



# Recovery of bladder and bowel fullness sensation by nerve transfer in a canine decentralized bladder model



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## INTRODUCTION

**BACKGROUND:** In our previous work we confirmed the motor reinnervation of the decentralized canine bladder after nerve transfer<sup>1</sup>. Also observed full bladder and bowel sensation in the reinnervated animals<sup>2</sup>.

### OBJECTIVES:

The goal of this study is to determine whether these micturition and defecation postures are eliminated in decentralized animals. Awake cystometrograms were performed to confirm the functional micturition behaviour with full bladder. Assessment of sensory nerve reinnervation will also be performed by retrograde neurotracing techniques.

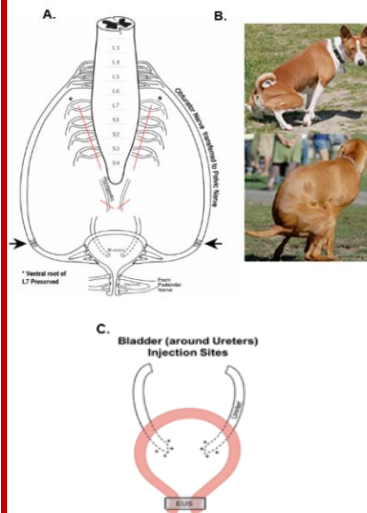
## REFERENCES

1. Gomez-Amaya, S.M., et al. J Urol. 2015. 193(3):1042-51.
2. Ruggieri MR, Sr., et al. J Urol. 2016. 195(4):e373.
3. Gomez-Amaya, S.M., et al. Anat Histol Embryol. 2015 Apr;44(2):118-27.

## ACKNOWLEDGEMENT

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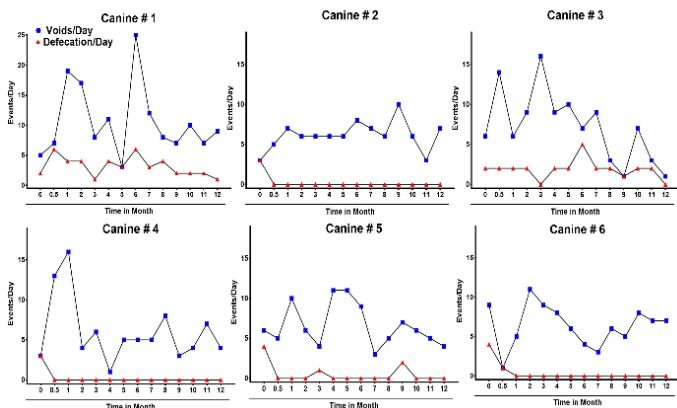
## METHODS



**Figure 1:** A) Surgical approach used for decentralization and reinnervation. B) Observation of micturition and defecation postures in canines pre-operatively (t=0 in figure 2) and at monthly intervals post-operatively (PO) via housing surveillance of housing cage. C) Cystoscopic injection of fluorogold at ureterovesical junction 3 weeks prior to euthanasia. Plus signs indicate the injection site.

## RESULTS

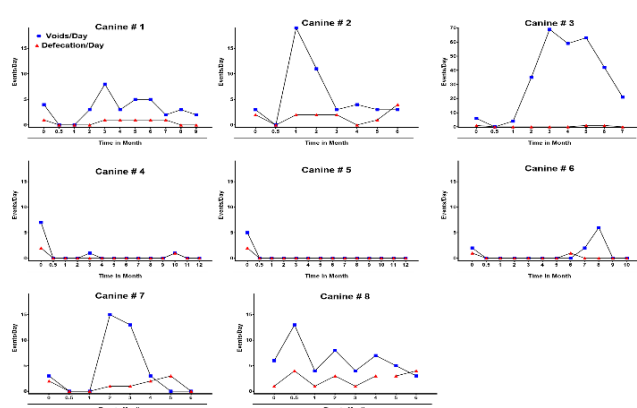
### A. L7 Dorsal Root Intact



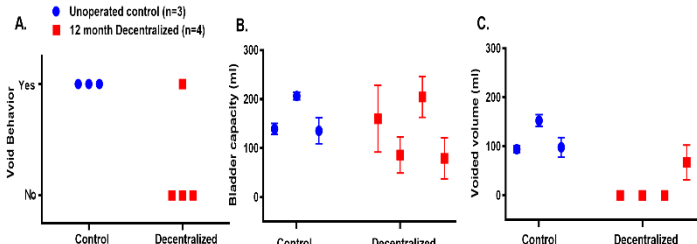
**Figure 2A:** We observed that all animals with intact L7 dorsal roots showed micturition postures, but, only 2 of these 6 animals (#1 and #3) showed defecation postures at each monthly observation period of 24 hours, from the 1st through the 12th postoperative month as shown.

- Urinalysis and cultures were performed in the remaining 5 of 8 animals (#4-8) with transected L7 dorsal root.
- Four of five animals (#4-7) showed microhematuria.
- Urinary tract infections resolved in all 4 animals following Enrofloxacin treatment.
- Micturition postures were not observed after resolution of urinary tract infections (#6 & #7).

### B. L7 Dorsal Root Transection

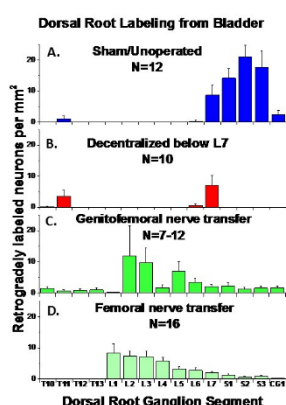


- **Figure 2B:** One of these 8 animals (#5) showed no micturition and defecation postures up to 12-month PO and one (#4) has shown 2 single incidences of micturition postures at 5th and 10th months PO and 1 incidence of defecation posture at 10th month.
- Two of the other 6 dogs (#7 and #6) started showing unusual postures (intermediate between micturition and defecation) at 2nd or 7th month PO. One of these two animals (#6) has shown one single incidence of defecation posture at 6th month PO.
- 3 of 4 animals that consistently showed micturition postures at monthly observation periods were euthanized at 8-9 months PO (#1, #2 and #3); the remaining one (#8) is still alive.
- 4 of 8 animals (#1, #2, #7 and #8) with the additional L7 dorsal root transection started showing defecation postures in the early post operative months.



- **Figure 3:** 4 of 8 decentralized and 3 unoperated animals were tested at weekly intervals for full bladder sensation (1 test/week for three successive weeks for individual animals).
- 1 of 4 decentralized animals showed voiding behavior in the recovery cage only once before the end of the 10 minute observation period (Figure 3A).
- All 3 unoperated control animals showed micturition postures within 3 minutes after removal of bladder catheter during each cystometry (Figure 3A).
- These 3 animals voided 67-74% of their cystometric bladder capacity (Figure 3B-3C).

- **Figure 4:** Substantial number of bladder sensory neuronal cell bodies in the L7 DRG was observed in Sham/Unoperated group and decentralized group without L7 transection (A-B).
- Reduced L7 DRG labelling was observed in nerve transfer groups (C-D).
- Substantial DRG labelling was observed in the L2-L5 level in genitofemoral nerve transfer group and in the L1-L4 level in the femoral nerve transfer groups (C-D).



## CONCLUSIONS

- More complete sensory decentralization achieved by including L7 dorsal root transection reduces the number of animals able to recover bladder and bowel fullness sensation (Figure 2B).
- Resolution of urinary tract infections (UTI) eliminated unusual postures in decentralized animals.
- Urination and defecation postures in animals not tested for UTIs may be the result of undetected UTIs, sensory nerve sprouting or variations in sacral sensory innervation<sup>3</sup>.
- Full bladder sensation observed functionally in unoperated animals (Figure 3A).
- L1-L5 DRG labelling results in the nerve transfer groups (Figure 4C-4D) strongly support that both bladder and bowel fullness sensation are transmitted through these new neuronal pathways established by the nerve transfer surgery.