



## Epifisiodesse tibial proximal em um cão em crescimento

### Proximal Tibial Epiphysiodesis in a Growing Dog

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#### ABSTRACT

**Background:** It is believed that the inclined tibial plateau angle to be a major cause of cranial cruciate ligament (CCL) rupture, and the treatment of this disease is the tibial plateau leveling for decrease the cranial tibial thrust. However, there are breeds predisposed to rupture of the cranial cruciate ligament and in this patterns breed the tibial plateau is more inclined due to the conformation of the limb. The aim of this communication was to evaluate the effectiveness of the locking screw and cauterizing the growth plate of the tibial plateau as a preventive method of cranial cruciate ligament rupture.

**Case:** In a young dog, one stifle joint randomly chosen for placing a screw in order to block the tibial plateau growth line. There was placed a 3.5 mm x 20 mm cancellous bone screw in the dorsocranial surface of the tibial plateau of the left hindlimb. Two months after the first surgical intervention, the contralateral limb was cauterized in the tibial plateau growth line. Electrocauterization was performed with a spatula electrode set at 60 watts, performing ablation on the cranial third of the tibial plateau physis with access to the medial and lateral surfaces of the proximal tibia. The electrode was placed against the physis for 10 seconds at each site. Both members were followed radiographically to measure the tibial plateau angle and observed the angle reduction. After 30 and 60 days post-surgery, the tibial plateau angle in left hindlimb decreased to 11° and -4°, respectively. However, the decrease plateau tibial angle was intense and severe and the screw was removed of the bone. However, even with the proximal tibial physis still open, withdrawing the screw did not alter the tibial plateau angle, which remained at -4° until the animal reached adulthood. The right left hindlimb was used as a control until the dog was 6 months old, when the tibial plateau angle exhibited a 26°. With the electrocauterization technique the tibial plateau angle decreased to 18° and 16° at 30 and 60 days after surgery, respectively, remaining at this last value until the animal completed its growth.

**Discussion:** In the animals with cranial cruciate ligament rupture is indicate same surgical procedures like tibial plateau leveling osteotomy. In these cases, the recommended tibial plateau angle is approximately 5°. This study sought to block the line of growth of the tibial plateau to be reached an angle of approximately 5°. Epiphysiodesis technique with screw was already described for treating CCL rupture in young dogs, and the tibial plateau slope was reduced in all dogs studied. The surgical technique used was effective in blocking the physis; however, we observed that the tibial plateau slope was excessively modified and the screw was removed. This fact is explained by the dog's immaturity, since the plateau leveling occurs more intensively in very young dogs. In epiphysiodesis using the electrocauterization technique, the same surgical principle of juvenile pubic symphysiodesis for treating coxofemoral dysplasia was used. However, in the current pilot study, it was unable to achieve the desired tibial plateau slope with this technique, possibly due to performing the procedure at an age in which the proximal tibial physis would have limited functional capacity. In this study, there was a reduction in the angle of the tibial plateau in both the techniques. However, further studies should be conducted to in order to confirm the actual effectiveness of both techniques described in this report.

**Keywords:** cranial cruciate ligament, locking screw, electrocauterization, stifle joint.

**Descritores:** ligamento cruzado cranial, parafuso bloqueante, eletrocauterização, articulação fêmoro-tíbio-patelar.

## INTRODUCTION

The cranial cruciate ligament (CCL) is the main stabilizing structure of the femoral-tibial-patellar joint (FTP) in the dog [8]. The CCL rupture is one of the most common articular disease in dogs [3] and, consequently, causing lameness, osteoarthritis, synovitis and meniscus injury [4]. The excessive tibial plateau slope in dogs can lead to high load on the cranial cruciate ligament (CCL), predisposing it to rupture [1,6].

The natural inclination of the tibial plateau varies from 18° to 24° [2,4]. The tibial plateau angle (TPA) in dogs with CCL abnormal varies 23.5° the 28.3°, while when it exceeds 34° is considered an excessive angle [3].

It is believed that by changing the TPA, the animal returns the functional support member without the presence of a ligament and without cranial displacement of the tibia relative to the femur. Studies have evaluated the angle correction to 0° and 5°, and concluded that the 0° there is neutralization of cranial tibial thrust, however, converts it to caudal, overloading the caudal cruciate ligament. To correct the plateau for the 5° there is not conversion, but there is a discrete cranial tibial thrust maintenance and without forcing the caudal cruciate ligament [7].

This pilot study aimed to evaluate two epiphysiodesis techniques in preventive tibial plateau leveling in a growing dog.

## CASE

It was selected a healthy male, medium-sized mixed breed dog. The animal was assessed preoperatively using conventional radiographs to measure the tibial plateau angle (TPA) in both hindlimbs. At 4 months old, the left hindlimb (LHL) was subjected to partial proximal tibial epiphysiodesis using the screw technique, while the contralateral hindlimb remained intact for over 2 months as a control. At 6 months old, the right hindlimb (RHL) was subjected to partial proximal tibial epiphysiodesis using the electrocauterization technique.

In the screw technique, a craniolateral parapatellar approach was used to perform an arthrotomy and identify the dorsocranial surface of the tibial plateau. First, a guide pin was placed to identify the central portion of the cranial part of the tibial plateau. Next, a hole was drilled using a bone drill, and a 3.5 mm x 20 mm cancellous bone screw (orthopedic surgical

instruments)<sup>1</sup> was placed. The screw head rested on the dorsocranial margin of the tibial plateau, cranial to the intermeniscal ligament, and the body of the screw extended approximately 15mm below the physis (Figure 1a and 1b).

After 2 months from the first surgical procedure, the contralateral hindlimb was subjected to electrocauterization technique. The surgical approach was similar to the previous technique; however, no arthrotomy was required. The cranial surface of the tibial plateau physis was identified by partial divulsion of the muscular fascia and periosteum. Electrocauterization was performed with a spatula electrode (electronic scalpel high power vet Vet1 300 Watts)<sup>2</sup> set at 60 watts, performing ablation on the cranial third of the tibial plateau physis with access to the medial and lateral surfaces of the proximal tibia. The electrode was placed against the physis for 10 s at each site.

The dog was clinically and radiographically evaluated every 2 weeks and 30 days, respectively, until complete radiographic physeal fusion. During clinical assessment no orthopedic change was found. At 4 months old, a 20° TPA was observed in both still-intact hindlimbs. With the screw technique, a sharply reduced TPA in the LHL was obtained. At 30 and 60 days post-surgery, the angle decreased to 11° and -4°, respectively. Due to the sharp and negative leveling, the screw was removed at 60 days after the initial procedure. Even with the proximal tibial physis still open, withdrawing the screw did not alter TPA, which remained at -4° until the animal reached adulthood. The RHL was used as a control until the dog was 6 months old, when the tibial plateau exhibited a 26° angle. With the electrocauterization technique the TPA decreased to 18° and 16° at 30 and 60 days (Figure 2a and 2b) after surgery, respectively, remaining at this last value until the animal completed its growth (Table 1).

## DISCUSSION

The epiphysiodesis technique with screw was already described for treating CCL rupture in young dogs, and the tibial plateau slope was reduced in all dogs studied [9]. The researchers suggested that this technique should be studied as a preventive treatment in predisposed breeds, mainly because it is a minimally invasive procedure. However, we found no reports on the use of electrocauterization for preventive tibial plateau leveling and we believe that this pilot study is an unprecedented description of the procedure.



**Figure 1.** Immediate post-operative radiographic image of the proximal tibial epiphysiodesis using the screw technique. Observe the cancellous bone screw inserted in the dorsocranial surface of the tibial plateau. Mediolateral view (a). Craniocaudal view (b).



**Figure 2.** Radiographic image after 60 days post-operative of the proximal tibial epiphysiodesis using the electrocauterization technique. Mediolateral view (a). Craniocaudal view (b).

Physeal fusion on the tibial plateau usually occurs in dogs that are between 6 and 11 months old [10]. Epiphysiodesis using the screw technique was performed in a 4-month-old dog, as the proximal tibial physis would be at its full functional capacity [5]. The surgical technique used was effective in blocking the physis; however, we observed that the tibial plateau slope was excessively modified. This fact is explained by the dog's immaturity, since the plateau leveling occurs more intensively in very young dogs. When an excessively reduced tibial plateau slope was observed at 6 months old, the screw was withdrawn. However, the value remained stable until the dog completed its

skeletal maturity. Thus, it is recommended that animals subjected to preventive leveling using the screw technique be radiographically examined for periods shorter than 30 days, so that the screw can be removed, obtaining the ideal TPA [10].

The studies indicate to reach TPA of approximately 5° for treating the CCL rupture [4, 8]. Obtaining lower angles than 5° should be avoided to prevent the tibial plateau from having an excessive caudal orientation that can compromise the caudal cruciate ligament integrity [7, 11]. The animal in this pilot study exhibited no changes in caudal cruciate ligament in the limb with excessively reduced TPA during early adulthood.

In epiphysiodesis using the electrocauterization technique, the same surgical principle of juvenile pubic symphysiodesis for treating coxofemoral dysplasia was used, there was induced thermal necrosis of stem chondrocytes and no endochondral bone growth arrest [9].

However, in the current pilot study, it was unable to achieve the desired tibial plateau slope with this technique, possibly due to performing the procedure at an age in which the proximal tibial physis would have limited functional capacity [5]. It is noteworthy that electrocauterization is an irreversible procedure and should be used with caution in very young animals with high potential for bone growth. In none of the leveling techniques described noted complications, unlike other authors cited valgus deviation of the tibia in some animals [10].

This study is characterized as a pilot study on one dog, but it provides valuable guidance about

**Table 1.** Measurements of the tibial plateau angle (TPA) in a dog after performing the proximal tibial epiphysiodesis using screw technique in the left hindlimb (LHL) and electrocauterization technique in the right hindlimb (RHL).

animal age	TPA in the LHL	TPA in the RHL
4 months <sup>a</sup>	20°	20°
5 months	11°	26°
6 months <sup>b</sup>	-4°	26°
7 months	-4°	18°
8 months	-4°	16°
9 months	-4°	16°
12 months	-4°	16°

<sup>a</sup>Epiphysiodesis in the LHL using the screw technique. <sup>b</sup>Epiphysiodesis in the RHL using the electrocauterization technique and removing the screw from the LHL.

using epiphysiodesis techniques for preventive tibial plateau leveling. We can suggest that the age for surgery to achieve the ideal plateau angle would be at approximately 5 months old. It is also suggested that the screw technique is more effective in blocking the proximal tibial physis, although the electrocauterization technique was applied later in relation to animal age. Further studies are need to be conducted to evaluate the ideal age for applying these techniques, taking breed variation into account.

## MANUFACTURES

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**Ethical approval.** The study was approved by the Institution Bioethics Committee in Utilization of Animals by number 003/2010.

**Declaration of interest.** The authors report no conflicts of interest. The authors alone are responsible for the content and writing of the paper.

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