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KINEMATICS EVALUATION OF PELVIS DURING THE STEP *PLIÉ* OF CLASSICAL BALLET

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INTRODUCTION

The *ballet* was based on maintaining the position technique called *en dehors*, for "out" in French language (external rotation of the hip joints, causing the inner edge of the feet form a maximum angle of 180°) in all steps and choreographic movements of this type of dance. It is known that classical *ballet* is based on the physical and biomechanical scientifically correct, however, those individuals who do not have an *en dehors* efficient or suitable for the technical demands of the activity may well compensate for this lack specific externally rotating the tibia or doing use of offsets in the pelvis and spine, for example, causing deviations from the joint and proper body alignment. This compensation, among other factors, whether employed on a cyclical and repetitive can cause greater stress on the structures involved in the technical movements and possible future related injuries. Step *plié* is considered one of the most important steps of classical *ballet*. This is a basic step that is found in all the movements of this dance form, is directly dependent on proper completion and maintenance of *en dehors* and also maintaining the neutral position and consequent pelvic stability throughout all phases of the movement. However, given the lack of studies that have analyzed dynamically its implementation, taking into account the technical criteria stipulated by the methodology of classical *ballet*, the objective of this study was to use kinematic assessment to quantify two important technical criteria pertaining to the pelvis during completion of step (1) its neutral position, and (2) their stability.

METHODS

The sample was purposive and consisted of 18 dancers from Porto Alegre/RS/Brazil, with a mean age of 26.6±8.3 years and 18.2±7.7 years of uninterrupted practice of *ballet*. Were fixed in the pelvis of these dancers reflective markers shaped ball on the following anatomical landmarks: pubis, anterior-superior iliac spine and posterior-superior right. The dancers were filmed for 4 synchronized cameras while performing the following step *plié*, comprising 2 *demi pliés* (short flexions of knees to

about 45 degrees) and 2 *grand pliés* (maximum flexion of knees). The software MATLAB ® 7.9, was used to analyze the metrics and angular variations of anatomical landmarks and software Dvideow - "Digital Video for Biomechanics for Windows 32-bit" to scan and reconstruct kinematically filming. After the reconstruction were obtained reference values that allowed us to classify pelvic alignment and stability of the dancers. A descriptive statistical analysis, performed with SPSS 18.0, understood the calculation of median, minimum and maximum both criteria analyzed. The overall ratings determined according to the literature were: (a) "pelvis neutral" - angulation between 12 and 15° between the line drawn joining the anterior and posterior iliac spines upper right over another line parallel to the ground passing the first spine; (b) "retroversion" - angles less than 12°; (c) "anteversion" - angles above 15°, (d) "pelvic instability" - angular range greater than 3° from one phase to another the step, and (e) "pelvis stable" - maximum angular variation of 3°.

RESULTS AND DISCUSSION

The values of median, minimum and maximum pelvic positioning corresponding to the pelvic angles obtained in all steps from step static *plie* are shown in Figure 1. The values of median, minimum and maximum pelvic angle variation corresponding to the variation of the angle pelvic in all eight steps *plié* movement step, namely during the continuous knee flexions (decreases for *demi pliés* and *grand pliés*) and during continuous extensions (*demi pliés* rises and *grand pliés*), both the first and the second position of feet are presented in Figure 2. These values were defined angular variation from the maximum value minus the minimum value of the pelvic angle achieved during the entire movement of descent and ascent of the whole movement of each *demi plié* and *grand plié* each.

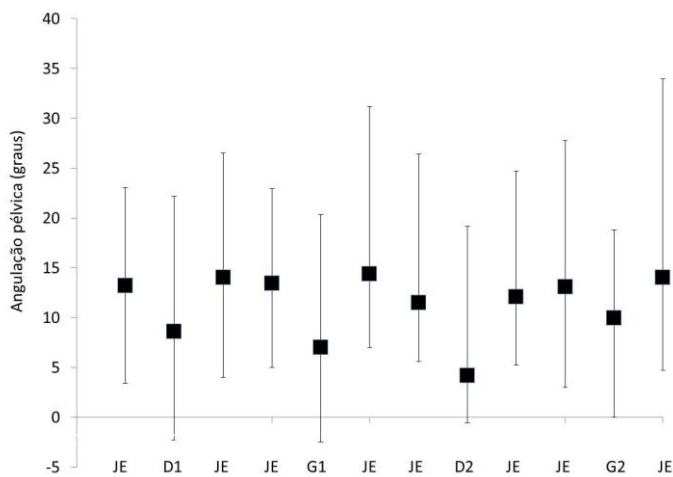


Figure 1 – Median, minimum and maximum, corresponding to the angle breach in the twelve steps static of step *plié* (when the knees were extended and the amplitudes of knee flexion maximum or final), both in the 1st and in the 2nd position feet (n=18). Legend: JE - Knee extended; D1 – Final of *demi plié* in 1st position of feet; G1 - Final of *grand plié* in 1st position of feet; D2 – Final of *demi plié* in 2nd position feet; G2 - Final of *grand plié* in 2nd position feet.

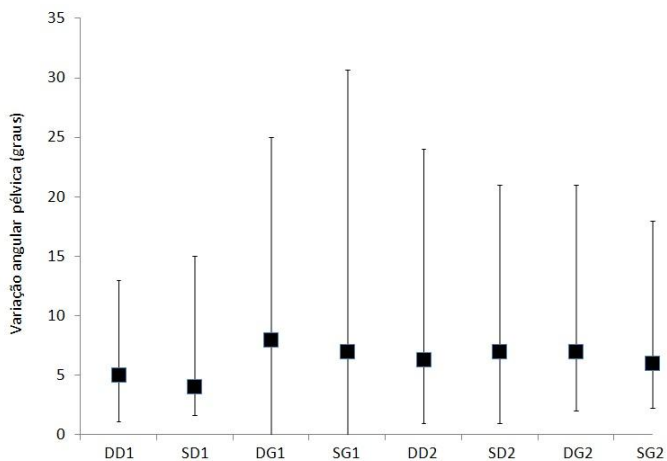


Figure 2 – Median, minimum and maximum, corresponding to the angle pelvic the eight steps of moving step *plié* (during descents, or pushups continuous kneeling, and climbing, or continuous lengths), both in the 1st and in the 2nd position feet (n=18). Legend: DD1 - Descend to the *demi plié* in 1st position of feet; SD1 - Rise of the *demi plié* in 1st position of feet; DG1 - Descend to the *grand plié* in 1st position of feet; SG1 - Rise of the *grand plié* in 1st position of feet; DD2 - Descend to the *demi plié* in 2nd position feet; SD2 - Rise of the *demi plié* in 2nd position feet; DG2 - Descend to the *grand plié* in 2nd position feet; SG2 - Rise of the *grand plié* in 2nd position feet.

The results for these two technical criteria demonstrated quantitatively evaluated the dancers, in general, when they were with the knees straight, kept their pelvises into "neutral" position, though, so they performed the steps of descent or ascent and showed angular variations being classified as having "pelvic instability" in these steps motion. This instability was further enhanced by obtaining general "retroversion" pelvic obtained in all later stages of knee flexion (*demi pliés* and *grand pliés*), or the great

majority of the sequence initiated with the pelvis "neutral" reached the end of *demi pliés* and *grand pliés* or with the pelvis in "retroversion" and finalizing the sequence of movements with the pelvis again in "neutral" position. In short, changing a rating of "neutral" - pelvic angle between 12 and 15° - for the "retroversion" - pelvic angle below 12° - and vice versa, automatically, the dancers began to obtain the classification of "pelvic instability"- pelvic angle variation above 3°. Studies emphasizes that the pelvis is the key to a good postural alignment to a global or defective, since the muscles that maintains the proper alignment of the pelvis, both anteroposterior and laterally, are vital in maintaining a good general alignment. So when this maintenance does not occur, there has to pelvic instability, which consequently may lead to postural problems and musculoskeletal injuries described mainly occurs when the grueling repetition of movements of classical *ballet* classes, rehearsals and performances choreography. It is believed that, in his hands the results of this study, for the pelvic evaluative criteria technicians, professionals involved in this process may support qualifiers on the parameters presented and even compare the results of their students or patients with found here.

CONCLUSIONS

From the kinematic assessment, an evaluation method biomechanics of human movement, it was possible to quantify and determine metric and angular kinematic parameters during step *plié* of classical *ballet*. Using these parameters it was possible to identify the sample presented in general, the classification of "pelvic instability" with a tendency to "retroversion" throughout the execution of the steps of the step *plié*.

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