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TYPE:	Article CC:CCL
JOURNAL TITLE:	Veterinary surgery
USER JOURNAL TITLE:	Veterinary surgery
ARTICLE TITLE:	Effect of betamethasone and exercise on equine carpal joints with osteochondral fragments
ARTICLE AUTHOR:	Foland JW, McIlwraith CW, Trotter GW, Powers BE, L
VOLUME:	23
ISSUE:	5
MONTH:	Sep-Oct
YEAR:	1994
PAGES:	369-376
ISSN:	0161-3499
OCLC #:	3905443

Processed by RapidX: 4/20/2015 4:33:28 PM

Veterinary Surgery
23:369-376, 1994

Effect of Betamethasone and Exercise on Equine Carpal Joints With Osteochondral Fragments

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Osteochondral fragments were created arthroscopically on the distal aspect of both radial carpal bones in 12 horses. On day 14 after surgery, one middle carpal joint of each horse was injected with 2.5 mL Betavet Soluspan (3.9 mg betamethasone sodium phosphate and 12 mg betamethasone acetate per milliliter) and the contralateral joint was injected with 2.5 mL saline as a control. Intra-articular treatments were repeated on day 35. On day 17, six horses began exercising 5 days per week on a high-speed treadmill. The other six horses were kept in box stalls throughout the study as nonexercised controls. On day 56, all horses were examined clinically and radiographically and then were euthanatized. Samples were obtained for histological, histochemical, and biochemical evaluation. Mild lameness was observed in five of the six exercised horses at day 56; four horses were lame in the control limb and one horse was lame in the treated limb. Of the five nonexercised horses evaluated for lameness, two were lame in the control limb, two were lame in the treated limb, and one was lame in both the control and the treated limb. No differences were noted on radiographs or palpation of steroid treated limbs versus control limbs. Firm reattachment of the osteochondral fragment to the radial carpal bone occurred in all but three joints. Gross cartilage damage was not different between steroid-treated joints and joints injected with saline. Histologically, there were no significant detrimental effects of betamethasone with or without exercise, but there was a tendency for more pathological change in treated joints. There was a trend toward decreased glycosaminoglycan staining in steroid treated joints of rested horses, whereas exercised horses had similar glycosaminoglycan staining in treated and control joints. No significant difference in the water content or uronic acid concentration was detected between treated and control joints. Intra-articular betamethasone administration in this carpal chip model was not associated with any significant detrimental effects in either rested or exercised horses.

LAMENESS IS AN IMPORTANT problem in the equine athlete and accounts for many lost days of race training.[1,2] Many of the lamenesses observed in racehorses are attributable to joint problems. Carpal arthropathies in particular are a common problem in the racehorse, especially in the racing quarter horse.[3] The most commonly accepted treatment for osteochondral chip fractures involving the carpal bones is arthroscopic removal of the chips followed by a period of rest. Immediate surgical treatment may not be feasible in some horses because of its economic value or racing schedules. Accordingly, a

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0161-3499/94/2305-0008$3.00/0

medical treatment that would limit the development of osteoarthritic changes and permit continued training and racing is of interest to owners, trainers, and veterinarians.

The use of corticosteroids for the treatment of equine joint disorders was first described in 1955.[4] Corticosteroids are a widely used and popular mode of therapy for equine arthritis; however, some deleterious effects of intra-articular corticosteroids also have been recognized. The term "steroid arthropathy" was introduced into the literature despite adequate definition of such a syndrome.[5] In one study, horses forced to exercise with surgically induced carpal fractures were more likely to develop osteoarthritis in joints treated with corticosteroids than in nontreated joints.[6] However, it was unclear whether the arthritis was caused by a direct effect of corticosteroids on the articular cartilage or to the increased use of the limb after corticosteroid injection. Furthermore, the role of joint instability after creation of a large fracture, or the effect of the arthrotomy alone, as a contributing factor to arthritis, could not be determined. Others have shown both chondrocyte degeneration and intercellular cartilage matrix degeneration after intra-articular injection of 6-α-methylprednisolone acetate into normal equine joints.[7,8] However, large doses of the drug were used in these studies.

Recently, it has been reported that steroids may be beneficial in reducing osteoarthritic changes in humans with rheumatoid arthritis[9] by causing a decrease in degradative enzymes. In animals, a protective effect of low-dose corticosteroids on articular cartilage has been reported for chemically induced arthritis and for mechanical instability models of arthritis.[10,11] These reports, combined with the second author's clinical impression of a low correlation between arthroscopically observed degenerative changes in articular cartilage and previous intra-articular corticosteroid therapy, were the impetus for the current study. Most of the previous experimental work with corticosteroids in equine joints has used high doses of methylprednisolone acetate. The study reported here evaluated the effects of a different corticosteroid (betamethasone) and exercise in a carpal chip model that we believe more closely resembles the clinical disease than do previously reported models. We hypothesized that in this model betamethasone would have fewer detrimental effects in the joints of horses that were rested compared with the joints of an exercised group of horses.

MATERIALS AND METHODS

Twelve mixed breed horses between 2 and 5 years of age were used. All horses were free of lameness, were negative to carpal flexion tests in both forelimbs, and had no palpable abnormalities of either carpus. There were no abnormalities of the carpal joints on radiographic examination and all middle carpal joints were normal on arthroscopic examination. The horses were randomly divided into two groups; group 1 consisted of six horses that were stall rested for the entire study, whereas group 2 consisted of six horses that were exercised on a high-speed treadmill. The latter group was accustomed to exercise on a high-speed treadmill before the study started.

Bilateral osteochondral fragments were created in all horses. Under general anesthesia horses were positioned in dorsal recumbency and both carpal regions were prepared aseptically for surgery. An arthroscope was inserted through a lateral portal to examine the middle carpal joint.[12] An instrument portal was created medial to the tendon of the extensor carpi radialis muscle and adjacent to the proximal articular border of the third carpal bone. A 9.5-mm curved osteotome was introduced through the instrument portal, positioned over the dorsomedial edge of the distal radial carpal bone, and struck with a mallet to create an osteochondral fragment in each carpal joint. The medial edge of the fragment remained attached to the synovial plica, and the proximal edge of the fragment remained attached to the joint capsule. The fragment was manipulated to ascertain that it had been freed from the radial carpal bone. The arthroscopic and instrument portals were closed with 00 nylon in simple interrupted skin sutures and the limbs were then bandaged.

All horses were housed in 3×3 m stalls and monitored twice daily for signs of discomfort. Bandages were changed every third day until suture removal on day 14. At the time of suture removal, one randomly selected midcarpal joint of each horse was aseptically prepared and injected with 2.5 mL of Betavet Soluspan (Schering, Kenilworth, NJ). The contralateral joint received 2.5 mL of sterile saline (0.9% NaCl) solution. The limbs were rebandaged and all horses were kept in stalls for 3 additional days. On day 17, horses in group 2 began exercising 5 days per week on a high-speed treadmill. Exercise periods consisted of 2 minutes at a brisk trot (8 to 12 mph), 2 minutes at a gallop (25 to 33 mph), and 2 minutes at a trot, for 6 consecutive minutes of exercise. Horses in group 1 were kept in stalls except during lameness evaluations. The intra-articular injections of betamethasone in treated joints and saline in control joints were repeated on day 35.

All horses were examined for carpal swelling, capsular thickening, and lameness on day 17 and again at weeks 6 and 8 after surgery. After clinical evaluation on day.56, all carpi were radiographed and the horses were euthanatized. Radiographs were examined for joint space width and osteophyte production and were compared with those taken before surgery. At necropsy, the middle carpal joint was opened, any effusion was noted, and a full-thickness section was collected from the joint capsule adjacent to the osteochondral fragment. Gross changes in the joint capsule and articular cartilage were noted and the amount of healing at the fracture site was assessed.

Two osteochondral specimens were collected from the carpal bones (Fig 1). One specimen (sample A) was taken from the radial carpal bone immediately adjacent to and including part of the fragment, and the second specimen (sample C) was taken from the third carpal bone directly opposite the fragment. Cartilage slices (samples B and D) were collected immediately adjacent to the two osteochondral specimens, and from the intermediate facet of the third carpal bone (sample E). An 8 × 8 mm section of articular cartilage was collected from the radial carpal bone medial to the osteochondral fragment (Fig 1) and was frozen at −70°C for biochemical analysis.

The joint capsule and cartilage specimens were fixed in 10% neutral-buffered formalin for 5 to 7 days, embedded in paraffin, and sectioned at 5 μm. Osteochondral specimens were fixed in 10% neutral-buffered formalin and then decalcified for 7 to 10 days in 10% formic acid with constant agitation over ion exchange resin. The decalcified specimens were then embedded in paraffin and sectioned at 5 μm. Joint capsule, articular cartilage, and osteochondral sections for histological examination were stained with hematoxylin-eosin. Additional articular cartilage sections were histochemically stained with safranin O-fast green.

Joint capsule sections were graded for cellular infiltration, synovial intimal hyperplasia, subintimal edema, subintimal fibrosis, and increased vascularity. These variables were graded from 0 to 4 (0, normal; 1, occasional changes noted in section; 2, changes noted in approximately 50% of section; 3, changes noted in >50% of section; and 4, changes throughout section). The median grade for each variable was then calculated for each of the four treatment groups (rested control, rested treated, exercised control, and exercised treated).

Osteochondral and cartilage sections were similarly evaluated for articular cartilage fibrillation, chondrocyte necrosis, chondrone formation, and focal loss of cells. Median grades for these four variables were added to give an articular cartilage score for each section. Since the grade for each variable could range from 0 to 4, the articular cartilage score could theoretically range from 0 (normal) to 16 (very abnormal in all characteristics). An articular

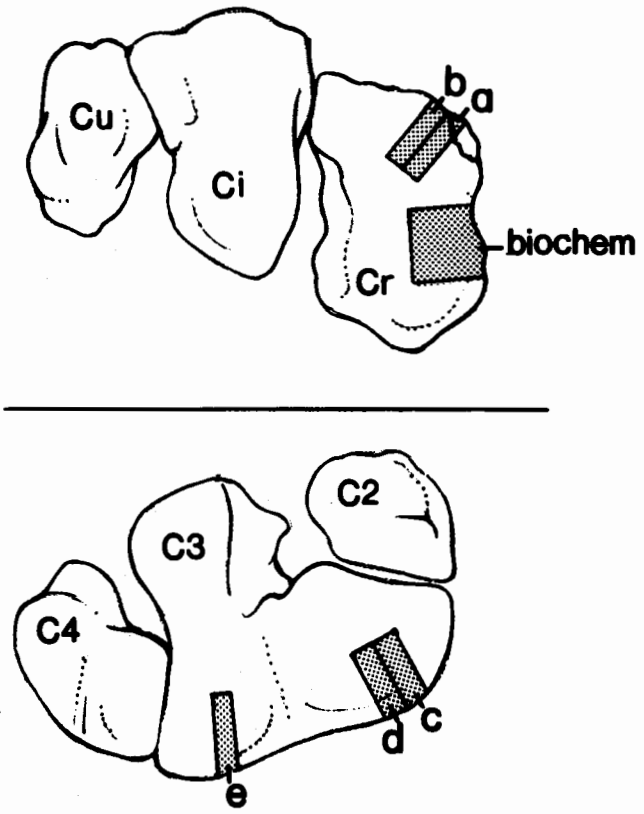

Fig 1. Bones of the middle carpal joint showing sample locations. Samples A (a) and C (c) are osteochondral sections and samples B (b), D (d), and E (e) are cartilage slices. Abbreviations: biochem, area of cartilage collected for biochemical analysis; C_u, ulnar carpal bone; C_i, intermediate carpal bone; C_r, radial carpal bone; C_2, second carpal bone; C_3, third carpal bone; and C_4, fourth carpal bone.

cartilage score was then calculated for each specimen (A, B, C, D, and E) for each treatment group. The osteochondral section which included the fragment was graded separately for quality of healing on a scale of 0 to 3: 0, only fibrous tissue present between the fragment and the parent bone; 1, more fibrous tissue than bone in fracture line; 2, more bone than fibrous tissue in fracture line; and 3, complete bony union.

Cartilage sections stained for histochemical evaluation were examined for staining intensity in the tangential, intermediate, radiate territorial, and radiate interterritorial zones. Four investigators, unaware of the treatment assignments, graded each zone on a scale of 0 to 4 (0, no stain uptake; 1, 25% of normal stain uptake; 2, 50% of normal stain uptake; 3, 75% of normal stain uptake; and 4, normal stain uptake), and then gave an overall grade to each section. Each examiner was then asked to look at all sections from each carpus and choose a "best staining joint" for each horse.

Table 1. Median (Range) Scores for Synovial Membrane Histological Variables

Treatment/Exercise Group	Cellular Infiltrate	Intimal Hyperplasia	Subintimal Edema	Subintimal Fibrosis	Increase Vascularity
Rested control	0 (0-2)	0 (0-2)	1 (1-3)	1 (0-2)	1 (0-2)
Rested treated	1 (0-2)	2 (0-2)	2 (0-4)	2 (1-2)	1 (0-3)
Exercised control	.5 (0-2)	.5 (0-2)	2 (0-2)	2 (0-2)	1 (1-2)
Exercised treated	1 (0-2)	0 (0-2)	.5 (0-2)	1.5 (0-4)	1 (0-2)

Articular cartilage specimens for biochemical evaluation were analyzed for water content and uronic acid concentration using the method of Bitter and Muir.[13] To determine whether there were any effects from betamethasone or exercise, data from all 22 joints was analyzed using a 2-way repeated measures analysis of variance for continuous outcomes (biochemical results), a 2-way analysis of variance on the ranks of the data for ordinal outcomes (clinical examination findings, lameness grades, gross pathological findings, and histology and histochemistry scores), and the Mantel-Haenszel chi-squared procedure for dichotomous outcomes (gross chip healing and best staining joint). Significance was set at $P \leq .05$.

RESULTS

All horses recovered well from the surgical procedure and exhibited minimal lameness after surgery. One horse in the nonexercised group developed septic arthritis in the control joint on day 16 (2 days after saline injection). This was successfully treated with joint lavage on 3 consecutive days, in conjunction with systemic antibiotics and nonsteroidal anti-inflammatory drugs. Results from this joint were not included in the statistical analysis, but observations are reported.

There was no significant difference in the degree of lameness between treated and nontreated limbs or between exercised and rested horses at any time during the study. Lameness was observed in five of the six exercised horses at the end of the study; four horses were lame in the control limb and one horse was lame in the treated limb. Lameness was noted in each of the five rested horses that could be evaluated at the end of the study; the horse that developed septic arthritis was excluded. Two of these horses were lame in the control limb, two were lame in the treated limb, and one was lame in both the control and treated limbs. There were no radiographic differences between treatment and exercise groups.

Capsular thickening ranged from none to moderate, with the exception of the infected joint, which had severe capsular thickening. Effusion was only noted in seven joints. Two horses in the exercised group had mild (palpable but not visible) effusion in both joints, one rested horse had mild effusion in the control joint, and another rested horse had moderate (palpable and visible) effusion in both joints. No difference in capsular thickening or joint effusion was noted between treatment and exercise groups.

On postmortem examination, there were no differences in the gross appearance of the fibrous joint capsule or the synovial membrane between treatment and exercise groups. The osteochondral fractures appeared to be healed in all but three joints. One of these was the infected joint, one was the treated joint of an exercised horse that had a loose but nondisplaced fragment, and one was an exercised treated joint in which the fragment had been dislodged from its soft-tissue attachment and could not be identified. In one of the rested control joints, the fragment had healed but was displaced approximately 2 mm distally. Gross articular cartilage damage was noted in eight joints including the septic joint. Focal partial-thickness erosions were observed in both joints of one exercised horse and one rested horse, in the treated joint of one rested horse, and in the control joint of one exercised horse. The exercised horse in which the fragment had dislodged had diffuse partial-thickness cartilage erosions in the treated joint. There were no significant differences in joint capsule changes, fragment healing, or articular cartilage damage between treatment and exercise groups on gross examination.

No significant differences in the histological variables were seen between treated and control limbs or exercised and rested horses (Table 1). Cellular infiltrate grades in the synovial membrane ranged from 0 to 2, except the septic joint that was a grade 3. In the rested group, two horses had the same grade

Table 2. Median (Range) Articular Cartilage Histological Scores

Treatment/Exercise Group	Sample A	B	C	D	E
Rested control	2.5 (1-3)	3 (2-6)	2.5 (2-4)	3 (0-4)	2.5 (1-4)
Rested treated	2.5 (2-4)	3 (2-7)	2.5 (2-4)	3.5 (1-7)	2 (1-7)
Exercised control	2 (1-3)	2 (1-6)	2.5 (1-9)	2.5 (1-7)	1.5 (1-4)
Exercised treated	3 (2-6)	2.5 (1-9)	3.5 (3-8)	5.5 (1-9)	2 (0-8)

NOTE. 0 = normal and 16 = most severe change.

for treated and control joints, two horses had higher grades in the treated joints, and one horse had a higher grade in the control joint. In exercised horses, more cellular infiltrate was observed in the treated joint of three horses, in the control joint of two horses, and no difference was detected between the treated and control joints of one horse.

Synovial intimal hyperplasia scores ranged from 0 to 2; two of the rested horses had no difference between treated and control joints and three had higher scores in the treated joint. Three exercised horses had identical scores in treated and control limbs, one horse had a higher score in the treated limb, and two horses had higher scores in the control limb. Subintimal edema scores ranged from 0 to 4. Three of the rested horses had higher scores in the treated joint and two horses had higher scores in the control joint. Three of the exercised horses had the same score in the treated and control joints and three horses were higher in the control joint.

Subintimal fibrosis scores ranged from 0 to 4. Two of the rested horses had identical scores in the treated and control joints and three horses had higher scores in the treated joints. Two of the exercised horses had the same score in the treated and control joints, two horses had higher scores in the treated joints, and two horses had higher scores in the control joints. Scores for increased vascularity ranged from 0 to 3. Two of the rested horses had the same score in treated and control joints and three horses had higher scores in the control joint. Three of the exercised horses had the same scores in the control and treated joints, two horses had higher scores in the control joint, and one horse had a higher score in the treated joint.

The overall cartilage scores for individual joints ranged from 0 to 9. There were no significant differences in the cartilage scores between treated and control joints or between rested and exercised horses (Table 2). It was noted, however, that the median cartilage scores for all sample sites were higher in the steroid treated joints within the exercised group but the median scores in the nonexercised group were the same for samples A, B, and C, higher in the steroid treated joints for sample D, and lower in the steroid treated joints in Sample E.

Healing of the osteochondral fragment to parent bone (sample A) ranged from fibrous tissue in the defect (grade 0) to complete bony union (grade 3). In the rested group, healing was better in the control joint of three horses and no difference was observed between the control and treated joints in the other two horses. In the exercised group, two horses showed better healing in the treated joint, two horses showed better healing in the control joint, one horse showed no difference between joints, and one sample was not available for evaluation. There was no significant difference in the grades for healing between the groups.

There was no safranin 0 staining in the superficial zone of any specimens. The scores for the intermediate zone of sample B were significantly lower ($P = .03$) in the treated joints than in the control joints (Table 3). This appeared to be caused more by the difference between rested control samples and rested treated samples than by the difference between exercised control and exercised treated samples. There were no significant differences in histochemical staining between treatment or exercise groups in other zones of sample B or between zones in samples D and E. The overall scores for histochemical staining were not significantly different between treatment or exercise groups for any of the three cartilage samples. Sections from sample E consistently stained less intensely than sections from samples B and D. When all samples were evaluated, the control joint was picked as the "best staining joint" in four of the rested horses and no difference could be determined

Table 3. Median (Range) Histochemistry Scores for Each Treatment Group

Treatment/Exercise Group	Histochemistry Scores			
	Intermediate	Radiate Territorial Zone	Radiate Interterritorial Zone	Overall
Sample B				
Rested control	2.0 (2-3)‡	3 (3-3)	2.0 (1-2)	2.5 (2-3)
Rested treated	1.0 (1-2)§	2.5 (2-3)	1 (1-2)	2.0 (1-2)
Exercised control	2.0 (0-3)‡	2.5 (1-3)	1.5 (0-3)	2.0 (0-3)
Exercised treated	1 (1-2)§	2 (2-3)	1.5 (1-2)	2.0 (1-3)
Sample D				
Rested control	1.5 (1-3)	3 (2-3)	1.5 (1-2)	2 (2-3)
Rested treated	1 (0-2)	2.5 (2-3)	1.5 (1-2)	2 (1-3)
Exercised control	1 (0-2)	3 (2-3)	1.5 (1-2)	2 (1-2)
Exercised treated	1 (1-2)	2.5 (2-3)	1.5 (1-2)	2 (1-3)
Sample E				
Rested control	1 (1-2)	2.5 (2-3)	1 (1-2)	2 (1-2)
Rested treated	1 (0-2)	2 (2-2)	1 (0-2)	1 (1-2)
Exercised control	1 (0-2)	2 (1-3)	1 (0-1)	1.5 (1-2)
Exercised treated	1.5 (0-2)	2 (2-3)	1 (1-2)	1 (1-2)

NOTE. 0, no stain uptake; 1, 25% of normal stain uptake; 2, 50% of normal stain uptake; 3, 75% of normal stain uptake; and 4, normal stain uptake.

‡§ Significant differences between treatment and control limbs. (‡, control; §, treated.)

between control and treated joints of the fifth horse. In the exercised group, the control joint was picked as the "best staining joint" in three horses, and the treated joint was better in the other three horses.

The mean (± standard error of the mean [SEM]) water content expressed as a percentage of dry weight were 66.6% (±1.1) for rested controls, 65.4% (±2.2) for rested treated joints, 66.0% (±3.0) for exercised controls, and 66.3% (±2.2) for exercised treated joints. Mean (±SEM) uronic acid concentrations were 65.6 mg/g (±8.8) for rested controls, 54.1 mg/g (±11.5) for rested treated joints, 65.4 mg/g (±7.7) for exercised controls, and 58.9 mg/g (±15.4) for exercised treated joints. The values for H_2O are slightly higher than those values reported for lactated Ringer's infected joints in another study (H_2O = 60.5% to 63.4%).[14] Uronic acid concentrations from normal equine articular cartilage in other studies have ranged from 60.18 mg/g[15] to 73.2 mg/g.[14,16] There were no significant differences in water content or uronic acid concentration between treatment or exercise groups in this study.

DISCUSSION

This model of osteochondral fractures created by arthroscopy gave a controlled level of fragmentation without the complications associated with arthrotomy. The short postoperative recovery time allowed exercise earlier than would be possible after arthrotomy and eliminated variability that could have been associated with the arthrotomy incision. We feel that this model more closely resembled the clinical entity than did the previously reported arthrotomy model.[6]

Although small numbers may have kept the results of lameness examinations from being statistically significant, the fact that four of the five lame horses in the exercised group were lame in the control limb at the end of the study is worth noting. This might suggest that the therapeutic effects of betamethasone may last longer than previously believed. If corticosteroid injections were administered less frequently in clinical cases of osteochondral fragmentation, the likelihood of degenerative changes may decrease. The frequency of intra-articular corticosteroid administration needed to counter inflammatory effects has not been well defined.

Healing of the surgically created osteochondral fragment did not appear to be limited by the use of intra-articular corticosteroids. Two of the three joints that did not have gross evidence of healing were exercised treated joints. However, histologically there was comparable healing in the treated and control joints of the exercised group. When scores for his-

tological healing were averaged, the treated joints of exercised horses had slightly higher values (better healing) than the control joints. This finding is contrary to that reported previously using an arthrotomy model of carpal chips.[6] In the rested group, there was a trend toward better healing in the control joints although the difference was not significant. This model may not exactly simulate the clinical situation because gross healing of osteochondral fragments was observed in all but three joints, whereas clinical fractures seldom heal with or without corticosteroids. However, it is still worth noting that this dose of betamethasone did not inhibit gross or histological healing of the fragments.

Although no significant differences were observed, the results of microscopic evaluation of synovial membrane were interesting. Mean scores for inflammatory changes in rested joints treated with betamethasone were higher than in rested control joints. In the exercised group, synovial membrane scores were only slightly lower for treated joints, and only in three of the five variables that were evaluated. From this it would appear that corticosteroid in the rested joints resulted in a nonsignificant increase in inflammatory changes, which may have been because of the micro-crystalline nature of the preparation, but slightly decreased the inflammation associated with exercise of the injured joint.

Based on microscopic evaluation of the osteochondral and chondral samples we could not detect any consistent or significant deleterious effects of corticosteroids on articular cartilage. There was a trend for exercised horses to have more deleterious changes in the treated joint and for rested horses to have similar changes between treated and control joints. It should also be noted, however, that the one exercised horse that had the loose fragment in its treated joint and gross evidence of severe cartilage erosion may have negatively skewed the results for the exercised group. On gross pathological examination, it appeared that the cartilage damage may have been caused by the loose fragment grinding between the articular surfaces. When cartilage scores for all five samples of each joint were examined, the scores for this joint were almost twice as high as the scores of the next highest scoring joint.

The intensity of histochemical staining with safranin O-fast green is directly related to the amount of glycosaminoglycans in the articular cartilage matrix; the intensity of staining is known to be decreased in experimental models of equine arthritis.[17] Decreased articular cartilage staining intensity with safranin O has also been reported in normal equine carpal joints after treatment with large doses of methylprednisolone acetate.[7,8] Our results using betamethasone were quite different from the results of previous studies. These differences may be a reflection of the corticosteroid used or of dose differences. In our study, although cartilage sections from rested control joints consistently stained better than cartilage from exercised controls, histochemical staining appeared to be decreased more by betamethasone use in rested horses than in exercised horses.

The results of histochemical staining seemed to be supported by biochemical analysis of the articular cartilage. Uronic acid is a component of the chondroitin sulfate chains of proteoglycans and is used as a measure of the proteoglycan content of cartilage. Uronic acid concentrations for control joints were similar for rested (65.6 mg/g) and exercised groups (65.4 mg/g). The mean value for the exercised treated joints (58.9 mg/g) was higher than that for the rested treated group (54.1 mg/g), which corresponds to the results of histochemical staining.

In conclusion, we found no consistently severe, detrimental effects of intra-articular betamethasone administration using this osteochondral fragment model. In addition, it did not appear that exercise caused further detrimental effects in corticosteroid-treated joints. Although the histological changes were minimal but slightly worse after corticosteroid administration and exercise, there was less reduction in safranin O staining intensity in the exercised group than in the rested group. We speculate that the significant detrimental effects of corticosteroids observed in previous studies may have been a result of the type of corticosteroid that was used and the large doses that were used. Some practitioners believe that superior results are achieved with intra-articular injection of betamethasone compared with methylprednisolone acetate. Although this study did not evaluate different corticosteroids, it at least indicated that betamethasone may be less harmful than previously believed when used as a short-term treatment for small osteochondral fragments until arthroscopic removal can be performed. We are not recommending that intra-articular treatment with corticosteroids replace arthroscopic surgery for the management of carpal chips. Optimal treatment would

still involve the earliest possible removal of such fragments. Although certain corticosteroids in low doses may not directly damage articular cartilage and may even be chondroprotective in some circumstances, it should still be noted that the continued use of a joint with osteochondral fragmentation may cause more damage than if the horse was allowed to rest.

REFERENCES

1. Rossdale PD, Hopes R, Wingfield-Digby NJ, et al: Epidemiological study of wastage among racehorses in 1982 and 1983. Vet Rec 116:66-69, 1985
2. Jeffcott LB, Rossdale PD, Freestone J, et al: An assessment of wastage in thoroughbred racing from conception to four years of age. Equine Vet J 14:185-198, 1982
3. Goodman NL, Baker BK: Lameness diagnosis and treatment of the Quarter Horse racehorse. Vet Clin North Am Equine Pract 6:85-108, 1990
4. Wheat JD: The use of hydrocortisone in the treatment of joint and tendon disorders in large animals. J Am Vet Med Assoc 127:64-67, 1955
5. O'Connor JT: The untoward effects of the corticosteroids in equine practice. J Am Vet Med Assoc 153:1614-1617, 1968
6. Meagher DM: The effects of intra-articular corticosteroids and continued training on carpal chip fractures of horses. Proc Am Assoc Equine Pract 16:405-412, 1979
7. Chunekamrai S, Krook L, Lust G, et al: Changes in articular cartilage after intra-articular injections of methylprednisolone acetate in horses. Am J Vet Res 50:1733-1741, 1989
8. Trotter GW, McIlwraith CW, Yovich JV, et al: Effects of intra-articular administration of methylprednisolone acetate on normal equine articular cartilage. Am J Vet Res 52:83-87, 1991
9. Pelletier JP, Martel-Pelletier J: Effect of steroids on neutral metalloproteinase activity in human rheumatoid and osteoarthritic cartilage. Adv Inflam Res 12:81-85, 1988
10. Williams JM, Kenneth DB: Triamcinolone hexacetonide protects against fibrillation and osteophyte formation following chemically induced articular cartilage damage. Arthritis Rheum 11:1267-1274, 1985
11. Pelletier JP, Martel-Pelletier J: Protective effects of corticosteroids on cartilage lesions and osteophyte formation in the Pond-Nuki dog model of osteoarthritis. Arthritis Rheum 32:181-193, 1989
12. McIlwraith CW: Diagnostic and surgical arthroscopy of the carpal joints, in McIlwraith CW (ed): Diagnostic and Surgical Arthroscopy in the Horse (ed 2). Philadelphia, PA, Lea & Febiger, 1990, pp 34-39
13. Bitter T, Muir HM: A modified uronic acid carbazole reaction. Anal Biochem 4:330-334, 1962
14. Gustafson SB, Trotter GW, Norrdin RW, et al: Evaluation of intra-articularly administered sodium monoiodoacetate-induced chemical injury to articular cartilage of horses. Am J Vet Res 53:1193-1202, 1991
15. Trotter GW, McIlwraith CW, Yovich JV, et al: Effects of intra-articular administration of methylprednisolone acetate on normal equine articular cartilage. Am J Vet Res 52:83-87, 1991
16. Vachon A, Kelley FW, McIlwraith CW, et al: Biochemical analysis of normal articular cartilage in horses. Am J Vet Res 51:1905-1911, 1990
17. McIlwraith CW, Van Sickle DC: Experimentally induced arthritis of the equine carpus: Histologic and histochemical changes in the articular cartilage. Am J Vet Res 42:207-215, 1981