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KINEMATICS ANALYSIS OF VERTEBRAL POSTURE IN THE DÉVELOPPÉ À LA SECONDE

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INTRODUCTION

The dance has movement as its structuring element. This study analyzes kinematics of the spine in a movement of classical ballet, called développé à la seconde (Figure 1). Several biomechanical studies are conducted in order to improve technique, prevent injuries, rehabilitation or simply describe the movement. In the case of classical ballet, unfortunately there are not many studies about the movements used in this art. This study, then, aims to analyze one of many movements in the classical ballet, movement which if poorly executed can lead to injury due the many times it is repeated during class.

Figure 1. *Développé à la seconde* [1]

METHODS

We analyzed 10 volunteers, dancers, which are part of an advanced class in Goiania / Brazil, aged between 13 and 21 years old and experience in ballet between 5 and 11 years. Among the three trials for each side (right and left), was analyzed the highest altitude reached movement. This information was made possible through the graph obtained from the Matlab ® software that describes the trajectory of the ball marker positioned at the lateral malleolus which represented the ankle.

The environment had three cameras positioned posteriorly to the volunteers. In the measurement of the geometric shape of the column, was used the method proposed by Brenzikofer et al. [2], in which retroreflective markers are placed in dorsal skin so that it is possible to identify the line formed by the spinous processes of the vertebrae. The measurement of the movement of the markers was performed by an automatic tracking markers optical system, the Dynamic Posture developed in Campos [3], performing the 3D reconstruction by DLT. The construction of the graphics and analysis was performed by Matlab ®.

RESULTS AND DISCUSSION

The analysis was performed at the instants shown in Figure 2.

A B C

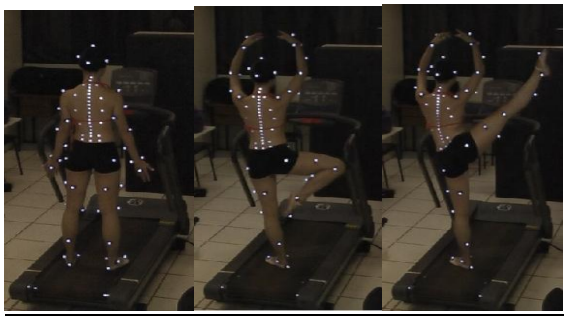

Figure 2. Picture A: anatomic back posture, Picture B: passé and Picture C: *développé à la seconde*.

In data processing, the origin of the coordinate system was translated to T12. Thus, the vertical coordinate (z coordinate) had in its positive values, the thoracic region, and their negative values represents the lumbar region. Regarding concavities, it was determined that in the frontal, plane positive values of geometric curvature are the representation of a concavity to the left and negative values to the right. Already in the sagittal plane, positive values of the geometric curvature represent the concave anterior and negative values, posterior.

In the frontal plane, during the movement, the geometric curvature suffered deviation and the concavity goes to the side of the moving leg, and it was bigger during the développé. For 90% of the participants, the peak of curvature in the lumbar region occurred in the same direction in which the motion has higher amplitude, such

as the volunteer 9 that had the greatest range of motion with the right leg in the développé (Figure 3).

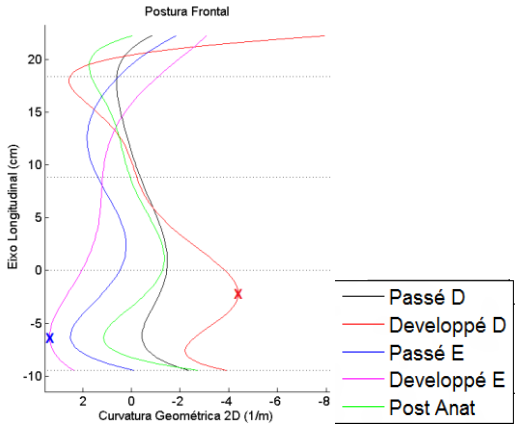

Figure 3. Frontal plane of V9, the red "x" (right leg) indicate where happened the bigger curvature peak (-4,39 1/m) and the blue "x" (left leg) indicate where happened the bigger curvature peak (3,34 1/m).

The frontal plane had not a pattern of decreasing geometric curvature in the lumbar region according to the years of experience from the volunteers. As can see in Figure 4, the difference of geometric curvature in the lumbar region is high in both cases.

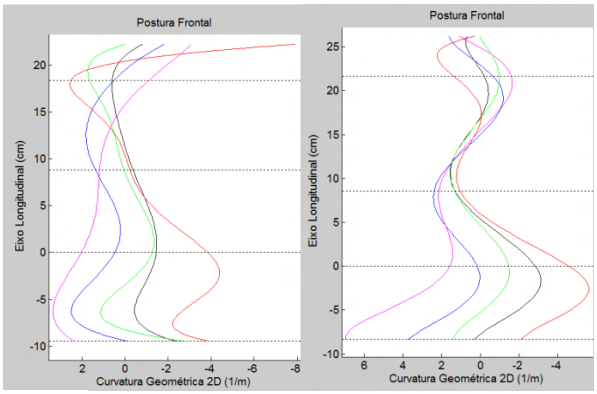

Figure 4. Frontal plane. left: V9 5 years in classic ballet. Right: V10, 11 years in classic ballet.

In the sagittal plane, the geometric curvature tended to diminish along the movement, this correction is due to what is called in ballet docking. The rectification was more significant at the time of développé, in the lumbar region, as the participant 6 that showed higher rectification in moments of développé, with his right leg in the lower lumbar and left leg in the high lumbar region (Figure 5).

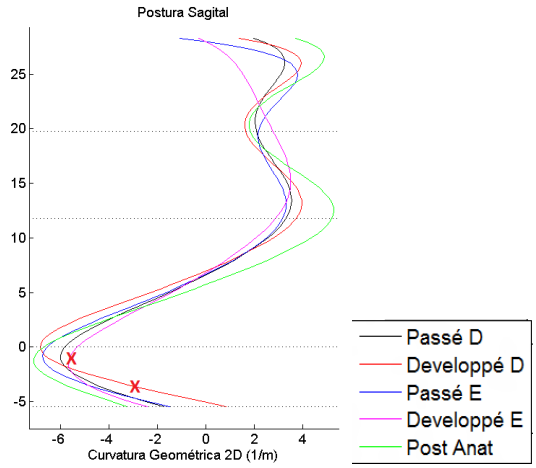

Figure 5. Sagittal Plane. V6, the red "x" indicate where the rectification was bigger.

There was a pattern of decreasing geometric curvature in the lumbar and thoracic region, increasing the rectification according to the years of experience of the volunteers. As can be see in Figure 6, the curvature of the participant 10 is smaller, particularly in the thoracic region..

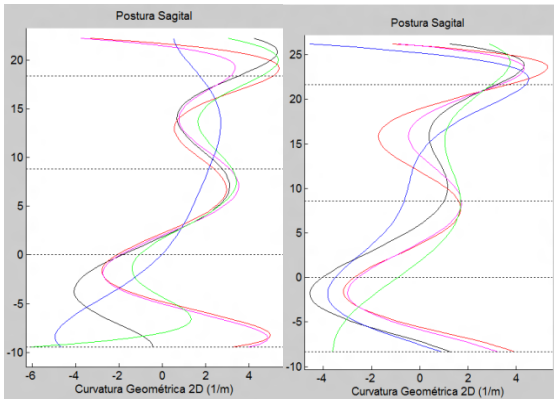

Figure 6. Frontal Plane. Left: V9 5 years in classic ballet. Right: V10, with 11 years in classic ballet.

CONCLUSION

The study showed good results with the chosen methodology and leaves open the need and importance of having more work on ballet movements. In the future, further studies will be conducted to better understand the postural responses of dancers

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