanning is performed only on the body's back surface; the subject should therefore not be repositioned for analysis on the other sides (front and profile). This minimizes the effect of postural variations during the examination, greatly increasing the accuracy and repeatability (in other words, the reliability) of the obtained results. The whole procedure takes a few seconds.

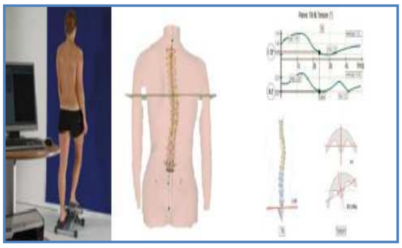


Figure 2

The analysis of motion analysis is crucial in clinical diagnostics and biomechanics. Measurements had so far been limited to the analysis of the findings of markers placed on the patient's skin (BAK, Gait Analisys). With the 4D + formetric system is now it is possible to analyze the movements of the whole body and the skeletal system (spine and basin) by measuring volumetric acquisition of 10,000 points, with a rate of up to 24 images per second. Such postural exams in orthostatistics generally last from 30 to 60 seconds, a time that allows you to detect the coordination skills and muscle deficit of the subject. In addition to the representation of engine models, accurate morphological and volumetric (graphical and numerical) variations are displayed within the chosen time frame. Typical applications are the examination of walking on treadmill or stepper. Analysis of surface curvature on the sagittal plane allows the identification of functional blocks and functional dysfunctions of the Rachid segments, contractors or muscular imbalances or trophic alterations of the connective tissue, not detectable by traditional radio diagnostic techniques. This examination also allows early diagnosis of spine lesions (spondylolisthesis) to be formulated and confirmed by radiological examination. The Spinometria Formetric 4D + system, thanks to its volumetric scanning, constructs a three-dimensional morphological model of the entire vertebral column and position of the basin, which can be visualized at different angles (instant to instant in case of motion analysis) automatically calculating as a report of the analysis numerous parameters including:

- Trunk length and positioning of dorsal and lumbar points and cervical-dorsal inversion points, back-lumbar and lumbar sacrum • lateral and lateral flexion of the trunk
- Lateral deviation (maximum and quadratic mean values)
- Vertebral rotation degrees (section, maximum and quadratic mean values)
- pelvic and antero-retrograde basin inclination and the two emibacins
- lordotic and cifotic angles, arrows Cervical and Lumbar Examinations The results of the exam are presented immediately on the screen even in graphic form and are obviously printable.

Formetric 4D + Spinometry has a wide range of application fields. Early diagnosis and monitoring of scoliosis and scoliosis, lumbar hyperlogy, dorsal hyperchyrosis, back-lumbar pharyngeal limb, Scheuermann's disease (curved juvenile back), flat back, Bechterew's disease (ankylosing spondylitis), etherometry and dissection of the lower limbs in the evolutionary age

- Evaluation of the postural contribution to musculoskeletal, organic and aesthetic problems (e.g. algae, skeletal alterations, cranio-cervical-mandibular disorders, DCM, balance problems, visual impairment, headaches, circulatory problems, cellulite). postural adaptations resulting from painful musculoskeletal and organic conditions: see the real case presentation (ppt)
- Design and verification of ergonomic and orthopedic devices (ergonomic plantar, bite, prosthesis, orthosis etc.)
- Support for therapeutic and postural rehabilitation programs and control of results obtained
- Optimization of sport performance thanks to the best e quantification and motor coordination
- Interdisciplinary use (orthopedics, physiotherapy, sports medicine, orthodontics, gnatology, otolaryngology, angiology, neurology, rheumatology, ophthalmology, gynecology, aesthetics, fitness, wellness, peritals etc.)

The design of the Formetric 4D + conducted in collaboration with the most important European university institutes under a project promoted by the European Union; such collaboration allows continued development of such applications. Numerous clinical studies confirm the precision of the Formetric detection system. Formetric Spinometry today represents the three-dimensional optical analysis system of the most widely used posture (and spine) in the world, becoming more and more crucial, among the posturology instrumental exams, regarding postural examination and postural rehabilitation programs. Thanks to this innovative system, radiographies patient surveys have been reduced by over 70%. The Diers Formetric optoelectronic scanning system principle is based on triangulation. Active triangulation techniques allow you to detect the surface of a particular object by means of a light source that illuminates it at a certain angle, and a camera that captures the reflected light. Considering the object as a point, the three lines consisting of the straight-linking light source-camera, the light beam of the light source-object and the light-reflecting object-camera light, derives a triangle (resulting in the name of the technique). Knowing the irradiation direction and the camera-source distance it is possible to calculate the distance separating the object (point) of the camera. By performing this procedure by projecting parallel luminous bands (raster image), it is possible to execute with great precision (up to 0.01 mm) three dimensional surface pads. Such technique is termed projection of bands or video-raster-stereograph. Thanks to the analogies between raster-stereograph and stereo photography, the principle of triangulation can also be used for pixel transposition, thus enabling the virtual three-dimensional reconstruction of the surface of the object. To this end, the pixel coordinates for each point on the surface of the "hit" object is detected by a light band; the scanning density is therefore directly proportional to the density of light bands, which, however, if too high causes problems in data processing.

The results now available in the form of three-dimensional coordinates (x, y, z) are not suitable for human morphological analysis with the aim of obtaining clinically relevant parameters and relatable with other examinations such as, for example, radiographic plates; and for several reasons: - Coordinate values depend on the patient's casual position with respect to the image capture system; - the points detected are distributed on the skin surface in more or less regular fashion; - unlike the technical objects, the surface of the human body has a homogeneous and mutilated morphology. Two images of the same subject are not comparable even if it is both in the same position. It is therefore necessary to represent the morphological characteristics of the body surface, irrespective of their random arrangement in space. This is made possible by the use of invariants that can be calculated on the basis of coordinates even though they are independent of them. Examples of invariants are the length of a segment, the volume of a body, the angle formed by the edges of a polyhedron and, in the case of bodies with an irregular surface, the curves. Surface curves are invariant factors as they describe the shape and not the position of a body. The shape is specifically defined by the most convex / concave points such as edges, protrusions, angles, depressions, and so on. The curvature of the surface is a local value or has a defined value for each point. Convex or concave surface portions have respectively convex or concave concave curves respectively, while saddle-shaped regions have opposite convex-concave curves. Particular cases are the parts of cylindrical surfaces and flat surfaces where one or both of the main bends are canceled. To facilitate the representation, calculate the Gaussian curvature (product of the main curvature) or the mean curvature (average curve values). It is possible to graph graphically the average curvature using shades of intensity of color, eg. With a red-white-blue chromatic scale representing respectively the different degrees of convex-flat-concave. If points of particular morphology corresponding to a characteristic curvature are identified by the distribution of surface curvature, they will also be invariants. An example of this is the points of repair, points that allow to perform various invariant measurements and bodily comparisons, that is independent of the subject's position with respect to the image capture system. Such anatomical reference points are therefore of particular importance in the video-raster-stereography and are: the VII cervical vertebrae (called "prominent"), the left and right lumbar (Michaelis iliac thighs), sacral point (top of the gluteal line) and the line of symmetry. The symmetry line is also an invaric, which in the subject with ideal posture coincides with the median line of the body (dividing it along the median sagittal plane in 2 right and left hemispheres equal) is determined by combining the points which in each transverse body section exhibit greater lateral symmetry. The symmetry line may be considered coincident with the line of spinous processes. Given the correlation between the superficial surface points and the underlying skeletal structure, it is thus possible to reconstruct a three-dimensional model with great precision as well as to derive reliable evaluation parameters. A winning feature of the raster stereotype with respect to alternative procedures is the ability to reconstruct the actual bony bone morphology and to automatically define a spatial relationship between the morphology of the back trunk and the bone skeleton.

This feature opens important prospects for clinical use, as the method of raster radiation can be used as an alternative to radiography investigations. Evaluation of the bony bone morphology goes through the following phases: 1. Automatic localization of the spinous process line by calculating the symmetry line; surface rotation measurement with respect to the line of spinous processes as a measure of vertebral rotation; localization of the center of the vertebra by evaluating its anatomical size. Within seconds after the measurement the examiner will have the following information:

- Sagittal profile of the spine and the spine
- Lateral deviation of the spine (on the frontal plane)
- Surface rotation spine rotation (transverse plane)
- Total tridimensional view of the spine.

The studies confirm the clinical relevance of raster radiography in the morphological analysis of the trunk in relation to the diagnosis and follow-up of rachid deformations (scoliosis, dorsal hyperchyrosis, lumbar hyperlordosis, etc.) important as well as in pre and post operative phase. Particular attention should be given to the need to subject subjects generally in juvenile or infant years to regular radiological controls, with the consequent load of radiations (x-rays) which results in a significant increase in oncogenic risk, despite the poor reliability of radiographic examination in three-dimensional morphological deformations of the spine, such as scoliosis. X-rays do not, for example, allow precise determination of vertebral rotation, given the greater clinical relevance in such cases, or less the aesthetic appearance of morphological defect, which is of great importance to the subject.

Method

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).

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).

DISCUSSION AND CONCLUSIONS

For a detailed analysis of the observed data it can be noticed 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 on average/good levels.

Considering the data collected for the other athletes, we can say that the values are covered by the standard.

For example Valkay feels pain. As we can see in the table, she does not show irregular values, except for a slightly 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.

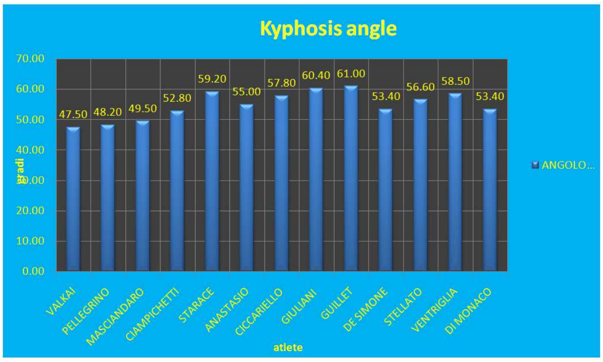
The human body can adapt in a morpho-functional and compensatory way, but we cannot deny that a prolonged wrong posture can damage the good health of the athletes especially at the end of their sport career.

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.

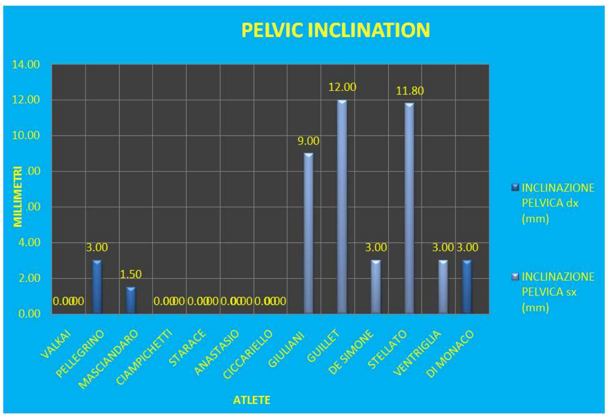
Table 1: Summary of the Data Collected

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
MASCIANDARO	49,50	45,70	1,50		1,00	2,60		12,00	6,10
CIAMPICHETTI	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
CICCARIELLO	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

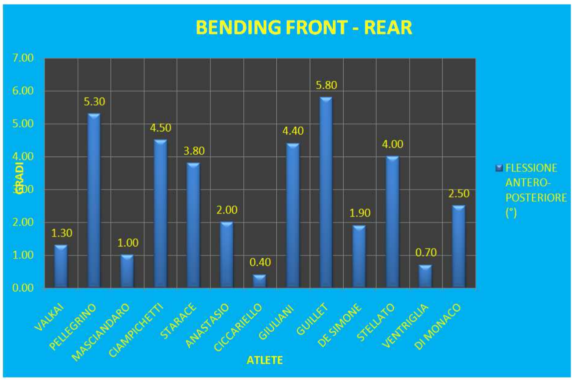


Graph 1: Kyphosis angle

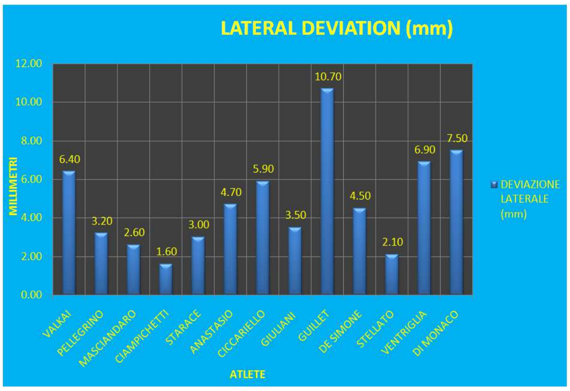
Graph 2: Lordosis Angle



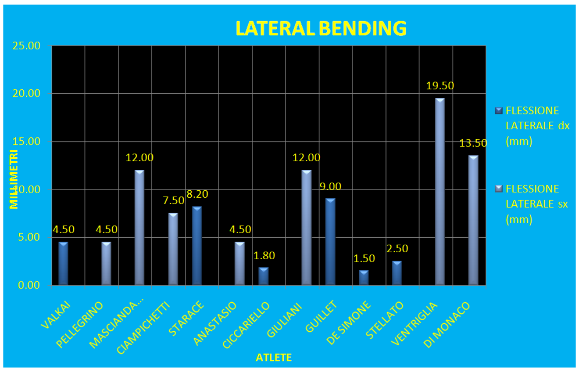
Graph 3: Pelvic inclination



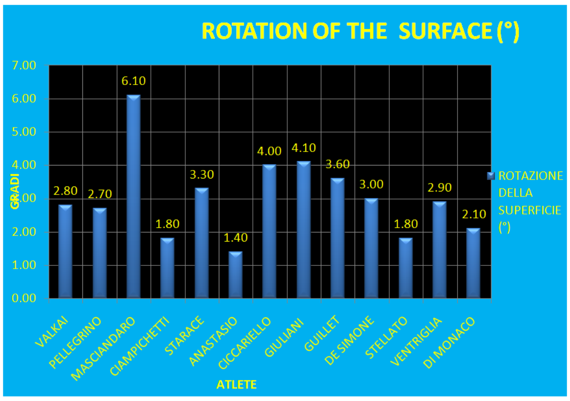
Graph 4: Bending Front - Rear



Graph 5: Lateral Deviation



Graph 6: Lateral Bending



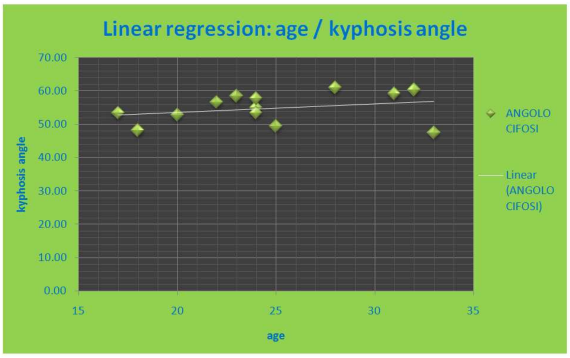
Graph 7: Rotation of the Surface

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							

Table 3

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



Graph 8: Linear regression

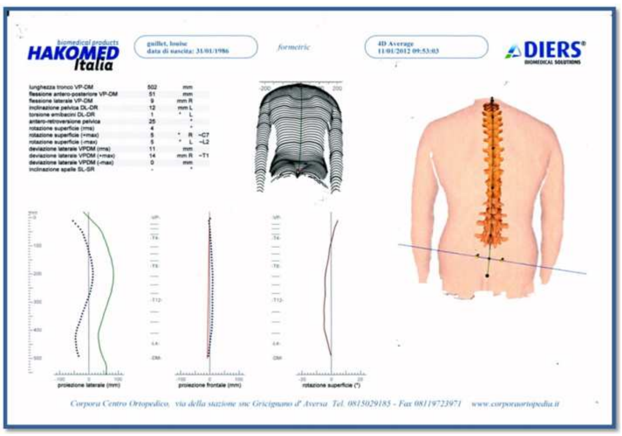


Figure 3

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