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Spine deformation caused by inadequate posture adopted in front of a portable technological device

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Summary— **Body posture refers to the composition of the positions of all joints of the human body at a particular point in time. The interest in its analysis is due to the increase in the number of people that suffers back pain and proliferation of muscle skeletal problems such as dorsal kyphosis, lumbar lordosis, scoliosis or cifolordosis. These diseases have been associated with repetition and maintenance of certain postures that cause degenerative changes in articular tissues responsible for stabilizing the spine [11]. This paper uses image processing techniques in order to obtain biomedical analysis of posture in today's society who do not care about postural hygiene and ergonomics when they are using either a computer, cell phone tablets or any technological device.**

Key words— **Postural hygiene, ergonomics, biomedical analysis of posture, technological devices**

I. INTRODUCCIÓN

Summary— **Body posture refers to the composition of the positions of all joints of the human body at a particular point in time. The interest in its analysis is due to the increase in the number of people that suffers back pain and proliferation of muscle skeletal problems such as dorsal kyphosis, lumbar lordosis, scoliosis or cifolordosis. These diseases have been associated with repetition and maintenance of certain postures that cause degenerative changes in articular tissues responsible for stabilizing the spine [11]. This paper uses image processing techniques in order to obtain biomedical analysis of posture in today's society who do not care about postural hygiene and ergonomics when they are using either a computer, cell phone tablets or any technological device.**

Key words— **Postural hygiene, ergonomics, biomedical analysis of posture, technological devices**

I. INTRODUCTION

Rapid technological development in industrialized countries and computing revolution that took place from the second half of the twentieth century are largely responsible for the adoption of improper position of the column [5]. The sitting position and back pain have stimulated the development of biomechanical analysis of postural hygiene by some image techniques by some authors like "Análisis biomecánico de la postura mediante técnicas viodeograméticas" by Sanabria J [12]. When it is kept for long time, the sitting position prolonged leads to lumbar flexion, reduced lordosis in this region and static overload in musculoskeletal tissues of the spine, which are factors that are directly related to the development of low back pain [9].

The relationship between the sitting position and back pain stimulated the development of biomechanical analysis of posture through image, in a specific human being sample using tablets or technological device comparing the results with the parameters of postural hygiene and ergonomics established

II. METODOLOGY

Break the methodology in sections so that it is easier to follow, understand.

- Selection criteria
- Sample size analysis:
- Posture measurement
- Data processing

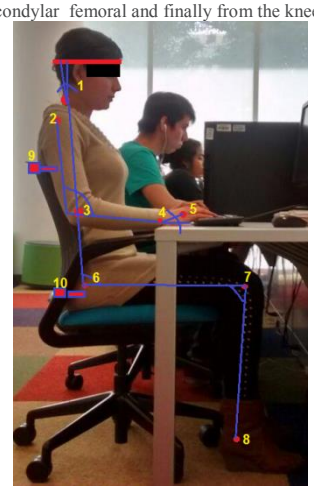
Minitab was the software used to obtain the sample size equivalent to 25 people.

It was evaluated the posture of people while they are reading through and electronic device through 10 markers in different position shown in the table 1 and fig 1.

Table. 1. Marker positions to analyze human while is reading through and iPad

Markers	Positions
0	Forehead
1	C7 prominence
2	Acromion
3	Lateral epicondyle of the distal humerus (Olecranon)
4	Styloid process of the radius
5	Distal part of the fifth metacarpal
6	Iliac spine
7	Lateral femur condilye
8	Lateral malleolus
9	Top of the chair back
10	Botton of the chair back

Fig. 1 shows red marker to track principal positions, 1st direction is from the red band in the forehead to C7; 2nd position is C7 to iliac spine; 3rd direction is from iliac spine to the lateral condylar femoral and finally from the knee to lateral malleolus



This information was compared with the indications of postural hygiene should be taken when you are reading a book (Fig. 1)

III. RESULTS

In the next section, there are shown postural results that includes both image processing and statistical analysis in order to show the complications of an incorrect posture.
Fig. 2 shows the comparison between an ideal and an adopted posture when a person reads through a technological device.

Fig. 2 Postural hygiene while a person is reading through a technological device. (A) Ideal posture. (B). Real posture

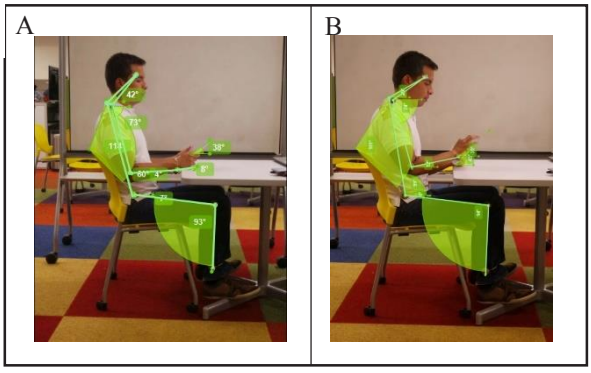


Table 2 shows the mean angles, standard deviation, and rank in 9 body references, table 1, while study subject are reading with a technological device.

Table 2. Statistic analysis in 9 body references

References	Mean	Standard deviation	Range in t	Difference rank	Porcentual rank
1	95.4	18.1	94-97	3	16.5
2	18.4	8.4	18	0.3	3.5
3	83.9	10.5	82-85	3	28.4
4	75.9	19.2	74-77	3	15.6
5	13.8	9	13-14	1	11
6	86.6	15.7	84-87	3	19
7	11	9.8	8-14.	6	61
8	23.2	12.4	13-21	8	64.1
9	32.6	17.3	30-34	4	23

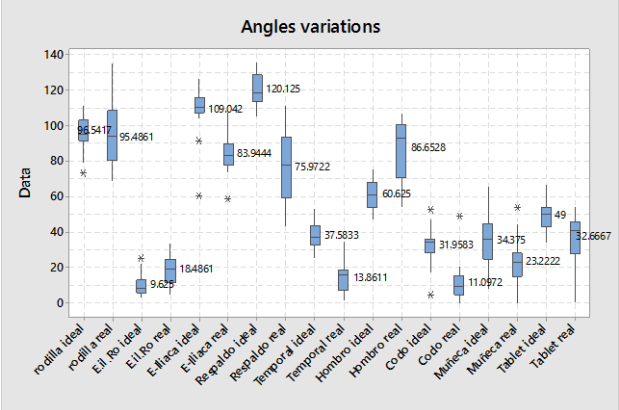
Table 3 shows the p-value from 9 different angles, shown in Fig. 1.

Table 3. Pi value beetween ideals and reals angles in 9 key references

References	1	2	3	4	5	6	7	8	9
	0.4003	0.0001	0	0	0	0	0	0.0027	0.0001

Fig. 4 shows the information analyzed by box plot. Ideal angles are contrasted with the real angle (next to the right) of the indicators. Mean values are highlighting. Asterisks represent atypical data that could be explain as an error in the indicator´s position.

Fig. 4. Statistical analysis of real and ideal angles



IV. DISCUSSION

The null hypothesis is accepted according to the representative values of p-value from all angles expressed in table 3 of results, except the angle of the knee.

Percentage rank shown in table 2 was calculated as the percentage of the range difference with regard to standard deviation in order to determine if the study could be considered as static when the range of movement, along all the image analysis, represents less than 33.3%, otherwise the analysis is considered as dynamic. As shown in table 2, fig. 2, and fig. 3, all angles, except elbow and distal part of the

fifth metacarpal, are considered static. So another important aspect to analyze in the sitting position is the time that this is changed since several changes in posture are recommended not to cause discomfort or fatigue and the average time interval between two consecutive exchanges should be 5 minutes. In addition, this permanency position for more than four hours is a risk for the development of pain lumbar. Also this position, reduces disc height to 2.1 mm. This reduction in height intervertebral disc can cause discal degeneration [9].

Angles mean measurements in knees an in trunk, were more than 90°. Since the straight sitting posture, in which the angles of the hips, trunk, knees and ankles are kept in 90, creates tension in the hamstrings and buttocks, causing retroversion pelvis, flattens the sacral angle and rectifies the lumbar lordosis. This generates an increasing in the compressive loads intervertebral disc, and lead fatigue of erector spine [8]. 1 and 3 angles in ideal conditions decrease the tension in hamstrings and buttocks

V. Conclusion

According to a study developed at the Universidad Tecnológica de Nogales users spend around to 22.4 hours per weeks in the internet approximately 3.2 hours a day due to facilities that technological devices have brought. Suggesting that most of the user have wrong sitting position while they are using the technological devices, they increase the probability of suffering a lumbar, dorsal injury.

We concluded that study subjects adopt a static position until they start writing, presenting movements greater that 30% of the standard deviation.

An acceptable sitting position will be considered when angle measurements are under ideal standard deviation. Electromyographic studies have demonstrated that the positions with increasing or reduction in lumbar curvature, when compared it with an ideal curvature, have lower activity of the internal oblique muscle and lumbar multifidus surface [8]. In the sitting position, most of the body weight is transferred to a tuberosity support area isquiáoptical and soft tissues. Thus, if no correct support in the lumbar region, intradiscal pressure can be raised up to 35%. To reduce the pressure intradiscal is necessary to tilt behind the backrest support. This contributes to diffusion of nutrients across the board vertebral end, which promotes intervertebral disc nutrition [9].

The present study has several points that have to be considered and improved for future studies. First, the chair back and seating elevation were not adjustable for the study subjects. Second, the chair didn´t have arm to support the weight of the human arms. The ergonomic of the seat was predefined simulating a normal day where most of the time subject's couldn´t modify this characteristic. However, free adjustment of the seat has to be considered for study subjects in order to bring them the opportunity of seating according their height and weight. A chair with the capability of modifies the inclination and height with arms is suggested. Third, study subjects with obesity introduced error in the positioning of indicators because fat tissue increase the distance from the bone protrusions and were difficult to find it. Nevertheless, this kind of study subjects leads to new research of how obesity could modify the seating position.

To try to reduce the impact of posture sitting on musculoskeletal structures when people are using technological devices, the positions determined along the paper are identified as healthy because they reduce intradiscal pressure, disc degeneration and show low levels of stress injury ligament.

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