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RESEARCH ARTICLE

Traumatic Lumbosacral Joint Dislocation in 3 Dogs: Clinical Presentation, Diagnosis, Treatment and Short-term Follow-up

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ABSTRACT

Traumatic lumbosacral joint dislocation (TLSJD) without L7 vertebral body fracture is a rare injury in dogs. This report describes clinical presentation, therapy and outcome in 3 dogs. Three crossbreed dogs with non-ambulatory paraparesis and lumbar pain were referred. Radiographs confirmed TLSJD and dorso-ventral displacement (DVD) was measured pre and postoperatively. Case 1 was treated by percutaneous transilial pinning. Cases 2 and 3 were treated by internal fixation with pins and PMMA. Within 72h after surgery all dogs were able to stand and walk, and faecal incontinence resolved. To the author's knowledge this is the first description of a case series of TLSJD in the dog. The biomechanics of TLSJD in animals have not been investigated. It is likely that a single trauma severely hyper-extends L7-S1 causing disruption of the supra and inter-spinous ligaments with simultaneous shear and compression forces that cause ventral slipping of the sacrum. Pins and PMMA compared to percutaneous transilial pinning, provided more strength and stability. In conclusion, TLSJD requires appropriate surgical reduction and stabilization to allow fibrous healing of the L7-S1 junction, resulting in satisfactory neurological recovery.

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INTRODUCTION

Traumatic lumbosacral joint dislocation (TLSJD) without the typical short oblique vertebral body fracture seems to be a rare injury in dogs, as compared to the relative high incidence of vertebral fracture-luxations (VFL). In fact, VFL are one of the most common causes of neurologic injuries in small animal practice and they result, typically, after a major physical trauma, like a traffic injury (Jeffery, 2010). VFL represent 7% of all neurological disorders in dogs (Bali *et al.*, 2009), the lumbar area being the most common location, accounting the 39% of all vertebral lesions. In cats, a previous report describes two cases of TLSJD in polytrauma patients (Zulauf *et al.*, 2008). In dogs, 4 cases of luxation-subluxation are reported, without any description of radiological features, treatment and outcome (Zotti *et al.*, 2011).

In this report we described three cases of TLSJD without the typical short oblique vertebral body fracture in the dog, including surgical treatment and outcome.

Cases histories: Three crossbreed dogs with TLSJD were referred with a history of trauma by a local animal shelter to the Veterinary Teaching Hospital, Department of Veterinary Medicine and Animal Productions – University of Naples Federico II.

All dogs were non-ambulatory paraparetic and had back lumbar pain, with dorsally displaced spinous processes of L7 as compared to the level of the ilial wings; all of dogs had neurological signs consistent with a L6-S2 myelopathy. Radiographs documented cranio-ventral sacral displacement without a short oblique vertebral body fracture of the L7 vertebral body.

In each dog the dorso-ventral displacement (DVD) was measured as described by Lewis *et al.* (1989), pre- and postoperatively in latero-lateral radiograph projection for evaluating vertebral displacement and reduction (Lewis *et al.*, 1989). In all three dogs surgical treatment consisted of open reduction of the luxation and vertebral column stabilization.

Pre-and postoperative care: Preoperative analgesia was provided by intramuscular (IM) administration of methadone (Eptadone, L. Molteni & C. dei F.lli Alitti Società di Esercizio S.p.A., Fraz. Granatieri – Scandicci (FI), IT) at dose of 0.4 mg/kg. During the surgery, dogs received a loading dose (2 µg/kg, intravenously [IV]) of fentanyl (Fentanest, Pfizer Italia S.r.l., Latina, IT), followed by constant rate infusion (4–8 µg/kg/h, IV). From recovery time, postoperative analgesia was managed with methadone (0.4 mg/kg, IM) in the first 2 hours, followed by buprenorphine (Temgesic, SCHERING PLOUGH S.p.A., Segrate (MI), IT) (0.02–0.03 mg/kg, every 8h, IM) and concomitant nonsteroidal anti-inflammatory drug (NSAID) therapy with carprofen (Rimadyl: Pfizer Italia S.r.l., Latina, IT) (4 mg/kg, every 12h, IV). Analgesia after hospital discharge consisted of carprofen (2 mg/kg, every 24h, per *os*) for 7 days. Perioperative cefazolin (Cefazolina Teva: TEVA ITALIA S.r.l., Milano, IT) was administered (20 mg/kg, IV) 45 minutes before surgery. Intramuscular cefazolin was administered at the same dose every 12h during the first day of hospitalization; thereafter, home antibiotic therapy continued per *os* every 12h for 7 days. Ranitidine (Ranitidina Hex: HEXAL S.p.A., Agrate Brianza (MB), IT) (2 mg/kg SC or IM every 12h for 10 days) was given to prevent possible adverse reactions to NSAIDs.

Case 1**:** A 30kg crossbreed 9-year-old female dog was presented with non-ambulatory paraparesis, decreased left pelvic limb withdrawal reflex, and urinary and faecal incontinence. Deep pain sensation was preserved bilaterally. The measured DVD was 223%. Open reduction through a dorsal approach and percutaneous trans-ilial pinning as described by Di Dona *et al.* (2016) was performed (Di Dona *et al.*, 2016). The measured DVD on the post-operative radiographs was decreased to 36% (Fig. 1).

Faecal incontinence resolved within 72h, but a mild urinary incontinence persisted. Twenty-five days after surgery the dog's neurological status had deteriorated with hind limb proprioceptive deficits developing. Radiographic examination showed osteolysis at the level of pin-bone interface and implant instability occurred. Therefore, at 50 days after surgery, the implant was removed whereupon the dog's neurological status improved, and, within 10 days, the dog showed only a mild lameness on the left hind limb and a persisting minor urinary incontinence.

During a 7 months follow-up, there was marked further improvement of the neurological status; only a mild urinary incontinence was persisting, which was easily manageable.

Case 2 and 3**:** A 15 kg crossbreed 4-year-old male dog (Case 2) was presented with non-ambulatory paraparesis, decreased withdrawal reflex of both pelvic limbs and urinary and faecal incontinence. Deep pain sensation was preserved. The measured DVD was 215%.

A 20 kg crossbreed 4-year-old male dog (*Case 3)* was presented with severe lumbosacral pain, non-ambulatory paraparesis, and urinary and faecal incontinence. An inflammatory skin lesion was present in the dorsal lumbosacral area. The DVD measured was 294%. The surgical management of this dog was planned after the healing of the skin lesion, which occurred in 10 days.

Again, open reduction through a dorsal approach was performed. Two 1.6 mm Kirschner pins (Eickemeyer s.r.l, Via Giuseppe Verdi, 8, 65015 Montesilvano (PE), Italy) were placed through the caudal articular facets of L7 and the cranial articular facets of the sacrum up to the lateral cortical bone of the ileum. Four 1.6 mm Kirschner pins were driven into the body of the sixth and of the seventh vertebra through the origin of their transverse process, at an angle of inclination of 30° to the vertical axis and at angle of 45° from the horizontal axis. All pins were cut and bent to achieve maximum overlap. Forty grams of Polymethylmethacrylate (PMMA) (BIOCEMIUM I, Foschi s.r.l. – DEMAS, Via di Salone 132, 00131 Roma, Italy) were prepared and then applied dorsally to bond emergent parts of the pins, achieving joint stability. Muscular, subcutaneous and skin layers were closed in routine fashion the measured DVD on the post-operative radiographs was decreased to 6% (Fig. 2) and 8% (Fig. 3) for *Case 2* and *3* respectively.

In the *Case 2* the dog was able to ambulate within 24h after surgery, although a residual left hind limb paresis. Two weeks after surgery a low-grade lameness was still detectable and only a slight urinary incontinence was reported. Follow-up over 7 months showed the ambulatory deficit resolving within 90 days and the urinary incontinence gradually improving with a completely resolution at 5 months postoperatively. In *Case 3* the dog was able to stand and walk within 72h after surgery; faecal incontinence resolved within the first 72h; urinary incontinence was present during the first week after surgery. At the follow-up, 4 months after surgery, the dog had completely recovered neurologically, having regained normal motility in terms of ambulation, micturition and defecation.

DISCUSSION

To the author's knowledge this is the first clinical description of a case series of TLSJD in the dog. A bibliographic search yields only one description of TLSJD in two cats (Zulauf *et al.*, 2008). One other previous report describes briefly 4 dogs with L7-S1 luxation/subluxation, but, gives no further details on clinical or radiographic features nor were they treated surgically (Zotti *et al.*, 2011).

In human medicine, traumatic lumbosacral dislocation is a quite rare injury that involves luxation or fracture/ luxation of the L5-S1 articular facets (Davis Carragee, 1993; Ryan *et al.*,1993). In human patients, concurrent injuries are common and lumbosacral dislocation may go unrecognized in many cases (Guillamon *et al.*, 1985; Vialle *et al.*, 2004; Vialle *et al.*, 2007). The condition is usually treated surgically (Anderson *et al.*, 1997; Carlson *et al.*, 1999; Cruz-Conde *et al.*, 2003; Robertson *et al.*, 2005). Although this dislocation is the result of a high-energy trauma, the biomechanics of this injury, which involves disruption of soft tissues only, are still obscure (Ryan *et al.*, 1993; Beaver *et al.*, 1996; Vialle *et al.*, 2007). A combination of compression, lateral translation and rotational forces, rather than an isolated unidirectional force, may explain the lumbosacral injury (Vialle *et al.*, 2007).

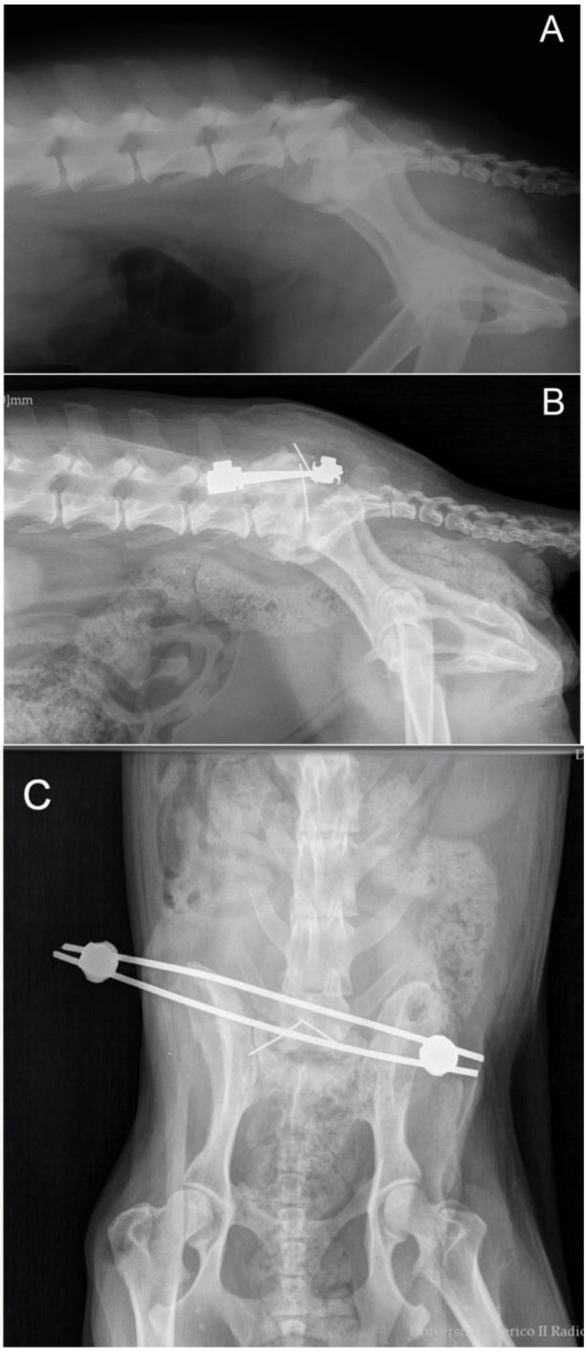

Fig. 1: Case 1 – A) Preoperative lateral radiographic projection of the lumbosacral joint showing L7-S1 dislocation and the ventral slippage of the sacrum; B) Postoperative lateral radiographic projection of the lumbosacral joint with transilial pinning implant in situ; C) Postoperative ventro dorsal projection 50 days follow-up, before implant remotion.

The biomechanics of TLSJD in animals are likely similar but have not been investigated. TLSJD is a rare injury compared to fracture/luxation of L7-S1 (Zotti *et al.*, 20011; Di Dona *et al.*, 2016). It seems that specific mechanical forces are required to cause this massive soft tissue injury without bony lesions. In the canine lumbosacral joint the supra and interspinous ligaments act as tension band between the spinous processes (Jeffery, 2010). It is possible that a single trauma severely hyper-extends L7-S1 causing disruption of these ligamentous structures with simultaneous shear and compression forces that cause ventral slipping of the sacrum, while the body and articular facets of L7 remain intact.

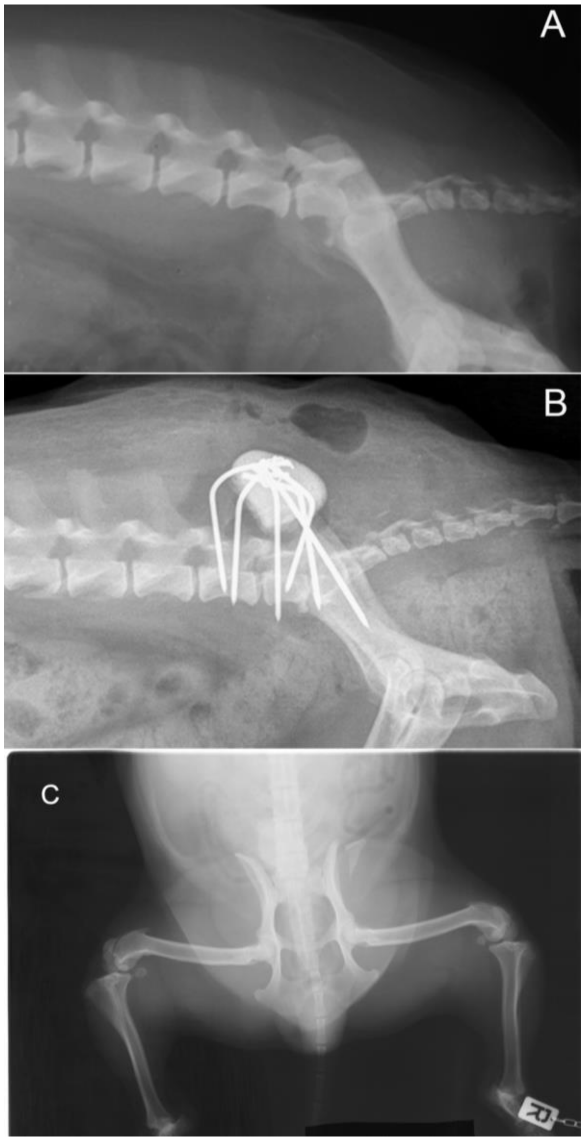

Fig. 2: Case 2 – A) Preoperative lateral radiographic projection of the lumbosacral joint showing L7-S1 dislocation and the ventral slippage of the sacrum; B) Postoperative lateral radiographic projection of the lumbosacral joint with pins and PMMA implant in situ; C) Preoperative ventrodorsal projection show a slight superimpression of L7-S1 joint and a partial fracture of the right iliac wing.

An anatomic classification of traumatic lumbosacral dislocation based on the injury pattern was proposed in humans. TLSJDs were classified in pure dislocation (Type I) and fracture dislocation (Type II). The type I can occur as unilateral rotatory dislocation of articular facets (Ia), bilateral dislocation with lateral displacement of facets (Ib) and bilateral dislocation of articular facets with anterior slippage of L5 vertebra (Ic). The type II can occur as unilateral articular facets fracture-dislocation (IIa), bilateral articular facets fracture-dislocation with anterior slippage (IIb) and with rotatory slippage (IIc) (Vialle *et al.,* 2007). The pattern of the lesion in our cases could be compared to the Anterior Type Ic pure dislocation. In fact, all three dogs showed a cranio-ventral sacrum slippage and intact articular facets at radiological and intraoperative direct inspection. The lack of cross-sectional images such as CT scan represent a diagnostic limit due to the impossibility to assess if the small bony fragments being a fracture of end plate of L7 or originate from Spondylosis Deformans.

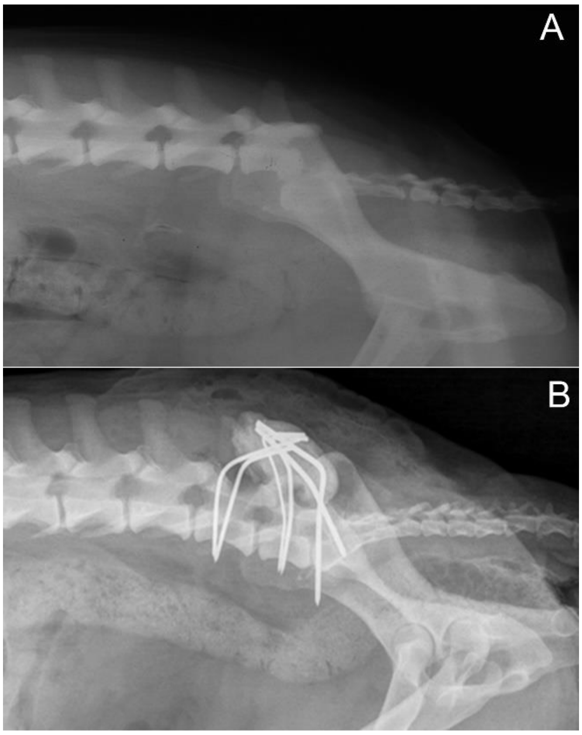

Fig. 3: Case 3 – A) Preoperative lateral radiographic projection of the lumbosacral joint showing L7-S1 dislocation and the ventral slippage of the sacrum; B) Postoperative lateral radiographic projection of the lumbosacral joint with pins and PMMA implant in situ.

Clinical diagnosis of LS trauma was based on the neurological examination, the evaluation of lumbar pain and the palpation of a dorsally displaced spinous process of L7. Radiographs were needed to establish the diagnosis of TLSJD. Despite the large degree of displacement in all three cases, neurological dysfunction was moderate and long-term neurological recovery after surgery was satisfactory throughout. Caudal lumbar lesions have usually a better neurological status at initial presentation as compared to more cranially located vertebral injuries (Beaver *et al.*, 1996). The neuro-anatomy of the lumbosacral area favours positive outcomes: the canine spinal cord terminates within the sixth lumbar vertebra; although the medullary cone and the nerves of the *cauda equina* are more resilient to trauma than the cord itself, they are still damaged by lumbosacral junction displacement (Barquet *et al.*, 1993; Beaver *et al.*, 1996). The neurological deficits are caused largely by the injury to the nerve roots inside the vertebral canal of the L7-S1 tract. Such traction or avulsion injury to the nerve roots likely results in functional deficits of the pudendus nerve and of the sacral plexus, innervating primarily anus, rectum and urinary bladder (Slocum *et al.*, 1998). As evidenced in all our cases, TLSJD as well causes sciatic nerve dysfunction with ambulatory deficits. These dysfunctions proved to be transient, resolving post-operatively over time. Thus, in our cases the follow-up showed a slow but consistent improvement of the clinical features. Each dog was able to stand and walk within a period between 24h and two weeks after surgery. Faecal incontinence resolved within 72h to two weeks in all of the dogs; while urinary incontinence gradually improved over time.

The aim of the surgical treatment in the dogs with a vertebral luxation such as TLSJD is to achieve vertebral reduction and stability for minimizing further neuronal damage and to allow recovery of the affected nerves. Different techniques have been described for the stabilization of fracture and luxation of the caudal lumbar spine (Shores *et al.*, 1989; Connolly *et al.*, 1992; Garcia *et al.*, 1994; Krauss *et al.*, 2012; Di Dona *et al.*, 2016). In case 1, we employed a percutaneous transilial pinning. This technique appeared not suitable for TLSJD treatment, because we experienced early implant loosening. Internal stabilization technique with pins and PMMA proved to provide more strength and stability and required minimal postoperative care. Since we experienced pin loosening with translation in case 1 (although without impaired long-term outcome), we treated the other two dogs with internal pins and PMMA fixation technique.

Postoperative biomechanics in cases of L7 vertebral body fracture are different as compared to TLSJD, because bony healing provides stabilization of the fractured site in a shorter time, as compared with the fibrous soft tissue healing required to permanently stabilize TLSJD injuries.

Conclusions: TLSJD seems a rare injury in dogs; being a soft tissue damage, it requires appropriate surgical reduction and stabilization as soon as possible after injury. This includes vertebral alignment and cemented internal pin fixation to allow neuronal recovery and fibrous healing of the L7-S1 junction. Prognosis is favorable for long-term outcome and for complete neuronal recovery.

Authors contribution: GDV, FdD, GF performed surgical procedure. GDV, GF, CC preparation and revision of the manuscript. GM performed imaging and interpretation of radiographs. BL, MPP FL contributed to the revision of the manuscript. All authors gave their final approval of the manuscript.

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