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Palmar digital neurectomy with intra-osseous nerve transposition: technique and results

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INTRODUCTION
Palmar digital neurectomy for incurable foot pain in the horse has been practised using the guillotine method\(^1\) for over 100 years but it is associated with a significant complication rate. Painful neuroma formation is the complication considered to have the highest incidence which has been quoted at 6 to 60% of treated nerves\(^2,3,4\) followed by nerve regeneration\(^4\). Other complications are incomplete desensitisation and (less frequently) sloughing of the hoof wall, deep digital flexor tendon (DDFT) rupture and luxation of the distal interphalangeal joint. Painful neuroma formation and regeneration of the nerve are two complications that could be related to the surgical technique and there have been several studies on techniques that might affect their incidence. These include cryotherapy, electrosurgery, laser therapy, epineural capping, treatment with neurotoxins and suturing\(^5,6,7,8\), but the results have been unconvincing in the longer term and there are few large studies on the outcome of the different techniques. Observations during the Second World War that nerves buried in fractured bone seemed to be less prone to painful neuroma formation were confirmed using intraosseous nerve transposition in experimental dogs\(^9\). Lose and Hopkins described the use of this technique in 8 horses with no complications reported at an unspecified time postoperatively\(^2\); Harris and Kennedy treated 28 horses with the technique reporting no painful neuroma or nerve regeneration over a mean follow up of 39 months\(^10\). This presentation is a report on the outcome of palmar digital neurectomy with intraosseous nerve transposition in 18 horses.

MATERIALS AND METHODS
All the horses were presented for palmar digital neurectomy because of incurable foot pain that was abolished by palmar digital analgesia at the site of the proposed neurectomy. Surgery was performed with the horse in dorsal recumbency under general anaesthesia using standard aseptic technique. The long arm of an L shaped skin incision was made parallel to the abaxial border of the DDFT for the proximal 2/3rds of the pastern and was continued at right angles just distal to the fetlock. Having reflected the skin flap, an area was dissected clear of soft tissue on the abaxial border of the first phalanx (P1) palmar to the extensor branch of the suspensory ligament and dorsal to the neurovascular bundle; a hole 4.0mm was then drilled 3cm deep into the bone while angling the drill approximately 30\(^\circ\) distally. Approximately 4 cms of the palmar digital nerve were then dissected free of surrounding tissue as far proximally and distally as possible. The nerve was sectioned under tension at its distal extremity using a fresh scalpel and was then passed dorsally to the mouth of the drill hole by tunnelling under the neurovascular bundle. As much of the nerve as possible was then placed in the hole and retained in position by suturing the adjacent connective tissue over the hole. Sterile saline was used throughout the procedure to keep the tissues moist. Any smaller nerve branches were removed by sharp transaction. The incision was closed in two layers (subcuticular and skin) and covered with a protective bandage which included the solar surface of the foot. Postoperatively the horses were stable rested for 2 months before commencing work. Phenylbutazone was administered for the first 2 weeks (2.2 mg/kg bwt twice daily) and procaine penicillin on the day prior to and the day of surgery (15 mg/kg bwt i.m.). Follow up was carried out by telephoning the referring veterinary surgeon and owner. Horses were re-examined at the hospital if there were complications. Records were kept of the details of the horse, the duration and severity of the lameness, the diagnosis of the lameness, the number of nerves treated, complications, and duration of follow up. A comparison was made with the results of other reports in which electrocoagulation\(^3\), guillotine\(^3\) or laser\(^7\) were used to transect the palmar digital nerve. The results of this study were then combined with those of another report on palmar digital neurectomy with nerve transposition\(^10\) and the aggregate compared with the other 3 methods. The rates of painful neuroma and reinnervation as well as the proportions sound in each treatment group were compared between groups using Yates corrected chi squared test or Fishers exact test where numbers of expected animals in one sub-group were less than 5.

RESULTS
The 18 horses treated included 7 thoroughbreds, 6 warm bloods, 2 polo ponies, 1 standardbreds, 1 thoroughbred and 1 anglo arab. There were 17 geldings and 2 mares and limbs treated included 8 forelimbs bilaterally, 5 left fore, 5 right fore and 1 right hind involving 53 nerves. Median duration of lameness was 12 months, me-
dian grade of lameness was 3/10. Causes of lameness were palmar foot pain and navicular syndrome (12), traumatic injury (3), neuroma from previous neurectomy (2), osteoarthritis of the distal interphalangeal joint (1). Median time to follow up was 24 months (more than 12 months in all but one horse). Follow up information was obtained on all horses and 14 returned to full use. Nerve regeneration occurred in 2 horses and painful neuroma in 1 horse which was re-operated and was sound 3 years later. The results of the 5 reports analysed are summarised in table 1. In this report on the nerve transposition technique the statistical power of the case numbers was too low for comparison with other techniques. When combining the cases with the other report on nerve transposition10 and comparing them with the electrocoagulation technique there was a significantly lower incidence of reinnervation (p=0.001) and a higher rate of soundness (p=0.02) following nerve transposition. When comparing them with the guillotine technique the incidence of reinnervation was also significantly lower (p=0.02). None of the differences in painful neuroma incidence were significantly different. There was no statistical difference between the outcome of laser treatment and any of the other techniques.

DISCUSSION

An improvement in the relatively high complication rate for palmar digital neurectomy in horses would be a valuable contribution to equine surgery. The nerve transposition technique appears to have potential. While this study shows a significant improvement in soundness outcome and reinnervation rate compared with the electrocoagulation and guillotine techniques, higher case numbers are needed for confident comparisons. The author was unable to find any other reports with large enough case numbers and long enough postoperative duration that would permit significant comparison.

ACKNOWLEDGEMENTS

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<th>Incidence reinnervation</th>
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