VERTEBRAL METRICS
Application of a Mechanical Instrument to Evaluate the Spinal Column in Pregnant Women

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Abstract: The incidence of problems related to rachialgiae is so frequent and usual that it must be studied as if it were an epidemic and social disease (Knoplich, 2003). It was built a completely mechanically and non-invasive system, designed as Vertebral Metrics, which is able to identify the position x, y and z of each spine apophysis, from the first cervical vertebra to the first sacral vertebra in standing position. The measuring part is the "body" of the instrument, and the "support". This devise was applied in a pregnant woman in four moments of the pregnancy: 12; 20, 32 and 37 weeks. In the second moment of the evaluation of the spine the curvatures decrease when compared with the other moments of the evaluation, where an increase of these curvatures, related to rachialgie, is evident.

1 INTRODUCTION

Rachialgiae constitute a relevant problem in modern society (Alexandre & Moraes, 2001). In many women, this problem. appears for the first time during pregnancy. 80% of pregnant women have rachialgiae . where 50% of those remains affected for the rest of their lives. This situation causes serious troubles of absenteeism and consequently a great loss for the labour market, under an economic perspective.

In view of the number of women affected, and of the economic implications of the problem, the development an instrument that evaluates, in a global way, the spinal column in standing position, as become important in order to better understand the behaviour of the spine during the gestational period.

For that purpose a completely mechanical and non-invasive instrument registered as Vertebral Metrics, was built, which is able to identify the x, y and z positions of each vertebra, from the first cervical vertebra to the first sacral vertebra (Quaresma et al 2009). After entering these data into a mathematical model of the spine, the curvatures and lateral deviations in the standing position can be calculated (Forjaz Secca et al, 2008).

The credibility of the instrument has been recognized by means of the register of the patent as well as the acceptance of the study with pregnant women by the Ethics Committees of the Maternidade Dr Alfredo da Costa and Regional Health Administration of Lisboa and Vale do Tejo (Quaresma et al 2009).

The validation process was successfully .performed at Biomechanics Laboratory, of the Faculty of Human Kinetics, at the Technical University of Lisbon, Portugal (Quaresma, 2009).

Vertebral Metrics provided evidence to be a reliable, consistent and valid instrument in comparison with an optoelectronic system, when performed by one examiner (Quaresma, 2009).

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Figure 1: Image of Vertebral Metrics.

The main components of the apparatus (Figure 1) are the *"body"* and the *"support"* (Forjaz Secca, et al, 2008)

The *"body"* has a vertical piece, mounted in the support, with 18 horizontal pieces called *"2D Positioner*". Each *"2D Positioner"* slides along the scaled ruler attached on the vertical piece.

The *"support"* has two pieces, one vertical, where the body of the instrument fits, and one horizontal piece where the person to be evaluated stands up.

All the 18 2D *Positioner*s are identical and adjustable, allowing the identification of the x, y, and z positions of each vertebra (Quaresma, 2009)

The component 1 of the 2D *Positioner*s is a square sectioned rod, cone shaped, which is the contact point for each vertebra (Figure 2)..

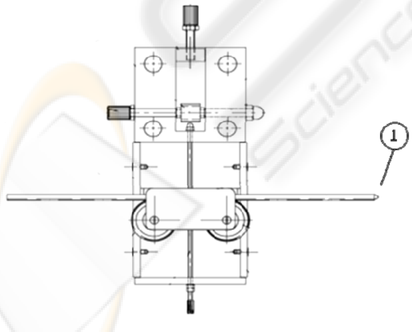

Figure 2: The *"2D Positioner*".

Three of the *"2D Positioner*" are used in four different ways (Quaresma et al 2009)..

The first is placed in the occipital region and is used as a reference point during the data collection;

The second piece collects the data of the cervical vertebrae:

The third, which is piece number fifteen, collects the data from the first, second and third lumbar vertebra;

Finally, the remaining horizontal pieces will identify the position of all other vertebra of the spinal column.

The x, y and z positions of each *"2D P*" are then obtained and the 3 coordinates can be read using different rulers on the device.

2 VERTEBRAL METRICS: APLICATION

In order initiate the evaluation process the horizontal pieces of the instrument are roughly adjusted, according to the height of each woman

The examiner, starts by marking on the skin the vertebral apophyses, from the first cervical vertebra to the first sacral vertebra, using a washable pen (Figure 3).

Figure 3: Marking the vertebral apophyses with a washable pen.

Each pregnant woman stands up then on the "*support*" of the apparatus with the posterior face of the trunk facing the "*body*" of the Vertebral Metrics, followed by adjustment of each *"2D Positioner"* to each mark on the various points along the spinal column(Quaresma et al 2009).

The evaluation starts by placing the first horizontal piece in the occipital region.

Immediately afterwards the second, fourteenth and the last *"2D Positioner"* are adjusted to the seven cervical vertebra, twelve dorsal vertebra and the first sacral vertebra. This points are used as reference points to stabilize to position of the spine.

Subsequently the remaining *"2D Positioner" are* adjusted

The x, y and z positions of each *"2D Positioner*" are then obtained (Quaresma et al 2009).

Figure 4: Example of application of Vertebral Metrics.

Despite the apparent complexity of the device and of the respective measurements, each data collection only lasts seven minutes (Figure 4).

The collected data are then recorded and transferred to a specific data basis which includes correction factors associated with the instrument

3 PREMILINARY RESULTS

This study is part of a broader analysis where we intend to identify and describe the biomechanical changes of the spinal column that occur throughout pregnancy.

This paper presents the application of Vertebral Metrics to one pregnant woman. Data collection was made in three periods of the pregnancy:12, 20, 32 and 37 weeks of the gestation.

As can be observed in figures 5 to 8.in the corresponding diagrams 1 to 4 .the curvatures of the spine change during pregnancy. In the second moment of the evaluation of the spine the curvatures decrease when compared with the other moments of the evaluation, where an increase of these curvatures, related to rachialgie, is evident.

4 CONCLUSIONS

Vertebral Metrics is a non-invasive mechanical instrument, which is able to identify the position x, y and z of each vertebra in standing position (Quaresma et al 2009).

Figure 5: Pregnant woman- 12 weeks of gestations.

Figure 6: Pregnant woman - 20 weeks of gestations.

Figure 7: Pregnant woman - 32 weeks of gestations.

Figure 8: Pregnant woman - 37 weeks of gestations.

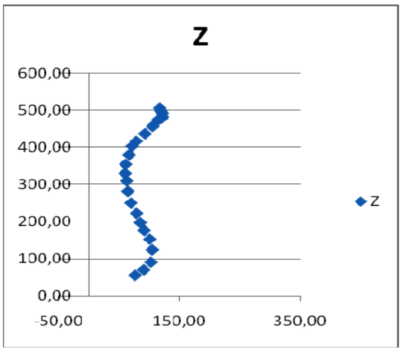

Diagram 1: Spine - 12 weeks of gestations.

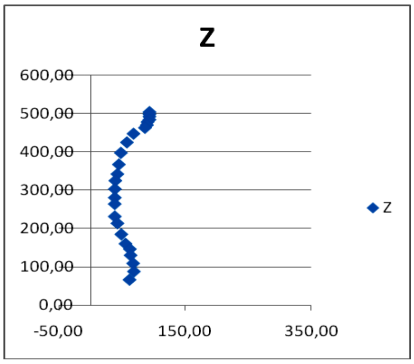

Diagram 2: Spine - 20 weeks of gestations.

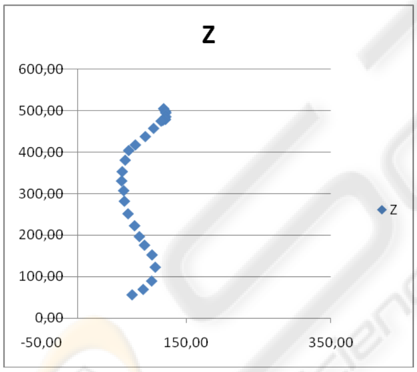

Diagram 3: Spine -32 weeks of gestations.

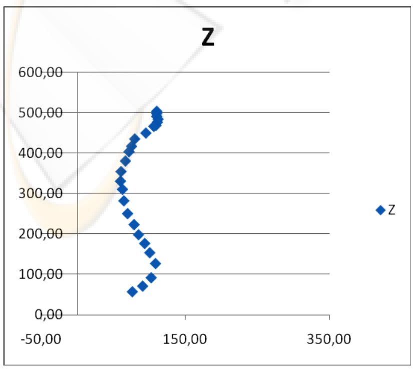

Diagram 4: Spine - 37 weeks of gestations.

This instrument allows a global simultaneous assessment of the spine. Thus, identification of dysfunctions and / or diseases of the spinal column in pregnant women, will be shown on a full diagnosis. Intervention programs, directly connected to specific problems of each pregnant woman, may then be elaborated and implemented (Quaresma et al 2009).

Vertebral Metrics was originally planned and built to be applied to pregnant women, althout it can be easily applied to the general population (Quaresma et al 2009). This device can also be applied in other situation, including the orthopaedic, neurosurgical and rehabilitation area.

A automatic system to speed up the process of the data collection is currently being developed.

Besides the mentioned importance of Vertebral Metrics, it should be provided out that the present instrument is easily carried making feasible its use in any health institution.

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