MEDIUM AND LONG TERM RETROSPECTIVE EVALUATION IN 30 DOGS AFFECTED BY CRANIAL CRUCIATE LIGAMENT RUPTURE TREATED BY *TIBIAL PLATEAU LEVELLING OSTEOTOMY* (TPLO)

VALUTAZIONE RETROSPETTIVA A MEDIO E LUNGO TERMINE DELL'EVOLUZIONE DELL'OSTEOARTRITE IN 30 CASI DI LESIONE DEL LEGAMENTO CROCIATO CRANIALE TRATTATI CON INTERVENTO DI *TIBIAL PLATEAU LEVELLING OSTEOTOMY* (TPLO)

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SUMMARY

Cranial cruciate ligament rupture is one of the most common cause of hindlimb lameness in dogs. In 1993 Slocum and Devine invented the tibial plateau livelling osteothomy (TPLO) that face the problem in a new biomechanical point of vue in comparison with other surgical tecniques.

Osteoarthritic (OA) degeneration after cranial cruciate ligament rupture is progressing and it has been observed in post surgery examination after different kind of surgical procedures as well.

30 cases of cranial cruciate ligament rupture traited by TPLO technique have been examinated in our retrospective study.

Dogs that has been included in the present work have been evaluated subjectively by owners with a questionnaire, and clinically by clinicians with an orthopaedic examination, both under sedation and not.

We evaluated osteoarthritic changes on standard radiographs, performed during preoperative examination and during long term follow-up. Follow-up periode has been included from 6 months to 3 years post surgery.

For quali-quantitative examination of osteoarthritic evolution observed between the preoperative and follow-up examination we used and compared two different kind of grading system.

Our results show that osteoarthritic degeneration doesn't stop completely with TPLO surgery, but it continues in a limited way, both in a temporal and quantitative way.

Comparing the two grading methods, the modified method by Citi in our Department seems to be more exact than the classic one.

Key words: cranial cruciate ligament; TPLO; osteoarthritis.

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RIASSUNTO

La rottura del legamento crociato craniale è una delle maggiori cause di zoppia all'arto posteriore del cane. Nel 1993 Slocum e Devine hanno ideato l'intervento di osteotomia livellante del plateau tibiale (TPLO), che approccia il problema da un'ottica biomeccanica differente da quelle esistenti fino ad allora.

L'evoluzione osteoartrosica (OA) in seguito a lesione del legamento crociato craniale è in continua progressione, ed è stata documentata anche in seguito all'esecuzione delle altre tecniche chirurgiche.

Nel nostro studio retrospettivo abbiamo analizzato le eventuali variazioni artrosiche presenti in 30 articolazioni trattate con intervento di TPLO.

I soggetti che sono stati inseriti nello studio sono stati valutati soggettivamente dai proprietari tramite la compilazione di un questionario, e clinicamente attraverso un esame ortopedico sia da svegli che in sedazione.

Per quel che riguarda la valutazione radiografica del grado di degenerazione osteoartrosica sono state eseguite proiezioni radiografiche nei due posizionamenti standard durante la visita pre-operatoria e durante l'ultima visita di controllo. Il periodo di follow-up varia da 6 mesi a 3 anni post-intervento.

Per l'analisi quali-quantitativa dell'evoluzione osteoartrosica che si è avuta tra prima dell'intervento e al momento del controllo, sono stati utilizzati e messi a confronto due sistemi di valutazione radiografica a punteggio.

Dai nostri dati risulta che l'evoluzione osteoartrosica non si arresta totalmente con l'intervento, ma si sviluppa in maniera limitata da un punto di vista quantitativo e temporale. Tra i due metodi di valutazione utilizzati, quello modificato nel 2004 da Citi et al. nel nostro Dipartimento sembra essere più particolareggiato e quindi più preciso.

Parole chiave: legamento crociato craniale; TPLO; osteoartrosi.

INTRODUCTION

Cranial cruciate ligament (CCL) rupture is one of the the most common cause of hindlimb lameness in dogs and the main cause of osteoarthritic degeneration of the stifle.

New concepts around joint biomechanic led Slocum and Slocum in 1993 to conceive a new surgical technique for the treatement of this disease. This technique is the tibial plateau levelling osteotomy (TPLO), and it's goal is to neutralize the tibial cranial thrust changing the tibial plateau slope.

First retrospective studies concerning TPLO treatement showed that within 3 to 4 months postsurgery, affected limbs are returned to a good clinical use, according to Slocum's reporting (Slocum & Slocum, 1993).

One of the most important criteria in determining the success of the TPLO technique is that there should be no progression in osteoarthritis after surgery.

However, recent studies showed that there is some sort of evolution in degenerative changes concerning operated stifles.

Several methods have been reported for evaluation of long-term results in dogs with surgical management of cranial cruciate ligament rupture, the most common

are owner's questionnaires, orthopeadic examination, radiographical examination and force plate analysis.

Clients questionnaires can be useful, but owners opinion may not accurately reflect limb function. Clinical examination also presents some limitation, such as clinician subjectivity, timing of lameness evaluation and dog's temperament. Force plate analysis give more objectives data, but needs a specific equipement not frequently available.

An advantage of radiographic osteoarthritis scoring over other methods of evaluation is the ability to specifically isolate the stifle for examination. One disadvantage of this kind of scoring is bias of an individual reviewer, as well as intra or inter observer variability. To minimize these effects, and to get an evaluation as objective as possible, is very important the choice of the scoring methodology.

The goal of our study has been the long-term evaluation of 30 cases of cranial cruciate ligament rupture treated by TPLO using owner questionnaires, clinical and radiographical examination, in a follow-up period within 9 months to 3 years.

Radiographical examination has been performed using two different scoring methods: the method of Vasseur and Berry (Vasseur & Berry, 1992), that grades osteoarthritic progression of the entire stifle using a scale from 0 to 4, and a personal system that calculates the score of osteoarthritic proliferation in all the different points of the joint, considering the size of osteophytes proliferations.

In this way we could have a parameter to compare the value of these two different methods of evaluation.

MATERIAL AND METHODS

Medical records and radiographs from dogs that underwent surgical management of cranial cruciate ligament rupture by TPLO in the periode within august 2002 to december 2004 at Clinica Veterinaria Apuana were retrospectively evaluated. Inclusion criteria were: complete preoperative clinical and radiographical examination, at least 6 months between surgery and final examination, owner's disponibility to come back at the Clinic for final clinical and radiographical examination under general anestesia. So 21 dogs, 12 with monolateral cranial cruciate ligament rupture and 9 with bilateral cranial cruciate ligament rupture, occurred at different moments, were recruited of our study.

There were 14 males and 7 females. Age at surgery was between 9 months and 11 years, with 4 years and 10 months of average. Age at final examination was between 2.5 years and 12.5 years (Median: 3 years). Weight, size and breed were different, as showed in Tab. I.

In 13 cases the rupture concerned the right limb, in 17 cases the left limb; in 6 trauma was present, whereas in the others 24 cases owners didn't report any traumatic event before the beginning of the lameness.

During follow-up clinical and radiographic examination were performed, and we asked owners to answer a questionnaire concerning the subjective evaluation

Tab. I. Breed, sex, operated stifle, age at surgery and size of dogs recruited for the present study.

Name	Breed	Sex	Stifle	Age	Aehtiology	Size
ETTORE	English Bulldog	M	R	3 years	no trauma	Medium
CHICO	Yorkshire Terrier	M	L	10 years	trauma	Small
LIGA	Rottweiler	F	L	2,5 years	no trauma	Large
			R	3 years	no trauma	
DENNY	Collie	M	L	10 years	trauma	Medium
TOBIA	New Foudland	M	R	2 years	no trauma	Large
			L	3 years	no trauma	
GIULIO	Cross Breed	M	R	6,5 years	no trauma	Medium
KIRA	Rottweiler	F	R	5 years	no trauma	Large
			L	4 years	trauma	
DIDÌ	Epagneul Breton	M	L	10 years	trauma	Medium
MILÙ	New Foudland	F	R	1 year	trauma	Large
			L	1,5 years	no trauma	
STEVEN	Cross Breed	M	R	1 year	no trauma	Medium
VASCO	Boxer	M	L	4 years	no trauma	Medium
MIMY	Mastino Napoletano	F	R	3 years	no trauma	Large
			L	2 years	no trauma	
HIRO	Rottweiler	M	L	9 months	no trauma	Large
			R	1,5 years	no trauma	
FRED	Cross Breed	M	R	8 years	no trauma	Medium
			L	8,5 years	no trauma	
FLIC	Corse	M	R	5,5 years	no trauma	Large
			L	7 years	no trauma	
SNOOPY	Dobermann	M	L	4 years	no trauma	Large
ZARA	German Shepherd	F	R	7 anni	no trauma	Medium
ARGO	Segugio Italiano	M	L	11 anni	trauma	Medium
DEINA	Golden Retriever	F	R	1 year	no trauma	Medium
			L	1 year	no trauma	
ERA	Boxer	F	L	3,5 years	no trauma	Medium
OTTO	Schnauzer gigante	M	R	7 years	no trauma	Large

about dog's clinical status. Samples of synovial fluid have been collected at the same moment, to have another parameter for the evaluation of osteoarthritic degeneration of the joint.

Preoperative and final radiographic examination have been performed under general anestesia, in both the mediolateral and the caudocranial view.

For radiographic evaluation of osteoarthritic changes two methods have been used; the first one is the Vasseur and Berry method, named classic method, that evaluate the entire joint with a scale from 0 to 4, as shown in Tab. II.

The second is the score method studied in our Departement by Citi et al. (not published data). With this method we graded the osteoarthritic proliferation from 0

Tab. II. Rapresentation of Vasseur and Berry method to evaluate osteoarthritis on radiographic examination.

Grade	Interpretation
0	Absence of osteophytes
1	Osteophytes on patella only
2	Osteophytes on patella and troclear notch
3	Osteophytes, on patella, troclear notch, femoral condyles and tibial plateau
4	Osteophytes, on patella, troclear notch, femoral condyles and tibial plateau. Subcondral sclerosis on femoral condyles

to 3, depending on osteophytes size, with a corresponding score: grade 0 for absence of osteophytes (score 0), grade 1 for osteophytes < 2 mm (score 1), grade 2 for osteophytes beetween 2 mm and 5 mm (score 2), and grade 3 for osteophytes > 5 mm. (score 3). This evaluation has been done in definite districts of the joint, and specifically:

1) lateral and medial troclear notch (mediolateral view),
2) lateral and medial femoral epicondyle (caudocranial view),
3) distal and proximal part of patella (mediolateral view),
4) fabellar bones (both mediolateral and caudocranial view),
5) lateral and medial tibial condyle (caudocranial view)
6) central and caudal intercondilar area of tibial plateau (both mediolateral and caudocranial view)

Adding the score obtained for all these different points, we could have a new grade for osteoarthritic evaluation:

Mild osteoarthritis: from 0 to 11 points
Moderate osteoarthritis: from 12 to 22 points
Severe osteoarthritis: from 23 to 33 points

RESULTS

Owner's questionnaires reported good recovery in 87% of cases, within 7 to 75 days (Median 25 days). Owners reported absence of lameness in 15 cases on 21, irregular lameness especially after work in 3 cases, bilateral lameness in 1 case and persistent lameness in 1 case; no one reported some kind of difficult in climbing or going down the stairs. As complications, dogs owners reported in 3 cases moderate swelling of the operated joint, especially in the first periode after surgery; in 2 cases axial deviation of the limb has been found, and in 7 cases the sit test was positive.

At the moment of the final clinical examination, we found some sort of lameness in 2 dogs, one of them that limped at the non operated limb as well. Concerning the sit test, 2 cases were positives and 2 cases gave a doubtful result. In 3 cases dogs showed a reduction of the weightbearing on the operated limb. In any case we had

pain with flexion and extension movements of the stifle; in one case we reported pain in a joint underwent Flo's stabilization (Flo, 1975) before the TPLO surgery. In this case we found lameness, reduction of the weightbearing, positivity for the sit test, as well as reduction of the range of motion and loss of muscle mass.

At palpation, we found some sort of swelling in 7 joint (belonging to 6 dogs).

Under anestesia, we could evaluate joint stability: drawer sign as well as tibial compression test were positive in 1 case and doubtful in 2 cases, in 2 cases we found some grade of muscle atrophy.

Synovial fluid examination showed many degeneratives changes in almost all the joint (i.e. in 27 samples).

Radiographic examination and evaluation of osteoarthritis have been performed with both the classic and the modified method described before. Radiographs taken at the final control have been compared with pre-operative radiographs. In this way we could compare the two methods of grading osteoarthric degeneration.

All the cases have been devided in 3 groups, depending on the length of follow-up periode, to evaluate the osteoathritic progression during the time.

DISCUSSION

According to Slocum & Slocum there are five criteria to evaluate the success of TPLO procedure: complete flexion of the limb (sit test negative), that is obtained approximately 3 months postsurgery, muscle mass recovery, absence of joint swelling, restoring of the normal limb function and stop of osteoarthritic degeneration.

Clinical results obtained in this study are in accord with bibliography reports (Slocum & Slocum, 1993) concerning owners satisfaction (good in 87% of cases) and recovery of limb function (good in 84% of cases).

Osteoarthritic progression of the stifle with cranial cruciate ligament rupture after surgical stabilization can be used to evaluate the efficacy of the different surgical procedures (Matis et al., 2004).

In the present study, according with similar papers recently published (Lazar et al., 2005) we found that osteoarthritic degeneration doesn't stop after TPLO surgery, and we observed some degree of osteoarthric progression in long term evaluation of subjects treated, both with the classic and the modified method of scoring.

Also, according with Lineberger and coworkers (Lineberger et al., 2005), we observed that stifles that at surgical moment had an high grade of osteoarthritis, show a mild evolution of joint degeneration, compared with stifles that are operated in condition of absence or very low grade of osteoarthritic changes. In these second cases we observed a bigger difference in the scoring between pre-operative examination and final examination.

In the present study we found that the most important osteoarthritic changes are observed essentially the first year post surgery, and we didn't see big differences in joint degeneration between cases with a follow up of 1 year and cases with follow

Tab. III. Comparison between the modified and the classic method of evaluation performed on radiographs at follow-up and at preoperatory examination.

Name	Operated Stifle	Postop Score		Preop Score	
		Classic M.	Modified M.	Classic M.	Modified M.
1 - ARGO	L	4	22	1	4
2 - CHICO	L	1	1	1	0
3 - VASCO	L	4	22	1	12
4 e 5 - HIRO	R	2	12	1	3
	L	1	4	1	7
6 e 7 - TOBIA	R	3	12	1	7
	L	3	18	0	2
8 - ETTORE	R	1	4	0	6
9 e 10 - DEINA	R	2	8	1	5
	L	2	6	2	2
11 e 12 - FRED	R	0	2	0	2
	L	2	5	1	9
13 e 14 - MILÙ	R	3	12	2	12
	L	2	12	2	11
15 - ERA	L	4	28	1	2
16 - DIDÌ	L	3	18	0	2
17 e 18 - FLIC	R	3	18	0	8
	L	3	25	0	4
19 - OTTO	R	3	12	0	6
20 - STEVEN	R	1	6	1	7
21 - SNOOPY	L	2	9	1	12
22 e 23 - KIRA	R	3	16	2	11
	L	2	14	0	6
24 - GIULIO	L	2	10	1	4
25 - DENNY	L	2	8	1	8
26 e 27 - MIMÌ	R	3	16	1	4
	L	3	20	0	2
28 e 29 - LIGA	R	1	7	0	2
	L	2	10	0	0
30 - ZARA	R	2	16	1	13

up of 3 year. This is in accord with published data (Matis et al., 2004).

Observing the reported Tab. III and IV, we found some significant differences between the two scoring methods for radiographic evaluation used.

With the classic method we found a minimal evolution (0-1 score) in osteoarthritic degeneration in 26 cases on 30 (87% of cases), with the modified method the minimal degre of evolution (0-4 score) is observed just in 14 cases (47% of cases), and in 53% of cases we found higher values.

In particular, comparing the two methods we could observe that the classic one,

Tab. IV. Comparison between osteoarthritic score in different follow-up periodes obtained with the two different methods.

Surgery <1 year			Surgery >1 and <2 years			Surgery >2 and <3 years		
Name	OA score		Name	OA score		Name	OA score	
	Classic	Modif		Classic	Modif		Classic	Modif
CHICO	1	0	ARGO	1	4	TOBIA dx	1	7
HIRO dx	1	3	VASCO	1	12	DEINA dx	1	5
FRED dx	0	2	HIRO sx	1	7	DEINA sx	2	2
FRED sx	1	9	TOBIA sx	0	2	OTTO	0	6
DENNY	1	8	ETTORE	0	6	MILU' sx	2	11
			MILÙ dx	2	12	ERA	1	2
			DIDÌ	0	2	FLIC dx	0	8
			FLIC sx	0	4	SNOOPY	1	12
			STEVEN	1	7	KIRA sx	0	6
			MIMI dx	1	4	KIRA dx	2	11
			ZARA	1	13	GIULIO	1	4
			LIGA dx	0	2	MIMI sx	0	2
						LIGA sx	0	0

considering all the joint at the same time, is less accurate in grading osteoarthritic degeneration, especially in cases with high preoperative values.

Synovial fluid examination is a very sensitive test to evaluate joint condition, because it's one of the first structure that shows some change in degenerative disease. (Bojrab, 2001) In this study we could see that also in cases where we found mild or absent osteoarthritis on radiographic examination, both with the classic and the modified method, synovial fluid showed significant signes of degenerative joint disease.

The present study, using two different methods of radiographic scoring allowed us to conclude that the classical method, considering the all joint as a single structure, is easier and quicker, but is less accurate, especially in cases with high levels of osteoarthritis in preoperative examinations. With this method is difficult to appreciate postoperatives changes in the follow-up.

The modified method is more complex and difficult to use but gives more informations especially with high grades of degeneration and allow us to appreciate more degeneratives changes is operated stifles.

Using this method we could conclude that in more than the 50% of the cases in this study we had moderate to severe osteoarthritic evolution after TPLO surgery.

However, clinical results obtained with this retrospective study show that Slocum's TPLO, considering all the existent methods to treat cranial cruciate ligament rupture in dogs, represent a good surgical option expecially in large breed dogs.

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