Acta Veterinaria Brasilica June 11 (2017) 124-128

Acta Veterinaria Brasilica

Journal homepage: http://periodicos.ufersa.edu.br/revistas/index.php/acta

Clinical Report

Pantarsal arthrodesis with a locking plate as treatment for reabsorptive calcaneal injury in an obese dog: case report

Rodrigo Casarin Costa[1], Guilherme Sembenelli[2], Mônica Carolina Nery Wittmaack[2], Fabiana Del Lama Rocha[2], Paola Castro Moraes[3], Bruno Watanabe Minto[3], Luís Gustavo Gosuen Gonçalves Dias[3]*

[1] Residente do Hospital Veterinário Governador Laudo Natel da Unesp Câmpus de Jaboticabal (SP).
[2] Mestrando(a) pela FCAV/Unesp Câmpus de Jaboticabal (SP).
[3] Docente do Departamento de Clínica e Cirurgia da FCAV/Unesp Câmpus de Jaboticabal (SP).

A R T I C L E I N F O

Article history
Received 27 March 2017
Received in revised form 08 June 2017
Accepted 08 June 2017

Keywords:
Bone plate
Canis lupus familiaris
Immobilization
Joint
Orthopedics

A B S T R A C T

The purpose of this study was to describe a pantarsal arthrodesis using a medial locking plate in an overweight dog. A 5-year-old, 28 kg, female dachshund presented with a left plantigraded hindlimb with calcaneous osteolytic injury and bone exposure. First, the patient was treated for the skin wound and started on a weight-loss program. A customized locking plate was used in the pantarsal arthrodesis. A normal hindlimb position and gait were observed after 27 days, and bone fusion was achieved at 60 days postoperatively. Implant removal was performed at 120 days, and the patient was discharged. The dog was kept on weight-loss therapy until it achieved a body weight of 11 kg. The customized bone implant used for pantarsal arthrodesis proved feasible and effective in treating an obese dog with low bone density.

INTRODUCTION

According to Galateanu et al. (2013), the tibiotarsal and tarsometatarsal joints are formed by the distal portion of the tibia and fibula, tarsal bones, and proximal portion of the metatarsal bones. The tarsus is formed by three irregular rows consisting of seven bones. The proximal row is formed by the calcaneus and talus, which articulate proximally with the tibia and the fibula. The central bone of the tarsus articulates with all the bones of the tarsus, acting as a support for the intertarsal joint. The third row is formed by the first, second, and third tarsal bones. The fourth tarsal bone covers the length of the two tarsal rows on the lateral side.

Arthrodesis, or inhibition of the mobility of a joint or a set of joints by promoting bone fusion, is the final solution for joints traumatized or degraded by an inflammatory/infectious process in which the development of osteoarthritis is unavoidable (SHANIL; YESHURUN; SHARAR, 2006). The technique is considered a salvage procedure for hyperextension lesions; dislocations; degenerative ligament conditions; immune-mediated arthritis; irreparable comminuted intra-articular fractures; severe degenerative joint disease; severe trauma to soft tissues; and/or bones not amenable to primary repair, infections, and some cases of paralysis or nerve damage (TORUDON, 2010; TULNER; KLINKENBIJL; ALBERS, 2011).

There are four basic steps for performing an arthrodesis: debridement of articular cartilage, application of bone graft, positioning of the articulations at functional angles, and promotion of stable osteosynthesis (DeHERR, 2012; JOHNSON; HOULTON, 2005; MUSCARELLA; SADRI; PUSATERI, 2012). In the case of pantarsal arthrodesis, in which there is induction of fusion of the bones forming the tibiotarsal, intertarsal, and tarsometatarsal joints, the

* Corresponding author: gustavogosuen@fcav.unesp.br

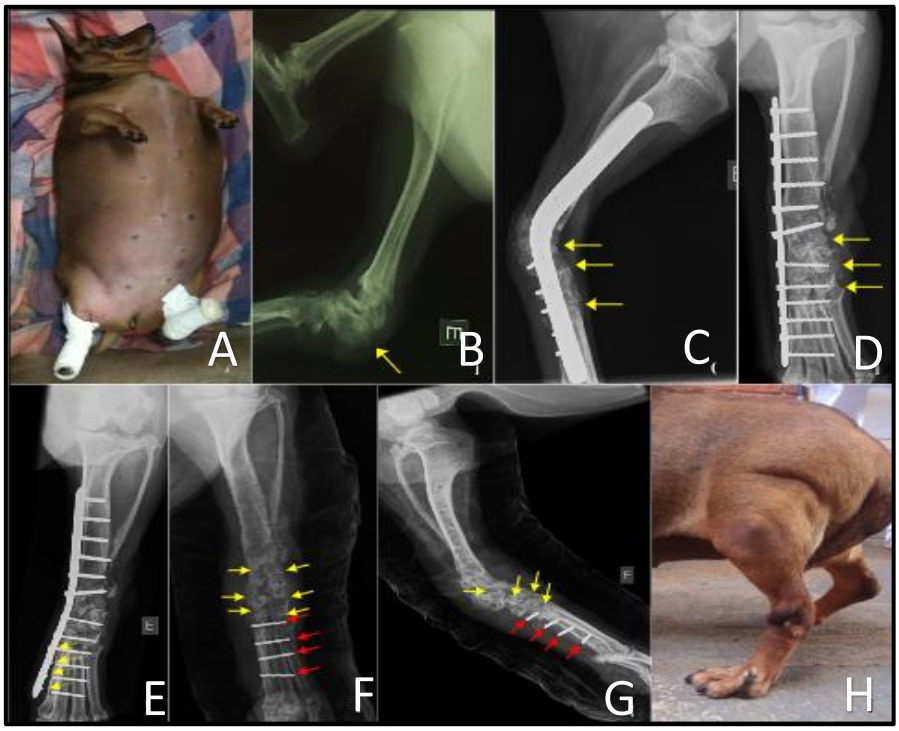
http://dx.doi.org/10.21708/avb.2017.11.2.6947

fixation can be accomplished by one of several methods. These include using a plate on the dorsal, medial, or lateral aspects of the tarsus (McKEE; MAY; MACIAS, 2004; SHAIL; YESHURUN; SHARAR, 2006); by pin placement and tension band (ALLEN; DYCE; HOULTON, 1993); by compression screws (lag) (KLAUSE; PIERMATTEI; SCHWARTZ, 1989); or through use of an external transarticular skeletal fixator. Here, we describe a case using pantarsal arthrodesis with a hybrid medial locking plate in an obese dog with osteolytic calcaneal injury.

CASE REPORT

A 5-year-old dachshund female weighing 28 kg was admitted for weight loss treatment. The dog had claudication of the pelvic limbs, left plantigraded hindlimb support, and the right hindlimb partially plantigraded due to the obese condition of the patient (Figure 1A).

Figure 1. Photographic and radiographic images (mediolateral and craniocaudal projections) of the patient (canine female) submitted for left pantarsal arthrodesis.



(A): Excess weight at the time of care. (B): Osteolysis of the left calcaneus (arrow) and subsequent loss of fixation of the gastrocnemius tendon. (C and D): Postoperative 30-day imaging showing well-positioned implants (customized locking plate and locking screws), and early joint fusion (arrows). (E): Failure (arrows) of the distal screws (metatarsals) at 120 postoperative days. (F and G): Radiographic images at 21 days after the second surgical intervention, showing the removal of the plate and intact screws, and the remaining four fragments of the fractured screws (red arrows). There is fusion between the articular lines (yellow arrows). (H): Support with limb load submitted for pantarsal arthrodesis (left) at 60 days following implants.

On physical examination, nothing was found outside the normal patterns for the species, except for an increase in popliteal lymph nodes and the presence of a wound with exposure of the left calcaneus and tendinous involvement. Laboratory tests such as hemogram and serum biochemistry (renal and hepatic) were within the reference values, but the leukocyte count was at the lower limit (6,300 µl). Due to the absence of clinical signs or history of cardiac disease, cardiac exams were not performed as well as research for endocrinopathies with hormonal tests due to restrictions on the part of the owner and the good response to weight loss food management program.

Radiographic examination revealed signs of septic arthritis in the tibiotarsal and left tarsometatarsal joints, with osteolysis of the calcaneus and loss of the fixation point of the common tendon of the gastrocnemius, as well as chondrodystrophy (Figure 1B). Wound management included dry dressing after washing with physiological solution and the use of healing ointment. We employed a wet-dry dressing after granulation and antimicrobial therapy with amoxycillin and potassium clavulanate (22 mg/kg every 12 hours for 28 days). Other facets of the treatment plan included maintenance of the weight-loss regimen and customization of a locking plate (for use on the medial face of the limb) with a 120 degrees angle and perforations of 1.5 mm and 2.0 mm to accommodate the left pantarsal arthrodesis procedure. The angle of the

plate was based on the contralateral joint with the patient in quadrupedal position.

After the implant was manufactured, new laboratory tests demonstrated resolution of the leukopenia. For the surgical procedure, anesthetic protocols were completed, and the patient was maintained under inhalation anesthesia with isoflurane (1,5-2 CAM) combined with epidural anesthesia with lidocaine (2 mg/kg), bupivacaine (0.75 mg/kg), and methadone (0.1 mg/kg). After induction, cefazolin (30 mg/kg) was administered intravenously; at the end of surgery, dipyrone (25 mg/kg) was administered subcutaneously.

The patient was placed in the left lateral decubitus position, previous and definitive antisepsis of the affected limb were performed. For exposure of the crural tarsal joint, osteotomy of the medial malleolus was performed. After arthrotomy, we debrided the articular surface with an electric drill until the subchondral bone was exposed under irrigation. The intertarsal and tarsometatarsal joints were then debrided in the same manner. To ensure adequate fit of the plate to the medial surface of the involved bones, the remainder of the medial malleolus of the tibia was milled. Access to the right iliac wing was created for the collection of cancellous bone, which was placed between the milled joints.

After anatomical reduction of the crural tarsal joint, screws were inserted through the plate in the talus and in the distal tibia, maintaining reduction of the crural tarsal joint. At the same time, manual compression of the fragments was performed. The other screws were inserted—first into the metatarsals—thus maintaining the stability of the joint, then the remaining holes were blocked, ensuring the angle of the joint was consistent with the angle of the plate, as previously determined (Figure 1C and 1D). The incised tissues were sutured with poligrecapone 25 2-0 and nylon 3-0.

A Robert Jones bandage was applied only on the first postoperative day. Sutures were removed on the ninth postoperative day, at which time the patient already supported the hindlimb and the cutaneous surgical wound was completely sealed. It was recommended that the patient adhere to a physiotherapy program to ensure better results, but that recommendation was not followed by the owner. A monthly radiographic follow-up was performed until bone fusion was visible between the involved joints, which occurred around the 60th postoperative day.

At four months following surgery, the patient began to exhibit acute lameness of the operated limb, accompanied by pain on manipulation of the involved joint. After the physical and radiographic examinations, we noticed a deviation of the implant from the bone axis and breakage of the four distal screws (Figure 1E). Since the arthrodesis was already complete, a Robert Jones bandage was used to limit further damage and provide comfort until the patient's implants were removed. Implant removal occurred close to the 180th postoperative day, since the owner presented restrictions that prevented mediated intervention (Figure 1F and 1G). Near the 21st day following the second surgery, the patient—which now had functional limb strength and maintenance of joint angulation—was discharged surgically (Figure 1). The patient was monitored for weight control during the entire period.

DISCUSSION

The patient exhibited a satisfactory clinical evolution, with progressive limb support from the first postoperative week and total support on the 27th postoperative day, showing improvement in ambulation with total correction of the plantigraded position.

The decision to place a medial locking plate was based on its biomechanical advantages of greater resistance and durability over an external skeletal fixator in light of the loads to be supported, primarily because the patient was overweight (score of 9, according to the Nestlé Purina Body Condition System Pet Care Center, validated by LAFLAMME, 1997). Other factors were the unreliability and reduced durability of the external skeletal fixator, and the fact that an external skeletal fixator would cause constant friction on the patient's abdomen. In addition, the angular stability conferred by locking plates and screws is especially advantageous in cases where there is poor bone quality (FITZPATRICK et al., 2009). The hybrid medial locking plate adequately corresponded to the proposed purpose, demonstrating enough resistance to allow weight support. There were no failures in the critical postoperative phase, with failure occurring only after the arthrodesis process was nearly complete. The positioning of the plate allowed complete immobilization of the involved joints and neutralization of the forces acting in place. Despite the anatomical difficulties of the region (PIERMATTEI; FLO, 2006), the case evolved satisfactorily.

The autogenous cancellous bone graft proved to be of great benefit in the evolution of the case—corroborating the literature—and promoted osteoconduction and increased surface area for joint fusion (THORDARSON; KUEHN, 2003). Interfragmentary compression is also recommended to ensure greater durability of the implants by ensuring greater contact between the load-distributed surfaces, in addition to allowing faster joint fusion (DEHEER, 2012; MUSCARELLA; SADRI; PUSATERI, 2012; PIERMATTEI; FLO, 2006). However, the patient had low bone density, so it was decided that a locking plate would be used without interfragmentary compression.

The articulation of the tarsus has normal angles of flexion and extension, varying between 65 and 75 degrees, and

between 90 and 110 degrees, respectively (NOGUEIRA; TUDURY, 2002). In the case of arthrodesis of this joint, the recommendation was to preserve the articular angle of 140 degrees (TURNER; LIPOWITZ 2005). However, due to the obesity of the patient, we chose maintenance of a 120 degrees joint angle measured in the contralateral limb in order to avoid postoperative ambulatory difficulties.

The use of a high-rotation mill under irrigation to perform the chondrectomy was satisfactory, since it allowed adequate exposure of the subchondral bone and preservation of the contour of the articular surface without loss of limb length (PIERMATTEI; FLO, 2006; TURNER; LIPOWITZ, 2005).

It is worth emphasizing the importance of the continuity of the weight reduction program as complement to the success of the orthopedic intervention. The patient—a dachshund—went from a condition of obesity (28 kg) to acceptable overweight (11 kg at discharge). This weight loss did not create apparent changes in the angles of the evaluated joints, but it did result in a lower load, guaranteeing preservation of the previous angulations.

Fusion of the joint occurred slowly and progressively. At the 27th postoperative day of the first surgery (Figure 1C and 1D), the bone union already showed expected evolution for the period, since there were no changes that suggested areas of cartilage permanence (FU; HUANG; TIEN, 1999). We observed mild bone consolidation without signs of joint arthritis (GORSE; EARLEY; ARON, 1991). However, at the time, there was a reduction in the bone mineral density of the distal portions of the left tibia and fibula, as well as of the ipsilateral tarsal bones, and the fixation method was efficient at that point for the bone condition, as reported by Fitzpatrick et al. (2009). It was believed that this condition was due to disuse of the limb (MAEDA et al., 1993) or nutritional deficiency (CROCHIK et al., 1996), and recommendations included daily sun baths for 30 minutes in the morning, continued mineral supplementation, and light walking In subsequent monthly return visits, improvement of the bone condition was observed until complete joint fusion at about 60 postoperative days, which corresponds to findings presented by other authors, such as Dórea Neto (2003).

We did not remove the implant due to the absence of complications, as described by Harasen (2002), but close to the 120th postoperative day, there was fracture of the distal screws and deviation of the plate on its axis (Figure 1E). This was probably due to the action of the weight and forces of the ligaments, tendons, and adjacent long bones. Acting as levers, these structures end up working against immobilization at the attachment sites (LAUGE-PEDERSEN, 2003; OLMSTEAD et al., 1995), but without affecting the quality of the joint (Figure 1E). The Robert Jones bandage was effective in providing stability and comfort until removal of the implants.

As no signs of osteomyelitis were observed, we decided to leave the distal screws in place. The screws had fractured over a period of time and become incorporated into the local fibrous tissue, making removal traumatic and possibly causing local instability.

At 21 days following the second intervention, the patient showed good recovery, with no signs of pain or discomfort on palpation. The patient walked without limping with a full load on the limb, and maintenance of the proposed joint angle was observed, demonstrating success of the procedure (Figure 1F, 1G and 1H).

CONCLUSION

The surgical technique proved to be feasible and satisfactory, ensuring the immobilization of the articular surfaces, weight support, and correction of the plantigraded position. It allowed and bone formation and remodeling at 60 postoperative days, even though the patient was obese and had low bone density.

REFERENCES

ALLEN, M.; DYCE, J.; HOULTON, J. E. F. Calcaneal quartal arthrodesis in the dog. **Journal of Small Animal Practice**, v.34, p.205-210, 1993.

CROCHIK, S. S. et al. Clinical and radiographic aspects of nutritional osteodystrophies in dogs. **Brazilian Journal Veterinarian research Animal Science**. v.33, n.4, p.293-243, 1996.

DeHEER, P. A., et al., Ankle arthrodesis: a literature review. **Clin Podiatr Med Surg**. V.29, n.4, p.509-27, 2012.

DÓREA NETO, F. A. **Avaliação da hidroxiapatita em artrodeses experimentais e em ensaio clínico**. Jaboticabal. SP: UNESP, 2003. 71p. Dissertação (Mestrado em Cirurgia Veterinária) – Faculdade de Ciências Agrárias e Veterinárias de Jaboticabal, 2003.

FITZPATRICK, D. C. et al. Relative stability of conventional and locked plating fixation in a model of the osteoporotic femoral diaphysis. **Clinical Biomechanics**. v.24, n.2, p.203-209, 2009.

FU, Y. C.; HUANG, P. J.; TIEN, Y. C. Ankle arthrodesis: internal non-compression arthrodesis versus internal arthrodesis. **The Kaohsiung Journal of Medical Sciences.** v.15, p.550-555, 1999.

GALATEANU, G. et al. Canine tarsal architecture as revealed by high-resolution computed tomography. **The veterinary journal**. v.196, p.374-380, 2013.

GORSE, M. J.; EARLEY, T. D.; ARON, D. N. Tarsocrural artrhodesis: Long – term functional results. **Journal of American Animal Hospital Association**. v.27, p.231, 1991.

HARASEN, G. Arthrodesis – Part II: The tarsus. **The Canadian Veterinary Journal**. V.43. p.806-808, 2002.

JOHNSON, A.; HOULTON, J. Arthrodesis of the carpus. In: JOHNSON A. L.; HOULTON J. E.; VANNINI, R. (Eds). **AO principles of fracture management in the dog and the cat**. Stuttgart: Thieme, 2005, p.446–57.

KLAUSE, S.; PIERMATTEI, D. L.; SCHWARTZ, P. D. Talocrural arthrodesis: complications and recommendations. **Veterinary Comparative Orthopedics and Traumatology**. v.3, p.119-124, 1989.

LaFLAMME, D.; Development and validation of a body condition score system for dogs: **Canine Pract.**; 1997; 22:10-15

LAUGE-PEDERSEN, H. Percutaneus arthrodesis. **Acta. Orthopedica Scandinavica Suplementum**, v.74, n.307, p.1-30, 2003.

MAEDA, H. et al. Muskulo-skeletal recovery following hindlimb immobilization in adult female rats. **Bone**. v.14, p.153–159, 1993.

McKEE, W. M.; MAY, C.; MACIAS, C. Pantarsal arthrodesis with a customized medial or lateral bone plate in 13 dogs. **Veterinary Record**, v.154, p.165-170, 2004.

MUSCARELLA, V.; SADRI, S; PUSATERI, J. Indications and considerations of foot and ankle arthrodesis. **Clin Podiatr Med Surg**. v.29, n.1, p. 1-9, 2012.

NOGUEIRA S. R.; TUDURY E. A. Exame clínico ortopédico de cães e gatos - parte 1. **Clin. Vet**., v.36, p.34-56, 2002.

OLMSTEAD, M. L. et al. Principles of fracture repair. In. OLMSTEAD, M. L (Ed.). **Small animal orthopedics**. 3.ed. Philadelphia: Mosby, 1995. p.111-160.

PIERMATTEI, D. L.; FLO, G. L. Handbook of Small Animal Orthopedics and Fracture Repair. 4 ed. Philadelphia: WB Saunders, 2006, 665p.

SHANIL, J., YESHURUN, Y., SHARAR, R. Arthrodesis of the tarsalmetatarsal joint, using type II ESF with acrylic connecting bars in four dogs. **Veterinary Comparative Orthopedics and Traumatology**. v.19, p.61-63, 2006.

THORDARSON, D.B.; KUEHN, s., Use of demineralized bone matrix in ankle/hindfoot fusion. **Foot Ankle Int**. v.24, n.7,p. 557-60, 2003.

TORUDON, Y. The results of ankle arthrodesis with screws for end stage ankle arthrosis. **J Med Assoc Thai**, 2010. 93 Suppl 2: p. S50-4

TULNER, S.; KLINKENBIJL, M.; ALBERS, G., Revision arthrodesis of the ankle: a 4 cannulated screw compression fixation technique. **Acta Orthop**. v.82, n.2, p. 250-2, 2011

TURNER, T. M.; LIPOWITZ, A. J. Artrodese In: BOJRAB, M. J. **Técnicas atuais em cirurgia de pequenos animais**. 3.ed. São Paulo: ROCA, 2005, p.775-786.