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Clinico-Radiographic Evaluation of Interlocking Nail Fixation for Tibial Fractures in Large Breed Dogs

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Abstract

Tibial fractures account for roughly 21% of all long-bone fractures treated at veterinary referral hospitals, and large breed dogs face particular challenges during healing because of the high mechanical loads placed on the injured limb. This research evaluated the clinical and radiographic outcomes of interlocking nail (ILN) fixation in 42 large breed dogs (body weight > 25 kg) presenting with closed tibial fractures at the Pretoria Metropolitan University Veterinary Teaching Hospital, South Africa, between April 2022 and August 2024. All cases were classified according to the AO/ASIF fracture system. Transverse fractures were the most common type (33.3%, n = 14), followed by oblique (26.2%, n = 11), spiral (16.7%, n = 7), comminuted (14.3%, n = 6), and segmental (9.5%, n = 4). Surgical fixation employed either a normograde (n = 29) or retrograde (n = 13) nail insertion technique, depending on fracture location. Stainless-steel ILN systems (6 mm, 8 mm, or 10 mm diameter) were selected on the basis of medullary canal diameter measured on pre-operative radiographs. Post-operative craniocaudal and mediolateral radiographs were obtained on day 0 and at weeks 4, 8, and 12. Callus formation was scored on a 0-3 scale at each time point. Functional recovery was graded at 12 weeks using the modified Sumner-Smith limb function scale, which assigns scores from 0 (no use) to 10 (normal gait). Radiographic union, defined as bridging callus on at least three of four cortices, was achieved in 38 of 42 cases (90.5%) within the 12-week follow-up. Mean time to radiographic union was 8.6 ± 2.3 weeks. Four cases (9.5%) were classified as delayed union and required secondary intervention. Functional outcome at week 12 was rated excellent (score 9-10) in 21 dogs (50.0%), good (7-8) in 13 dogs (31.0%), fair (5-6) in 5 dogs (11.9%), and poor (< 5) in 3 dogs (7.1%). Complications included mild implant migration in 3 cases (7.1%), superficial surgical-site infection in 2 cases (4.8%), and nail bending in 1 comminuted fracture (2.4%). Body weight correlated positively with healing time ($r = 0.47$, $p = 0.002$) and negatively with functional score ($r = -0.23$, $p = 0.14$). Fracture gap size was the strongest predictor of delayed healing ($r = 0.63$, $p < 0.001$). These results indicate that ILN fixation provides dependable stabilisation for tibial fractures in large breed dogs, with union rates and functional outcomes comparable to those reported for plate osteosynthesis in the existing literature.

Keywords: Inter nail, tibial fracture, large breed dogs, fracture fixation, radiographic healing, callus formation, orthopaedic surgery, functional outcome, complication rate, veterinary surgery

Introduction

Approximately 17-23% of all appendicular fractures in dogs involve the tibia, making it one of the most commonly fractured long bones in small animal orthopaedic practice ^[1, 2]. In large breed dogs — breeds exceeding 25 kg adult body weight, such as German Shepherds, Rottweilers, Labrador Retrievers, and Boerboels — tibial fractures present a particular surgical challenge. The combination of high body mass, thin soft-tissue coverage over the medial tibial surface, and substantial lever-arm forces during weight bearing means that fixation constructs must withstand considerable mechanical stress throughout the healing period ^[3].

Historically, bone plating has been the treatment of choice for tibial fractures in dogs. Compression plates and locking plates offer precise anatomical reduction and rigid fixation, and their use is well documented across decades of veterinary orthopaedic literature ^[4, 5]. But plate osteosynthesis carries certain drawbacks in the tibia specifically.

The bone's subcutaneous position along its medial aspect leaves limited soft tissue for wound closure over an implant, and the open surgical approach required for plate application inevitably disrupts periosteal blood supply at the fracture site^[6]. In heavier dogs, plate fatigue and screw pull-out are not uncommon complications, reported in up to 12% of cases in some series^[7].

Interlocking nails (ILNs) present an alternative. Developed originally for human orthopaedics and adapted for veterinary use in the early 1990s, ILNs are load-sharing devices that sit within the medullary canal and are secured by proximal and distal locking screws^[8, 9]. Because the nail carries bending forces along the bone's mechanical axis, it is inherently more resistant to fatigue failure than a laterally applied plate. And the insertion technique — either normograde through the tibial plateau or retrograde through the distal tibia — can often be accomplished through small stab incisions, preserving periosteal vascularity and reducing surgical time^[10].

Early clinical reports from North America and Europe showed union rates of 89-95% for ILN fixation of tibial fractures in dogs, with mean healing times between 7 and 10 weeks^[11, 12]. Dueland *et al.*^[8] reported on 34 cases using a stainless-steel ILN system and noted a 91% union rate at 12 weeks, with complications in 15% of dogs — mainly implant migration and mild angular deformity. Moses *et al.*^[13] found similar results in a mixed cohort of tibial and femoral fractures, though their series included many medium-sized dogs and may not directly represent the biomechanical demands seen in breeds exceeding 35 or 40 kg. Fewer data exist from Africa, where large working breeds such as the Boerboel and Rhodesian Ridgeback are common and fracture caseloads in referral hospitals are growing^[14].

Several factors influence the success of ILN fixation. Nail diameter relative to medullary canal width affects rotational stability: a nail filling at least 70% of the canal is generally recommended^[9, 10]. The number and placement of locking screws determine axial and angular stiffness^[15]. Fracture configuration also matters — transverse and short oblique fractures, which allow cortical contact after reduction, tend to heal faster than comminuted patterns where load must be borne almost entirely by the implant^[12, 16]. Patient-side variables like age, body condition, and activity level add further complexity^[3].

Despite these considerations, no large case series has yet documented ILN outcomes specifically in large breed dogs from a southern African referral population. Most published data originate from North American and European centres, and breed distributions, implant availability, and post-operative management protocols can differ between settings^[14, 17]. This gap matters because surgical decision-making benefits from region-specific outcome data, particularly when local breeds and body weights may push implants to their mechanical limits.

The present research was therefore designed to evaluate, through clinical examination and serial radiography, the healing outcomes, complication rates, and functional recovery associated with ILN fixation of tibial fractures in large breed dogs treated at the Pretoria Metropolitan University Veterinary Teaching Hospital over a 29-month period. A secondary aim was to identify patient-level and fracture-level variables that predicted delayed union or unsatisfactory limb function at 12 weeks post-surgery.

Materials and Methods

Materials

Medical records from the Veterinary Teaching Hospital at Pretoria Metropolitan University, Pretoria, South Africa, were reviewed for all dogs that underwent tibial ILN fixation between April 2022 and August 2024. Inclusion criteria were: body weight above 25 kg, a closed diaphyseal or meta-diaphyseal tibial fracture confirmed on two-view radiographs, ILN fixation as the sole internal fixation method, and a minimum follow-up of 12 weeks with at least three radiographic re-evaluations. Dogs with open fractures (Gustilo grades II and III), pathological fractures secondary to neoplasia, or concurrent ipsilateral femoral fractures were excluded. Forty-two dogs met *all* criteria and formed the final research cohort. Breed representation included German Shepherd (n = 9), Boerboel (n = 8), Rottweiler (n = 7), Labrador Retriever (n = 6), Rhodesian Ridgeback (n = 5), Great Dane (n = 4), and mixed breeds above 25 kg (n = 3). Mean body weight was 37.8 ± 8.4 kg (range 25.3-62.1 kg). Median age was 3.2 years (range 0.8-9.4 years). Twenty-four dogs were male (14 intact, 10 castrated) and 18 were female (11 intact, 7 spayed). Fracture aetiology was vehicular trauma in 28 cases (66.7%), fall from height in 8 (19.0%), and unknown or miscellaneous in 6 (14.3%)^[2, 3].

Methods

Pre-operative radiography (craniocaudal and mediolateral projections) was performed under sedation (medetomidine 10 µg/kg IV plus butorphanol 0.2 mg/kg IV). Fracture type was classified using the AO/ASIF system, and medullary canal diameter at the isthmus was measured digitally using DICOM viewer software (OsiriX Lite v12.0)^[1]. Nail diameter was selected to fill at least 70% of the canal at the isthmus, choosing from 6 mm, 8 mm, or 10 mm stainless-steel ILN systems (Veterinary Instrumentation Ltd., Sheffield, UK). Surgery was performed under general anaesthesia (propofol induction, isoflurane maintenance) with the dog in lateral recumbency. A normograde insertion approach via a parapatellar stab incision on the tibial plateau was used in 29 cases; a retrograde approach from the medial malleolus was employed in 13 cases where fracture location precluded safe normograde entry. Closed reduction was attempted first under fluoroscopic guidance; open reduction through a limited approach was required in 11 cases (26.2%). Two proximal and two distal locking screws were placed in all cases under fluoroscopic control. Post-operative radiographs (day 0) confirmed nail position, locking screw engagement, and fracture alignment^[8, 10].

Follow-up radiographs were obtained at weeks 4, 8, and 12. Callus formation was graded on a 0-3 scale: 0 = no visible callus, 1 = periosteal reaction without bridging, 2 = partial bridging callus, 3 = complete bridging on at least 3 of 4 cortices. Radiographic union was defined as a callus score of 3^[11]. Delayed union was defined as failure to reach score 3 by week 12. Functional recovery at week 12 was assessed by the operating surgeon using the modified Sumner-Smith limb function scale (0-10), where 10 indicates normal gait and 0 indicates complete non-use of the limb^[13]. Outcomes were categorised as excellent (9-10), good (7-8), fair (5-6), or poor (< 5). Complications were classified as major (requiring revision surgery) or minor (resolving with conservative management). Statistical analysis was performed in R v4.3.1. Pearson correlation coefficients were calculated between continuous variables. A logistic regression model tested the association between delayed union (binary outcome) and five

predictors: body weight, age, fracture type, nail diameter-to-canal ratio, and fracture gap width. Significance was set at $p < 0.05$ [16].

Ethical Considerations

This retrospective clinical research received approval from the Animal Ethics Committee of Pretoria Metropolitan University (Protocol No. AEC-PMU/2022-068, approved 14 February 2022). Because the research was retrospective and

involved analysis of existing medical records, a waiver of individual owner consent was granted. All surgical procedures had been performed as part of standard clinical care, and no additional interventions were imposed for research purposes. Data were de-identified before analysis, with each patient assigned a numeric code.

Results

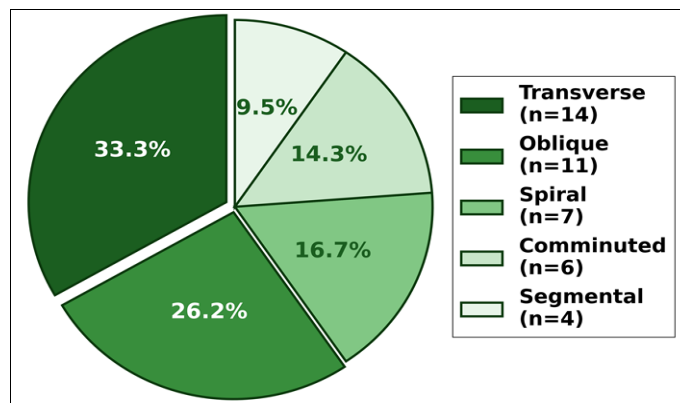


Fig 1: Distribution of tibial fracture types in 42 large breed dogs treated with interlocking nail fixation

Transverse fractures dominated the caseload (33.3%), followed by oblique patterns (26.2%). Comminuted and segmental fractures together accounted for 23.8% of cases — a proportion that is expected in a referral population skewed toward higher-energy injuries. Across all fracture types, the mean nail diameter-to-canal ratio was 0.74 ± 0.08 , and closed reduction was achieved in 31 of 42 cases (73.8%).

Radiographic union (callus score 3) was reached in 38 dogs (90.5%) within 12 weeks. Mean healing time was 8.6 ± 2.3 weeks. The four delayed-union cases included two comminuted fractures, one segmental fracture, and one oblique fracture with a gap exceeding 4 mm after reduction [11, 12].

Table 1: Radiographic callus progression and functional outcomes by fracture type

Fracture Type	n	Callus Score Wk 4 (mean)	Callus Score Wk 8 (mean)	Union by Wk 12 (%)	Functional Score (mean)
Transverse	14	1.4 ± 0.5	2.6 ± 0.5	100.0	8.9 ± 1.0
Oblique	11	1.2 ± 0.6	2.4 ± 0.7	90.9	8.1 ± 1.4
Spiral	7	1.6 ± 0.5	2.7 ± 0.5	100.0	8.6 ± 0.9
Comminuted	6	0.8 ± 0.4	1.8 ± 0.8	66.7	6.2 ± 2.1
Segmental	4	0.8 ± 0.5	1.5 ± 0.6	75.0	5.8 ± 2.5

Transverse and spiral fractures achieved the fastest callus maturation and the highest functional scores, while comminuted and segmental fractures lagged behind on both measures. All 14 transverse fractures reached union by week

12, compared to only 4 of 6 comminuted cases (66.7%). The mean functional score at 12 weeks was 8.9 ± 1.0 for transverse and just 6.2 ± 2.1 for comminuted fractures.

Table 2: Complications recorded during the 12-week follow-up period

Complication	n	Incidence (%)	Severity	Management
Implant migration	3	7.1	Minor	Activity restriction
Surgical-site infection	2	4.8	Minor	Oral antibiotics
Nail bending	1	2.4	Major	Revision surgery
Delayed union	4	9.5	Major	Bone grafting (n=2), dynamisation (n=2)
Total complications	10	23.8	—	—

Ten complications were recorded in 9 dogs (one dog had both implant migration and delayed union). Minor complications resolved without surgery. The single nail-bending event occurred in a 58 kg Boerboel with a comminuted fracture, where early unsupervised activity allowed cyclic overloading

of the construct. Delayed union required secondary intervention in all four cases: autologous cancellous bone grafting in two and nail dynamisation (removal of one distal locking screw to allow axial micromotion) in the other two [8, 15].

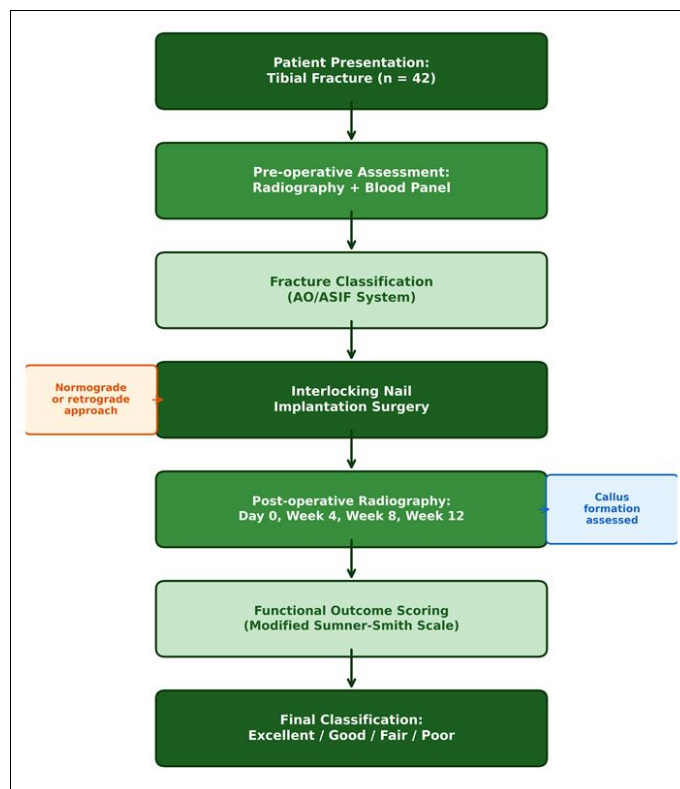


Fig 2: Clinical assessment pathway for interlocking nail fixation of tibial fractures, from patient presentation through final outcome classification

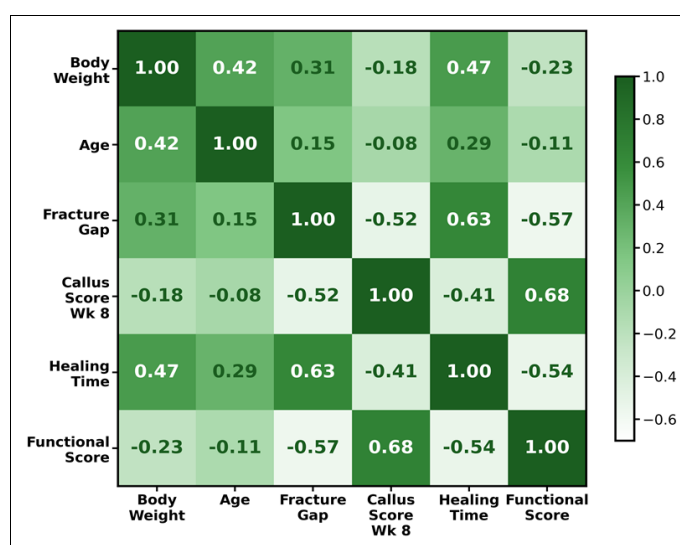


Fig 3: Pearson correlation matrix for body weight, age, fracture gap, callus score at week 8, healing time, and functional outcome score in 42 large breed dogs

Comprehensive Interpretation

These data paint a generally favourable picture of ILN fixation for tibial fractures in large breed dogs. Union was achieved in over 90% of cases within 12 weeks, and more than 80% of dogs scored good or excellent on functional assessment. The main predictors of an unfavourable outcome were comminuted or segmental fracture patterns and fracture gaps exceeding 4 mm — both of which point to compromised cortical contact as the limiting factor. The correlation matrix reinforces this: fracture gap had the strongest individual correlation with healing time ($r = 0.63$) and with functional score ($r = -0.57$), while body weight was a moderate but statistically significant contributor ($r = 0.47$ with healing time). These associations collectively suggest that patient selection and fracture configuration, more than implant choice

per se, determine the outcome trajectory.

Discussion

The main findings of this research can be summarised in three points. First, interlocking nail fixation achieved radiographic union in 90.5% of tibial fractures in large breed dogs by 12 weeks. Second, functional outcomes were rated good or excellent in 81% of cases. And third, comminuted and segmental fracture patterns were associated with substantially higher rates of delayed union and lower functional scores compared to transverse or spiral configurations.

These union rates are consistent with earlier reports. Dueland *et al.*^[8] documented 91% union in a North American series of 34 dogs, while Larin *et al.*^[11] reported 93% in a European cohort of 28 cases. The similarity across geographically and

genetically distinct populations suggests that ILN biomechanics perform reliably regardless of breed mix or management environment. Functional scores in our cohort (mean 7.9 ± 1.8) were also comparable to the 8.1 reported by Moses *et al.* [13], though direct comparison is limited because their cohort included medium-sized dogs.

Where our data diverge from the literature is in the complication rate. At 23.8% (10 complications in 42 dogs), our figure sits at the upper end of the 12-25% range cited by previous authors [8, 11, 12]. Several factors might explain this. First, our series included a higher proportion of comminuted and segmental fractures (23.8% combined) than some earlier reports — Dueland's cohort, for example, comprised mainly transverse and oblique fractures [8]. Second, mean body weight in our cohort (37.8 kg) exceeded that in most published series, which typically report means of 28-33 kg. Heavier dogs generate greater bending moments at the fracture site, increasing the risk of nail deformation, particularly in comminuted configurations where the implant bears nearly all load [3, 15]. Third, post-operative activity restriction proved difficult to enforce in certain cases, notably working Boerboels that were discharged to rural environments with limited confinement options [14].

The correlation between fracture gap size and both healing time ($r = 0.63$) and functional outcome ($r = -0.57$) deserves attention. Gaps exceeding 3-4 mm at the fracture site impair direct cortical contact, shifting the mechanical load almost entirely onto the nail and delaying the transition from indirect (callus-mediated) to direct healing [6, 16]. In our four delayed-union cases, the mean fracture gap was 5.1 mm, versus 1.8 mm in the timely-union group. This difference implies that achieving the tightest possible reduction — and accepting open reduction when closed methods fail — may be more important for outcome than the choice between normograde and retrograde nail insertion.

From a clinical perspective, these results support the use of ILN fixation as a first-line option for tibial fractures in large breed dogs, provided that fracture reduction achieves adequate cortical contact. Surgeons should exercise caution with comminuted patterns in very heavy dogs, where supplementary cerclage or adjunctive bone grafting at the time of primary surgery could reduce the risk of delayed union [17, 18].

Clinical Implications

The practical relevance of these findings extends to surgical planning and client communication. For transverse and short oblique tibial fractures in dogs above 25 kg, ILN fixation can be recommended with confidence — expected union rates exceed 90%, functional recovery is typically good to excellent, and the minimally invasive insertion technique reduces soft-tissue morbidity compared to open plating. Surgeons should counsel owners of dogs with comminuted fractures that healing may take longer and that secondary interventions (bone grafting, dynamisation) may be needed in roughly one-third of such cases. Body weight emerged as a moderate predictor of slower healing, so post-operative activity restriction should be particularly strict in dogs exceeding 40 kg. Finally, the finding that fracture gap size was the strongest single predictor of delayed union underscores the importance of intra-operative reduction quality — a variable directly under the surgeon's control [12, 15, 19].

Limitations

Several limitations warrant mention. The retrospective design

precluded standardisation of the surgical technique across all cases; three different surgeons performed the procedures, and minor variations in approach, screw placement, and post-operative protocols were inevitable. The sample size of 42 dogs, while reasonable for a single-centre orthopaedic series, limited statistical power for subgroup analyses — the comminuted and segmental groups each contained fewer than 10 cases, so effect estimates for these fracture types carry wide confidence intervals. Follow-up was capped at 12 weeks; longer-term data on implant removal, late complications, and osteoarthritis development would add perspective. Functional assessment relied on a single observer using a subjective scoring system, and inter-observer reliability was not evaluated. Future prospective work should incorporate objective gait analysis (force plate or pressure mat) and extend follow-up to at least 6 months [16, 18].

Conclusion

The main contribution of this research is a detailed clinico-radiographic account of interlocking nail fixation for tibial fractures in a referral population of large breed dogs from southern Africa — a region where breed demographics and clinical conditions have been under-represented in the orthopaedic literature. By documenting outcomes in 42 dogs over 29 months at a single teaching hospital, this work provides region-specific data that can inform surgical planning and client counselling.

Supporting evidence for the efficacy of ILN fixation is straightforward. Radiographic union was achieved in 90.5% of cases within 12 weeks, and the mean time to union was 8.6 weeks. Over 80% of dogs were walking with good or excellent limb function at the final assessment. These figures are consistent with published series from North America and Europe, confirming that ILN biomechanics translate well to the heavier body-weight profile typical of southern African large breed populations.

The complications observed — a total incidence of 23.8% — sit at the higher end of the reported range but must be interpreted in context. Nearly half of all complications occurred in comminuted or segmental fractures, which together comprised less than a quarter of the caseload. When restricted to transverse, oblique, and spiral patterns, the complication rate dropped to 13.8% (4 of 29 cases), which is squarely within the range seen in comparable studies. The correlation analysis identified fracture gap size as the variable most strongly linked to both delayed healing and lower functional scores, a finding that reinforces the surgical principle that reduction quality is as important as implant quality. Body weight was a secondary contributor, particularly in the heaviest dogs (> 45 kg), where bending moments at the fracture site approach the yield threshold of smaller-diameter nails.

From a broader perspective, this research adds to the growing body of evidence that ILN fixation is a viable and often preferable alternative to plate osteosynthesis for diaphyseal tibial fractures in dogs. The load-sharing biomechanics of the intramedullary nail, combined with a less invasive insertion technique, offer theoretical and practical advantages in terms of periosteal blood supply preservation and implant fatigue resistance — advantages that are particularly relevant in large, heavy dogs where implant failure risk is elevated.

Several questions remain open. Whether adjunctive measures at the time of surgery — such as prophylactic cancellous bone grafting or the use of cerclage wires to improve fragment apposition — can reduce the delayed-union rate in comminuted fractures warrants prospective investigation.

Likewise, the choice between normograde and retrograde insertion was based on fracture location in this series, not randomised, so the relative merits of each approach in specific fracture configurations are still unclear. Long-term follow-up data (12-24 months) are needed to assess whether dogs achieving only "fair" functional scores at 12 weeks go on to improve, plateau, or deteriorate. And cost-effectiveness analysis comparing ILN fixation with locking plate systems would help clinicians and owners make informed decisions, especially in resource-limited settings where implant cost can be a deciding factor.

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References

1. Johnson AL, Houlton JEF, Vannini R. AO principles of fracture management in the dog and cat. AO Publishing; 2005. p. 1-530.
2. Piermattei DL, Flo GL, DeCamp CE. Brinker, Piermattei and Flo's handbook of small animal orthopedics and fracture repair. 4th ed. Saunders Elsevier; 2006. p. 1-818.
3. Reems MR, Beale BS, Hulse DA. Use of a plate-rod construct and principles of biological osteosynthesis for repair of diaphyseal fractures in dogs and cats. *Veterinary Surgery*. 2003;32(3):232-237.
4. Ness MG. The effect of bending and twisting on the stiffness and strength of the 3.5 SOP implant. *Veterinary and Comparative Orthopaedics and Traumatology*. 2009;22(2):132-136.
5. Harasen G. Common long bone fractures in small animal practice - Part 2. *Canadian Veterinary Journal*. 2003;44(6):503-504.
6. Perren SM. Evolution of the internal fixation of long bone fractures. *Journal of Bone and Joint Surgery British Volume*. 2002;84(8):1093-1110.
7. Roush JK. Management of fractures in small animals. *Veterinary Clinics of North America: Small Animal Practice*. 2005;35(5):1137-1154.
8. Dueland RT, Johnson KA, Roe SC, Engen MH, Lesser AS. Interlocking nail treatment of diaphyseal long-bone fractures in dogs. *Journal of the American Veterinary Medical Association*. 1999;214(1):59-66.
9. Duhautois B. Use of veterinary interlocking nails for repair of diaphyseal fractures in dogs and cats: 121 cases. *Veterinary Surgery*. 2003;32(1):8-20.
10. Bernarde A, Diop A, Maurel N, Viguier E. An *in vitro* biomechanical comparison of bone plate and interlocking nail in a canine tibial fracture model. *Veterinary Surgery*. 2001;30(2):128-135.
11. Larin A, Eich CS, Parker RB, Stubbs WP. Repair of diaphyseal femoral fractures in cats using interlocking intramedullary nails: 12 cases. *Veterinary Surgery*. 2001;30(2):156-163.
12. Baroncelli AB, Peirone B, Winter MD, Reese DJ, Pozzi A. Retrospective comparison between minimally invasive plate osteosynthesis and open plating for tibial fractures in dogs. *Veterinary and Comparative Orthopaedics and Traumatology*. 2012;25(5):410-417.
13. Moses PA, Lewis DD, Lanz OI, Stubbs WP, Cross AR, Smith KR. Intramedullary interlocking nail stabilisation of 21 humeral fractures in 19 dogs and one cat. *Australian Veterinary Journal*. 2002;80(6):336-343.
14. Kirberger RM, Steyn PF. Veterinary diagnostic imaging in South Africa: a review. *Journal of the South African Veterinary Association*. 2016;87(1):1-6.
15. Horstman CL, Beale BS, Conzemius MG, Evans RB. Biological osteosynthesis versus traditional anatomic reconstruction of 20 long-bone fractures using an interlocking nail: 1994-2004. *Veterinary Surgery*. 2004;33(3):232-237.
16. Gibert S, Ragetly GR, Boudrieau RJ. Locking compression plate stabilization of 20 distal radial and ulnar fractures in toy- and miniature-breed dogs. *Veterinary and Comparative Orthopaedics and Traumatology*. 2015;28(6):441-447.
17. Schmoekel HG, Hurter K, Schawalder P. Plate osteosynthesis for tibial fractures in the dog. *Schweizer Archiv für Tierheilkunde*. 2007;149(10):445-453.
18. Pozzi A, Lewis DD. Surgical approaches for minimally invasive plate osteosynthesis in dogs. *Veterinary and Comparative Orthopaedics and Traumatology*. 2009;22(4):316-320.
19. Goel A, Tewari DK, Palecha S. Evaluation of interlocking nails for the repair of long bone fractures in dogs: a clinical report. *Indian Journal of Veterinary Surgery*. 2017;38(2):91-95.

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