

Pedal bone rotation as a prognostic sign in laminitis of horses

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SUMMARY

We reviewed 91 cases of laminitis in horses admitted to the Michigan State University Veterinary Clinical Center between Jan 1, 1973 and Dec. 30, 1978. From information in the case records and from the results of a telephone questionnaire, cases were classified into 4 categories on the basis of return to athletic function. The degree of pedal bone rotation was inversely correlated with return to athletic performance. Horses with less than 5.5 degrees rotation returned to former athletic function, whereas horses with more than 11.5 degrees rotation lost their use as performance animals. Ponies had significantly more pedal bone rotation, when compared with horses.

IN THE HORSE, acute laminitis of 10 or more days' duration, cracks in the coronary band, rotation of the pedal bone, and septic laminitis are suggested indicators of an unfavorable prognosis,^{1,2} but none of these factors has been correlated with the horse's subsequent athletic ability. Pedal bone rotation is one of the easiest of these factors for the practitioner to quantitate. For that reason, we chose to investigate the relationship between the degree of pedal bone rotation and the return of athletic function. Our objective was to devise specific prognostic criteria for determination of the performance abilities of a horse affected with laminitis.

Materials and Methods

Review of Medical Records—We retrieved the medical records of horses with laminitis from hospital files at Michigan State University's Veterinary Clinical Center. The period of review was January 1973 through December 1978. The diagnosis was established from information in each case record and from accompanying radiographic findings. The criteria for utilization of a case in the study were: (1) radiographs of the digits were adequate for determination of hoof angles and position of the 3rd phalanx within the hoof; (2) the medical record included diagnosis, treatment, and progress of the case; (3) the horse did not die or was not euthanatized for reasons other than laminitis; and (4) the owner(s) of the horse was contacted and information on the horse's subsequent performance was obtained. Information requested from owners included

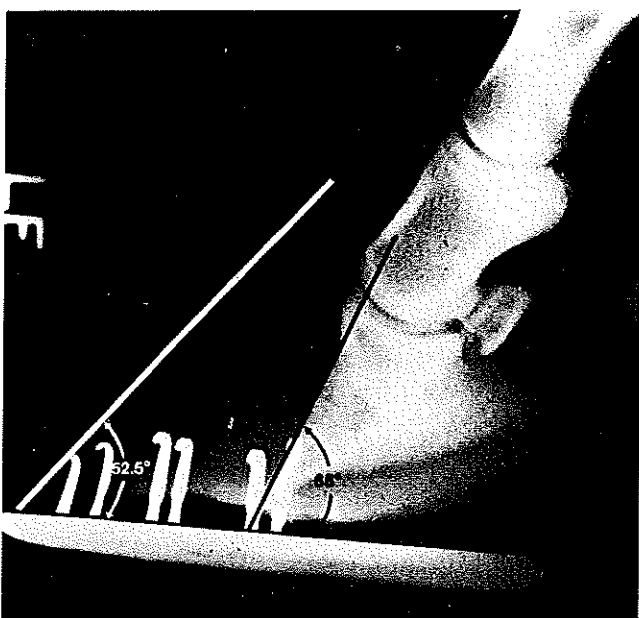
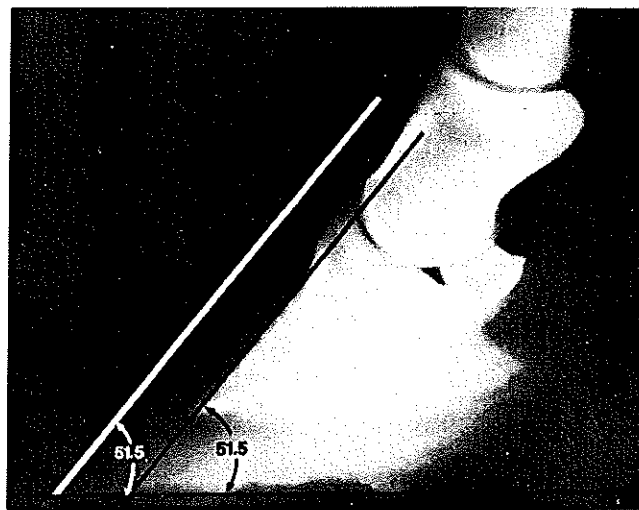


Fig 1 Top—Lateral radiograph of normal equine digit, showing that the angle of the 3rd phalanx and hoof angle are the same, with no pedal rotation. Angle of the 3rd phalanx is 51.5 degrees and the hoof angle is 51.5 degrees; thus, rotation is 0 degrees.

Bottom—Lateral radiograph of equine digit, showing rotation of the 3rd phalanx. Subtraction of the hoof angle (52.5 degrees), shown by white vertical line and horizontal black line, from the angle of 3rd phalanx (68 degrees), shown by the vertical and horizontal black lines, gives the amount of pedal bone rotation (15.5 degrees).

any additional treatment regimens, use of the horse before the laminitis developed, and appraisal of function the horse retained after the laminitis was treated.

Determination of Pedal Rotation—Pedal rotation was determined from radiographs (Fig 1). The hoof angle was determined from the intersection of a line drawn parallel to

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the palmar or plantar aspect of the hoof and a line drawn parallel to the cranial aspect of the hoof wall. The angle of the 3rd phalanx was formed by the intersection of lines drawn parallel to the anterior aspect of the 3rd phalanx and the palmar or plantar aspect of the hoof wall. The degree of rotation was obtained by subtraction of the hoof angle from the angle of the 3rd phalanx. In cases with sequential radiographic examinations and when 1 digit was more severely affected than another, the greatest measurement of pedal bone rotation was used.

Classification of Usefulness—All horses were categorized into 4 groups (I–IV), on the basis of subjective appraisal of return to function after the laminitis had been treated. Group I consisted of horses able to return to former athletic capacity; group II included horses that could still perform in an athletic capacity, but not as well as before contracting laminitis; group III included horses with persistent lameness such that they never regained soundness sufficient for performance use; and group IV was comprised of horses that were euthanatized because of laminitis.

The degree of pedal bone rotation of each functional group was compared by 1-way analysis of variance, with the differences between groups evaluated by use of the Student-Newman-Keuls procedure.³ The same analysis was used to evaluate the effect of breed and sex on pedal bone rotation. The significance value for all tests was $P=0.05$.

Results

Of the 114 cases of laminitis available from the period of review, only 91 met the criteria established for this study. The predominant breeds were Quarter Horse (22), Arabian (14), Thoroughbred (13), Standardbred (11), and Morgan (7). There were 47 mares, 30 stallions, and 14 geldings.

Pedal bone rotation ranged from 0 to 44.5 degrees, with a mean of $10.52 \pm (\text{SEM}) 0.86$ degrees and with $>75\%$ of the horses having ≤ 15 degrees of rotation. The mean (\pm SEM) degree of rotation for each breed was: Quarter Horse, 10.61 ± 2.18 ; Arabian, 10.96 ± 1.39 ; Thoroughbred, 11.88 ± 1.74 ; Standardbred, 7.73 ± 2.01 ; Morgan, 12.64 ± 4.66 ; and the remaining breeds, 10.08 ± 1.66 . There was no significant difference in the degree of rotation of each breed, and there was no significant difference in the degree of pedal bone rotation among geldings, stallions, or mares.

Because of the variability in signs of laminitis and types of therapy, these factors could not be examined independently as factors in pedal bone rotation.

There were 30 horses in group I, 10 in group II, 18 in group III, and 33 in group IV. Figure 2 is a scattergram showing the degree of pedal bone rotation of the horses in each group. Multiple comparisons of the degree of rotation among groups showed that group I had significantly less rotation than all other groups, whereas group II had significantly less rotation than group IV. In group IV, some horses were euthanatized for humane or economic reasons before pedal bone rotation could develop. To eliminate this variable (early euthanasia) and to allow a more accurate assessment of the effects of pedal bone rotation on return to performance capability, the analysis of variance was repeated without group IV

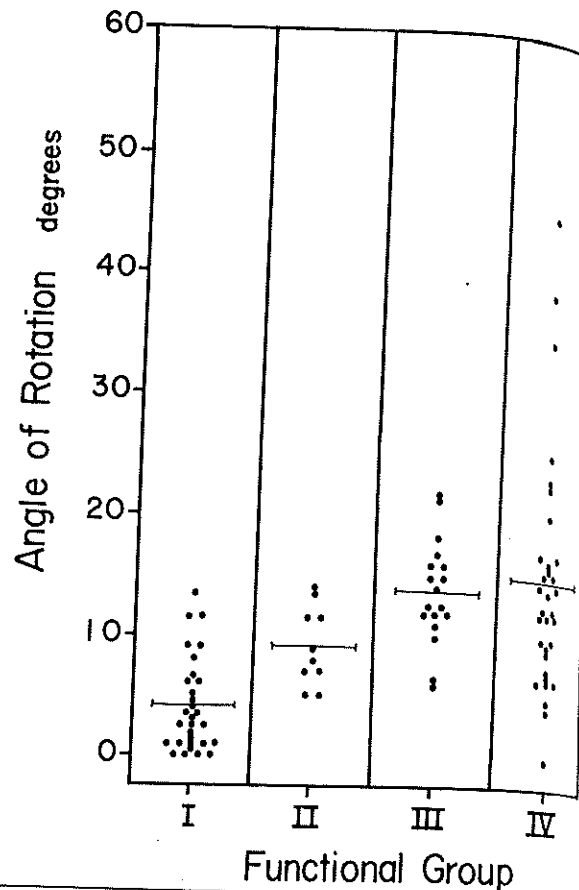


Fig 2—Scattergram showing the amount of pedal bone rotation in horses with laminitis. The horses were categorized according to return to athletic capabilities (functional groups). Group I = return to performance capabilities equal to status before contracting laminitis; group II = performed well, but not as well as before contracting laminitis; group III = persistent lameness such that soundness sufficient for performance use was never regained; group IV = euthanatized because of laminitis. Each case is represented by a dot, with the mean angle of pedal bone rotation of each group depicted by a bar.

horses. Multiple comparisons of the degree of pedal bone rotation in the remaining groups showed significant differences between groups I and II and between groups II and III. This analysis demonstrated the negative correlation between the degree of rotation and athletic capabilities.

Although there were insufficient horses of any breed for statistical comparison of the degree of pedal bone rotation of each functional group, a similar trend was found when breeds were examined independently.

Discussion

This study demonstrated that there is an inverse relationship between the degree of rotation of the 3rd phalanx and the ability of the horse to return to athletic function. In order to be able to use pedal bone rotation to provide a prognosis, we calculated the 95% confidence limits of each group. Means and 95% confidence intervals are shown in Figure 3. This analysis shows that: (1) horses with pedal bone rotation ≤ 5.5 degrees would have a favorable prognosis for athletic use, (2) horses with a rotation of

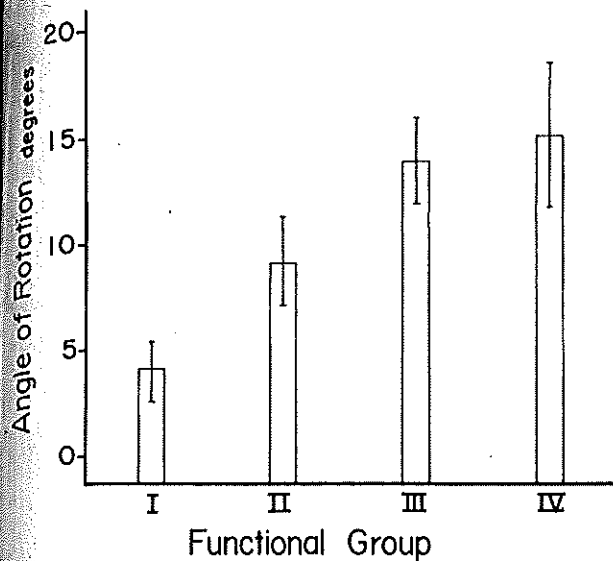


Fig 3—Mean and 95% confidence limits for the amount of pedal bone rotation, by functional group. Group I = return to performance capabilities equal to status before contracting laminitis; group II = performed well, but not as well as before contracting laminitis; group III = persistent lameness such that soundness sufficient for performance use was never regained; group IV = euthanatized because of laminitis.

between 6.8 and 11.5 degrees would have a guarded prognosis, and (3) horses with a rotation ≥ 11.5 degrees would have an unfavorable prognosis for return to performance capabilities and may be used for breeding (group III), provided they do not have to be euthanatized as a result of pain (group IV).

Because there was no significant difference in pedal bone rotation between sexes or breeds and because all ages and types of performance uses (eg, show and racing) were included in the analysis of data, it is our opinion that prognosis for return to athletic function can be determined from the degree of pedal bone rotation regardless of the age, sex, breed, or use of the horse.

Because of the great variation in therapy and

individual response of a given animal to that therapy, the final outcome of a case may not depend solely on the amount of pedal bone rotation. For example, 3 horses in group IV had pedal rotation < 5.5 degrees (the upper limit of the confidence interval of group I) but were euthanatized because of inability of therapy to control pain from laminitis. This suggests that while pedal bone rotation is a useful prognostic indicator in laminitis, the control of pain is also a major determinant of the outcome of the case.

It has been suggested that horses are more likely to be crippled by laminitis than are ponies.⁴ However, when ponies were added to this study (n=7), they were all in group IV, having a significantly greater degree of pedal bone rotation (mean, 24.57 ± 5.67 degrees) than horses. While this greater pedal rotation in ponies suggests they are more likely than horses to be crippled by laminitis, it is possible that the greater financial value of horses, as compared with ponies, may have made horse owners seek medical attention following the 1st attack of laminitis whereas pony owners may not have sought medical attention until the pony was crippled. It also is possible that the pony's propensity for obesity and recurrence of acute episodes of laminitis results in excessive pedal bone rotation, which makes euthanasia necessary.

This study was an attempt to establish an easily measured objective criterion for determination of prognosis in a horse with laminitis. It provides a basis for evaluation of a given case so that appropriate therapy can be chosen in accordance with the expected future athletic performance of the animal.

References

1. Adams OR: *Lameness in horses*, ed 3. Philadelphia, Lea & Febiger, 1976, pp 247-260.
2. Coffman JR, Garner HE, Hohn AW, et al: Characterization of refractory laminitis, in *Proceedings 18th Annu Meet, Am Assoc Equine Pract*, pp 351-358, 1972.
3. Steel RGD, Torrie JH: *Principles and procedures of statistics*. New York, McGraw-Hill Book Co, 1960.
4. Garner HE: Update on equine laminitis. *Vet Clin North Am [Large Anim Pract]* 1:25-32, 1980.

Luteolysis in mares after endometrial biopsy

The length of diestrus was not changed in 4 mares by taking endometrial biopsy specimens during estrus. In contrast, taking endometrial biopsy specimens on postovulation day 4 induced premature luteolysis and significantly reduced the length of diestrus. A concurrent decrease in serum progesterone occurred to verify the premature luteolysis in these mares. Bacterial cultures of endometrial swab samples from these mares were negative for growth at the 1st estrus before and after the last biopsy procedures, indicating that luteolysis was induced by the biopsy procedure and was not due to uterine infection. Seemingly, infusion of antibiotic solution after endometrial biopsy on postovulation day 4 prevented premature luteolysis.—C. B. Baker, D. I. Newton, E. C. Mather, et al in *Am J Vet Res*, 42, No. 10, (Oct 1981): 1,816.