Veterinary Surgery, 22, 4, 285–288, 1993

Palmar Digital Neurectomy in Horses
57 Cases (1984–1990)

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The medical records of 57 horses that had palmar digital neurectomy performed between 1984 and 1990 were reviewed. Neurectomies were performed either by transection and electrocoagulation (47 horses) or by the guillotine technique (10 horses). Middle-aged geldings, Quarter Horses, and Thoroughbreds were significantly over-represented when compared with the hospital population. Horses used as hunter/jumpers also appeared to be over-represented. Complications occurred in 17 (34%) of the 50 horses for which follow-up information was obtained. Recurrence of heel pain was the most common complication (14 horses). Palpable painful neuromas were detected in three horses. One year after neurectomy, 74% of the horses were sound; this decreased to 63% after 2 years.

PALMAR DIGITAL NEURECTOMY has been performed in horses for more than a century to alleviate heel pain.[1] The most common indication for palmar digital neurectomy is navicular disease that is not responsive to corrective shoeing and medical therapy.[2,3] However, it is also used in horses with fractures of the distal phalanx, calcification of the collateral cartilages of the distal phalanx and fracture of the navicular bone.[2–4] Palmar digital neurectomy is considered a palliative procedure because it only alleviates the associated pain and does not alter the progression of the pathologic condition.

Many different methods of palmar digital neurectomy have been described, and these techniques can be separated into three general categories. The first category involves application of a chemical or physical irritant to the nerve that results in interruption of the transmission of nervous impulses; no transection of the nerve is performed. The second category of neurectomy involves a clean, sharp surgical transection (guillotine technique) of the nerve and a segment of the nerve is usually removed. The third category also involves surgical transection of the nerve but additional procedures are performed on the proximal nerve stump to reduce complications associated with neurectomy. These additional procedures include epineural capping, electrocoagulation, freezing, capping the nerve stump with exogenous material, injection of the proximal nerve stump with a neurotoxin, and suturing or incomplete transection of the proximal nerve stump.[5–10]

Reported complications of palmar digital neurectomy include painful neuroma formation, regeneration of the nerves (reinnervation), incomplete desensitization of the heel, rupture of the deep digital flexor tendon, sloughing of the hoof wall, and subluxation or luxation of the distal interphalangeal joint.[2–11] In horses, the most commonly reported complication after palmar digital neurectomy is painful neuroma formation.[3]

There are few clinical studies in horses that have characterized the success rate and frequency of complications associated with palmar digital neurectomy. This study identified complications associated with palmar digital neurectomy and the frequency of occurrence of these complications, and determined the long-term success rate of palmar digital neurectomies using either the transection and electrocoagulation, or guillotine technique in horses.

Materials and Methods

The medical records of all horses admitted to the University of Georgia for palmar digital neurectomy between February 1984 and February 1990 were retrieved and reviewed. The criteria for inclusion of a horse in this study was that a neurectomy of the palmar digital nerves had been performed on either one or both forefeet because of

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Presented at the 1991 Veterinary Orthopedic Society Meeting, Snow Mass, Colorado.
No reprints available.

persistent lameness. A lameness evaluation was performed on all horses[12] and the severity of lameness greatly improved (> 90%) after desensitization of the palmar digital nerves with local anesthesia. Most horses had radiographs of both front feet taken before surgery. Navicular bone alterations, when present radiographically, were classified as mild, moderate, or severe. An increase in the size and number of nutrient foramina along the distal border of the navicular bone was classified as a mild change. Sclerosis of the medullary cavity, marked changes in the nutrient foramina, and osteophyte production of the navicular bone extremities were classified as moderate changes. Erosion of the flexor cortex, cystic lesions, and fracture or gross remodeling of the navicular bone were classified as severe changes.

Neurectomy was performed using either the guillotine method or the transection and electrocoagulation technique. Most horses were administered antimicrobials and phenylbutazone perioperatively. Surgery was performed under general anesthesia, and the surgical approach to the palmar digital nerves was identical for both neurectomy techniques. A 3 to 4 cm longitudinal skin incision was made on the palmar aspect of the middle to distal pastern region just abaxial to the deep digital flexor tendon. The palmar digital nerve was carefully dissected from surrounding tissues and was then sharply transected with a scalpel blade at the distal end of the incision. A hemostat placed on the proximal nerve stump was used to apply distal traction to expose approximately 4 to 6 cm of the palmar digital nerve.

For the guillotine method, the nerve was transected sharply with a scalpel blade at the proximal aspect of the incision. When electrocoagulation was used, another hemostat was used to grasp the nerve at its proximal aspect once a section of nerve had been removed. The electrocautery unit was applied to the hemostat and the nerve was coagulated until a yellow discoloration was seen. Care was taken to avoid touching the nerve or hemostat to the skin during coagulation. After coagulation, the nerve was sharply transected proximal to the hemostat with a scalpel blade leaving approximately 0.5 cm of the remaining coagulated nerve stump. Once transected, the nerve almost always retracted proximal to the incision. The subcutaneous tissue was sutured with absorbable suture in a simple continuous pattern. Nonabsorbable suture was used to appose the skin in a simple interrupted pattern. Pressure bandages were applied to the distal limbs and were changed every 2 to 4 days for 2 to 3 weeks. The skin sutures were removed in 14 days and all horses were confined to stalls for 3 to 10 weeks after surgery. Most horses had corrective shoeing performed sometime after suture removal but before return to exercise. After stall confinement, an exercise regimen considered normal for the horse was resumed.

Data retrieved from the medical records included the age, sex, breed, and occupation of the horse before surgery, the duration and severity of lameness, the type of conservative therapy attempted before surgery, the radiographic findings, the surgical technique used, the type of aftercare, and any early complications that occurred after surgery. Horses were categorized into six groups by age: < 2 years, 2–3 years, 4–6 years, 7–10 years, 11–15 years, and > 15 years. The long-term outcome (> 18 months) was derived by asking the owners or trainers a series of questions to determine their satisfaction with the horse's gait and ability to perform. Complications were determined by conversation with the attending veterinarians or reevaluation of the horse at the University hospital. Comparisons of age, breed, and sex were made between the horses in this study and the hospital population during the same period, using chi-square analysis. Relationships between the severity of lameness and the radiographic changes, the severity of lameness and the outcome, and the severity of radiographic changes and the outcome were made with the Kruskal-Wallis H-test for a completely randomized design. Results were expressed as the mean ± standard deviation or the median with a range. Significance was set at $p \leq .05$ for all comparisons.

Results

The horses in this study were affected with navicular disease (or navicular syndrome; 53 horses), calcification of the collateral cartilage of the third phalanx (one horse), fracture of the navicular bone (one horse), degenerative joint disease of the distal interphalangeal joint (one horse) and fracture of the wing of the third phalanx (one horse) as determined by physical examination, lameness examination, regional anesthesia, and radiographs. Palmar digital neurectomy was performed on 210 nerves in 57 horses. The mean age of the horses in this study was 10.4 ± 4.0 years (range, 3 to 21 yr). Horses 7 to 15 years of age (77%) were significantly over-represented and horses < 7 years of age (4%) were under-represented compared with the hospital population ($\chi^2 = 55.8$, $p = .0001$). The frequency of Quarter Horses and Thoroughbreds undergoing a neurectomy was over-represented and nearly twice as high as the hospital population, whereas Arabians and Tennessee Walking Horses were under-represented since they were absent from the study ($\chi^2 = 35.8$, $p = .0001$). Geldings were significantly over-represented compared with the hospital population (86% vs. 34%; $\chi^2 = 67.6$, $p = .0001$).

Hunter/jumpers comprised the majority of horses undergoing neurectomy. Twenty-six (46%) of the 57 horses were used as hunter/jumpers, 11 (19%) were used for showing, four horses were used for pleasure riding, three horses were used for dressage, three horses were used for cutting, and two horses were broodmares. The primary

use of four horses was unknown and one horse each was used for barrel racing, schooling, trail riding, and as a blood donor.

The duration of lameness before neurectomy ranged from 1 month to 10 years with a median duration of 12 months and mean duration of lameness of 18.5 months. Forty-nine (86%) of the 57 horses had a grade 2/5 or 3/5 lameness, with approximately equal numbers in each group. Based on the information available, conservative therapy had been attempted in 54 of 55 horses. The most common treatments included corrective shoeing, isoxsuprine hydrochloride, and phenylbutazone.

Radiographs of the affected digit(s) were obtained in 53 horses. Forty-five horses (85%) had radiographic changes in their navicular bones, whereas five horses had no radiographic abnormalities. One horse had evidence of calcification of the collateral cartilage of the third phalanx, one horse had a wing fracture of the distal phalanx and one horse had degenerative joint disease of the distal interphalangeal joint. Of the 45 horses with radiographic abnormalities of the navicular bone, 44% were classified as mild, 25% as moderate, and 31% as severe changes. There was no correlation between the severity of the radiographic findings and the degree of lameness, and neither the severity of lameness or the radiographic abnormalities correlated with the outcome.

The transection and electrocoagulation technique for neurectomy was used in 46 horses and the guillotine method was used in 10 horses. One horse had electrocoagulation performed on the palmar digital nerves of one limb and the guillotine method used on the contralateral limb. The selection of the surgical technique was dependent on the surgeon's preference. The duration of stall rest varied; 18% of the horses were confined for less than 4 weeks, 56% were confined for 4 to 6 weeks and 26% were confined for more than 6 weeks.

Long-term followup (> 18 months) was obtained for 50 of the 57 horses (42 horses with the electrocoagulation technique; 8 horses with the guillotine technique). Complications occurred in 17 horses (34%), of which 13 (76%) occurred within 1 year of surgery. Horses defined as having complications were reexamined at the University (n = 12) or were examined by other veterinarians (n = 5). The type of complication was determined from the horse's medical record. Painful neuromas were detected by a combination of palpation and local anesthesia in three horses (6%). All of these horses had the neurectomy procedure performed by electrocoagulation and all of the neuromas occurred within 7 months of surgery. One horse that developed a painful neuroma had a neurectomy procedure repeated twice because of development of subsequent neuromas of the same nerve. Two months after the third surgery, this horse ruptured the deep digital flexor tendon on this limb, with subsequent subluxation of the distal interphalangeal joint, and was euthanatized.

Recurrence of heel pain, which was defined as a detectable lameness that was alleviated by local anesthesia of the palmar digital nerves but no presence of painful neuromas on palpation, was found in the remaining 14 horses (28%). Of these horses, 10 were lame within 1 year, two horses became lame between 1 and 2 years and the remaining two horses became lame at 4 and 5 years. Eleven of these horses had the transection and electrocoagulation neurectomy, two horses had the guillotine neurectomy and one horse had the guillotine technique performed on one foot and electrocoagulation performed on the other foot.

The duration of follow-up for 50 horses ranged from 18 to 78 months (median, 48.5 months; mean, 44.6 months). Thirty-three horses were sound (66%), nine horses were being used but were lame because of pain in their heels (18%) and seven horses were retired because of persistent heel pain (14%). Thirty-seven of 50 horses (74%) were sound at 1 year, whereas 29 of 46 horses (63%) were sound at 2 years. One horse, described above, was euthanatized because of a complication associated with the neurectomy procedure. Seven of the nine lame horses still being ridden were considered greatly improved after surgery despite being slightly lame. Of the 50 owners contacted, 32% stated that they were very pleased with the final outcome, 46% were pleased, whereas 22% were disappointed with the long-term results.

Discussion

Palmar heel pain is a common cause of lameness in horses and is often refractory to conservative therapy. In an attempt to maintain horses with palmar heel pain as athletes, palmar digital neurectomies are performed. The possible complications of neurectomy and their frequency of occurrence are important considerations when deciding whether to perform this procedure. Previously, development of painful neuromas was the most common complication occurring after neurectomy.[3] However, in our study recurrence of heel pain appeared to be a more common complication than painful neuroma formation (28% vs. 6%).

Many different techniques for manipulating the proximal nerve segment have been developed to reduce or eliminate the complications associated with neurectomy. Most of these surgical techniques are intended to interfere with axon sprouting and thus prevent painful neuroma formation. The complications in the present study were related to recurrence of heel pain and painful neuroma formation. Unfortunately, as few of the horses with complications had repeat surgery, the exact reason(s) for the recurrence of heel pain could not be definitively determined. Possible explanations for recurrence of heel pain include: 1) incomplete desensitization of the heel related to an aberrant branch of the nerve that was not removed;

2) presence of a painful neuroma not detectable by palpation but still causing pain; and 3) regrowth of the nerves or reinnervation of the heel region. Peripheral nerves have tremendous regenerative capabilities, making it plausible that with time reinnervation of the heel region may occur in some neurectomized horses. This may explain why heel pain recurred in the majority of horses without palpable sensitivity over the previous surgical site. The two ends of the nerve may reunite, but axons sprouting from the proximal nerve stump may anastomose with other local nerve branches causing reinnervation of the heel region. Conversely, these horses may have developed painful neuromas that were not detected with digital palpation. However, because most transected nerves form neuromas, it is difficult to diagnose a painful neuroma without some pain evident on deep palpation of the nerve.

The percentage of horses that became sound after palmar digital neurectomy in the present study compared favorably with previously reported outcomes.[13–15] Seventy-four percent of the horses treated in the present study were sound 1 year after surgery and 63% were sound after 2 years. In one study, 68% of the horses were sound 1 year after surgery but this decreased to 59% and 57% at 2 and 3 years, respectively.[13] Another study reported an 81% successful outcome 1 year after surgery.[14] A third study stated that 67% of the horses were sound after 1 year while only 40% continued to be sound after 2 years.[15] These reports suggest that the success rate after palmar digital neurectomy decreases with time, possibly due to the regenerative capabilities of the palmar digital nerve or the chronic progression of navicular disease that occurs in most affected horses. In the study reported here, most horses that developed complications were either retired, used sparingly with concurrent phenylbutazone administration, had the neurectomy repeated, or the lameness was tolerated.

It was not surprising that Quarter Horses and Thoroughbreds were over-represented, or that middle-aged horses and geldings were the primary population in which palmar digital neurectomy was performed. These breeds historically exhibit more problems with heel pain and the surgical procedure is often performed to salvage these horses as athletes. The high prevalence of hunter/jumpers in this study population suggests that there may be a strong predisposition for the development of palmar heel pain in horses used for this activity. More than 45% of the horses in this study were classified as hunter/jumpers, which contrasts with the estimated 15% that this activity group comprises of the overall hospital population. Additionally, no correlations were detected between the severity of the radiographic findings and the severity of lameness, the radiographic abnormalities and the outcome of the horse, or the severity of the lameness and the final soundness of the horse. Conversely, there was no evidence to suggest that horses with severe radiographic abnormalities of their navicular bones should not be considered as candidates for palmar digital neurectomy.

In this study, the relationship between the degree of soundness and the level of owner satisfaction after palmar digital neurectomy were comparable to previous studies. The complications after neurectomy were mostly related to continued heel pain or recurrence of heel pain that may have been related to neuroma formation or possibly to regeneration of the palmar digital nerves. Future efforts should address different surgical techniques for neurectomy to identify if a superior technique exists. A large prospective study evaluating several different neurectomy techniques is necessary to determine advantages and disadvantages of each technique. Unfortunately, the small number of horses in which the guillotine method of neurectomy was used in this study precludes accurate comparison with those horses that had the transection and electrocoagulation technique. Histologic studies of nerves in horses with complications (recurrence of heel pain) may help further characterize the specific type of complication that develops.

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