140 - VARIATION OF THE DIFFERENCE IN DIGITIZING PROCESS INTER AND INTRA RESEARCHERS IN ADULT GAIT

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INTRODUCTION

The process of shooting and the digitization of the anatomic points in human motion have an important function in health areas like: orthopedics, traumatology, sports and exercise (AMADIO & SERRÃO,2004; HE,2005), providing data to kinematics parameters of movement (angle, speed, displacement) (MCGINNIS, 2002). However, the system (camera, software and manual digitizing) may generate error.

The error is inherent to measurement process, with that, will never completely eliminated. Even if the measure was very carefully and the instrument very accurate, is not possible to realize a perfect direct measurement (VUOLO, 1996). The error may be minimized eliminating every possible source of error (systematic or aleatory, accidental or rude). When is realized a measure, is necessary assess quantitatively the error (VUOLO, 1996).

Error in bidimensional analysis may happen for any factors: camera system (mainly the errors related to lenses), for the distance between the camera and the object (different plan of the movement to the calibration plan) and for projection error (oblique position of the object) (NIGG & HERZOG, 1995). In addition to the factors related to the shooting, the process of digitization of anatomical points can also generate error.

Schutz (2006) said that an error, in a kinematic data acquisition, propagates itself as other important parameters go deriving for the movement analysis.

The aim of this study was to review the variation of manual digitizing process intra and inter evaluators in the adult gait.

METHOD

One subject had participated of this study, adult, 20 years old, chosen intentionally, who received marks in the iliac crest, greater trochanter of femur, femoral epicondyle, lateral malleolus and the fifth metatarsal.

For the data acquisition was utilized a MiniDv digital camera, 30 Hz frequency, localized 3 meters to the middle of the ramp, this one measure 7,5 meters. The subject had to walk in comfortable speed on the ramp (Figure 1).

The videos had been edited through the software Winproducer from InterVideo ® 3 DVD, version 3.1.

To realize the digitizing of the anatomic points had been selected 4 experienced researchers. Each one, through the software Degeeme v. 1.0, remarked manually 5 times the anatomic point of the right knee of the subject. After the digitizing, the knee coordinators "x" and "y" had been exported.

To value the digitizing had been chosen pictures that represent the initial contact (CI) Q1; medium support (AM) Q12; Propulsion (PR) Q25; initial balance (BI) Q28; medium balance (BM) Q31 and final balance (BF) Q37.

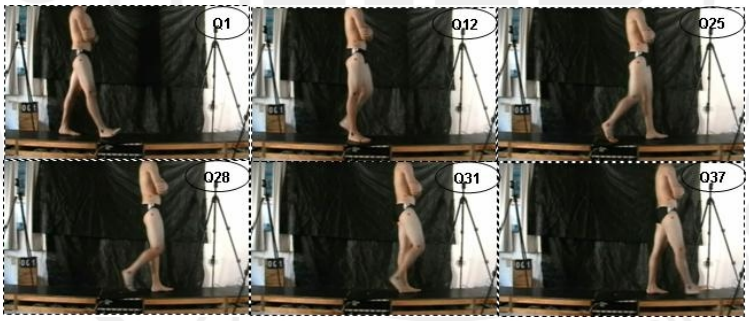

Figure 1: Representation of selected frames of a gait to be analyzed.

Was used descriptive statistics to review the data. The average, standard deviation and coefficient of variation had been calculated for the pictures that each researcher had digitized for 5 times. The data was tabulated and analyzed through the Microsoft Excel.

RESULTS AND DISCUSSION

On Table 1, it can be observed the variation intra-researchers during the process of digitization on x axis, ranging between 0.1% and 0.5% and inter-researchers 0.0% to 0.9%.

Table 1: Values for the knee position in "x".

Researcher		Q1	Q12	Q25	Q28	Q31	Q37
1	Average	0.57	0.59	0.56	0.58	0.61	0.59
	SD	**0.002**	**0.002**	**0.002**	**0.002**	**0.002**	**0.002**
	CV%	0.8	0.3	0.3	0.4	0.3	0.3
2	Average	0.57	0.58	0.56	0.57	0.61	0.58
	SD	**0.002**	**0.001**	**0.003**	**0.003**	**0.004**	**0.002**
	CV%	0.2	0.2	0.5	0.5	0.6	0.3
3	Average	0.58	0.58	0.56	0.57	0.61	0.59
	SD	**0.003**	**0.003**	**0.002**	**0.002**	**0.002**	**0.002**
	CV%	0.4	0.5	0.4	0.3	0.3	0.3
4	Average	0.57	0.58	0.56	0.57	0.61	0.59
	SD	**0.001**	**0.001**	**0.001**	**0.003**	**0.002**	**0.001**
	CV%	0.2	0.1	0.2	0.5	0.4	0.2
Inter	Average	0.57	0.59	0.56	0.58	0.61	0.59
	SD	**0.005**	**0.005**	**0.000**	**0.005**	**0.000**	**0.005**
	CV%	0.9	0.9	0.0	0.9	0.0	0.9

Subtitle: SD: standard deviation; **VC%:** coefficient of variation.

On table 2, it can be observed the digitization in y axis, the variation intra-evaluators was between 0.1% to 0.7% and inter-evaluators 0.0% to 0.4%.

Table 2: Values for the knee position in "y".

Researcher		Q1	Q12	Q25	Q28	Q31	Q37
1	Average	0.73	0.93	1.31	1.50	1.64	1.81
	SD	**0.005**	**0.004**	**0.004**	**0.003**	**0.004**	**0.002**
	CV%	0.7	0.4	0.3	0.2	0.2	0.1
2	Average	0.73	0.93	1.30	1.50	1.64	1.82
	SD	**0.004**	**0.003**	**0.004**	**0.003**	**0.005**	**0.003**
	CV%	0.5	0.3	0.2	0.1	0.2	0.2
3	Average	0.73	0.93	1.31	1.50	1.64	1.82
	SD	**0.002**	**0.003**	**0.004**	**0.003**	**0.004**	**0.002**
	CV%	0.3	0.3	0.3	0.2	0.3	0.1
4	Average	0.73	0.93	1.31	1.50	1.65	1.82
	SD	**0.003**	**0.003**	**0.003**	**0.004**	**0.002**	**0.002**
	CV%	0.4	0.3	0.2	0.2	0.1	0.1
Inter	Average	0.73	0.93	1.31	1.50	1.64	1.82
	SD	**0.000**	**0.000**	**0.005**	**0.000**	**0.005**	**0.005**
	CV%	0.0	0.0	0.4	0.0	0.3	0.3

Subtitle: SD: Standard deviation; **VC%:** coefficient of variation.

It can be observed that the variation was higher in X than Y inter researchers, it means that the digitization ranged more in the horizontal direction than vertical. This might happen because the movement had been analyzed predominantly in the horizontal (x axis) increasing the variation of this coordinate.

However, in this study, the variation may be considered small intra and inter researchers. How lower is the variability between repeated measures of the same researcher (intra-researchers) or of two or more researcher (inter-researchers), the precision is higher (PERINI, 2005).

Some studies have assessed the reliability of the measures using the coefficient of variation. Guimarey et al. (1981) found coefficients of variation between 5% to 6% for skinfolds and 1% to 5% for the arm circumference between 4 evaluators. A study of Klipstein-Grobusch et al (1997) also analyzed the error in anthropometric measures between and among evaluators found a coefficient of variation of 9.3 to 20.9% inter and intra 3.6 to 6.4% evaluators. Studies to verify the reliability of measurements or scans are important to minimize errors and thus improve the technique of measuring and marking of points for digitization (FRAINER, 2007).

CONCLUSION

The results of this study found that the researchers managed to reproduce the form shown markings, attesting to its accuracy. There also playing the scans between the different researchers, thus indicating the reliability of them.

As important as knowing the value variation, is know your percentage, even though they can eliminate it. Since it is possible to establish a value of confidence for the data in question, or even minimize them.

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VARIATION OF THE DIFFERENCE IN DIGITIZING PROCESS INTER AND INTRA RESEARCHERS IN ADULT GAIT

ABSTRACT

The process of manual digitization of anatomical points during the movement can generate error. The research aimed to analyze the variation in the digitization of the anatomical points intra and inter researchers during the movement of an adult. Participated in the study 1 subject with 20 years who received marks in the iliac crest, greater trochanter of the femur, femoral epicondyle, lateral malleolus and the fifth metatarsal. The subject walked in comfortable speed and was shot by a camera of 30Hz. 4 experienced researchers were selected to complete the process of digitization. Each one remarked through the software Degeeme v. 1.0, for 5 times the anatomical points of the right lower limb for the same subject's step. For analysis was selected the point of the knee at 6 frames of a total of 38 who composed the step. The 6 tables are for the initial contact, the medium support, propulsion, initial balance, medium balance and final balance. Had been exported the coordinates "x" and "y" of the position of the knee point in each frame. The average, standard deviation and coefficient of variation were calculated from the five repetitions of each evaluator and among evaluators. The results show that the variation within researcher for the x axis was 0.1% to 0.5% and 0.1% to 0.7% for y axis. The researchers inter variation was 0.0% to 0.9% for x axis from 0.0% to 0.4% for y axis. The results of this study found that the researchers managed to reproduce the form shown markings, attesting to its accuracy. There also playing the scans between the different researchers, thus indicating the reliability of them.

Key Words: Biomechanics, digitization, error.

VARIATION INTRA ET INTER CHERCHEURS DU PROCESSUS DE DIGITALISATION DE POINTS ANATOMIQUES DANS LA MARCHE D'ADULTES.

RÉSUMÉ

Le processus de digitalisation manuelle des points anatomiques pendant le mouvement peut produire erreur. L'objectif de ce travail a été analyser la variation de la digitalisation des points anatomiques intra et inter chercheurs pendant le mouvement de la marche d'un adulte. Un sujet avec 20 ans qui a reçu marqueurs dans la crête iliaque, grand trochanter du fémur, epicondyle fémorale, condyle atérale du fémur et cinquième metatarse. Le sujet a marché dans une vitesse confortable et a été filmé par une caméra de 30Hz. Ont été sélectionnés 4 chercheurs avec expérience pour réaliser le processus de digitalisation. Chacun a marqué cinque fois les points anatomiques du membre inférieur droit du sujet à travers du logiciel Degeeme v. 1,0 pour le même passage du sujet. Pour l'analyse est sélectionné le point du genou dans 6 frames d'un total de 38 qui ont composé la filmage. Les 6 frames fait reférence au début de l'appui, état médian de l'appui, propulsion, oscillation initial, oscillation moyen et oscillation final. Ont été exportés les valeurs afférent aux coordonnées « x » et « y » de la position du point du genou dans chaque tableau. La moyenne, l'écart-type et le coefficient de variation ont été calculés entre les cinq répétitions de chaque évaluateur et entre les évaluateurs. Les résultats obtenus montrent que la variation intra chercheur pour le coordonnées « x » est de 0.1% à 0,5% et de 0.1% à 0,7% pour le coordonnées « y ». La variation inter chercheur a été de 0.0% à 0,9% pour le coordonnées « x » et de 0.0% à 0,4% pour le coordonnées « y ». Les résultats obtenus dans cette étude ont vérifié que les chercheurs ont réussi à reproduire de forme constante les marques, en certifiant leur précision. S'est vérifiée aussi la reproduction des digitalisations entre les différents chercheurs, en indiquant ainsi la fidélité de les mêmes.

VARIACIÓN INTRA E INTER INVESTIGADAS EN EL PROCESO DE DIGITALIZACIÓN DE LOS PUNTOS ANATÓMICOS EN LA MARCHA DE LOS ADULTOS

RESUMEN

El proceso de digitalización manual de los puntos anatómicos durante el movimiento puede generar error. El objetivo de este trabajo fue analizar la variación de la digitalización de los puntos anatómicos intra e inter investigados durante el movimiento de la marcha de un adulto. Participo del estudio un sujeto con 20 años, que recibió marcaciones en la cresta iliaca, en el trocánter mayor del fémur, epicóndilo del fémur, maleolo lateral y quinto metatarsiano. El sujeto camino a una velocidad cómoda y fue grabado con una cámara de 30Hz. Fueron elegidos 4 investigadores con experiencia para realizar el proceso de digitalización. Cada uno marcó a través del software Degeeme v. 1.0 5 veces los puntos anatómicos del miembro inferior derecho referentes a una misma pasada del sujeto. Para el análisis fue seleccionado el punto de la rodilla en 6 cuadros de un total de 38 que componían la pasada. Los 6 cuadros son los referentes al contacto inicial, al apoyo medio, a la propulsión al balanceo inicial, al balanceo medio y al balanceo final. Fueron expuestos los valores referentes a las coordenadas “x” e “y” de la posición del punto de la rodilla en cada cuadro. La media, desvio el padrón y coeficiente de variación intra investigado para el eje “x” fueron 0.1% a 0.5% y de 0.1% a 0.7%, para el eje “y” los resultados obtenidos en este estudio verificaron que los investigadores consiguieron reproducir de forma constante las marcaciones, atestando la precisión de ellos. También verificó la reproducción de las digitaliaciones entre los diferentes investigadores, indicando asi la fiabilidad de las mismas.

Palabras claves: biomecánica, digitaliación, error.

VARIAÇÃO INTRA E INTER PESQUISADORES DO PROCESSO DE DIGITALIZAÇÃO DE PONTOS ANATÔMICOS NA MARCHA DE ADULTOS

RESUMO

O processo de digitalização manual dos pontos anatômicos durante o movimento pode gerar erro. O objetivo deste trabalho foi analisar a variação da digitalização dos pontos anatômicos intra e inter pesquisadores durante o movimento da marcha de um adulto. Participou do estudo 1 sujeito com 20 anos que recebeu marcações na crista ilíaca, trocânter maior do fêmur, epicôndilo femoral, maléolo lateral e quinto metatarso. O sujeito caminhou em velocidade confortável e foi filmado por uma câmera de 30Hz. Foram selecionados 4 pesquisadores experientes para realizar o processo de digitalização. Cada um remarcou, através do software Degeeme v. 1.0, por 5 vezes os pontos anatômicos do membro inferior direito referentes a uma mesma passada do sujeito. Para análise foi selecionado o ponto do joelho em 6 quadros de um total de 38 que compuseram a passada. Os 6 quadros são referentes ao contato inicial, apoio médio, propulsão, balanço inicial, balanço médio e balanço final. Foram exportados os valores referentes as coordenadas “x” e “y” da posição do ponto do joelho em cada quadro. A média, desvio padrão e coeficiente de variação foram calculados entre as cinco repetições de cada avaliador e entre os avaliadores. Os resultados obtidos mostram que a variação intra pesquisador para o eixo x foi de 0.1% à 0.5% e de 0.1% à 0.7% para o eixo y. A variação inter pesquisadores foi de 0.0% à 0.9% para o eixo x e de 0.0% à 0.4% para o eixo y. Os resultados obtidos nesse estudo verificaram que os pesquisadores conseguiram reproduzir de forma constante as marcações, atestando a sua precisão. Verificou também a reprodução das digitalizações entre os diferentes pesquisadores, indicando assim a confiabilidade das mesmas.

Palavras Chaves: biomecânica, digitalização, erro.