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Partial rupture of the cranial cruciate ligament treated with tibial tuberosity advancement without debridement of the remaining ligament: A clinical study of 18 cases

D. Skytte[1], H. Schmökel[1], J. Miles[2]

[1]Specialistdjursjukhuset Hund och Katt, Strömsholm, Sweden, [2]Department of Veterinary Clinical and Animal Sciences, Faculty of Health and Medical Sciences, University of Copenhagen

Instability following complete cranial cruciate ligament (CrCL) rupture is ongoing (Tashman et al., 2004) and leads to inflammation, degenerative joint disease, and cartilage and meniscal damage (Messmer et al., 2001; Boudrieau, 2009). Often inflammation and osteoarthritis begin already in stifles with partial CrCL ruptures despite apparent mechanical stability. If left untreated these dogs continue in most cases to develop degenerative joint disease (DJD), finally leading to a complete rupture of the CrCL with consequent instability and meniscal damage (Hayes et al., 2010). A case series published (Hulse et al., 2010) showed that partial CrCL ruptures treated early with a tibia plateau leveling osteotomy (TPLO) leaving the remaining ligament in situ had less progression of the DJD compared to the stifles with a complete CrCL rupture and TPLO. The objective of this study is to report the incidence of late complete cruciate ligament rupture after a tibial tuberosity advancement (TTA) procedure in patients with partial cruciate ligament tears at the time of the TTA and the outcome of this treatment.

Animals, Material and Methods

Dogs included in the study were diagnosed as having a partial tear of the CrCL. Medical data (signalment, lameness history, radiographs, surgical reports as well as perioperative and postoperative complications) were collected and evaluated (Tab. 1). The diagnosis was based on the history of hind limb lameness, clinical examination, radiological assessment (joint effusion, osteophyte formation), and surgical exploration of the stifle joint. In all cases a tibial compression and cranial drawer tests were performed under anesthesia before surgery and showed stability against cranial tibial translation and internal rotation of the tibia compared to the other hind leg. The indication for the arthrotomy was based on the persisting clinical lameness and the joint effusion/osteophytes in the stifle.

Surgery was performed on 18 stifles in 18 dogs comprising 11 female and 7 male dogs. The mean age at the time of surgery was 4y 5m (range 1y 10m to 8y 5m). The patients were assessed clinically and radiographically 6 weeks and 7–14 months (mean 11.2 months) after the TTA by the operating surgeon. The lameness was evaluated during walking and trotting the dog outdoors and scored on a scale of 0–4 (0 = no lameness, 1 = mild lameness, 2 = clear lameness, 3 = severe lameness, 4 = non weight bearing lameness). Stifle stability was evaluated pre-operatively and during all post-operative examinations using the tibial compression and the cranial drawer test. A follow-up questionnaire was filled out by the owners 7–14 months after the TTA and reviewed during the control visit. The final result was defined by the clinical exam, radiographs and the questionnaire to be "very good" if the dog was free of lameness, instability and joint effusion and did not need NSAIDs for his daily life; "good" if there was only mild lameness after heavy exercise and no NSAIDs were needed; "fair" if there was mild lameness after walks or rest and "poor" if the dog was often lame and needed NSAIDs on a regular basis.

Surgery, pre- and postoperative care

A small craniomedial arthrotomy was performed to evaluate intra-articular structures. All partially ruptured CrCL had visible damage, but the probing showed no significant laxity of the intact fibers. The remaining part of the CrCL was left in place without debridement. No meniscal surgery had to be performed except in one patient (case 9) in which a damaged medial meniscus was found and partially resected. A TTA performed using commercially available equipment as described in the literature (Lafaver et al., 2007). Postoperative lateral radiographs confirmed sufficient tibial tuberosity advancement in all cases, judged by a patellar tendon angle ≤ 90° at 135° extension of the stifle joint. Peri- and postoperative analgesia was provided with methadone, and after discharge the next day with tramadol and carprofen. Owners were instructed to keep their dogs strictly on the lead for the following six weeks and to reduce activity to short walks. Once control radiographs revealed adequate osteotomy healing, exercise was gradually increased and hydrotherapy to support muscle strength intensified.

Table 1: Signalment, complications and final results of 18 cases with partial cranial cruciate ligament rupture treated with TTA without debridement. f = female, fs = female spayed, m = male, mn = male neutered.

Case	Breed	Age	Sex	Major complications within follow up	Clinical outcome 7–14 months post-op
1	Boxer	4y	fs	none	very good
2	Newfoundland	2y 4m	m	none	very good
3	Doberman	5y 1m	m	total CrCL rupture, 2nd look	good
4	Labrador	3y 6m	fs	none	very good
5	Boxer	6y 11m	mn	total CrCL rupture, 2nd look	good
6	Mixed Breed	8y 5m	fs	total CrCL rupture, 2nd look , meniscal damage	fair
7	Australien Sheperd	8y 1m	f	none	very good
8	Estrella Mountain Dog	2y 6m	f	none	very good
9	German Shepherd	3y 6m	f	none	very good
10	English Bulldog	2y	f	none	very good
11	Golden Retriever	4y 8m	mn	none	very good
12	Labrador	2y 1m	fs	none	good
13	Staff. Terrier	3y 3m	fs	none	very good
14	Labrador	1y 10m	m	none	very good
15	Rottweiler	6y 9m	f	none	very good
16	English Bulldog	4y 7m	f	none	good
17	ChowChow	3y 9m	m	total CrCL rupture palpable at 9 months	good
18	Labrador	6y 10m	mn	total CrCL rupture, 2nd look , meniscal damage	fair

Results

All controlled patients had functional stability of the CrCL with a negative drawer test 6 weeks after TTA, and radiographs confirmed healing of the osteotomy. The owners did not notice lameness or pain in the operated stifles in 13 cases (72 %) during the follow up period; and examination of these cases 7–14 months after the TTA showed no instability. In 5 (28 %) cases there was a sudden recurrence of lameness in the operated limb during the study follow up time. Clinical examination of these cases showed cranial instability. Craniomedial arthrotomy or arthroscopy was performed in 4 cases (3, 5, 6 and 18), and the totally ruptured CrCL was debrided and damaged menisci partially removed in 2 cases (Tab. 1). Case 17 recovered with conservative treatment to a good result.

Discussion

In clinical cases the rate of partial CrCL tears is reported to be in the range of 30 % (Bleedorn et al., 2011; Fuller et al., 2012). Continuous mechanical stress generated by the cranial tibial thrust (CTT) has been proposed as an aetiopathology for the damage of the CrCL (Griffon, 2010). The TTA neutralizes the CTT and an *in vitro* study demonstrated that TTA counteracts cranial tibial thrust under simulated limb loading (Kipfer et al., 2008). We hypothesized that unloading a partially ruptured ligament with a TTA procedure might halt the degenerative process of the ligament. This would be beneficial for the affected stifle because the remaining functional CrCL could protect the cartilage and the menisci from cranio-caudal instability and excessive internal rotation. This effect was evident in a case series of partial CrCL ruptures treated with a tibia plateau leveling osteotomy (TPLO) (Hulse et al., 2010). Partially damaged CrCL which were functional at the time of surgery remained functional, and these stifle joints showed fewer degenerative changes compared to the ones with a total CrCL rupture (Hulse et al., 2010). In our study 72 % of the cases achieved a good or very good result after TTA with functional stability of the remaining CrCL, while 28 % developed during the follow up time of 7–14 months a complete rupture of the remaining CrCL, 3 of them having a good outcome at the end. The questionnaire in this study has been used in two other retrospective studies of short- and mid-term success of TTA (Hoffman et al., 2006; Stein und Schmökel, 2008). The results and satisfaction reported by the owners in this series compare favorably with a similar study with 70 cases mainly having complete CrCL ruptures (Stein und Schmökel, 2008). In this series 61 % of the dogs show no lameness compared to 39 %; and 94 % do not need NSAID for full activity compared to 72 % (Stein und Schmökel, 2008).

Conclusion

The result of this study indicates that an early treatment of partially ruptured CrCL with a TPLO or TTA provides a better long-term result with the remaining CrCL staying intact in most cases providing the affected stifle with stability, resulting in less DJD and less need of NSAID.

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Corresponding author

Hugo Schmökel
Specialistdjursjukhuset Hund och Katt
Djursjukhusvägen 11
734 94 Strömsholm
Sweden
hugo.schmokel@stromsholmdjursjukvard.se

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