45 - BALANCE EVALUATION OF INDIVIDUALS WITH ANTERIOR CRUCIATE LIGAMENT LESION THROUGH FOAM-LASER DYNAMIC POSTUROGRAPHY

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INTRODUCTION

The balance is related to the capacity to maintain the line that goes by the gravity center, perpendicular to the soil and inside of a support base (BARCELLOS; IMBIRIBA, 2002). The balance maintenance is determined by the functional integration of the coming information of the sensorial structures of the vestibular, visual and proprioceptive system. In that way, the alterations of the balance can happen due to some flaw in an or several of these systems, taking the individual to the corporal unbalance (GANANÇA et al., 1999). Those structures act in an integrated way and differentiated for each disturbance on the human body (DUARTE, 2001).

The straight posture is not a static event, being characterized by oscillations, maintaining the body in continuous movement. Those oscillations are of involuntary order and they depend on neuromuscular mechanisms, seeking to preserve the balance (BARCELLOS; IMBIRIBA, 2002). The oscillation of the body during the straight posture is usually investigated being used force platforms. The variable more common to analyze this oscillation it is the position of the pressure center, the point of application of the forces resultant acting in the support surface. The displacement of the pressure center represents a sum of the actions of the postural control system of and by gravity force (DUARTE, 2001).

The knee is the joint more attacked by lesion of the human body, one of the largest and more complex structures of the human anatomy is considered, being easy to be lesioned due joint type and restricted movements, what contributes to the high anterior cruciate ligament (ACL) lesions incidence, being this responsible for 50% of the damages in the knee ligaments (BONFIM; PACCOLA; BARELA, 2003). The knee neural control involves the muscles activity coordinate, mainly of the quadriceps, supplying active stability for that joint. The knee proprioceptive integrity is essential for the neural control, being its evaluation an important method of diagnostic and prognostic information; it could generate evidence of the therapeutic procedures effectiveness, as well as to increase the understanding of the dysfunction degree after lesion (LOBATO et al., 2005).

The ACL proprioceptive neurophysiological function has been considered as important as its biomechanical function in the joint stability maintenance. The complications happened after the ACL lesion, it seem to happen due not only to the mechanical instability, but also to the decrease or the alteration of the proprioceptive information. The ACL mechanoreceptors and of another knee structures they make a fundamental action in the joint dynamic stability maintenance (TOOKUNI et al., 2005). Alterations in the acting of tasks as the balance, they seem to be due the reduction of sensorial information, supplied by the ACL mechanoreceptors, which are damaged for the lesion and/or reconstruction of that ligament (BOMFIM; BARELA, 2004).

The proprioception is a term used to describe all the neural information originated in the joint, muscles, tendons, capsules and ligaments mechanoreceptors, that are sent through afferent ways to the central nervous system, on the relationships biomechanics of the joint tissues, which can influence the muscular tonus, motor execution and coordination programs, synesthesia, muscular reflexes, balance and joint stability (BACARIN et al., 2004). Reports indicate that a proprioceptive deficit exists after ACL rupture (FATARELLI; ALMEIDA; NASCIMENTO, 2004), which stays after the surgical reconstruction (BONFIM; PACCOLA; BARELA, 2003).

The current approach to balance evaluate investigates specific variables related to the posture control and it tries to determine which alteration in its functions contributes to the stability and mobility loss. In general, that evaluation involves the privation of an or more sensorial sources or it involves disturbances induced in the support surface through the use of mobile force platform (COHEN et al., 1996).

The dynamic posturography bases on the knowledge that the balance results of the visual, vestibular and proprioceptive afferences integration and it tests the balance exposing the individual in different situations. The posturography facilitates a precise quantification of the clinical facts observed. It is a system that allows to isolate and to quantify the vestibular, visual and proprioceptive participation, as well as its sensorial integration in the balance maintenance. The basic test accomplished by the dynamic posturography, the Sensorial Organization Test (SOT), it offers information regarding the organization and coordination of the motor answer evoked by the incentives receive in the orthostatic posture (ROSSI et al., 2003). Due such characteristic, besides the low cost, it could be an useful method, clinically, to find proprioceptive deficits in the individuals' balance submitted to the ACL reconstruction surgery in the orthostatic posture.

Due such arguments, this study has as aim to evaluate the balance in patients with ACL lesion, submitted or not to the surgical reconstruction, through the method of dynamic posturography, looking for to find proprioceptive alterations.

MATERIAL AND METHODS

Previous to the study beginning, this was analyzed and approved by the Ethics Committee in Unioeste Humans Research. All the patients were informed on the research procedures, and included after it accepts in participating and signature of the free consent and informed term.

To participate of the study the individuals they would be due come in the following inclusion criteria: to present diagnosis of ACL lesion with surgical indication; isolated ACL rupture, with collateral ligaments and posterior cruciate ligament damage absence; and, to be in agreement with the methodological procedure to be executed. Among the exclusion criteria were: total vision absence; diseases or surgeries in the contra-lateral knee; any disease or surgery in inferior limbs; vestibular disturbances; diabetes melittus; and or rheumatic diseases.

The sample was composed by 45 individuals of the masculine gender, with age between 20 and 46 years, and 30 presented clinical diagnosis of ACL lesion with surgical reconstruction indication. All the individuals of the postoperative group accomplished the surgeries in public hospital. The time of lesion to the evaluation varied of 28 days to three months. The individuals were divided in three groups: Before Surgery Group (GPRE) formed by 15 subjects, with confirmed clinical diagnosis of ACL isolated lesion and with surgical indication; Postoperative group (GPOS) this group was also composed by 15 individuals that accomplished ACL ligamentoplastic approach; Controls Group (GCTL) also composed by 15 individuals without ACL lesion history and that not had the exclusion criteria, presenting close age of the experimental groups (33,4 years).

For the data collection, the balance evaluation method was used the Foam-Laser Dynamic Posturography, being this a method for the accomplishment of the Sensorial Organization Test (SOT), developed by Castagno (1994).

The posturography tests the individual's dynamic balance and it consists in: a 1 m^2 cabin, with 2 m height, visual conflict image and medium density sponge; pen laser; and, centimeter paper.

The individuals were positioned in cabin front, with a ribbon, in which the pen laser was fastened, coupled in the waist. The individuals were submitted to different situations for the balance evaluation, with the SOT accomplishment, made in six conditions (ROSSI et al., 2003):

- SOT I open eyes, visual cabin and platform fastens (it evaluates the visual, proprioceptive and vestibular systems);
- SOT II closed eyes and stable platform (it evaluates the proprioceptive and vestibular systems);
- SOT III open eyes, stable platform and mobile visual cabin (it evaluates the proprioceptive, vestibular and, above all, the visual systems);
- SOT IV open eyes, stable visual cabin and mobile platform (it evaluates mainly the proprioceptive system);
- SOT V - closed eyes and mobile platform (it evaluates the proprioceptive and vestibular systems, due to the elimination of the visual afference and to the platform movement);
- SOT VI open eyes, visual cabin and mobile platform (it evaluates the proprioceptive, vestibular and visual systems).

The test was applied by two examiners, and one timed the time of each test and he accomplished the cabin movement (in the tests in that movement was demanded), and the other acted as observer registering the antero-posterior axis displacement, through the laser incidence in the centimeter paper. The maximum deviation was scored, and accomplished the evaluation of the capacity of somatosensory systems use (SOM) through the reason SOT II/SOTI; the visual (VIS) for the reason SOT IV/SOT I; and the vestibular (VEST) for the reason SOT V/SOT I; for the calculations accomplishment the available tools were used in the program Excel® (ROSSI et al., 2003).

All the tests were accomplished being placed the patient in orthostatic position, without shoes, with enlarged base. Each situation lasted long for 20 s, being SOT III and VI, where there is the cabin movement, accomplished 10 s moving forward and 10 s back, manually. The complete test was accomplished three serial times with an interval of two minutes (ROSSI et al., 2003), being used for the calculations the average of the observed results.

The patients were guided to stay the more possible immobile in the platform, even due to the oscillations of the same and of the visual field. The quantification of the obtained results varied of 100% (without some registered displacement) up to 0%, that corresponds to the fall in any one of the directions. Based on the data found in these conditions it is possible to calculate the average in each one of them, supplying an index of analysis of the somatosensory, visual and vestibular function.

Besides this clinical evaluation form, the data were appraised, for the descriptive statistics (average and standard-deviation) and for the test t of Student non-paired, after evaluation of the data normality.

RESULTS

The clinical evaluation, of the dynamic posturography, aims the capacity of to use the somatosensy (SOM), visual (VIS) and vestibular systems (VEST), for the maintenance of the orthostatic balance, considering normal values those larger ones than 92% for SOM, 88% for VIS and 67% for VEST (ROSSI et al., 2003). The table 1 shows the medium values obtained by the before surgery, postoperative and control groups.

Table 1 Sensorial analysis through Dynamic Posturography use capacity of the SOM, VIS and VEST systems, for the orthostatic balance maintenance.

Table 1 Sensorial analysis through Dynamic Posturography use capacity of the SOM, VIS and VEST systems, for the orthostatic balance maintenance.

	SOM	VIS	VEST
GPRE	89,51%	97,03%	83,65%
GPOS	93,33%	98,36%	84,84%
GCTL	94,34%	94,88%	84,01%
Reference	> 92%	> 88%	> 67%

The table 2 presents the variations and value of statistical significance for each appraised system.

Table 2 Values of the variation and value of the statistical significance (p) for each system.

	GPRE X GPOS		GPRE X GCTL		GPOS X GCTL	
	p	Variaÿÿo	p	p	Variaÿÿo	p
SOM	4,27%	0,2458	5,40%	0,1094	1,08%	0,6738
VIS	1,37%	0,7245	-2,22%	0,5549	-3,54%	0,0899
VEST	1,42%	0,7779	0,43%	0,9308	-0,98%	0,8141

The table 3 show the averages and standard -deviation of each SOT of the Dynamic Posturography evaluation in the before surgery, postoperative and control groups.

Table 3 Values of antero-posterior oscillation of the balance in SOT's I, II, III, IV, V and VI. The values are presented on the average and standard-deviation.

SOT	GPRE	GPOS	GCTL
I	78,60 ÿ 7,74	81,19 ÿ 5,30	82,79 ÿ 4,98
II	70,60 ÿ 11,88	75,62 ÿ 7,42	78,09 ÿ 6,39
III	72,48 ÿ 9,22	77,27 ÿ 5,31	74,74 ÿ 5,23
IV	74,75 ÿ 6,67	79,56 ÿ 5,63	78,38 ÿ 4,29
V	65,13 ÿ 12,01	68,50 ÿ 6,87	69,76 ÿ 9,96
VI	60,61 ÿ 10,96	70,09 ÿ 9,73	65,46 ÿ 8,57

The table 4 demonstrates the variation values and significance value for each appraised SOT.

Table 4 Variation Value and statistical significance value (p) for each appraised SOT.

SOT	GPRE X GPOS		GPRE X GCTL		GPOS X GCTL	
	Variaÿÿo	p	Variaÿÿo		Variaÿÿo	p
I	3,30%	0,2934	5,33%	0,0885	1,97%	0,4015
II	7,11%	0,1764	10,61%	0,0402*	3,27%	0,3349
III	6,61%	0,0915	3,12%	0,4147	-3,27%	0,1988
IV	6,43%	0,0421*	4,86%	0,0874	-1,48%	0,5251
V	5,17%	0,3538	7,11%	0,2606	1,84%	0,6904

* Statistically significant variations.

DISCUSSION

In the present study when observing the general evaluation, the individuals of the before surgery group presented deficit in the capacity of the somatosensory system use with inferior values to the reference (>92%) for the dynamic posturography test, such variation it was not significant when comparing with the postoperative and control groups, even so for being in a way of clinical evaluation, the result is clinically significant. It is believed that the ACL lesion produces proprioception loss, deteriorating the capacity of the individuals to detect knee static or dynamic alterations (FATARELLI; ALMEIDA; NASCIMENTO, 2004).

According to Rossi (2003), the proprioceptive dysfunction is diagnosed by the corporal oscillation increase with the eyes closed in comparison to the eyes opened in the conditions I and II of appraised SOTs. The before surgery group when compared with the control, it was observed in SOT II significant difference (p = 0,0402).

The oscillation variation producing the scores found in SOTs was in all the cases minor in the before surgery group.

However, significant variations were just observed when comparing the groups before and postoperative in SOTs IV (it evaluates mainly the proprioceptive system) and VI (it evaluates all the systems). When comparing the before surgery and control groups the difference it happened in SOT II, which evaluates the proprioceptive and vestibular system.

The fact of the postoperative group to have presented normal values in the capacity to use the vestibular, visual and mainly the proprioceptive systems in relation to the before surgery group, can be explained by the fact that with the surgical reconstruction the proprioception improvement exists in the individuals with the neoligament, however it is pointed out that the elapsed period of surgery, in the moment of the evaluation, it was not enough so that it happened the neoligament replacement, and probably just the neovascularization (FU et al., 1999). To Hopper et al. (2003) the knee joint proprioceptive restitution exists after the restoration, and this is attributed to the recovery of the ligament and capsular receptors. Ochi et al. (1999) with base in its potential exams evoked by electric stimulation of lesioned ACLs, reconstructed and normal, during the arthroscopy, they suggest that the sensorial reinervation happens in reconstructed ACL, this is correlated with an improvement of the knee position sense, they tell that it is possible, after a long period, that the graft used in the ACL reconstruction can be reinnervated.

According to Bonfim, Pacola and Barella (2003), that hypothesis has been demonstrated, in studies with animals, about the graft reiinervation possibility. Mansur and Parcias (2004) they come to confirm still more the existence of a proprioceptive deficit in individuals with lesion of ACL reconstructed; they evaluated the proprioception in the ACL postoperative comparing the joint position sense among the healthy and hurted knees, using dynamometry isokinetic; as result, they verified that the normal knees showed proprioceptive larger accuracy in relation to the knees with ACL reconstructed, reiterating the existence of consequent sensorial decrease to the ACL reconstruction.

Although the mechanisms that control the position sense are disturbed after the ACL rupture, it stays obscure if the surgical reconstruction of this ligament can recuperate or to improve the proprioceptive loss. In spite of the mechanoreceptors existence in other structures around the knee, it seems that there are not enough information and the sensorial deficit still stays even after the ACL reconstruction (BONFIM; PACCOLA; BARELA, 2003).

In the population with faulty or reconstructed ACL, the proprioceptive evaluation in the position of weight bearing can be potentially advantageous in comparison to the test without weight bearing, that because the co-contraction of the knee flexors and quadriceps they reduce the stress in ACL (SAMPAIO; SOUZA, 1994). Besides, tasks with weight bearing are more representative of the functional activities accomplished in orthostatic position. The tests with weight bearing can also promote an indicative more sensitive of the position sense, because of the contribution of the vestibular and visual system and of other afferent signs that it cannot be differentiated in the tasks without weight bearing (MARKS; QUINNEY; WESSEL, 1993).

In the present study, it tried to evaluate the proprioceptive deficit through the individual's balance in the orthostatic position for the dynamic posturography, that is to say, with weight bearing in both knees, besides in the reconstructed knee. The evaluation through the dynamic posturography is shown interesting for evaluating dynamically the balance and one of its components especially, the proprioception. However, as presented, the general values were not significant, but such results don't invalidate certain clinical aspects, as those observed in the somatosensory general evaluation of the before surgery group being shown inferior to the reference.

Yet, with relationship the comparisons done between the postoperative and the control group, the posturography didn't detect significant differences, what is extensively documented in the literature, demonstrating then that the dynamic posturography is just capable of detecting ruder alterations, as those of SOTs IV and VI among the before surgery and postoperative groups, and SOT II among before surgery and control.

According to Bonfim, Paccola and Barela (2003) after the ACL reconstruction sensorial deficit still exists in the reconstructed knee. This way, it is possible that happens damages during the ACL lesion, that even with the reconstruction, reduce the conduction of the afferent information on proprioception. In spite of mechanoreceptors they exist in another structures around the knee, it seems that there are not enough information and the sensorial deficit does stay after the ACL reconstruction.

It are stood out as limitations in the present study the not uniformity of the lesion time, until the evaluation moment (GPRE) or of the reconstruction (for GPOS); besides a limitation of the method that is the training need for the accomplishment of the deviations reading, observed by the laser radiation on the centimeter paper, seeking to minimize reading mistakes.

CONCLUSION

It is concluded that the Foam-Laser Dynamic Posturography can be used as clinical evaluation method of the balance in individuals with ACL lesions, standing out the proprioceptive component, even so this can just be evaluated grossly, with relationship to the deviations of the reference values.

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BALANCE EVALUATION OF INDIVIDUALS WITH ANTERIOR CRUCIATE LIGAMENT LESION THROUGH FOAM-LASER DYNAMIC POSTUROGRAPHY

ABSTRACT: The balance maintenance is possible through the structures integration as the motor system, the proprioception, the vestibular system and the vision. Dynamic Posturography bases on the knowledge that the balance results of the integration of the visual, vestibular and proprioceptive informations, and it tests the individual in different situations. The aim of this study was evaluate the balance in patients with anterior cruciate ligament (ACL) lesion, submitted or not to the surgical reconstruction, through Foam-Laser Dynamic Posturography, Trying to find proprioception alterations. A sample of 45 individuals of the masculine gender was used, being those divided in 3 groups: GBEF (before surgery) n=15, GPOS (postoperative) n=15 and GCTL (it controls) n=15. For the data collection, Foam-Laser Dynamic Posturography was used. The individuals were submitted to the accomplishment of sensorial organization test (SOT) in 6 different conditions. It met results statistically significant, being pointed out proprioceptive deficit in some tests of the GBEF in relation to the GPOS and GBEF in relation to the GCTL. It is concluded that the Foam-Laser Dynamic Posturography can be used as method of balance clinical evaluation in individuals with ACL lesions, standing out the proprioceptive component, even so this can just be evaluated grossly, with relationship to the deviations of the reference values.

Keywords: proprioception, anterior cruciate ligament, balance.

ÉQUILIBRE D'ÉVALUATION DES PERSONNES PHYSIQUES À L'LIGAMENT CROISÉ ANTÉRIEUR LÉSION PAR LASER-MOUSSE DYNAMIQUE POSTUROGRAPHE

RÉSUMÉ: L'équilibre alimentaire est possible grâce à l'intégration des structures comme le moteur du système, la proprioception, le système vestibulaire et la vision. Posturographe dynamique bases sur le fait que l'équilibre des résultats de l'intégration des visuels, vestibulaires et proprioceptifs informations, des tests et il l'individu dans des situations différentes. L'objectif de cette étude était d'évaluer l'équilibre chez les patients atteints de ligament croisé antérieur (LCA) lésion, soumis ou non à la chirurgie de reconstruction, par le biais de mousse-Laser Posturographe dynamique, en essayant de trouver la proprioception modifications. Un échantillon de 45 personnes du genre masculin a été utilisé, étant ceux qui sont divisés en 3 groupes: GAVA (avant chirurgie) n = 15, GPOS (postopératoire) n = 15 et GCTL (qu'il contrôle) n = 15. Pour la collecte de données, Laser Posturographe dynamique a été utilisé. Les individus ont été soumis à l'accomplissement de test sensoriel organization (SOT) dans 6 des conditions différentes. Il s'est réuni résultats statistiquement significative, étant souligné proprioceptifs déficit dans certains tests de la GAVA en ce qui concerne les objets Stratégie de groupe et GAVA par rapport à la GCTL. Il est conclu que la Laser Posturographe dynamique peut être utilisé comme méthode de l'équilibre dans l'évaluation clinique des personnes avec des lésions LCA, debout sur la composante proprioceptifs, même si cela peut seulement être évalué grossièrement, à la relation avec les écarts des valeurs de référence.

Mots-clés: la proprioception, ligament croisé antérieur, de l'équilibre.

EVALUACIÓN DE LOS BALANCES DE LAS PERSONAS CON LESIÓN DE LIGAMENTO CRUZADO ANTERIOR A TRAVÉS DE POSTUROGRAFÍA LÁSER DINÁMICO

RESUMEN: El saldo de mantenimiento es posible a través de las estructuras de integración como el sistema motor, la propiocepción, el sistema vestibular y la visión. Posturografía Dinámica bases en el conocimiento de que el balance de resultados de la integración de la visual, vestibular y proprioceptiva información, y pruebas de la persona en situaciones diferentes. El objetivo de este estudio fue evaluar el equilibrio en pacientes con lesión de ligamento cruzado anterior (LCA), presentado o no a la cirugía de reconstrucción, a través de la Laser Posturografía Dinámica, tratando de encontrar alteraciones propiocepción. Una muestra de 45 individuos de género masculino se utiliza, siendo los que están divididos en 3 grupos: GANT (antes de la cirugía) n = 15, GPO (postoperatorio) n = 15 y GCTL (control) n = 15. Para la recogida de datos, Laser Posturografía Dinámica se utilizó. Las personas se presentaron a la realización de la prueba de organización sensorial (SOT) en 6 diferentes condiciones. Se reunió resultados estadísticamente significativos, se señaló proprioceptivo déficit en algunas pruebas de la GANT en relación con la GPO y GANT en relación con la GCTL. Se concluye que la Laser Posturografía dinámica puede ser utilizado como método de equilibrio de la evaluación clínica en individuos con lesiones LCA, destacándose el componente proprioceptivo, incluso por lo que este puede ser evaluado sólo groseramente, con relación a las desviaciones de los valores de referencia.

Palabras clave: propiocepción, ligamento cruzado anterior, el equilibrio.

AVALIAÇÃO DO EQUILÍBRIO DE INDIVÍDUOS COM LESÃO DE LIGAMENTO CRUZADO ANTERIOR ATRAVÉS DA POSTUROGRAFIA DINÂMICA FOAM-LASER

RESUMO: A manutenção do equilíbrio é possível através da integração de estruturas como o sistema motor, a propriocepção, o aparelho vestibular e a visão. A Posturografia Dinâmica baseia-se no conhecimento de que o equilíbrio resulta da integração das aferências visuais, vestibulares e proprioceptivas, e testa o indivíduo em diferentes situações. O objetivo deste estudo foi avaliar o equilíbrio em pacientes com lesão de LCA, submetidos ou não à reconstrução cirúrgica, através do método de posturografia dinâmica Foam-Laser, buscando encontrar alterações na propriocepção. Foi utilizado uma amostra de 45 indivíduos do sexo masculino, sendo esses divididos em 3 grupos: GPRÉ (pré-operatório) n=15, GPÓS (pós-operatório) n=15 e GCTL (controle) n=15. Para a coleta dos dados, foi utilizada a Posturografia Dinâmica Foam-Laser. Os indivíduos foram submetidos à realização do teste de organização sensorial (SOT) em 6 condições diferentes. Encontraram-se resultados estatisticamente significativos, salientando-se déficit proprioceptivo em alguns testes do grupo pré em relação ao pós-operatório e pré-operatório em relação ao controle. Conclui-se a posturografia dinâmica pode ser utilizada como método de avaliação clínica do equilíbrio em indivíduos com lesões de LCA, destacando-se o componente proprioceptivo, porém este pode ser avaliado apenas grosseiramente, com relação aos desvios dos valores de referência.

Palavras-chave: propriocepção, ligamento cruzado anterior, equilíbrio musculoesquelético.