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RETROSPECTIVE STUDY OF 22 TPLO PROCEDURES IN DOGS WITH CRUCIATE LIGAMENT RUPTURE PERFORMED AT THE VETERINARY HOSPITAL OF THE FEDERAL UNIVERSITY OF PARANÁ – CURITIBA

(ESTUDO RETROSPECTIVO DE 22 PROCEDIMENTOS DE TPLO EM CÃES COM RUPTURA DO LIGAMENTO CRUZADO REALIZADOS NO HOSPITAL VETERINÁRIO DA UNIVERSIDADE FEDERAL DO PARANÁ – CURITIBA)

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RESUMO

A ruptura do ligamento cruzado cranial é uma doença muito estudada atualmente sendo a principal causa de claudicação de membro posterior no cão. O diagnóstico é clínico através do teste de compressão tibial e teste de gaveta. A ruptura do ligamento cruzado é diagnosticada com frequência em cães com problemas articulares, sendo a causa mais comum de afecção articular degenerativa do joelho. O tratamento cirúrgico permite a estabilização da articulação, garantindo retorno a função do membro, e diminuição da progressão da osteoartrite. Variadas técnicas cirúrgicas são descritas para o tratamento da CCrLR, dentre elas destaca-se a técnica de osteotomia e nivelamento do platô tibial (TPLO). Embora existam inúmeras referências quanto ao procedimento, poucos estudos avaliam os resultados da técnica. O presente trabalho objetivou avaliar clínica e radiograficamente o joelho de cães com diagnóstico de ruptura do ligamento cruzado, submetidos ao procedimento de TPLO. Realizou-se estudo retrospectivo dos prontuários médicos dos cães atendidos no Hospital Veterinário da Universidade Federal do Paraná, submetidos ao procedimento cirúrgico de TPLO, no período entre junho de 2016 a março de 2018, que compreendeu a 22 casos. Os pacientes foram avaliados no pré-operatório, e aos 7, 14, 30 e 60 dias quanto a evolução clínica e radiográfica. Avaliou-se o ângulo do platô tibial pré e pós-operatório, além das derivações D1, D2 e D3 no pós-operatório imediato. O procedimento cirúrgico de TPLO demonstrou-se eficaz para o tratamento da ruptura do ligamento cruzado neste estudo.

Palavras-chave: ortopedia, cirurgia, pós-operatório, radiografia, ruptura do ligamento cruzado, menisectomia, osteotomia.

ABSTRACT

Cranial cruciate ligament rupture is a closely studied disease currently being the leading cause of limb claudication in the dog. The diagnosis is clinical through the tibial compression test and drawer test. Cranial cruciate ligament rupture (CCrLR) is a common disease in dogs, being the most common cause of degenerative joint disease in the stifle. Surgical treatment allows stabilization of the joint, ensuring return of limb function, and reducing the progression of osteoarthritis. Several surgical techniques are described for the treatment of CCrLR, including osteotomy and leveling of the tibial plateau (TPLO). Although there are numerous references to the procedure, few studies have evaluated the results of TPLO.This study evaluated clinical and radiographic changes in the stifles of dogs following TPLO for CCrLR. The medical records of 22 dogs treated at the Veterinary Hospital of the Federal University of Paraná, which had undergone TPLO between June 2016 and March 2018, were retrospectively screened. The patients were evaluated preoperatively, and at 7, 14, 30 and 60 days after surgery to monitor clinical and radiographic progress. The pre and postoperative tibial plateau angle was evaluated, and the D1, D2 and D3 measurements in the immediate postoperative period. TPLO was shown to be effective for the treatment of cranial cruciate ligament rupture in this study.

Keywords: cruciate ligament, orthopedics, osteotomy, postoperative, surgery, radiography.

INTRODUCTION

Instability of the femorotibiopatellar joint (AFTP) due to rupture of the cranial cruciate ligament (CCrLR) is a frequent cause of pelvic lameness in dogs. The rupture occurs when joint forces exceed the tension force of the ligament which may be weakened by chronic degeneration (CANAPP, 2007; SLOCUM; SLOCUM, 1993). The CCrLR generates rotational and translational instability of the stifle and consequent meniscal injury and osteoarthritis (PIERMATTEI et al., 2009; HAYASHI et al., 2003). The CCrLR also promotes osteoarthritis (JOHNSON et al., 1994), triggering the development of degenerative joint disease (ANDRIACCHI; DYRBY, 2005; KORVICK et al., 1994).

The role of the cranial cruciate ligament is to limit the cranial displacement of the tibia in relation to the femur, preventing both internal rotation of the tibia and hyperextension of the stifle (ARCNOCZY, 1996). In addition, there is a significant increase in internal rotation and adduction of the tibia, especially in the step phase of the cycle (TASHMAN et al., 2004; KORVICK et al., 1994). Ligament rupture can be the result of a traumatic event, but in most cases, there is an underlying degenerative process (KIM et al., 2008) associated with ageing, conformational abnormalities and immune-mediated arthropathies (WILKE, 2005; ARNOCZY 1996).

The diagnosis of CCrLR is based on the presence of joint instability. After CCrLR, an acute inflammatory process develops within the joint, resulting in pain and intermittent lameness (FITZPATRICK; SOLANO, 2010). Secondary to the joint instability, degenerative joint disease develops (VASSEUR; BERRY, 1992). On clinical examination joint instability can be demonstrated by cranial drawer movement and tibial compression tests, but the absence of this instability does not rule out ligament rupture (SCHULZ, 2014; PIERMATTEI et al., 2009).

Radiographic examination allows the detection of joint effusion and degenerative joint disease, in addition to allowing the diagnosis of concomitant orthopedic disorders (SCHULZ, 2014). Radiography with tibial compression is used for diagnosis when cranial displacement of the tibia cannot be detected on clinical examination (ROOSTER et al., 1998); as well as to measure the angle of the tibial plateau, an essential factor for surgical planning and execution (GIERSON et al., 2005). In addition, imaging is essential for the evaluation of postoperative complications and to follow the bone consolidation process (PETTITT et al., 2014; CAREY et al., 2005; KERGOSIEN et al., 2004).

Several surgical techniques are described for the correction of CCrLR, including: intra and extracapsular and transposition of the fibula head and tibial plateau leveling osteotomies (KIM et al., 2008; TATARUNAS; MATERA, 2005). These techniques, in a static or dynamic way, neutralize the tibial cranial translational force (BOUDRIEAU, 2009). The goal of surgical treatment is to restore normal biomechanics of the stifle (TASHMAN et al., 2004), and despite the wide variety of techniques described, recreating normal biomechanics is a challenge (ARAGON; BUDSERG, 2005).

Reently, a number of alternative procedures have been described for the correction of stifle instability (TEPIC et al., 2002). These include the corrective osteotomies, which promote dynamic joint stabilization during limb support, reducing cranial tibial thrust and favoring early return to function (KIM et al., 2008). The techniques of TPLO (SLOCUM; SLOCUM, 1993), TTA (MONTAVON et al., 2002), cranial wedge osteotomy of the tibia (APELT et al., 2010) and tibial triple osteotomy (MOLES et al., 2009) aim to alter the mechanical forces acting on the stifle, rendering the cranial cruciate ligament redundant (GRIERSON et al., 2011).

TPLO is currently the surgical procedure of choice for the treatment of CCrLR and was proposed to reduce cranial tibial pressure and reduce caudodistal inclination guided by the tibial plateau (SLOCUM; SLOCUM, 1993). Angulation at 5º (SLOCUM; DEVINE, 1984) or 6.5º (WARZEE et al., 2001), will effectively maintain stifle stability. The reduced angle of the tibial plateau obtained by radial osteotomy of the proximal tibial metaphysis and rotation of the proximal fragment neutralizes the tibiofemoral shear force and stabilizes the stifle during weight bearing (SLOCUM; SLOCUM, 1993). After TPLO, the caudal cruciate ligament becomes the main stabilizer of the stifle (WARZEE et al., 2001).

The main complications arising from the TPLO procedure are osteomyelitis (FREY et al., 2010), tibial tuberosity fracture, and implant failures (GOTTLIEFF et al., 2011; STAUFFER et al., 2006; PACCHIANA et al., 2003; PRUDDY et al., 2003). Other problems associated with the procedure include tendonitis of the patellar tendon, injury to the medial tibial cortex, patellar dislocation, and permanent cranial translation due to insufficient plateau correction (GATINEAU et al., 2011). Despite the numerous complications associated with the TPLO procedure, only 3 to 6% of cases require surgical reintervention (GATINEAU et al., 2011; FITZPATRICK; SOLANO, 2010). The identification of pre-existing risk factors means that preventive actions can be taken, thus guaranteeing better results (BERGH; PEIRONE, 2012).

The prognosis following TPLO is good, with excellent clinical results in approximately 90% of cases. The surgical treatment promotes joint stability and, when associated with menisectomy, helps to decrease the progression of osteoarthritis, and contributes to a better long-term functional outcome (IMHOLT et al., 2011; PRIDDY et al., 2003).

Several techniques are studied, such as TPLO, are studied for the treatment of cranial cruciate ligament rupture in dogs. Therefore, the aim of this study was to retrospectively evaluate patients undergoing TPLO at the Veterinary Hospital of the Federal University of Paraná.

MATERIALS AND METHOD

This study included patients that underwent TPLO at the Veterinary Hospital of the Federal University of Paraná between June 2016 and March 2018. The diagnosis of RLCrC was based on clinical findings including joint pain, joint effusion, positive drawer test and positive tibial trust test. Radiographic evaluation of the affected limb was performed for surgical planning and assessment of the degree of osteoarthrosis.

The medical records of the patients were analyzed to determine breed, sex, age and weight. Clinical history, description of the surgical technique, presence of meniscal lesions and procedure were also evaluated. The angles of the tibial plateau were measured on pre- and immediately post-operative radiographs, and measurements D1, D2 and D3 were derived. The radiographs were used to evaluate the presence of degenerative joint disease, and for postoperative follow-up, to screen for complications and to monitor bone healing.

TPLO was performed according to the technique of Slocum and Slocum (1993), with the aim of leveling the tibial plateau and stabilizing the joint. A parapatellar arthrotomy and meniscal exploration were performed. After tibial osteotomy, the segment was rotated based on the previously calculated leads. The segment was stabilized with 2.7- or 3.5-mm plates with locking screws in the proximal fragment and blocked or cortical screws in the distal fragment. Radiography was performed

in the immediate postoperative period to confirm bone alignment, implant position and osteotomy in relation to joint space, as recommended by Slocum and Devine (1998).

The postoperative follow up examinations were performed after 7 and 14 days to evaluate the degree of inflammation and pain, surgical wound healing, and joint stability. Clinical and radiographic evaluations were performed 30 and 60 days after surgical procedure. The patients were discharged after radiographic confirmation of 75% or more bone consolidation. The values of the tibial plateau angle, pre- and postoperatively, and the values of D1, D2 and D3 were evaluated by the orthopedic surgeon

RESULTS

In the study, 22 patients underwent TPLO surgery at the Veterinary Hospital of UFPR - Curitiba. The signalment, body mass (kg) and affected imb are shown in Figure 1.

Figure 1. Breed, sex, age (years), weight and affected limb of the animals undergoing TPLO procedure at the Federal University of Paraná, Campus Curitiba.

Breed	Sex	Age (years)	Weight (Kg)	Affected limb
Mixed breed	Male	6	26	Right
Pitbull	Male	9	42	Bilateral
Brasilian Fila	Male	3	49	Right
Mixed breed	Male	6	17	Left
Brazilian Fila	Male	1	50	Right
Lhasa apso	Female	8	13	Bilateral
Mixed breed	Female	9	13	Right
American SBT	Male	1	33	Left
Boxer	Male	8	26	Right
Mixed breed	Male	5	30	Right
English Bulldog	Female	2	26	Left
Mixed breed	Female	7	13	Right
Mixed breed	Female	2	13	Left
Lhasa apso	Male	4	13	Right
Rottweiler	Female	9	48	Left
Chow-Chow	Female	2	16	Bilateral
Pitbull	Male	7	36	Right
Rottweiler	Female	6	49	Left
Mixed breed	Female	3	40	Right
Mixed breed	Female	11	21	Left
Mixed breed	Femlae	7	23	Right
Pitbull	Male	5	43	Bilateral

SBT= Staffordshire Bull Terrier

The statistical representation of the frequency of sex and affected limb is shown in Figure 2. The variables age and weight were calculated, and the results are shown in Figure 3.

Figure 2. Representation of the frequency of sex and affected limb, in percentage.

	Right	Left	Bilateral
Males and females	50%	31.82%	18.18%
Females	36.36%	45.45%	18.18%
Males	63.64%	18.18%	18.18%

Figure 3. Statistical representation of the variables age and weight.

Variable	Age (Years)	Weight (Kg)
Males and females	5.5 +- 2.92	29.09 +-13.58

A positive drawer test was performed in 17 animals and a positive tibial compression test in all the animals. The 22 patients had varying degrees of lameness at different times - varying between acute and persistent, and chronic and intermittent. Two patients had non-weight bearing lameness. Eight animals showed pain during the clinical evaluation and palpation of the articular region. Four animals had a bilateral presentation; in 11 animals the right limb was affected, and in seven patients the left limb.

The surgical procedure consisted of medial parapatellar arthrotomy in all cases. Meniscal lesions were observed in 20 patients, with partial menisectomy of the caudal pole in 4 patients and total menisectomy in 16 cases; only 2 dogs had intact menisci, which were preserved.

Concomitant orthopedic conditions were diagnosed on clinical and radiographic examination in three patients (two patients had bilateral patellar dislocation and one, hip dysplasia). In six patients, degenerative articular disease in the femorotibiopatellar joint, was seen on radiographic examination. The pre and postoperative tibial plateau angles, and dervied values D1, D2 and D3 postoperatively were evaluated and are described in Figure 4. The means and standard deviation were analyzed and described in Figure 5.

Figure 4. Pre-and postoperative tibial plateau angle, and postoperative D1, D2 and D3 calculations.

Breed	Pre-operative angle	Post-operative angle	D1	D2	D3
Mixed breed	30°	6°	1.45 cm	1.92 cm	1.98 cm
Pitbull	23°	5°	1.38 cm	1.62 cm	3.07 cm
Brazilian Fila	32°	8°	1.37 cm	1.47 cm	2.28 cm
Mixed breed	36°	6°	1.28 cm	1.64 cm	2 cm
Brazilian Fila	33°	6°	2.12 cm	2.45 cm	3.08 cm

Lhasa apso	31°	7°	0.65 cm	0.81 cm	1.79 cm
Mixed breed	25°	4°	0.85 cm	1.15 cm	1.66 cm
American SBT	36°	7°	1.05 cm	1.55 cm	2.31 cm
Boxer	32°	7°	1.45 cm	2.08 cm	2.59 cm
Mixed breed	21°	5°	1.55 cm	1.90 cm	2.46 cm
English Bulldog	17°	7°	1.17 cm	1.52 cm	1.97 cm
Mixed breed	26°	6°	1.44 cm	1.87 cm	1.96 cm
Mixed breed	25°	6°	1.3 cm	1.59 cm	1.63 cm
Lhasa apso	29°	6°	1.25 cm	1.67 cm	2.42 cm
Rottweiler	20°	9°	1.64 cm	1.92 cm	2.48 cm
Chow-Chow	28°	6°	0.92 cm	1.39 cm	2.16 cm
Pitbull	23°	4°	1.53 cm	1.81 cm	1.97 cm
Rottweiler	25°	5°	0.94 cm	1.37 cm	3.08 cm
Mixed breed	26°	7°	1.08 cm	1.32 cm	2.74 cm
Mixed breed	29°	6°	0.93 cm	1.15 cm	2.55 cm
Mixed breed	24°	6°	0.72 cm	1.21 cm	2.53 cm
Pitbull	32°	7°	1.09 cm	1.48 cm	2.40 cm

Figure 5. Statistical evaluation of the mean and standard deviation of the pre- and postoperative angles, and the postoperative derivations D1, D2 and D3.

	Pre-operative angle	Post-operative angle	D1	D2	D3
Males and female	27.40 +-5.08	6.18 +-1.18	1.23+-0.34	1.58+-0.36	2.32+-0.43

In 14 patients, 3.5 mm plates were used for TPLO and a 24mm saw used to cut the osteotomy. In one patient a 3.5 mm plate was used with a 27 mm saw and in another a 3.5 mm plate and a 30 mm saw. In six patients, the 2.7 mm plate and 18 mm saw were used. The main complications observed were local wound dehiscence and seroma in 7 animals. Dehiscence occurred 10 days after the surgical procedure in 5 patients. Seromas developed after an average of 7 days in 3 patients; requiring the use of a compression bandage and wound cleaning. One patient required surgical reintervention due to concommitant complications and exposure of the implant. All other patients with complications were treated conservatively no further interventions were required. Only one patient had a late fibular fracture, verified on the radiograph 30 days after the procedure, but there was no compromise of limb function.

At 30 and 60 days, the patients were reassessed and further radiographic examination was performed to follow the bone consolidation process. Bone consolidaton was graded as a 0% to 100%. All patients achieved at least 75% bone consolidation in this period. A large number of dogs failed to attend the 90-day postoperative examination, so it was not possible to evaluate the average time for

complete bone healing. In order to confirm clinical improvement in these patients owners were contacted by telephone and asked about the clinical progress, and in all cases there was confirmation of return of limb function.

DISCUSSION

CCrLR occurs mainly in large breed dogs, including Neopolitan Mastiff, Akita, St. Bernard, American Staffordshire Bull Terrier and Labrador (DUVAL et al., 1999). Boxers, Dobermans, Golden Retrievers and Labradors were the most prevalent breeds in a study by Lampmann et al. (2003), of 775 dogs with CCrLR. According to Johnson and Johnson (1993), dogs over 15kg, and under the age of five years are most predisposed. In the present study a variety of breeds were recorded: Mixed breed (9), Pitbull (3), Fila Brasileiro (2), Lhasa apso (2), Rottweiler (2), American Staffordshire Bull Terrier (1), Boxer (1), Bull dog and Chow-Chow (1), with a mean weight of 29 kg, and age of 5.5 years.

In the present study, the torn ligaments were not histologically evaluated. Wingfield et al. (2000) observed that Rottweiler dogs have less robust ligaments when compared to other breeds, explaining their predisposition to the disease. Reduced stength of the ligament may be related to the pattern of collagen fibers in certain breeds, as demonstrated in histological studies. The collagen ligaments showed a higher proportion of type I collagen and 10% of type III collagen in their structural conformation, whereas in the ruptured ligaments there was a higher proportion of type III collagen (DE ROOSTER et al., 2006). As performed in this work, it is extremely important to evaluate the preoperative (surgical planning) and postoperative APT. Piermattei et al. (2009), suggested an increased incidence of CCrLR in dogs with slightly angulated limbs, such as the Labrador Retriever.

According to Grierson et al. (2011) the pathological condition is present in both stifles, and a high percentage of dogs have bilateral rupture or contralateral rupture within 1 to 2 years of the first diagnosis. In the present study, there was a greater involvement of the right ligament (in 68.1% of cases), of which 18.18% were affected bilateral. Moore and Read (1995), however, reported a higher incidence of CCrLR in the left limb (58.9% of cases).

Positive cranial drawer and tibial compression tests were used for the diagnosis of CCrLR in this paper. The diagnosis of CCrLR is based on the presence of joint instability, cranial drawer and tibial compression tests (HARASEN, 2002). Radiographic evaluation of the stifle is useful for the diagnosis of bone abnormalities and other orthopedic alterations, as well as for appropriate surgical planning (BUQUERA et al., 2002; HARASEN, 2002).

The main clinical sign in patients with CCrLR is lameness with sudden inability to bear weight on the affected limb (VASSEUR, 2002). Clinical evaluation of dogs in this study showed lameness of varying degrees in 100% of the cases; 36.36% of the patients presented with pain on joint palpation. The drawer test was positive in 72.27% of the patients, and a positive tibial compression test was found in 100%. This result coincides with those observed by Ferreira (2013), who reported lameness and a positive drawer test in 80% and positive tibial compression test in 100% of cases. According to the author, failure to make a diagnosis using the drawer test is due to insufficient sedation, which makes it more difficult to identify the instability. Muir (2010) states that sedation and anesthesia help detect abnormalities, especially in cases with chronic osteoarthrosis.

Radiographic examination was useful in confirming concomitant conditions, bilateral patellar dislocation (grade 3), in 13.6% and hip dysplasia in 4.5% of patients. This complementary examination also identified degenerative joint disease in the femorotibiopatellar joint in 27.3% of the patients. In the present study, it was observed that the presence of osteoarthrosis is a consequence of CCrLR (LAZAR et al., 2005), and can be evaluated in radiographic examinations (FUJITA et al., 2006) or by direct visualization during stifle arthrotomy (DYMOND et al. 2010).

After performing the TPLO, a negative tibial compression test was observed in all patients. The tibial plateau leveling osteotomy was proposed by Slocum and Devine (1983), as an option for surgical treatment for CCrLR. The authors proposed that caudal instability with CCrLR can be eliminated by caudally-orientated leveling of the tibial plateau, thereby limiting the shear force generated during weight bearing, and controlling cranial tibial thrust.

In the present study, the pre-surgical APT was varied in this study. The post-surgical APT ranged from 5 to 9 degrees. According to Slocum and Slocum (1993), the greater the angle of the tibial plateau (APT), the greater the instability of the stifle following CCrLR, invariably leading to early and severe degenerative joint disease. The angle of the tibial plateau varies between individuals (WILKE et al., 2002), and dogs with RLCC have a higher APT than dogs without the disease (MORRIS; LIPOWITZ, 2001). The TPLO technique aims to obtain a final APT of 5˚ (SLOCUM; DEVINE, 1983).

According to Duer et al. (2008), the angle of the tibial plateau in dogs with changes in the cranial cruciate ligament varies from 23.5º to 28.30º, and when it exceeds 34º, it is considered an excessive angle. In the present study, the mean tibial plateau angle in the preoperative period was 27.4º, the highest angle being 36º in two patients.

According to Warzee et al. (2001), an angle of 5 to 6 degrees in the tibial plateau effectively maintains stifle stability. In the postoperative period, the mean tibial plateau angle obtained was 6.2º, with a variation of 4 to 9º, but no clinical alterations were observed among the patients. The mean postoperative values for D1, D2 and D3 were 1.23 cm, 1.59 cm, and 2.32 cm, respectively. Other

studies also identified altered tibial plateau angles after the TPLO procedure. Robinson et al. (2006) when evaluating the locomotive kinetics of Labrador Retrievers following TPLO, observed a satisfactory recovery of limb function with a wide range of APT values. Moeller et al. (2006), demonstrated that the APT value increased after the consolidation of the plateau fragment of the osteotomized tibia; however, the clinical impact of this information remains unclear.

According to Canapp (2007), the joint instability resulting from CCrLR promotes pathological alterations such as synovitis, osteoarthritis and meniscal injury, the latter being observed in the patients in this study. Degenerative joint disease was identified in 27.3% of the patients, and meniscal injury in 90.9% of the cases. Ferrigno et al. (2012) also observed a high percentage of meniscal injury associated with CCrLR the lesions secondary to CCrLR can occur in 40 to 60% of dogs, being more frequently seen in chronically unstable stifles (CASE et al., 2008).

In order to confirm the presence of meniscal lesions, a median parapatellar arthrotomy was used in all cases. Partial menisectomy of the caudal pole was performed in 18.18% and total menisectomy in 72.73%. Only 9.1% of the dogs had intact menisci, which were preserved. According to Bezerra and De Biassi (2013), arthrotomy is indicated in all patients, since it is estimated that meniscal lesions are present in between 20 and 77% of cases. The authors emphasize the importance of diagnosis and surgical intervention in cases of meniscal injury, to reduce morbidity in the postoperative period, and minimize the need for reinterventions, since future lameness may occur after joint stabilization (CASE et al., 2008; POZZI et al.

The occurrence of intra and postoperative complications range from 18% to 28%, and these include effusion, seroma, hematoma, and local dehiscence (PACCHIANA et al., 2003), hemorrhage and cortical lesions (Patel et al., 2003), patellar tendon thickening (BOUDRIEAU et al., 2003), tenderness of the patellar tendon and failure of implants (STAUFFER et al., 2006; PACCHIANA et al., 2003; PRIDDY et al., 2003). In this study 31.82% of the patients had local dehiscence of sutures and 13.64% developed seromas, which were treated conservatively. The exaggerated divulsion and pain were the two hypotheses raised with causes ofhiscence of sutures. Only one patient required reintervention due to infection of the surgical wound, and consequent dehiscence of the sutures and exposure of the implant. According to Gatineau et al. (2011), despite the high incidence of postoperative complications, only 1.6% to 9% of cases require a second surgical intervention.

Frey et al. (2010) observed a 6.1% rate of infection and inflammation in the postoperative period in dogs following a TPLO procedure. The authors suggest that the duration of anesthesia may contribute to postoperative infection and inflammation. According to Brown et al. (1997), increased duration of anesthesia may lead to suppression of the immune system and predispose patients to postoperative complications, such as wound infection. Dal-Bó et al. (2013) observed osteomyelitis in 16.6% of their cases. The authors attribute the high occurrence of complications to the limited

muscular coverage in the region of the implants and the size of the animal. According to Frey et al. (2010), large and giant breeds deliver a high mechanical stress to the implant and surgical wound, which has an impact on postoperative recovery. In the present study, the exposure of the implant to the size of the animal and to the agitated temperament characteristic of the Boxer breed is attributed to the present study.

Late fibular fracture was observed in one patient and was confirmed on the radiographic examination 30 days after the procedure, however no impairment of limb function was noticed. The angulation of the tibial plateau of 31 ° in this patient was considered a risk factor for the occurrence of fibular fracture after the TPLO (BERGH; PEIRONE, 2012; TAYLOR et al., 2011; PACCHIANA et al., 2003). Other complications described after the TPLO procedure are long digital extensor injury (HAALAND; SJOSTROM, 2007), avulsion of the tibia crest (BRUCE et al., 2007) and loosening or breaking of the screws (STAUFER et al., 2006; PACCHIANA et al., 2003) but none of these were observed in the present study.

Bone consolidation was evaluated by analysis of radiographs, assigning subjective scores of 0%, 25%, 50%, 75% and 100%. Although a subjective evaluation, this method is described in several studies, and is considered adequate (KROTSCHECK et al., 2012; DUERR et al., 2008). In this study, all the patients had 75% or more bone consolidation by 60 days after the surgical procedure. These results corroborate the findings of Krotscheck et al. (2012), who described more than 80% of animals with 75 or 100% consolidation by six weeks postoperatively. The confirmation of 100% consolidation was not possible, since a number of owners failed to present their pets for the 90 day post-op evaluation. Since significant clinical improvement will be seen by this time owners may choose not to return for follow up examinations.

TPLO is a well documented surgical procedure, and the results obtained in the present study are in accordance with previously reported findings. TPLO is a surgical technique suitable for treatment of cranial cruciate ligament rupture, and results in clinical improvement in patients in a short period of time (90 days) (DUERR (KELLER et al., 2008).

CONCLUSION

The surgical procedure of TPLO was shown to be effective for the treatment of cruciate ligament rupture in this study. In addition, there was a high incidence of meniscus injury (90% of patients), justifying knee arthrotomy in all patients with CCrLR

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