

Use of a locking plate “notched head T-plate®” for the fixation of an ilial body fracture in a dog

Utilização de placa bloqueada “notched head T-plate®” no tratamento de fratura do corpo do ílio em um cão

Cassio Ricardo Auada Ferrigno¹; Paulo Vinícius Tertuliano Marinho^{2*}; Márcio Poletto Ferreira³; Jaqueline França dos Santos⁴; Ísis dos Santos Dal-Bó⁴; Fernanda Paes⁵; Viviane Sanchez Galeazzi⁶

Abstract

Several types of implants may be used to treat iliac fractures in dogs, of which osteosynthesis with plate is the most described and recommended in the literature. The type of plate and screw are major factors in osteosynthesis success. The use of locking plates has been advocated for this purpose, as they do not allow the plate-bone-screw unit to shift, providing angular stability and rigidity to the system. The present study aimed to describe the unprecedented use of a locking notched head T-plate in the treatment of a caudal body of ilium fracture. A two year old male mongrel dog was attended after falling from a third floor height, with two days of evolution. The animal was in standing position, and during orthopedic examination non-weight bearing lameness of the right hind limb, instability, and crepitus in the right body of ilium, with considerable swelling and pain. The radiographic examination allowed diagnosing a complete fracture of the caudal body of ilium with decrease of the pelvic canal diameter. The patient underwent surgery, and the fracture was stabilized with an LCP notched head T-plate. The patient evolved satisfactorily, with good weight-bearing of the affected limb within 24 hours of surgery, and complete recovery with medical discharge after 60 days of postoperative period, with consolidation of the fracture.

Key words: Orthopedics. Traumatology. Pelvis. LCP.

Resumo

Vários tipos de implantes são utilizados no tratamento de fraturas de ílio em cães, sendo a osteossíntese com uso de placa a mais descrita e recomendada pela literatura. O tipo de placa, assim como o tipo de parafuso, são fatores preponderantes no sucesso da osteossíntese. Tem sido defendido o uso de placas bloqueadas, que não permitem movimentação entre a unidade placa-osso-parafuso, conferindo estabilidade angular e rigidez ao sistema. Objetivou-se descrever o uso inédito da placa bloqueada “notched head T-plate” no tratamento de fratura caudal de corpo de ílio. Um cão, macho, sem raça definida, de dois anos de idade foi atendido apresentando histórico de queda de terceiro andar, com dois dias de evolução. O animal apresentava-se em estação e durante a avaliação ortopédica observou-se deambulação com impotência funcional do membro pélvico direito, instabilidade e crepitação em corpo

¹ Prof., Universidade de São Paulo, USP, São Paulo, SP, Brasil. E-mail: cassioaf@gmail.com

² Discente de Doutorado, USP, São Paulo, SP, Brasil. E-mail: paulo.veter@gmail.com

³ Prof., Universidade Federal do Rio Grande do Sul, UFRGS, Porto Alegre, RS, Brasil. E-mail: ferreirapmarcio@gmail.com

⁴ Discentes de Doutorado, USP, São Paulo, SP, Brasil. E-mail: jaquejfs@yahoo.com.br; idb_vet@yahoo.com.br

⁵ Discente de Mestrado, USP, São Paulo, SP, Brasil. E-mail: fpaesmv@gmail.com

⁶ Médica Veterinária, USP, São Paulo, SP, Brasil. E-mail: vsgaleazzi@gmail.com

* Author for correspondence

do ílio direito com aumento de volume considerável e muita dor. Diagnosticou-se fratura completa caudal do corpo do ílio com diminuição do diâmetro do canal pélvico, através de exame radiográfico. O paciente foi submetido à cirurgia e a fratura foi estabilizada com o uso de uma placa LCP em “T” com a cabeça chanfrada. O paciente apresentou evolução satisfatória com bom apoio do membro 24 horas após a cirurgia e completa recuperação com alta médica aos 60 dias de pós-operatório com consolidação da fratura.

Palavras-chave: Ortopedia. Traumatologia. Pelve. LCP.

Introduction

Pelvic fractures are relatively common in clinical practice, accounting for 20-30% of fractures in cats and dogs (OLMESTEAD, 1998). Ilium fractures occur in 18-46% of traumatic pelvic injuries, the majority of which involve multiple fractures, compromising more than three bones (TROGER; VIRGUIER, 2008).

The ilium is an important weight-bearing interface between components of the pelvis and the spine during locomotion. Fractures of the ilium compromise the mechanical interaction and decrease the motor function of the pelvis (OLMESTEAD; MATIS, 1998); long oblique fractures in the medial ilium are the most common. Fracture location may vary. It can extend through the cranial aspect of the wing of ilium or along the dorsal aspect of the acetabulum, along with the caudal pelvic obliquity, without involving the coxofemoral joint. Comminuted or transverse fractures, though also observed, are much less common than oblique fractures. The caudal fragment of ilium fractures usually suffers medial and cranial displacement, compromising the diameter of the pelvic canal, which may damage the lumbosacral trunk located medially to the ilium body (DECAMP, 2012).

Treatment options for pelvic fractures range from surgical interventions to conservative therapies. Fractures that are relatively stable or slightly displaced can be treated with rest, moderate activity, nursing care, analgesics, and physiotherapy. However, if it was possible to critically evaluate patients months or years after the injury, many would likely exhibit a high degree of dysfunctionality, including constipation, dysuria,

and dystocia in breeding females (PIERMATTEI et al., 2009; DECAMP, 2012).

Surgical treatment, which involves stabilizing the fractured fragments and restoring the normal anatomy, should be considered for dogs with pelvic fractures involving weight-bearing areas, such as the sacroiliac joint, the acetabulum, and the body of ilium. These fractures can cause considerable narrowing of the pelvic canal (PIERMATTEI et al., 2009). In the case of ilium osteosynthesis, various techniques are described in literature, including placement of screws, bolts, steel wire, polymethylmethacrylate-augmented screws, external fixators, and different types of plates (FITZPATRICK et al., 2008; CHOU et al., 2013).

In the vast majority of fractures involving the caudal segment of the ilium, traditional plates present limited functionality, which prevents the application of at least two or three screws per bone segment in locked or unlocked plates, respectively; thus, requiring the (often laborious) procedure of modeling over the acetabulum. The goal of the present report lies on the unprecedented use of a Locking Notched Head T-plate® in the treatment of a fracture in the caudal body of the ilium in a dog.

Case Report

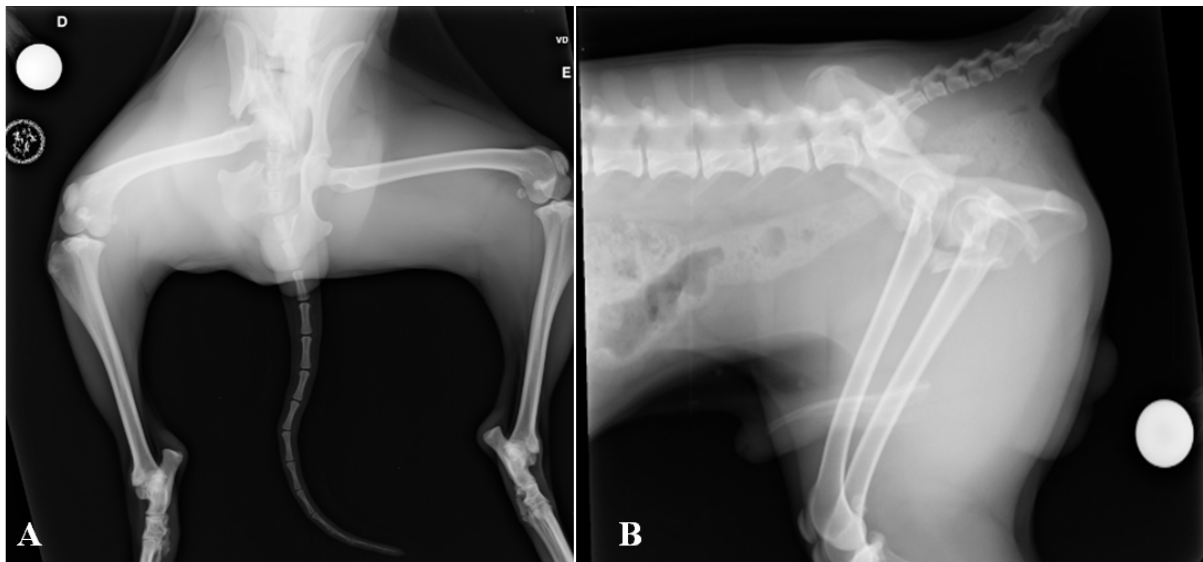
A two-year-old male mongrel dog was attended to two days after a fall from a considerable height. Physical examination revealed physiological parameters within the normal reference range and bladder repletion. The animal was in the standing position during the orthopedic evaluation, which revealed functional limitation of the right hind

limb, instability, crepitus in the right body of ilium during walking, and considerable swelling and pain. The neurological examination revealed no alterations.

After sedation and analgesia (acepromazine¹ 0.05 mg/kg/IM + meperidine² 3 mg/kg/IM), the patient was referred to the diagnostic imaging

service for an abdominal ultrasonography and radiographs of the chest and pelvic area. The former two exams revealed no significant alterations; the latter exam showed a complete fracture of the body of ilium, ischium body, and cranial branch of the right pubic bone, with deviation of the bone segment containing the right coxo-femoral joint towards the pelvic canal (Figure 1A and B).

Figure 1. Radiographic image of the pelvic region of a dog showing complete fracture of the body of ilium, ischium body, and caudal branch of the right pubis with deviation of the bone fragment containing the right coxo-femoral joint towards the pelvic canal.



The surgical procedure was scheduled for three days after the initial exam and after a pathological and clinical evaluation (hemogram and serum biochemistry) confirmed normal parameters for the species. Dipyrone hydrochloride (25 mg/kg/TID), tramadol hydrochloride (3 mg/kg/TID), and lactulose (2 mL/BID) were administered until the day of surgery.

On the day of the surgical procedure, the patient was sedated with acepromazine⁷ (0.05 mg/kg) and meperidine⁸ (0.5 mg/kg), and the entire pelvic area

was shaved. Anesthesia was induced using propofol⁹ (3 mg/kg) and maintained with isoflurane¹⁰ and oxygen (fixed amount of 250 mL + 30 mL/kg) in a semi-closed system. Prophylactic therapy was administered 30 minutes prior to the procedure with cefazolin¹¹ (22 mg/kg). The patient was placed in the left lateral decubitus position, and preoperative antisepsis was conducted using the anti-germ agent chlorhexidine 2%¹².

⁷ Apromazin 1% - Syntec, Cotia, SP, Brazil

⁸ Dolosal 10 mg/ml - Cristália, São Paulo, SP, Brazil

⁹ Propvan 10 mg/ml - Cristália, São Paulo, SP, Brazil

¹⁰ Isoforine 100% - Cristália, São Paulo, SP, Brazil

¹¹ Celozina 1 g - Cellofarm Farmacêutica, Serra, ES, Brazil

¹² Riohex 2% - Rioquímica Indústria Farmacêutica, São José do Rio Preto, SP, Brazil

Upon completion of antiseptics (chlorhexidine 2% and alcohol 70%¹³), surgical drapes were attached to the patient with Backhaus towel forceps for surgical field isolation. The surgical approach commenced through a skin incision from the cranial extension of the iliac crest to the femoral greater trochanter, followed by an incision in the superficial gluteus fascia, following the line of the skin incision and allowing for the separation of the tensor fasciae latae and gluteus medius muscles. This incision extended from the ventral iliac spine to the cranial edge of the biceps femoris muscle. The gluteus medius and gluteus minimus muscles were dorsally spread in order to gain access to the caudal portion of the body of ilium. The fracture was reduced by attaching a bone clamp to the femoral greater trochanter and moving it caudally and laterally until anatomical alignment with the cranial fragment of the ilium was achieved. A notched head Locking Compression Plate (LCP)¹⁴ with 2.4 x 9 mm 'T' holes, shaped to match the curvature of the lateral surface of the ilium, was used.

The plate was first attached with three locking screws to the caudal ilium fragment. In the cranial fragment, the screws were placed so that the hole most proximal to the fracture line and the third hole (cranial to caudal) were left empty (Figure 2A and B).

After the final irrigation, the fascia was sutured separately with an absorbable 2-0 monofilament¹⁵ in a simple continuous suture pattern. The subcutaneous tissue was sutured with an absorbable 3-0 monofilament in a zigzag pattern and the dermal suture was made with 3-0 nylon monofilament¹⁶ in a simple interrupted suture pattern. Methadone¹⁷ (0.3 mg/kg/IM), meloxicam¹⁸ (0.2 mg/kg/SC) and

dipyrone¹⁹ (25 mg/kg/SC) were administered in the postoperative period.

The wound was dressed with 0.9% NaCl solution and cleansed once a day with saline and chlorhexidine 1%²⁰ for a total of ten days, until the removal of skin sutures. The following were prescribed for oral intake: omeprazole²¹ (0.7 mg/kg/SID) for 10 days, cephalixin²² (30mg/kg/BID) for 10 days, meloxicam (0.1 mg/kg/SID) for 3 days, dipyrone (25 mg/kg/TID) for 7 days, and tramadol hydrochloride²³ (3 mg/kg/TID) for 7 days. Additional recommendations included resting in a restricted enclosure for a period of 30 days and starting physiotherapy 10 days into the postoperative period.

The patient evolved satisfactorily, with good limb support 24 hours after surgery. Skin sutures were removed 10 days after surgery. By day 10, the animal had become active with complete limb support and absence of lameness. Serial radiographic examinations were performed every 30 days. The patient was medically discharged 60 days after surgery, with clinical and radiographic evidence that the fractured iliac segment had consolidated (Figure 2C and D).

Ilium fractures in dogs and cats are most commonly treated using stabilization by plate. The plates provide excellent stability for fracture fixation; they usually allow early controlled limb support with an excellent bone consolidation rate. Preferably, the plate should be attached firmly to the bone using three screws per main fragment. However, in many iliac fractures, it is only possible to place two screws on one side of the fracture and three on the opposite side, due to the intrinsic stability provided by the attached soft tissue. Guidelines for plate attachment in fractures with very short fragments (less than 1cm long) can

¹³ Ethyl Alcohol 70% - Uniphar, Anápolis, GO, Brazil

¹⁴ LCP notched head T-plate - Synthes, Rio Claro, SP, Brazil

¹⁵ Caprofyl - ETHICON Division of Johnson & Johnson Medical Ltd.

¹⁶ Nylon Monofilament - Brasuture Ind. Com. Imp. Exp. Ltd.

¹⁷ Mytedon 10 mg/ml - Cristália

¹⁸ Meloxicam 15 mg/1.5 ml - Eurofarma Laboratórios Ltda

¹⁹ Febrax 500 mg/ml - Lema-Injex bioLOBIC

²⁰ SeptClean - Agener

²¹ Petprazol 20 mg - Vetnil

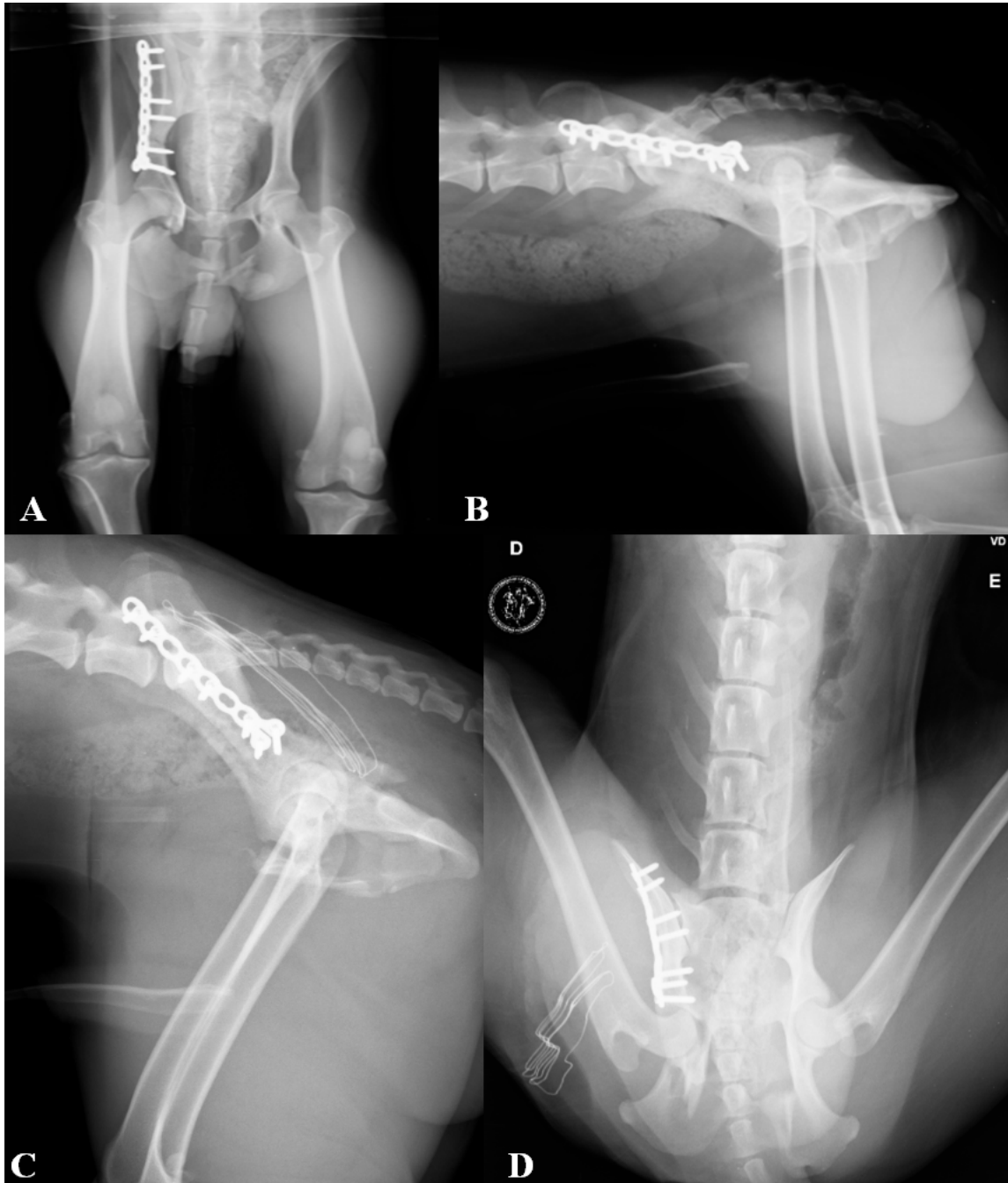
²² Cephalixin 500 mg - Eurofarma Laboratórios Ltda

²³ Tramal 100 mg/ml - Pharmacia

hardly be adhered to, such as those involving at least four, but preferably six, cortices on both sides of the fracture (TROGER; VIGUIER, 2008). Using

a T-plate increases the amount of involved cortices per fragment; the notched head allows for a better modeling and fitting to the caudal fragment.

Figure 2. Immediate postoperative radiographic image of a dog's body of ilium osteosynthesis with radiographic evidence of bone consolidation. An LCP Notched Head T-plate with a 3-screw attachment in the caudal iliac segment is evident in the (A) ventrodorsal and (B) laterolateral projections. Radiographic image taken 60 days after iliac body osteosynthesis surgery in a dog. An LCP Notched Head T-plate with a 3-screw attachment in the caudal iliac segment is evident in the (C) ventrodorsal and (D) laterolateral projections.



Despite the comprehensive description of iliac fracture-correcting implants (FITZPATRICK et al., 2008; CHOU et al., 2013), the first option in the present case was the locked plate, which had adequate dimensions and exhibited good fitting to the body of ilium. The locked plate is an internal implant with characteristics similar to compression plates in terms of neutralizing compressive, rotational, bending, and shearing forces observed in fractures. However, since the screws are locked to the plate, application to the body of ilium is facilitated because they act as internally-positioned external fixators, which do not require perfect alignment with the bone (HUDSON et al., 2009; FERRIGNO et al., 2011). The plate converts the shearing force into a compressive force at the bone-screw interface; the compressive force is equal to the sum of all the bone-screw interfaces. By acting as internal fixators, the locked plate allows angular stability and is independent of the frictional force between plate and bone, allowing proper blood perfusion under the plate. Preserving the periosteal blood supply allows for faster bone healing and decreases the incidence of post-operative complications (CORDEY et al., 2000).

The number of screws per main fragment is a contentious point inherent to locked plates. Gautier and Sommer (2003) suggested a minimum of two screws and three cortices per main fragment in simple fractures and at least two screws and four cortices in comminuted fractures. Fractures involving the caudal portion of the ilium body, in order to be properly fixed and stabilized, usually require modeling of a traditional plate over the acetabulum, thus rendering fixation more difficult (PIERMATTEI et al., 2009). In the present case, the procedure was significantly facilitated by using a T-plate, which allowed for the placement of three locking screws in the short caudal segment, without the need to model the plate over the acetabulum. This also provided adequate stability (GAUTIER; SOMMER, 2003).

The plate was discretely pre-modeled to enable better fitting to the bone axis, however, due to its biomechanical properties, this procedure is not necessary to ensure stability of the fracture (FITZPATRICK et al., 2008).

Although the locked plate precludes the need for each screw to transfix two cortices, Rose et al. (2012) reported complications related to block extrusion of plate and screw in one test case of iliac osteosynthesis with a locked plate. Thus, in the present report, all screws were fixated through two cortices. Screws were not placed in two plate holes. One screw coincided with the fracture line, while the application of an intermediate screw in the cranial iliac segment would not result in increased system stability. This approach follows that described by Stoffel et al. (2003), who assessed the best arrangement of screws on the locked plate. The authors concluded that resistance to axial and rotational forces remained unchanged (i.e., plate stability remained constant) when the plate was locked with three or more (up to six) screws per main fragment. The same study also looked at the influence of the positioning of the three screws on the plate and concluded that one screw should always be placed in the hole most distal to the fracture, while another should be placed in a more proximal position a distance that does not increase deformation of the fracture site. Finally, the third screw should be placed in an intermediate position. Although plate resistance does not show statistically significant changes, resistance increases if the intermediate screw is placed more distally to the fracture line. Several factors are associated with the good gait observed 24 hours after surgery, including the choice of surgical technique, its correct execution, and adequate post-operative care with rest and use of analgesics. Another factor that may have contributed to the good gait of the patient, similar to that described by DeCamp (2012), is the early rigid stabilization of bone fragments that allowed

for the anatomical restoration of fragments with minimal muscle contraction and little formation of fibrotic tissue, which certainly facilitated proper bone consolidation.

The present case can be considered a successful case of this type of surgery. As pain was rapidly reduced, there was an early return to walking, resolution of lameness, and radiographic evidence of bone healing. One can conclude that the LCP Notched Head T-plate was a viable and versatile alternative for treating fractures of the caudal portion of the body of ilium of the dog presented in this report, allowing for relative stability of the fracture and excellent patient recovery in the postoperative period.

References

- CHOU, P.; RUNYON, C.; BAILEY, T.; BÉRAUD, R. Use of Y-shaped TPLO plates for the stabilization of supracotyloid ilial fractures in four dogs and one cat. *Veterinary and Comparative Orthopaedics and Traumatology*, Stuttgart, v. 26, n. 3, p. 226-232, 2013.
- CORDEY, J.; BORGEAUD, M.; PERREN, S. M. Force transfer between the plate and the bone: relative importance of the bending stiffness of the screws friction between plate and bone. *Injury*, UK, v. 31, p. 21-28, 2000. Supplement 3.
- DECAMP, C. Fractures of the pelvis. In: TOBIAS, K. M.; JOHNSTON, S. A. *Veterinary surgery small animal*. New York: Elsevier, 2012. v. 1, p. 801-815.
- FERRIGNO, C. R. A.; CUNHA, O. da; CAQUIAS, D. F. I.; ITO, K. C.; NINA, M. I. D.; MARIANI, T. C.; FERRAZ, V. C. M. Resultados clínicos e radiográficos de placas ósseas bloqueadas em 13 casos. *Brazilian Journal Veterinary Research and Animal Science*, São Paulo, v. 48, n. 6, p. 512-518, 2011.
- FITZPATRICK, N.; LEWIS, D.; CROSS, A. A biomechanical comparison of external skeletal fixation and plating for the stabilization of ilial osteotomies in dogs. *Veterinary and Comparative Orthopaedics and Traumatology*, Stuttgart, v. 21, n. 4, p. 349-357, 2008.
- GAUTIER, E.; SOMMER, C. Guidelines for the clinical application of the LCP. *Injury*, UK, v. 34, p. 63-76, 2003. Supplement 2.
- HUDSON, C. C.; POZZI, A.; LEWIS, D. D. Minimally invasive plate osteosynthesis Applications and techniques in dogs and cats. *Veterinary and Comparative Orthopaedics and Traumatology*, Stuttgart, v. 22, n. 3, p. 175-182, 2009.
- OLMSTEAD, M. L.; MATIS, U. Fractures of the pelvis. In: BRINKER, W. O.; OLMSTEAD, M. L.; SUMNERSMITH, G.; PRIEUR, W. D. *Manual of internal fixation in small animal*. Berlin: Springer, 1998. p. 148-154.
- PIERMATTEI, D. L.; FLO, G. L.; DECAMP, C. E. Fraturas de pelve. In: _____. *Ortopedia e tratamento de fraturas de pequenos animais*. Barueri: Manole, 2009. p. 491-522.
- ROSE, S. A.; BRUECKER, K. A.; PETERSEN, S. W.; UDDIN, N. Use of locking plate and screws for triple pelvic osteotomy. *Veterinary Surgery*, Davis, v. 41, n. 1, p. 114-120, 2012.
- STOFFEL, K.; DIETER, U.; STACHOWIAK, G.; GACHTER, A.; KUSTER, M. Biomechanical testing of the LCP - how can stability in locked internal fixators be controlled? *Injury*, UK, v. 34, p. 11-19, 2003. Supplement 2.
- TROGER, J. C.; VIGUIER, E. Use of T-plates for the stabilization of supra-cotyloid ilial fractures in 18 cats and five dogs. *Veterinary and Comparative Orthopaedics and Traumatology*, Stuttgart, v. 21, n. 1, p. 69-75, 2008.

