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Research article

EVALUATION AND APPLICATION OF THE TTA-RAPID METHOD IN DOGS WITH CRANIAL CRUCIATE LIGAMENT RUPTURE

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The objective of this study intended the application of the current technique of modified tibial tuberosity advancement (TTA)- rapid method in dogs with cranial cruciate ligament rupture (CrCL) and reports on the clinical outcome and complications. The study material consisted of 17 male dogs of different breeds between the ages of 2-8 years, average weight of 32 kg with a diagnosed unilateral CCL rupture. Hudson Visual Analog Scale (HVAS)-Walking Test Rating, Canine Brief Pain Inventory (CPBI)-Pain Rating) were examined, and rupture of the CCL was diagnosed based on direct radiographic examination. The pre-operative evaluation of the implant to be used in TTA-Rapid technique was determined by measuring radiographic images of the CCL in dogs. Post-operative evaluation in the 1st, 2nd, and at 3 month was performed by radiographic examination, gait and pain tests. Major complications were recorded in 17.6% of the cases. Fourteen (82.4%) dogs had a good to excellent outcome 3 months after surgery. Lameness and pain assessment were performed up to 15 days prior to the operation and 1, 2, and 3 months after the TTA-Rapid technique procedure.

It can be concluded that TTA-Rapid technique procedure is a fast, easy to learn and non-invasive treatment of CrCL ruptures in dogs.

Keywords: Dog, Cranial Cruciate Ligament Rupture, TTA-Rapid, HVAS, CPBI

INTRODUCTION

Rupture of the cranial cruciate ligament is a common problem in dogs [1]. Medium to large breed dogs (e.g. Retriever breed size) between the ages of 6 and 10 years are most frequently affected. However, dogs as young as 1 to 2 years old and of any size including toy and giant breeds can rupture their cranial cruciate ligament [2,3]. In the vast majority of dogs, the cranial cruciate ligament ruptures as a result of long-term degeneration, whereby the fibres within the ligament weaken over time [4]. The precise cause of this problem is still unknown, but genetic factors are probably most important, with certain breeds being predisposed (including Labradors, Rottweilers,

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Boxers, West Highland White Terriers and Newfoundlands). Supporting evidence for a genetic cause was primarily obtained by assessment of family lines, coupled with the knowledge that many animals will rupture the CrCL in both stifles, often relatively early in life. Other factors such as obesity, individual conformation, hormonal imbalance and certain inflammatory conditions of the joint may also play a role [2,5,6,7]. Dogs will typically develop a sudden onset of non-weight bearing lameness. This will usually improve over a few weeks. Occasionally, the owner will identify an abnormal incident that caused the lameness such as falling off a deck or stepping in a hole. Most often however no incident is identified and animals become lame while performing everyday activities such as running and playing [8].

Numerous surgical techniques have been described to address CrCL deficiency in dogs [9]. The recommended treatment for a cranial cruciate ligament rupture is based on the size of the dog. In general, dogs that are less than 30 pounds do not require surgery. Instead, medical management is appropriately recommended. Medical management involves strict confinement for 6 to 8 weeks and administration of non-steroidal anti-inflammatory medications (NSAIDs). If this does not result in an acceptable improvement, then surgery should be considered. Surgery is recommended for dogs that weigh more than 30 pounds. Several surgical options exist. Most surgical procedures attempt to recreate the function of the cranial cruciate ligament in some way. The most commonly performed procedure is called lateral fabello-tibial suture stabilization. More recently tibial plateau leveling osteotomies (TPLO) are being performed to treat cranial cruciate ligament ruptures in dogs. This procedure is most commonly performed in dogs weighing over 50 pounds, but can be performed in dogs as small as 10 pounds. It has been proposed that the primary force across the joint would be parallel to the patellar ligament, rather than parallel to the anatomic tibial axis as stated in TPLO [10,11]. This resulted in the development of tibial tuberosity advancement (TTA). TTA has proven to be a technique with clinical results similar to those of TPLO [12,13]. In addition, advancement of the tibial tuberosity appears to decrease the intra-articular joint pressures whereas TPLO may increase pressure in the medial and lateral joint compartment [14]. The classical TTA is a technically challenging technique, involving multiple implants [15]. Therefore, TTA-Rapid technique could reduce the number of implants required and make the surgical procedure less complex [16].

The objective of the study was intended to apply the current technique of TTA-Rapid in dogs with cranial cruciate ligament rupture and report clinical outcome and complications.

MATERIALS AND METHODS

Dogs

The study design followed the published guidelines and was approved by the institutional Animal Care and Use Committee of the Faculty of Veterinary Medicine. Seventeen dogs with pelvic limb lameness were used as the study material. They had clinical evidence of unilateral lameness with the cause localized to a single stifle joint. A complete orthopedic examination was performed to locate the origin of the lameness. A combination of gait observations, physical examination findings (joint distention and cranial drawer sign and tibial compression test), medio-lateral and cranio-caudal radiographic projections of both stifles were used for diagnosis of CrCL.

Radiographic Examination

Radiographs of the affected joint obtained at weeks 0, 4, 8, 12 were examined. Joints were assessed for evidence of increased synovial fluid volume, displacement of the infrapatellar fat pad cranially, periarticular osteophyte formation, enthesiophyte formation at joints of insertion of tendons or ligaments, narrowing of the joint space, subchondral bone sclerosis, and mineralization of intra-articular, and periarticular soft tissues. Osteoarthritis was scored as mild (1), moderate (2), moderate to severe (2 to 3), or severe (3) [17].

Preoperative Planning

Neutral 135° mediolateral radiographs of the stifles were acquired. Images were transformed to real size and the common tangent TTA technique was used to determine the degree of advancement needed for optimal effect [18]. Two methods were used for calculation, Classic TTA template [19] and common tangent technique

Figure 1. Preoperative measurements. This image shows the measurement of the cranial cortex of the tibia using the TTA Rapid template (detail of a 6 mm cage template). The exact position of the Maquet hole along the long axis of the tibia is determined. Using the horizontal millimeter scale, the thickness of the cranial tibial cortex can be measured in the appropriate region. This measurement determines the exact craniocaudal position of the Maquet hole in the craniocaudal plane of the tibia. In this case, a cortical thickness of 5 mm was measured. These two combined measurements resulted in the optimal position for the Maquet hole relative to the tibia.

[18]. For the traditional method, first line overlay was placed along the tibial plateau. The second line touched the cranial margin of the patella. The scale measured how far the tibial tubercle advanced to bring it into line with the patella ligament. The TTA-Rapid surgery was then aimed to realign the patella ligament to an angle of 90 degrees with the tibial plateau. The length of the osteotomy was determined using a template with the optimal position of the Maquet hole, relative to the size of the cage. The thickness of the cranial cortex in the region of the Maquet hole under the tibial crest was measured using either the same template or the OsiriX measurement software (OsiriX Foundation, Geneva, Switzerland; Fig 1).

Equipments and Implants

TTA Instruments sets and implants were supplied by Rita-Leibinger, Germany. The smallest cage was 3 mm wide, which then increased by 1.5 mm increments. The largest cage had a craniocaudal width of 12 mm. Each width had a separate color code to facilitate differentiation during surgery. The mediolateral length of the cages varied from 10 to 28 mm, relative to the width. The proximodistal height of the cages varied from 15 to 30 mm relative to the width.

Anesthetic Protocol

Food was witheld from each dog for 12 hours before anaesthesia. Anesthesia was induced with intravenous xylazine hydrochloride (Alfazyne 2% 20 mg/ml, Egevet, İzmir) and ketamine hydrochloride (Alfamine 10%, 100 mg/ml Egevet, İzmir). After 10 minutes, anesthesia was maintained with isoflurane in oxygen (AErrane, Baxter 2%–4%). All dogs were administered amoxicillin/clavulanic acid (8.75 mg/kg subcutaneously). Carprofen (4 mg/kg IV) was administered when there were no contraindications for the administration of a non-steroidal anti-inflammatory drug. Lactated Ringer's solution (10 mL/kg/hour IV) was administered throughout anesthesia.

Surgical Technique

The limb was aseptically prepared from the proximal femoral region to the hock. The operation started with the dog in dorsal recumbency. Before the TTA Rapid procedure, in some patients arthroscopic examination or arthrotomy was performed for the inspection any intra-articular lesions. Especially, remnants of the rupture of the CrCL and medial meniscus were inspected. The joint was closed with absorbable monofilament sutures. A medial skin incision was made from the parapatellar region to 1 cm distal to the tibial crest (Fig.2). The TTA-Rapid procedure was followed according to Samoyed et al (2015) [16]. The subcutaneous tissue was separeted from the tibial crest. A stab incision was made by determining the location of the Maquet hole. Maquet hole is located pinpointing precisely both the proximodistal and craniocaudal plane of the tibia by drill quide. Firstly, a 1.2mm K-wire was inserted into the distal infrapatellar bursa. This pin indicates the region of the proximal aspect of the cage and was inserted into the vertical leg of the guide in the corresponding cage number. Secondly, the horizontal leg of the guide was inserted corresponding with the cranial cortical thickness. After determining the exact location of the Maquet hole it was drilled with either a 2 or 3mm drill bit, depending on the size of the tibia (Fig. 3). Before the osteotomy, a 2.5mm K-wire pin was placed through the joint capsule at the intersection of the femoral condyle and the tibial plateau. On the lateral side, the pin was placed slightly in front of the level of "Gerdy's Tubercle". This pin was used as the proximal fixation of the saw guide. A peg was placed into one of the holes in the horizontal arm of the drill guide, selecting the number of millimeters measured during pre-operative planning. The Maquet hole drill was used as the distal fixation of the saw guide. The osteotomy was created using the saw quide. A blade was used to open the fascia/periostium prior to the osteotomy. After osteotomy, K-wires were removed and the small blade of a 4mm bone spreader was gently inserted into the upper part of the osteotomy. Gentle turns of this spreader gradually advanced the tibial crest (Fig.5). A

Figure 2. A medial skin incision was made from the parapatellar region to 1 cm distal to the tibial crest.

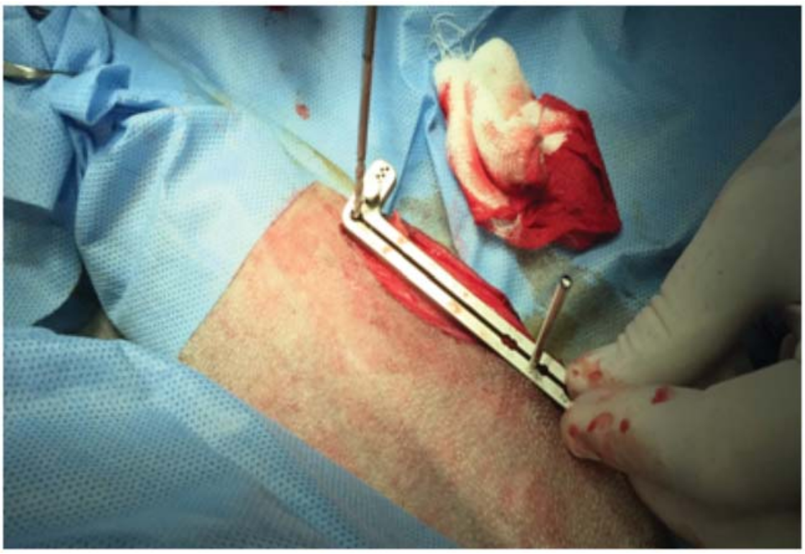

Figure 3. After determining the exact location of the Maquet hole, the Maquet hole was drilled with either a 2 or 3 mm drill bit, depending on the size of the tibia.

second spreader maintained the displacement to the distal region of the osteotomy. When necessary, this step was repeated with wider bone spreaders (7–13 mm), until adequate displacement was achieved. The soft tissue layer was elevated for bone contact and the caudal ears of the cage were bent slightly upward. The appropriate titanium cage was inserted. Once the cage was in place, the cage was fixed to the bone with either 4 or 6 (depending on the cage size) 2.4 mm titanium cortical screws (Fig.5). The

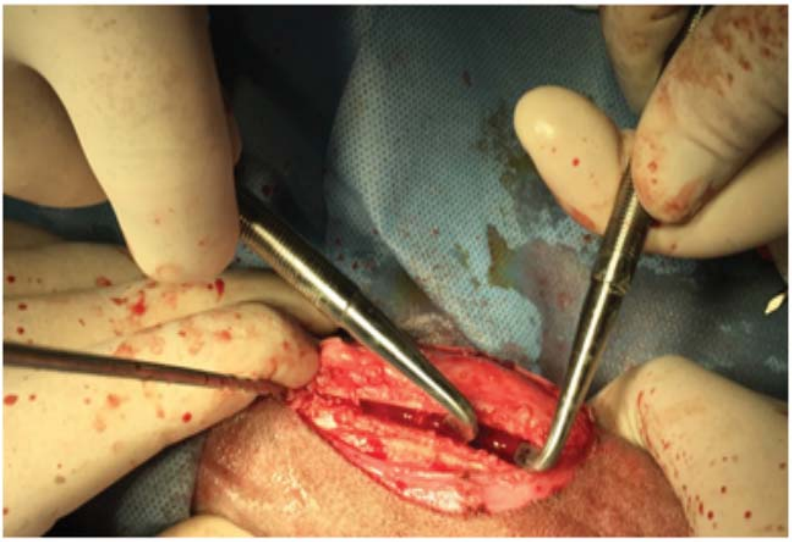

Figure 4. The small blade of a 4 mm bone spreader was gently inserted into the upper part of the osteotomy. Gentle turns of this spreader gradually advanced the tibial crest.

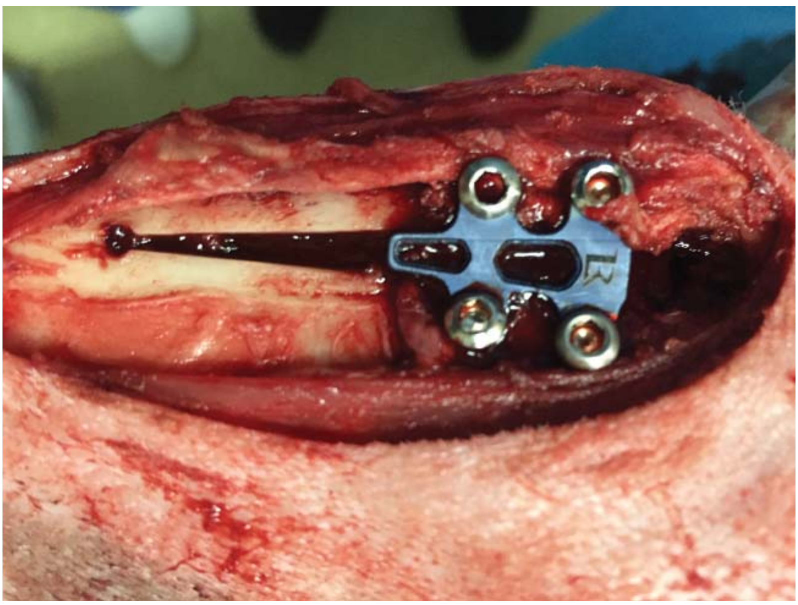

Figure 5. Once the cage was in place, the cage was fixed to the bone with either 4 or 6 (depending on the size of cage) 2.4 mm titanium self-tapping cortical screws.

direction of the screws was proximomedial-distolateral . The remaining open spaces in the osteotomy gap and the cage were filled with spongious bone or allograft. The wound was closed in a routine manner. A pressure bandage was applied for 2–3 days.

Postoperative Management

Immediately after surgery, cold packs were applied for 15-20 minutes on the surgical site 4 times a day. Dogs were administered oral meloxicam (Sanovel) (1 mg/kg İM) for three days and amoxicillin/clavulanic acid (Synulox, Phizer) for 5 days. No anti-inflammatory drugs or analgesic medication were administered after this. Restricted excercise was advised for 6 weeks.

Clinical and Radiographic Follow-Up

Lameness evaluation and radiographic follow-up were performed monthly up to 3 months postoperatively. Lameness evaluation was based on a lameness clinical score: lameness was graded as sound, mild, moderate, severe lameness, or non-weight bearing. Radiographs were assessed for implant position and bone healing of the osteotomy. The outcome at 3 months was graded as: excellent when no lameness was present and complete bone healing was observed; good when the dog showed mild or occasional lameness along with either clinical or complete bone healing; moderate when the dog had a distinct degree of lameness along with either clinical or complete bone healing; and poor when a very pronounced lameness or non-weight bearing was still present and/or when there was no healing of the osteotomy. The postoperative complications were rated as minor, major complication grade 1, or major complication grade 2 using previous guidelines [20].

Evaluation of Lameness and Pain

Lameness and pain assessment were performed prior to the operation and on the 1st, 2nd and 3rd month after the TTA-Rapid procedure. Scores for severity of lameness and pain were assessed by a clinician using the Hudson Visual Analog Scale (HVAS) [21], and *Canine* Brief Pain Inventory (CBPI) [22,23,24], respectively. The study was conducted in a blind manner. Each attending veterinarian scored all animals and the same scoring was used throughout the 12 weeks for all time points.

Statistical Analysis

The distribution of the dogs with CrCL, the functional assessment and the outcome after 3 months were reported as a percentage.

RESULTS

Seventeen dogs with unilateral CrCL rupture were included in the study. The breeds were: mixed breed (n=8), German Shepherd (n=1), Turkish Shepherd (n=6), Husky (n=1), Golden Retriever (n=1). Mean_SD age was 2-8 years and mean weight was 32 kg. Two dogs had a complete CrCL rupture and the other fifteen had partial CCL rupture. Artroscopic examination and arthrotomy showed no damage of the meniscus. Cage sizes used were 3 mm (3), 6 mm (6), 9 mm (6), and 12 mm (2). The 3 mm cage were 3/10, 3/13 and 3/16. The 6 mm cage were 6/16, 6/19, 6/22. The 9 mm cage were 6/16, 6/19, 6/22. The 12 mm cage were 12/22, 12/25. Complete monthly clinical and radiographic follow up was recorded for each dog. Implant failure occurred only once as described above. Clinical bone healing was seen at a mean 1.5 months (range, 1–3 months) (Fig.6). Seventeen dogs had complete bone healing at 3 months (Fig.7). On clinical examination at 3 months, 8 dogs (41.1%) had an excellent outcome, 6 dogs (35.2%) had a good outcome, and 3 dogs (17.6%) had a moderate outcome (Table 1). All owners were satisfied with the outcome and reported a marked improvement after surgery or a return to pre-injury status.

Figure 6. Karabaş, Turkish Shepherd dog, 6 years old, male, 40 kg, post-op 30 days medio-lateral x-ray.

The minor complication rate was 25 %. None of these minor complications required any specific treatment. Major short term complications occurred in 4 dogs (17.6%), within the 1st month postoperative. In both dogs, the tibial crest fractured and shifted cranially (Fig.8). Both cases occurred in the pre-guide stage. One of these dogs jumped off a window seat 3 weeks postoperatively and showed moderate lameness after the fracture, but still had good limb function and was treated conservatively with a good outcome. The dog required a 2nd surgery to regain full limb function. The tibial crest was reduced and secured with a craniodistal-caudoproximal orientated pin (Fig.9).

Figure 7. Aslan, Turkish Shepherd dog, 7 years old, male, 54 kg, post-op. 90 days medio-lateral X-ray.

Figure 8. Major complication . Cranial shift of the tibial crest in a dog 4 weeks postoperative (case 6).

Figure 9. Two millimeter Steinmann pin was inserted to restore the stability of the fracture.

Table 1. Complete monthly clinical and radiographic follow up recorded for each dog.

No	Age	Sex	Weight	Breed	Post-op. 1.month	Post-op 2.month	Post-op 3.month
1	4	♂	27	German Shepherd	Good	Excellent	Excellent
2	4	♂	24	Mix Breed	Fair	Fair	Fair
3	5	♂	25	Mix Breed	Good	Good	Good
4	5	♂	38	Turkish Shepherd	Good	Good	Good
5	7	♂	54	Turkish Shepherd	Good	Good	Excellent
6	6	♂	40	Mix Breed	Excellent	Excellent	Excellent
7	6	♂	40	Turkish Shepherd	Good	Good	Good
8	5	♂	40	Mix Breed	Good	Excellent	Excellent
9	6	♂	47	Turkish Shepherd	Fair	Fair	Fair
10	4	♂	26	Mix Breed	Excellent	Excellent	Excellent
11	5	♀	40	Turkish Shepherd	Good	Good	Excellent
12	4	♀	20	Golden Retriever	Excellent	Excellent	Excellent
13	4	♂	30	Mix Breed	Good	Good	Good
14	4	♂	21	Mix Breed	Good	Good	Good
15	4	♂	21	Husky	Excellent	Excellent	Excellent
16	6	♂	35	Kangal	Good	Good	Good
17	6	♂	40	Mix Breed	Fair	Fair	Fair

Evaluation of Lameness

Scores for all components of the HVAS and CBPI were not affected by the clinicians who evaluated the cases. For TTA-Rapid, scores for all components of the HVAS (Table 2), mood, attitude, comfort, activity, playfulness, exercise, walking comfort and for all components (typical pain, general activity, the ability to enjoy life, rise, walk, run and climb) of the CBPI were significantly different between pre-op and weeks 4, 8, and 12 ($p < 0.05$) (Table 3).

Table 2. There were significant differences between pre-op (0.days) and 30th, 60th, and 90th post-op days for Hudson Visual Analog Scale. The HVAS questionnaire represented the scale where "0" corresponded to lameness (worst pain) and "10" to no lameness (no pain).

	0.day	30th.day	60th.day	90th.day
Overall	8a	9b	9b	9b
Mood	8a	9b	9b	9b
Attitude	8a	9b	9b	8.5b
Comfort	8a	9b	9b	9b
Activity	8a	9b	8a	8a
Playfulness	8a	9b	8a	8a
Exercise	8a	8a	8a	8.5b
Arising stiff	8a	8.5b	8.5b	9b
Bedding stiff	2a	2a	1b	1b
Walking comfort	8a	8.5b	8a	8a
Turning comfort	7a	8.5b	8b	8b

The letters indicate statistical differences of the control of each group.There were statistical differences on 0. day and 30, 60, 90 days.($p<0.05$)

Table 3. There were significant differences between pre-op (0.days) and 30th, 60th, and 90th post-op days for–Canine Brief Pain Inventory. On the scale "0" represented lameness (worst pain) and "10" no lameness (no pain).

	0.day	30.day	60.day	90.day
General activity	8a	8a	8.5b	8a
Enjoys life	8a	9b	9b	9b
Can rise	8a	8a	8.5b	8.5b
Can walk	8a	9b	8a	8.5b
Can run	7.5a	8.5b	8b	8b
Can climb	7.5a	8b	8b	8b

The letters indicate statistical differences of the control of each group. There were statistical differences on 0. days and 30, 60, 90 days.($p<0.05$)

DISCUSSION

There are two main types of surgery that are recommended for medium and large breed dogs that have CCL tears: the tibial tuberosity advancement (TTA) [25-29] and the tibial plateau leveling osteotomy (TPLO). The TTA is a somewhat less invasive and gives similar results to the TPLO. Dogs that receive the TTA procedure will have a faster recovery; however by 4 months after surgery both procedures have similar outcomes. Recently, a modified technique for TTA and post-operative results have been reported [16]. The modified technique for TTA was easy and non-invasive. Classical TTA was associated with complications due to high body weight and preoperative patellar tendon angle in dogs. Thus, subsequent meniscal tear was the most common reason for surgery, suggesting that medial meniscal release of intact menisci should be considered when performing TTA in dogs [30]. It is limited, however, by challenges that can be encountered when applying the plate, which dictates that the positioning and orientation of the osteotomy is critical [25-26]. The surgeon has to ensure sufficient bone stock on the cranial tibial crest after osteotomy and sufficient space on the tibial shaft to allow placement of the plate, fork, and bone screws [26]. Although real implant failures are rare in TTA (2%), major complications (11.4%) described in a large study of 501 joints were often a consequence of the plate and fork construction (4% of all major complications) [30]. Because conventional TTA dislocates the entire tibial crest, the plate and fork must counteract the entire quadriceps muscle action. Samoyed et al. (2014) [16] showed that TTA-rapid is simple compared to classical TTA. The use of classic TTA in small breed dogs is difficult to use due to the plate and fork. The TTA-Rapid is also easy to use since it will only stabilize the bone of the tibial crest with screws. The diameter used for the Maquet hole varied from 2 to 3 mm. The separation from the tibial crest was easier after osteotomy. However, the Maquet hole should be 3mm in order to prevent bone fractures. 2 mm width of Maquet hole was enough for small breeds, in the case of tibial crest fractures. Because the size of the cage is often related to the size of the dog, a 3–6 mm cage often corresponds to a 2 mm Maquet hole, whereas a 10.5 mm (and larger) cage usually requires a 3 mm Maquet hole [16]. In 4 cases (23.5 %) bone fracture occoured on the 30th day post-operative period as a major complication. It is to be noted that the surgical team has to gain experience and increase the number of patients in order to reduce the rate of complications. The complication rate with a less experienced surgeon might be higher and of a different type [16]. Also, the usage of some clamps could be effective in preventing fractures in Maquet osteotomy region and the proximal holes. The bone gap between the tibial crest and the tibia is filled with a bone graft, such as autograft, allograft, xenograft, or a bone substitute [15,31]. In the conventional TTA technique, a full osteotomy and severance of the tibial crest allows a cancellous bone graft to be collected from the tibia. In the TTA Rapid protocol, the tibial crest is not fully detached from the tibia, which prevents local harvesting of the autograft material in most cases [16]. In our study, autografts and allografts are used to fill the defect created by the osteotomy. There were no differences between both applications. The Maquet hole could cause a slightly weakened tibial shaft because of the cranial displacement of the tibial crest. It may cause a predisposition to a higher risk on tibial fractures. A recent study investigated the use of bone grafting in TTA procedures and concluded that there was no need for bone grafting to achieve good radiographic healing [32]. The duration and frequency of occurrence of damage to the meniscus after the application of TPLO and TTA are still being debated [33,34]. It was first described by Slocum as a technique for preventing meniscal tearing after TPLO [35]. In a recent study, a 21.7% incidence of postoperative meniscal injury was associated with the classic TTA procedure [26]. The remaining rotational, and any remaining cranial tibial thrust, may be responsible for the postoperative meniscal injury [36]. When performed correctly, all types of meniscal release are effective, but persistent late meniscal injury despite the meniscal release might be responsible for increased morbidity [16,37,38]. During the study, we did not encounter any meniscal injuries in arthroscopic and arthrotomic examination of the cases. Patellar desmopathy has also been reported as the most common minor complication in TPLO [10]. In our study, the clinical implication of patellar tendon thickening is not clear; specific treatment of this condition was not required in our dogs. Especially, rehabilitation should be recommended for suspected cases after surgery.

A composite of the 11 questions from all three models will help clinicians determine the degree of lameness when a force plate is not available. The HVAS and CBPI have been evaluated in previous studies [21-24], and are accepted as subjective methods of assessing pain and lameness. Results of the present study indicated that clinical and behavioral efficacy of TTA-rapid should be evident to dog owners and clinicians.

As a conclusion, TTA-rapid is a fast and non-invasive method for treatment of CrCL rupture in dogs. Technical processing can be learnt easily; however our study has some limitations. Firstly, TTA-Rapid should be compared with classical TTA and TPLO. A larger group of dogs is needed for further studies and additional complications could be expected in the long term evaluation.

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Authors' contributions

AM has been involved in the section of the cases for clinical examination, the organisation of operations and the evaluation of the results. PK making radiological examinations, participation of operation assistant and post-operative care. SH applied for anesthesia protocol and post-operative care. All authors read and approved the final manuscript.

Declaration of conflicting interests

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

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EVALUACIJA PRIMENE TTA-BRZE METODE KOD PASA SA RUPTUROM KRANIJALNOG KRUCIJALNOG LIGAMENTA

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Cilj studije je bio da se ispita primena modifikacija sadašnje tehnike TTA (*Tibial tuberosity advancement*) – brze metode kod pasa sa rupturom kranijalnog krucijalnog ligamenta (CCL) kao i analiziraju izveštaji o mogućim komplikacijama pri primeni ove metode u praksi. Materijal ispitivanja činili su 17 muških pasa različitih rasa , uzrasta od 2 do 8 godina, prosečne telesne mase 32 kg, kod kojih je dijagnostikovana jednostrana CCL ruptura. Vizuelno, sumnja je postavljana na osnovu parametara Hudson Vizuelne Analogne Skale (HVAS), procene hoda i procene nivoa bola (*Canine Brief Pain Inventory* – CPBI). Dijagnoza je potvrđena pomoću direktne radiografije. Preoperativna evaluacija implantata koji bi bio upotrebljen u okviru TTA-brze metode, bila je određena merenjem radiografskih parametara CCL kod pasa. Postoperativna evaluacija u prvom, drugom i trećem mesecu, obavljena je radiografijom kao i testom hoda i bola. Najteže komplikacije su bile uočene kod 17,6% slučajeva. Kod četrnaest (82,4%) pasa uočen je odličan ishod operacije, tri meseca kasnije. Procena šepavosti i bola je obavljena 15 dana pre operacije kao i jedan, dva i tri meseca posle TTA-brze hirurške metode. Može da se zaključi da TTA-brza metoda jeste brza, lako se savladava i predstavlja neinvazivni tretman CCL rupture kod pasa.