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Research Article

NEW VARIATION ON AN OLD TECHNIQUE FOR REPLACEMENT OF CRANIAL CRUCIATE LIGAMENT RUPTURE AND IT INFLUENCE ON DOG STIFLE JOINT STABILITY RECOVERY

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ABSTRACT

The aim was to evaluate if the fascia lata ligament width (FLl) used for replacement of the ruptured cranial cruciate ligament (CCL) influenced the patient's thigh muscle morphometry evolution. A sample of 60 dogs, was submitted to the over-the-top technique, and was divided into two groups, according to the FLlw: G1 (FLlw=15mm) and G2 (FLlw=20mm). evolution in the healthy and operated limbs were evaluated for thigh muscle's morphometry over three different time points. Differences were registered between G1 and G2, concluding that the wider the FLl the higher is the achieved joint stability, and the earlier use of the operated limb.

INTRODUCTION

Rupture of the cranial cruciate ligament (CCL) is one of the most common diseases of the dog pelvic limb and the most common in knee (Innes,2006; Baraúna and Tudury, 2007; Houlton,2007; Comerford,2007; Glyde,2008; Piermattei *et al*.,2006). The main surgical goal is to restore stifle joint stability, to allow the patient to return to normal physical activity earlier and reduce the progression of degenerative joint disease(DJD) (Comerford,2007; Glyde,2008;Piermattei *et al*.2006; Buquera *et al*.,2004; Boal and Carreira, 2015). The choice of a particular surgical technique must account for the experience and preference of the surgeon, the patient's physical characteristics, and the economic constraints imposed by the owners, which limit the access of the patient to various medical and surgical procedures but should not impede treatment (Innes, 2006; Houlton, 2007; Buquera *et al*., 2004).

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Thus the surgeon may need to use the oldest and most economical surgical techniques, such as the intracapsular techniques, which restore joint stability by replacing the ruptured CCL (Buquera *et al*.,2004; Schulz, 2007), to the detriment of other newer and more expensive techniques, such as the dynamic stabilization techniques, which alter the stifle geometry in order to neutralize the tibia cranial movement and guarantee its stability. Regardless of the surgical technique used, 85% to 90% of the patients will present good to excellent results (Innes, 2006; Houlton,2007; Schulz, 2007; Bruce, 2007). The surgeon should achieve successful patient recovery, which translates into the ability to sit with full knee flexion, the recovery of the thigh muscle's diameter, the stop of DJD progression, and standard full limb function (Vezzoni, 2004). Thus, it is necessary to consider new variations for old techniques in order to improve the obtained results, thereby enhancing the surgeon's work outcome and improving the patient's life quality. Considering that thigh muscles cross two joints acting as a towline, which means that, during the movement they wield a opposite action on both joints so that the origin and insertion move in the same direction transferring

energy from one part to another potentiating their work, they are very important to evaluated the biomechanical efficiency of the knee joint. The study aimed to 1) evaluate if the *fascia lata* ligament width (FLlw) used for replacement of the ruptured CCL influenced the patient's thigh muscle morphometry evolution and, consequently the stifle joint stability recovery.

MATERIALS AND METHODS

A sample of 60 dogs (n=60) of both genders (25%females, 75%males), evaluated with diagnosis of complete CCL rupture, for which the tibial tuberosity advancement(TTA) biomechanical technique could not be used due to the owners'economic restrictions. The over-the-top intracapsular technique was applied for CCL correction instead. Participation in the study only began after each owner completed and signed a consent form. This project complied with all requisites found EU-Convention on the protection of animals revised directive 86/609/EEC and in Portuguese official law Nº113/2013.

The sample was divided into two groups (each=30 individuals), according to the FLlw used to replace the ruptured CCL: G1-(FLlw=15 mm) and G2-(FLlw=20 mm). Thigh muscle's morphology evolution in the operated and healthy limbs was evaluated over three different moments: M0 (pre-surgical), M1 (45 days after surgery), and M2(90 days after surgery). Data for beginning use of the operated limb were also registered. For statistical analysis, we used the SPSS®17.0 software. Shapiro-Wilks test was used for data normality, and for variance analysis the ANOVA test. Results were considered statistically significant for p-values<0.05.

RESULTS AND DISCUSSION

Sample characterization results are presented at Table 1, and the comparison between groups G1 and G2 based on the average thigh diameter of the operated and healthy limb, and between each study moment in Table 2.

Table 1. Total sample characterization, and G1 and G2 records relating to their clinical situation after surgery to correction of cranial cruciate ligament rupture

Parameters			Group	n	Moment	$\overline{x}$ ± SD	95%CI			
							min	max	OI	
Age (years)			-	60		6.7 ± 3.44	2	11		
Weigth (Kg)			-	60		22.7±12.36	7.95	42.7	58.7% < 20Kg	33.3% > 30Kg
TRUS (days)			-	60		14.4 ± 8.52	3	30	-	-
Lameless	With support		-	60		58.33%	-	-	-	-
(100%)	Without support		-			41.67%	-	-	-	-
Eliciting the		Easy	-	60		66.67%.	-	-	-	-
bascule signal		Median	-			8.33%	-	-	-	-
		Difficult	-			25%	-	-	-	-
Meniscus lesion (50%)		Medial	-	60		58.3%	-	-	-	-
		Lateral	-			41.7%	-	-	-	-
Muscle atrophy			-	60		75%	-	-	-	-
Start using the limb in			G1	30		50%				
first week			G2	30		66.67%				
Total weight support (days)			G1	30		16.8 ± 9.73	7	30		
			G2	30		11.6 ± 5.04	7	21		
Thigh diameter of the operated limb (cm)			G1	30	M0	21.8 ± 2.87	18	25.2		
					M1	22.7 ± 2.78	18.9	26		
					M2	22.9 ± 2. 98	19.1	27.2		
			G2	30	M0	31.7 ± 8.56	22	41		
					M1	32.3 ± 8.45	23.1	41.6		
					M2	33.3 ± 8.89	23.4	43.2		
Thigh diameter of the healthy limb (cm)			G1	30	M0	22.7 ± 2.10	19.5	25		
					M1	23.3 ± 2.42	20	26.3		
					M2	23.5 ± 2. 55	20.3	27		
			G2	30	M0	34.0 ± 9.43	24.9	47		
					M1	34.9 ± 10.10	25.2	48.6		
					M2	35.0 ± 9.79	25	47		

Sample (n); Data mean ($\overline{x}$) and dispersion (SD) measures obtained in a 95% confidence interval (CI), presenting the minimum (min) and maximum (max) values. Other Information (OI); Time from rupture until surgery (TRUS).

Table 2. Comparison between groups G1 and G2 based on the average thigh diameter of the operated and healthy limb, and between each study moment (M0, M1, and M2)

Parameters	Groups	Moment	Mean difference (I-J)	SD	p-value	95%CI	
						min	max
Thigh diameter of the	G1/G2	-	-9.96	3.70	0.02	-18.22	-1.69
operated limb (cm)		M0/M1	-0.75	0.19	0.00	-1.18	-0.31
		M0/M2	-1.35	0.23	0.00	-1.87	-0.84
		M1/M2	-0.60	0.17	0.00	-1.00	-0.21
Thigh diameter of the	G1/G2	-	-11.46	4.10	0.01	-20.60	-2.32
healthy limb (cm)		M0/M1	-0.70	0.16	0.00	-1.07	-0.32
		M0/M2	-0.87	0.26	0.00	-1.45	-0.29
		M1/M2	-0.17	0.21	0.42	-0.64	0.29

Sample (n); Data mean ($\overline{x}$) and dispersion (SD) measures obtained in a 95% confidence interval (CI), presenting the minimum (min) and maximum (max) values.

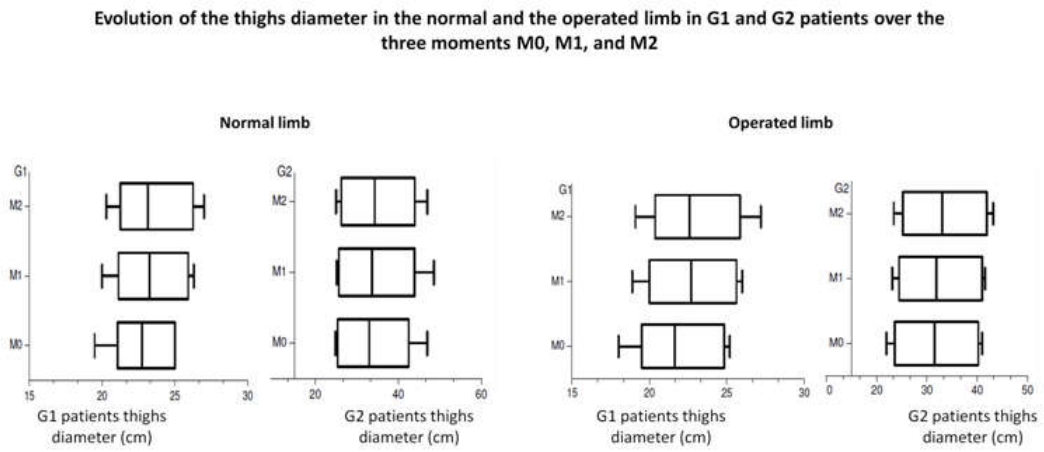

Figure 1. Evolution of the thighs diameter in the normal and the operated limb in G1 and G2 patients over the three moments M0, M1, and M2

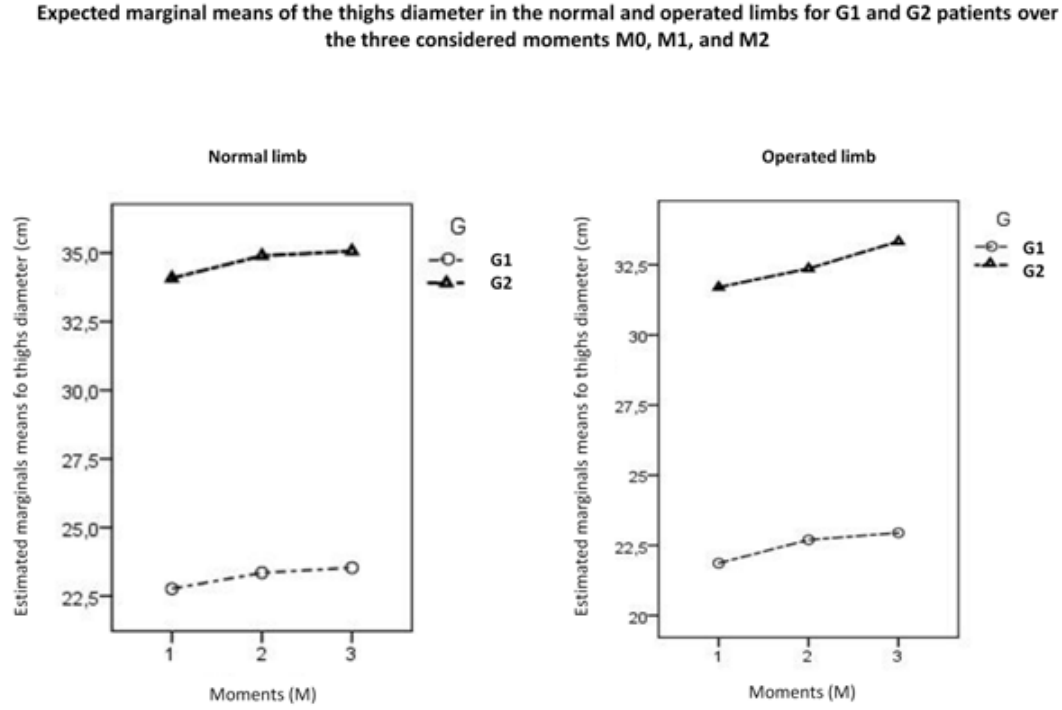

Figure 2. Expected marginal means of the thighs diameter in the normal and operated limbs for G1 and G2 patients over the three considered moments M0, M1, and M2

The ability to move in planes and the limited range of movement which is dependent primary upon the muscles restraints, characterize the joint degree of freedom, which in the knee joint is one with a large range of motion (Schafer, 1987). The greater the number, size, diameter, and length of thigh muscles fibers, the greater the force that each muscle can produce and be applied to change the momentum producing movement. According to the results there were statistically significant differences in early morphology between G1 and G2, considering the day of when limb use was started, with G2 starting six days sooner. The earliest use of the limb is associated with a higher level of stability and more efficient of joint work. Joint stability depends primarily upon its resistance to displacement, and is determined by mechanical and anatomic factors that interact allowing motion and promoting stability at same time (Shelburne *et al*., 2004). Stability of the knee joint is dependent upon the relationships between static factors like the ligaments which guide and align the joint providing a major stabilizing through their normal motion range, and dynamic factors like the muscles which besides providing motion, also absorb energy during cargo bearing, reducing the trauma and helping to stabilize the joint (Schafer, 1987; Blackburn *et al*., 2000). If joint architecture has been compromised by lack of ligaments stability, the muscles don't work as they should and their recruitment and loading forces support are decreased, impairing the usually mechanical advantages of the thigh muscles arrangement (Glass *et al*., 2014). Contrary is also valid being the thigh muscles more mechanical efficient as the higher the joint stability provided by the ligaments.

Under pathologic or surgical conditions, muscles experience adaptation where it mechanical functions are the result of influencing and being influenced by joint stability (An, 2002). ANOVA variance analysis showed statistically significant differences for thigh muscles diameter of the operated limb between G1 and G2 (p=0.023) and between M0/M1 (p=0.003), M0/M2 (p=0.000), and M1/M2 (p=0.006). Similarly, significant differences were observed for the thigh muscles diameter of the normal limb between G1 and G2 (p=0.019), M0/M1 (p=0.002), and M0/M2 (p=0.007)(Table 2). Improvement in efficiency of the limb's is expressed by an increase of the thigh muscles diameter which means that efficient mechanical principles are being appropriated applied and a heavy weight can be easier supported. Changes in thigh muscles diameter were greater in G2 patients at all time points, in association with superior joint stability and, consequently, better patient recovery during the post-operative period (Figures 1 and 2). It is possible to conclude that the width of the FLl used to replace the ruptured CCL influences the patient's recovery during the post-operative period, verifying that the wider the FLl, the higher the achieved joint stability, which is associated with earlier use of the operated limb, which must always be a priority in order to improve the patient´s recovery.

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REFERENCES

An, K.N. 2002. Muscle force and its role in joint dynamic stability. *Clin Orthop Relat Res.,* 403:37-42

Baraúna, J.D., Tudury, E.A. 2007. Uso do teste de compressão tibial e do deslocamento do sesamóide poplíteo no diagnóstico radiográfico da ruptura do ligamento cruzado cranial em cães. Revista Portuguesa de Ciências Veterinárias, 2007;102:71-74

Blackburn, T., William, E. Prentice, Kevin, M. Guskiewicz, Meredith A. Busby. 2000. Balance and Joint Stability: The Relative Contributions of Proprioception and Muscular Strength. JSR; 9:315 – 328

Boal, S., Carreira, L.Miguel. Reactive Protein level variations in dogs serum and synovial fluid with degenerative joint disease and their relationships with physiological parameters. Vet Res Commun,39,3:163-169. DOI: 10.1007/s11259-015-9640-7

Bruce, W.J. 2007. Cranial Cruciate Ligament Injuries: Surgical Management. Proceedings of the 32nd World Small Animal Veterinary Association Congress, Sydney, Australia,19-23

Buquera, L.E.C., Padilha-Filho, J.G., Canola, J.C. 2004. Ruptura del ligamento cruzado cranial en perros: revisión de literatura. Arq. Ciên. Vet. Zool. UNIPAR.;7,1:43-47

Comerford, E.J. 2007. Current thoughts on canine cranial cruciate ligament disease. Proceedings of the 56th SCIVAC Congress, Rimini, Italy, 47-148

Glass, S., Hatzel, B., Albrecht, R. 2014. Kinesiology For Dummies. Wiley; ISBN: 978-1-118-54925-4.

Glyde, M. 2008. Cruciate Disease and Meniscal Injury: Fact, Fiction or Surgical Failure? Proceedings of the 33rd World Small Animal Veterinary Association Congress, Dublin, Ireland, 20-24 August

Houlton, J.E.F. 2007. Cruciate Injuries: An Overview. Proceedings of the 32nd World Small Animal Veterinary Association Congress, Sydney, Australia,19-23 August

Innes, J. 2006.Current thoughts on cruciate ligament failure. Proceedings of the 13th European Society of Veterinary Orthopaedics and Traumatology Congress, Munich. 7-10 September:66-68

Piermattei, D.L., Flo, G.L., DeCamp, C.E. 2006. Handbook of small animal orthopedics and fracture repair. 4th ed. USA;Saunders.

Schafer, R.C. 1987. Basic factors of biodynamics and joint stability. In: Clinical Biomechanics: Musculoskeletal Actions and Reactions, Chapter 3, 2nd ed.; Wiliams & Wilkins.

Schulz, K. 2007. Diseases of the joints. In: Fossum TW. Small animal surgery. 3rd ed.:1143-1315. Missouri: Mosby Elsevier.

Shelburne, K.B., Pandy, M.G., Torry, M.R. 2004. Comparison of shear forces and ligament loading in the healthy and ACL-deficient knee during gait. *J Biomech.,* 37(3):313-9

Vezzoni, A. 2004. TPLO by Slocum: a successful approach in the treatment of cranial cruciate ligament injuries. Proceedings of the 29th World Small Animal Veterinary Association Congress, Rhodes, Greece,, 6-9 October

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