

Evaluation of Postural Differences between Acl-Reconstructed Subjects and Healthy Controls, Using New York Scale and Biophotogrammetry

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Abstract

The anterior cruciate ligament (ACL) can be easily torn, causing a significant functional loss in the skeletal muscle system. The evaluation of postural changes is an essential tool for healthcare professionals as it reveals the individual's adaptation to the treatment, which can determine a correct intervention, and therefore, provide a faster recovery and prevent the occurrence of functional impairment of the skeletal muscles. The posture evaluation of the photogrammetry and Scale New York method are important to evaluate, since they are incorporated in clinical practice and have good reliability and playback, allowing quantitative values to detect any pathological changes in the body posture. This study aimed to analyze the effects of the anterior cruciate ligament reconstruction procedure on the individual's posture using two methods: New York Scale and biophotogrammetry. Forty male individuals, aged between 23 to 29 years (24 ± 2 years) were divided into two groups: 20 individuals who underwent unilateral ACL reconstruction with patellar tendon graft and 20 matched controls participated in the study.

The individuals with ACL reconstruction were assessed at 6 months post operation. The individuals were submitted to two types of physiotherapist evaluation: the New York Posture Rating Chart for visual posture and computerized biophotometer for posture. The results show the values were statistically analyzed by using independent t test ($p \leq 0.05$). A small change was observed between the groups in using the visual postural evaluation with no significance ($p \leq 0,05$). In the computerized biophotogrammetry, some postural change was found between the groups in the region of shoulders, left elbow and scapulae. The results was significant only to right and left shoulder ($p < 0.05$). The study concluded that after the anterior cruciate ligament reconstruction, the individuals presented significant postural changes demonstrating the need for a follow-up by professional physiotherapists. This research suggested that individuals with ACL had changes in posture.

Keywords: Assessment posture; Kinemetry; Anterior cruciate ligament

Introduction

The anterior cruciate ligament (ACL) can be easily torn, causing a significant functional loss in the skeletal muscle system. It is estimated that approximately 70 thousand ligament reconstructions occur annually in the United States [1,2]. It occurs due to the heavy load sustained by the knees and the fact that they are situated between the two body's longest levers, making this ligament especially susceptible to injuries [3]. The ACL is characterized as a static stabilizer for the femorotibial joint. Individuals with such injury exhibit significant biomechanical changes that influence the performance of the reflex responses, which decrease the action of the knee extensor muscles and facilitate the action of the flexor muscles [4,5].

The postural alignment and its synchronicity are interdependent from the harmony of other adjacent systems, mainly the association of the visual stimuli, proprioceptive sensitivity and the vestibular apparatus. Its synchronicity is interdependent from the harmony of other adjacent systems [2]. It is characterized by the homeostatic state and balance, and its maintenance generates the smallest energy expenditure of the muscles, in order to protect the body from traumas, with the support basis and the center of gravity in the vertical. The homeostatic imbalance is characterized by the body attempt to readjust the muscle chains in a way to compensate, and consequently, to preserve the body of trauma [6].

The better postural alignment is characterized as the position of certain body segments capable of allowing a good alignment of the center of gravity favoring the maintenance of this posture by

allowing the musculoskeletal system are in a balanced way, being less susceptible to injury and deformity, without discomfort or difficulty in keeping it [7]. Therefore, methods that allow the postural assessment become important and use tools that allow quantitative data allows for increased accuracy evaluation. The evaluation of the posture of the photogrammetry and Scale New York method are important to evaluate, since they are incorporated in clinical practice and have good reliability and playback, allowing quantitative values to detect any pathological changes in the body posture [8].

To detect these postural disorders quantitatively, the physiotherapist has different tools and evaluation methods, for example, the New York Posture Rating Chart, a method characterized by the sum of the values adopted by the individual's posture, in lateral and posterior positions. The other one is the computerized biophotogrammetry, which consists of photographic applications within walking distance to obtain measurements of shapes and dimensions of the human body [9,10]. This study hypothesis is demonstrate that after anterior cruciate ligament

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injury by modifying the ligament proprioception, individuals with this ligament injury should be jeopardized postural severe disorganization neuroproprioceptiva, allowing new modifications of the muscle to keep the center of gravity aligned with new body awareness generated. This study aimed to analyze the effects of the anterior cruciate ligament reconstruction procedure on the individual's posture using two methods: New York Scale and biophotogrammetry.

Materials and Methods

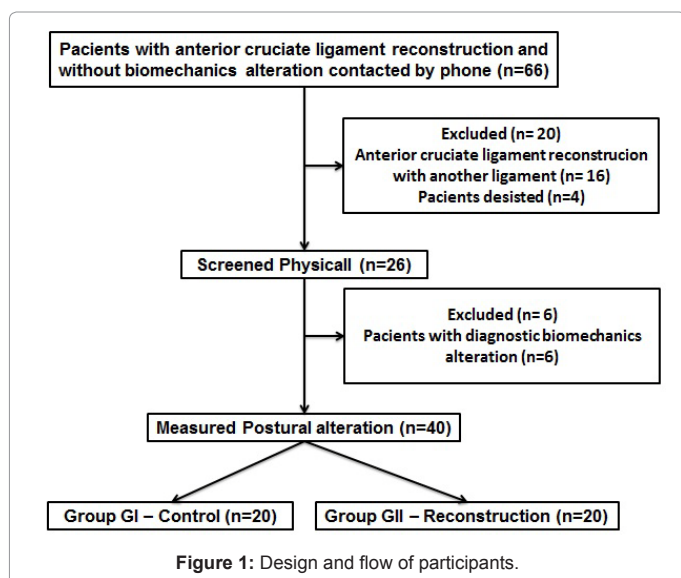
This study prospective are cross-sectional studies, in order to assess the posture of patients undergoing anterior cruciate ligament reconstruction to determine whether significant changes proprioceptor the loss of the anterior cruciate ligament to physiotherapy to complement the knowledge about these disorders. For this purpose we used patients in the postoperative phase with up to 6 months of reconstruction that were operated by the team's orthopedic State Hospital of Ribeirão Preto by the same surgical technique (Figure 1).

Participations

Forty male individuals, aged between 23 to 29 years (24 ± 2 years) were selected for the present study and divided into two groups: 20 individuals who underwent unilateral ACL reconstruction with patellar tendon graft and 20 matched controls participated in the study. Both groups had a BMI of 24.36 ± 1.43 , an average height of 1.76 ± 0.18 and righties. The group with ACL reconstruction had muscular atrophy of the injured limb and all subjects were operated by the same medical staff of the Hospital das Clínicas da Faculdade de Medicina de Ribeirão Preto- São Paulo, Brazil. All individuals after ACL reconstruction, were subjected to accelerated rehabilitation protocol, allowing individuals with 6 months postoperatively already had good musculoskeletal conditions, time that allowed the specific treatment of proprioception.

To calculate the sample was used Dimam 1.0 program using the angle values found in scores and analysis methods, accepting a significance level of 5% ($p < 0.05$) and a test power of 80% stipulating 15 a number of participants in each group.

This study was approved by the Research Ethics Committee according to process N. 14/2010. All individuals signed a free and informed consent, according to Resolution 196/96.



The inclusion criteria were as follows in Group with reconstruction: all participants with anterior cruciate ligament reconstruction, postoperative period ranging from 6 (six) months to 1 (one) year, aged 21-29, with no postural and neurofunctional impairment clinical diagnosed previously. The exclusion criterion for this study is related to the non-standardization of the subject within the existing inclusion criteria.

The inclusion criteria were as follows in Group Control: individuals should not be doing physiotherapy treatment or physical conditioning, not having had anterior cruciate ligament injuries in less than two years, without postural and neurofunctional impairment clinical diagnosed previously. The exclusion criterion for this study is related to the non-standardization of the subject within the existing inclusion criteria.

Outcome measures

It was planned to do the physiologic measures (imaging test) and self-report measure (posture rating scale). The New York posture rating [11], was used to diagnose the postural changes associated with the adapted sports biomechanics or by the paraplegia habitual inactivity. The scale analysis parameters are 0 to 39 points (Severe Impairment), 40 to 55 points (Moderate) and more than 55 points (No Impairment). To validate the results of the postural assessment, the individuals were photographed using biophotogrammetry recording patterns. This evaluation was performed with the individuals wearing trunks. To standardize the images, each subject was positioned over a three-dimensional leveling platform in front of a panel known as a simetrograph (200 x 100 cm x 10 cm).

An entire wall-ground leveling criterion was maintained prior to positioning. A Kodak p880 camera, 8.5 megapixels, was positioned on a tripod with a 3-meter distance between the focal lenses of the camera to the central area of the individual's body. This distance was marked on the ground with gaffer's tape for further reassessment. Another measure of standardization was the tripod height, which remained at 0.90 cm between the ground and the camera's focus [8].

The individuals with ACL reconstruction were assessed at 6 months post operation. After the samples were selected, the participants' evaluation was carried out following two stages: in the first, posture was analyzed using the New York visual scale; individuals wore light clothes and were positioned on a leveling platform in the lateral and posterior positions. In the second, the postural evaluation was performed with computerized biophotogrammetry. To standardize the images, a wall-ground-leveling criterion was held prior to positioning the individuals. They were positioned on a three-dimensional leveling platform facing panel called simmetrograph (200 x 100 cm and 10 cm).

A Kodak p880 camera 8.5 Mp, was positioned on a tripod with a 3 meter distance between the focal lenses of the camera to the central area of the individual's body. This distance was marked on the ground with a gaffer's tape for further reassessment. The tripod height was set at 0.90 cm between the ground and the camera's focus. The anatomical points (trunk and upper limbs) were marked using the postural assessment software SAPO. The images were obtained by a single observer, without zoom, and in three delimitation planes: anterior, posterior and lateral. Individuals were told to remain calm and relaxed to capture their habitual posture.

Data analysis

To obtain the New York posture rating scores, this sums all measurements from both conditions being analyzed. The ImageJ 1.36b

software version 1.36, with references to the areas in the shoulder, scapular positioning and inclination angle. The final scores were statistically analyzed by SPSS for Windows 19.0 (SPSS Inc.; Chicago, IL, USA) and by the Student's t-test for independent groups ($p \leq 0.05$).

Results

A small change was observed between the groups in using the visual postural evaluation with no significance (Table 1). In the computerized biophotogrammetry, some postural change was found between the groups in the region of shoulders, left elbow and scapulae. The results was significant only to right and left shoulder ($p < 0.05$) (Table 2).

Discussion

Following ACL reconstruction, the patients seek to return to their normal functional condition and to avoid the presence of joint laxity, loss of knee extension and joint degenerative pathologies [12].

The anterior cruciate ligament is related with the knee proprioception; however, several studies report that individuals with ligament reconstruction do not exhibit impaired proprioceptive arising from this ligament in patients evaluated after two years of reconstruction. However, individuals presented proprioceptive changes at one month after surgery [13].

For proper maintenance of body posture, the exteroceptive muscular structures, including the proprioceptive and mechanoreceptive ones, need to function in a satisfactory manner to detect potential problems in the skeletal muscle system [6].

The evaluation of postural changes is an essential tool for healthcare professionals as it reveals the individual's adaptation to the treatment, which can determine a correct intervention, and therefore, provide a faster recovery and prevent the occurrence of functional impairment of the skeletal muscles.

Among the screening tools, the New York Posture Rating is used to

assess the static posture comparatively and quantitatively in a specific rating chart to define the individual's alignment of body segments [14,15].

Computerized biophotogrammetry is being used to assess posture due to its advantages and effectiveness in clinical application. Some of the advantages include: low cost in photo interpretation and imaging system, high accuracy and reproducibility of results, no contact with the individual and use of visible light. These are non-invasive methods for quantitative evaluation, which provide criteria for planning and monitoring the interventions (Figure 2) [10].

In this study, the groups presented postural changes predominantly in Group II –ACL. This fact may have occurred primarily because the postural alignment is an association between the visual stimuli, proprioceptive sensitivity and the vestibular apparatus. Its synchronicity is interdependent from the harmony of other adjacent systems such as the stomatognathic system. Loss of function in any of these systems can lead to balance deficits and affect the individual's postural awareness through afferent stimuli [5].

This study does not corroborate with Howells et al. [9], Which affirmed the existence of postural abnormalities in patients with moderate ligament, due to reduced proprioception found in the knee region. In this study it can be noted that at six months of reconstruction, one can notice a posture that enables good alignment body. This fact may be justifiable at the time of evaluation, since it is known that six months after ACL reconstruction ligament grafted branch becomes a neural network that allows the replacement of a fabric similar to the victim [1].

This study corroborates the results found by Foster et al. [2]. The ACL injury generates biomechanical changes that affect the postural pattern even after its reconstruction as the postural control is decreased, even though there is some subtle improvement in trying to maintain an upright posture. These changes generate compensation in the knee standard cinematic observed by reduced proprioceptive information

Groups	p	Mean	Standard Error	95% Confidence of the Interval of the Difference	
				Lower Value	Upper Value
GI - Control	0.46 ^{ns}	44.55	±0.96	42.24	47.62
GII –ACL reconstruction		43.15	±1.64	41.87	46.15

^{ns} – Not significant for $p \leq 0.05$

Table 1: Means for impairment (points) and standard error of posture changes in GI –control and GII -ACL reconstruction (t test at $p \leq 0.05$).

Anatomical region	Group	p	Mean	Standard Error	95% Confidence of the Interval of the Difference	
					Lower Value	Upper Value
Right shoulder	GI - Control	0.03*	102.39	±1.19	99.55	105.82
	GII- ACL Reconstruction		98.94	±0.98	96.31	101.57
Left shoulder	GI - Control	0.05*	100.24	±1.10	97.48	103.35
	GII- ACL Reconstruction		97.39	±0.93	94.91	99.85
Right elbow	GI - Control	0.95 ^{ns}	158.23	±1.79	153.37	162.83
	GII- ACL Reconstruction		158.36	±1.78	153.63	163.09
Left elbow	GI - Control	0.53 ^{ns}	166.11	±1.64	160.84	169.97
	GII- ACL Reconstruction		164.82	±1.19	161.65	168.00
Right scapula	GI - Control	0.48 ^{ns}	123.73	±1.91	118.94	129.07
	GII- ACL Reconstruction		126.04	±2.69	118.95	133.14
Left scapula	GI - Control	0.25 ^{ns}	120.75	±1.79	116.05	125.40
	GII- ACL Reconstruction		123.48	±1.54	119.34	127.63

*Statistical significance $p \leq 0.05$

^{ns} Not significant for $p \leq 0.05$

Table 2: Means for postural angles (in degrees) and standard error of the right (RS) and left (LS) shoulders, right (RE) and left (LE) elbows and right (RS) and (LS) scapulae in GI (control) and GII (ACL reconstruction) (t test for $p \leq 0.05$).

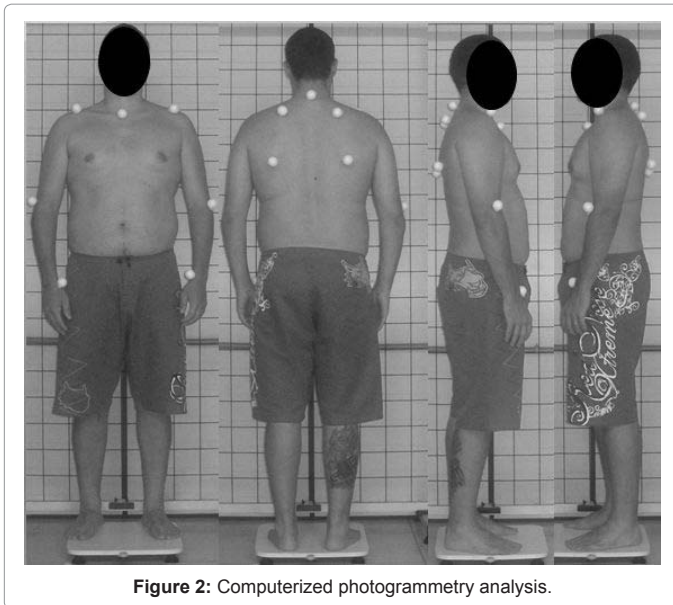


Figure 2: Computerized photogrammetry analysis.

of individuals, since, the ACL as well as the posterior cruciate ligament contains Pacinian corpuscles, type IV receptors and type I and III mechanoreceptors, acting directly on the knee biomechanics [16].

This research suggested that individuals with ACL had changes in posture, which demonstrated the effects of this ligament injury. Considering that the individuals were recovering, professional care was required to avoid posture problems.

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