THERMOGRAPHY IN DIAGNOSIS OF INFLAMMATORY PROCESSES IN HORSES IN RESPONSE TO VARIOUS CHEMICAL AND PHYSICAL FACTORS

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To study the effects of acute and chronic inflammatory responses of the horse's thoracic (front) and pelvic (hind) limbs, several studies were done over a seven year period at the School of Veterinary Medicine, Auburn University, Alabama.

Phase I. Normal Thermographic Pattern of the Horse Over 100 horses were used to establish normal thermographic patterns of both thoracic and pelvic limbs. There is a high degree of right leg to left leg symmetry to the infrared emission of the horse, which has also been shown in humans. But in the horse, there is also a high degree of symmetry between the front and rear legs from the carpus and tarsus distally. After exercise, the temperature patterns of lower legs remained very similar to normals obtained before exercise. Even though there was an overall increase of temperature due to exercise thermal patterns remained the same.

Phase II. Chemically Induced Acute Inflammation of the Thoracic (Front) Limbs and the Use of Anti—inflammatory Compounds in Horses Thirteen ponies were used to inject 1.25 ml of 1.9% iodine solution (hypodermin R) around the distal portion of the lateral left front splint. This was done to create an area of acute inflammation. Twenty-four hours after iodine injection, ponies were divided into four groups. Group 1 was control with no medical treatment. Group 2 was treated with Benzydamine Hydrochloride ointment. Group 3 was

treated with intramuscular injection of Benzy— damine Hydrochloride and Group 4 received intravenous injection of Phenylbutazone BID (twice a day). All treatments were done for 5 days and ponies were evaluated by clinical examination for heat, swelling, pain, and physical soundness, and thermographic evaluation was done before and after exercise. The objective of this study was to evaluate thermography as a means of quantitative determination of acute inflammation and therapeutic effectiveness of the anti-inflammatory compounds. The induced inflammation was readily shown with thermography while comparing control, nontreated and treated with anti—inflammatory compounds. Anti-inflammatory compounds like benzydamine and phenylbutazone decreased inflammation when compared to nontreated inflamed animals. Thermography was very effective in the diagnosis of inflammatory responses and healing processes.

Phase III. Thermographic Evaluation of Tennessee Walking Horses, Using Various Chemical and Physical Factors (A Field Trial) A one week extensive field study was performed on seven Tennessee Walking Horses, owned by various owners and trainers. This study was performed at Murfreesboro, Tennessee. Seven horses from various areas were brought and housed at University Camps of Murfreesboro, Tennessee. Each horse was individually handled by their trainers to provide field condition. Some of these horses were young and some were old. All had been shown at various Walking Horse shows in the nation. At one time or another these horses were considered to be sored according to the conversations with trainers and owners. Our objective for this phase of study was not to document how and when they were sored, but to evaluate these horses for a period of five to six days. Horses were given a thorough physical examination and pertinent data were recorded for information. Various thermographic views of all four legs were obtained pre—exercise and thereafter at 15, 75, 135, 255 minutes respectively for 5 to 6 days in each horse. In some horses 18 oz. chains were used for one day during exercise and then 10 oz. chains were used during exercise the other day. All horses were exercised by the trainer of a horse or by a trained horse rider hired on the research grant during the 6 day study period. With a few exceptions, most horses having old callouses will modify the thermographic patterns. But the effects of soring and the use of heavy chains can be differentiated from old callouses by comparing thermographic pictures with physical evaluation and location of the callouses. Thermographic pictures obtained 15 minutes after exercise in normal horses could be differentiated from the horses who were sore due to chemical or physical factors. This field trial produced results similar to those obtained by Dr. Nelson at Ames, Iowa.

Phase IV. Subclinical Diagnosis of Osteoarthritis by Thermographic Technique

Thermographic and radiographic evaluations of the tarsus (hock) were done in 20 horses, prior to and after exercise at 3

consecutive six week intervals. All horses were from the same stable, receiving identical care and training under equivalent schedules and conditions. Normal thermographic patterns were established for preexercise and postexercise workouts. These patterns corresponded to the underlying tarsal vasculature. Postexercise thermal patterns were generally warmer, and the increases were uniform. Abnormal thermal patterns were more localized and did not conform to the normal underlying vascular distribution. The results of this study suggest the four horses that were unable to race professionally suffered sufficient discomfort in their hocks to cause reduced performance and inability to meet minimum track qualifying times. These horses were clinically sound but all exhibited positive thermal changes of the medial aspect of their right hocks with no radiographic evidence of inflammation in the corresponding surfaces. It is my opinion that the medial aspect of the right hock bears more weight and stress when horses racing counterclockwise make the turns of the track, and is consequently prone to traumatization and early degeneration. Only one horse exhibited clinical lameness, supported by radiological findings as well as abnormal thermal patterns within the same area. It may then be concluded that abnormal thermal increases may be detected in the subclinical stages where only slight discomfort produces reduced performance. This study did determine that thermographic changes can be detected prior to radiologic changes and that these thermal increases were correlated with discomfort that presumably resulted in reduced performance. Standardbred horses were used in this study.

Phase V. Thermographic Evaluation of Sore Horses

Objectives of this study were: to evaluate chemical soring without use of action devices; to determine the pressure at six different areas of the foot below the fetlock joint in response to chemical soring; and to evaluate thermographic pictures along with the gait of horses using videotape recording. Normal thermographic patterns, before and after exercise were similar to those reported previously (Phase I) in all three horses. Application of detergent soap and leg wraps for two days produced an increase in IR-emission pattern of the treated legs. This increase in temperature varies from 2-4 degrees C warmer than the non-treated legs. Following use of detergent soap, same legs were used for application of mustard oil. After second application of mustard oil, horses showed obvious signs of pain and discomfort. Horses were also very sensitive to touch. Thermographic evaluation of affected foot showed increase in IR-emission pattern and consisted of about 5-7 degrees C rise in temperature when compared to the non-treated legs. Three to five days after the last application of mustard oil there was gradual decrease in temperature, but did not return to normal level for 3 to 4 weeks. Rectal temperature along with temperature recording from the pastern area of the foot also increased following treatment with mustard oil. Thereafter, there

was a gradual decline in both rectal temperature and the temperature in the pastern area of the foot. Rectal temperature was between 99 to 101 degrees F before soring. Seventy-two hours after second application of mustard oil rectal temperature averaged about 105.5 degrees F (preexercise). Immediately after exercise, in sore horses there was a slight decrease in body temperature, whereas non—sored horses had an increase of body temperature of 1 to 2 degrees F. Six point pressure (SPI) below fetlock joint were recorded in all horses. In clinically normal horses before exercise, a mean pressure of 36 to 37 lbs. were recorded, prior to the flinching response. Fifteen to 30 minutes after exercise the pressure dropped to a mean value of 31 psi. Application of detergent soap followed by wrapping of the leg for 24 to 48 hours caused slight inflammation. This inflammation was obvious on thermographic evaluation. When these horses were tested for pressure response on the treated foot there was a marked reduction in pressure recording. Thus, point pressure obtained indicated the presence of inflammation. After the second application of mustard oil, treated legs were sore and inflamed to the extent that horses will not tolerate point pressure above 5 to 10 psi in the affected areas. Whereas non-sored legs of the same horse will withstand a pressure ranging from 24 to 40 psi. Thus one could conclude that along with physical examination and thermographic evaluation, point pressure of affected areas could also determine the inflammatory responses which can be quantitated by using point pressure recording. Increase in body temperature could also be used in acute cases of active inflammation, but further studies are needed in this area with the speculation that in response to chronic pain, body temperatures may not stay elevated in all horses.

Phase VI. Determination of Thermographic Patterns in Response to l0 oz. chains

The objectives of this study were to determine the effects of 10 oz. chains on normal horses, before and after exercise for a duration of two weeks and to use pressure testing device along with thermography and photographic documentation of any lesions produced by 10 oz. chains. Three horses (Nos. 3, 4, and 6) were exercised without chains for several days to obtain normal thermographic patterns and pressure data. There- after, the horses were exercised with 10 oz. chains for 10 consecutive work days (given weekends off) and pressure data were collected along with thermography and photography documentation. Horse No. 4 had 10 oz. chains on both pasterns whereas Horse No. 3 had a chain on the left pastern and Horse No. 6 had a chain on the right pastern. The chains were fitted according to the USDA, APHIS, Veterinary Services regulations so that the chain struck the pastern at least one inch above the coronary band. Results of this study provided evidence that by day 7 of exercise with chains lesions can be produced on a horse’s legs. By the 10th day of exercise with chains, these lesions were more obvious and were present on the anterior and

posterior areas of both right and left pasterns. The anterior lesions were about 1 to 2 cm in diameter and about 0.5 cm •deep with the presence of edema, exudate and some bleeding. The posterior lesions were less deep, covered a larger area and had an appearance more like an abrasion. Thermo— graphically, horses exhibited altered thermal patterns as early as day 2 of exercise with chains. These altered thermal patterns persisted as long as chains were used. After 10 days of experimentation with chains the horses were exercised without chains, and it took about 20 days in recovery to obtain normal thermal patterns. Scars formed by using chains continued to show altered thermal patterns compared to the normal areas. Horse No. 6 was exercised with a 10 oz. chain on the right leg only so it could be compared to the left leg. The right pastern area developed inflammation and edema by day 8 and visible lesions by the 10th day. Alterations in thermal patterns of the right leg were present as early as day 3 after exercise with chains. Recovery in this horse was parallel to that of the other horses. It was concluded that the use of 10 oz. chains for 10 days without use of chemical soring produces lesions in the areas of the pastern which can be seen visually after 8 to 10 days and altered thermography patterns can be seen in 2 to 3 days. If animals are allowed to recover without use of anti-inflammatory treatment it would take 3 to 5 weeks for their thermal patterns to return to normal. Extent of soreness due to chains only are less dramatic than the chemical soring.

Phase VII. Simultaneous Use of Chemical and Chains for Soring Horses

The objectives of this study were to determine the effects on forefeet of horses of detergent, mustard oil and chains, before and after exercise for a duration of two weeks and to determine if pressure readings from the forefeet of sored horses will correlate with the thermographic findings. Three horses (Nos. 3, 5 and 6) were exercised several days in a normal fashion and the animals were monitored to establish pre-treatment physical condition of the forefeet. Data were obtained by pressure testing, thermography and by taking rectal temperature. Liquid detergent was liberally applied to the pasterns of the forefeet and they were then wrapped in plastic and cloth bandages. The next day the bandages were removed and # 3 was exercised 15 minutes with chains on both feet, # 5 with a chain on the right forefoot and # 6 with a chain on the left forefoot. Ten ounce chains were used. The next day 18 drops of oil of mustard were applied to each pastern after the horses had been exercised in chains as previously described. Plastic and cloth wraps were applied and left on overnight. Wraps were removed the next day and the: horses exercised in •chains for 15 minutes each day (except weekends) for 8 more days. The horses were then exercised in a normal manner 5 times during a 10 day recovery period. Results of this study showed that the combination of detergent, chains, and mustard oil caused the clinical signs of a sored horse described by Nelson (1975). Horse # 3 (chains on both

legs) and # 6 (chain on left leg) had some bleeding in the pasterns 8 days after detergent was applied. Horse # 5 did not bleed but had swollen and scabby pasterns. Thermal patterns of the foot were altered by the treatment with chemicals and mechanical devices but since detergent and mustard oil were applied to both pasterns of the forefeet of all three animals, and in 2 horses chains were used either on left or right foot, unchained feet were only sored chemically, were similar to the one with both chemical and chains. Thus inflamed area with or without chains showed similar results on thermography. Rectal temperatures were slightly higher during the period of treatment than for periods of non—treatment. The combined use of detergent, chains and mustard oil on the pasterns of horses causes lesions and tissue damage visible to the naked eye. They also cause alterations of the horse's behavior that are predictable. The pressure device is consistent in charting trauma caused to the feet of Tennessee Walking Horses. There is a wide margin between the pressures 'that an unsored horse will tolerate compared to those a sored horse can endure.

Phase VIII. Effects of Tranquilizers and Vasoactive Drugs on the Pattern of The Normal and Neurectomized Fore Legs of Horses

The objectives of this study were to determine the prolonged effects of neurectomies on the circulatory patterns of the legs of horses, and to determine the effects of epinephrine, norepinephrine, acetylpromazine and propanolol on the circulatory patterns of normal and neurectomized legs of horses. Four horses were used in this study. Normal patterns of the thoracic limbs were similar to those reported previously. To determine the effect of acetylpromazine, epinephrine, norepinephrine and propanolol, horses were injected with these drugs and thermographic patterns were determined for an extended period. Thereafter, posterior digital neurectomies were done and drug effects were evaluated again. Low and high volar neurectomies were also done. In 3 other horses the effects of local nerve blocks, high and low volar nerves and posterior digital nerve were studied to evaluate the circulatory patterns: Intravenous injection of acetylpromazine (0.06 mg/kg) caused increased thermal patterns of both the thoracic and pelvic limbs in horses. Similarly, epinephrine and propanolol caused vasodilatation and increased thermal patterns. Norepinephrine caused vasoconstriction and decreased temperatures of both pelvic and thoracic limbs (for reference see publication # 5). Following neurectomies in either the pelvic or thoracic limb at various sites there was increased heat in the areas supplied by these nerves. Within 3 to 6 weeks neurectomized areas had a readjustment of their local blood supply, and it was difficult to differentiate between the normal and neurectomized areas on thermography. Administration of acetylpromazine (0.06 mg/kg IV) caused increased heat in the non-neurectomized areas of the opposite limbs, whereas no effect was seen on the neurectomized limbs. Results obtained with low and high volar neurectomies were similar to those of a posterior digital

neurectomy. Thermographic evaluation of the thoracic and pelvic limbs were also done before and after local nerve blocks of both pelvic and thoracic limbs. Responses varied according to the site of injection. Nerve blocks only persisted for a short duration because carbocane is a short-acting local anesthetic. It was concluded that the thermography can be effectively used to evaluate vasoconstrictive and vasodilatory drugs in horses. Neurectomized areas can also be detected by thermographic techniques.

Phase IX. Thermographic Evaluation of Chemically (Amphotericine B) Induced Arthritis of the Carpus and Tarsus Joints Along With or Without Injection of Steroids in the Joint

The objectives of this study were to chemically induce intercarpal and tibiotarsal arthritis by injection of amphotericine B and to evaluate the effects of corticosteroids in the treatment of induced arthritis. Both thermography and radiography were used to evaluate the above stated objectives. Twelve ponies were used consisting of 48 joints to be evaluated. Eight joints were used as controls, 8 were injected with dextrose for a positive control 8 joints were used for amphotericine B injection only and of the other 16 joints, 8 were injected with methylprednisolone before amphotericine B and the other 8 were injected with methylprednisolone 24 hours after amphotericine B. Ponies were evaluated physically, thermographically and by radiography. Results of this study showed that the corticosteroid treatment of intra-articular injection in the joints was effective in alleviating the pain and clinical signs of lameness when compared to the induced arthritis non—treated joints. Even after the clinical signs of arthritis disappeared thermography still showed the presence of inflammation up to 30 to 40 days after the injection of amphotericine B. Radiographic evidence also provided that arthritis persisted longer than it was evident on physical exam. Present and previous studies from this clinic show that thermography can diagnose subclinical inflammation and it can be used to evaluate the healing processes. (See publication for more details).

Phase X. Use of 8 and 10 Ounce Chains on Scarred Horses

This study consists of two parts. In the first part of the experiment two horses were scarred using chain and mustard oil. Along with these, two scarred horses were bought. The second part of the study consisted of using 8 and 10 ounce chains and 14 ounce rollers on the scarred horses to evaluate their effect on the scar.

Part 1 of Phase X, Scarring Processes: Two horses were used to produce scars using 16 or 14 oz. chains with clinical soring described previously. It took an unpleasant 2 months of detergent, mustard oil and chain use to produce minimal scarring of two horses. Bleeding of pasterns first occurred in about 7 to 8 days, while

exercising in chains. Evidence of inflammation of the pasterns was noted on thermovision the day after presoring and chain use, particularly after exercise. The thermal pattern became more diffuse and abnormal as the study proceeded. Drop in pressure readings occurred with continued use of chemicals and chains. The animals displayed many signs of discomfort and distress during the use of chemicals and chains. Some were stiffness, trotting instead of gaiting, lying down in the stall, reluctance to move, vagueness as to surroundings, bearing more weight on hind feet, stumbling, falling, hanging the head, wobbling, altered facial expression, and a peculiar stance when standing. Although the horses were seldom exercised in chains more than 15 minutes per day and were not exercised each day because of rain, thrown shoes and weekends, it was apparent that 14 and 16 oz. chains inflict more trauma than 10 oz, chains. Scars can be produced on pasterns with chemicals and chains but despite 2 months of efforts to do so they were small scars and barely discernible in one horse. Thermograms and pressure readings readily distinguish a normal unsore horse from one being treated with chemicals on the pastern and exercised in chains.

Part 2 of Phase X, Effects of Actions Devices on Scars: The objective of the 2nd part of the study was to determine if legal action devices are injurious to the feet and legs of horses bearing scars in that area. Three Tennessee Walking Horses (#11, 13, and 14) with bilateral scars about the pasterns were subjected to studies in which legal action devices were affixed to their pasterns. Fourteen ounce aluminum rollers were used on # 11, 10 oz. chains on # 13 and 8 oz chains on # 14. Horse # 11 had less scar tissue than the other two. He was scarred on the premises with 14 oz. chains prior to this study. The other two horses were purposefully acquired with the scars. Horse # 11, a gelding, was exercised 7/28/80 - 8/1/80 without action devices for the purpose of monitoring his physical condition under normal circumstances. From 8/4 - 8/15 he was exercised 9 times for 20-22 minutes each time in 14 oz. rollers with vaseline as lubricant. From 8/18 - 9/15 he was exercised and monitored seven times to record data on his recovery. Horse # 13, a gelding, was exercised 6/26/80 - 7/11/80 without action devices for monitoring normal conditions. From 7/14 - 7/25 he was exercised and monitored for 15—30 minutes each time in 10 oz. chains. Vaseline was used as a lubricant. From 7/28 — 9/15 he was exercised and monitored 10 times during the recovery period. Horse # 14, a stallion, was exercised and monitored S times 9/15/80 — 9/19/80 without action devices to establish normal physical conditions. He was exercised and monitored nine times 9/22 - 10/3 in 8 oz. chains for 15 minutes each exercise period. Vaseline was used as a lubricant. From 10/6 - 10/22 he was exercised and monitored 12 times during the recovery period. Results of this study showed that all three horses developed raw lesions on the scarred pasterns when exercised in action devices and lubricant. The lesions bled on horses #13 and 14 that exercised in chains. Abnormal thermal patterns developed on the pasterns of the three horses during the

period of exercise in action devices and the drop in pressure readings occurred. Thermal patterns became more regular in appearance and pressure readings increased during the recovery period when the horses were exercised without action devices. Fourteen ounce rollers and 8 and 10 ounce chains will cause raw lesions on scarred pasterns of horses when the horses are exercised 15-30 minutes per day in the devices. Lesions occur in less than 2 weeks, even when the horses are not exercised on weekends. The action devices cause irregular thermal patterns detectable by thermovision, increased sensitivity to pressure on the pasterns, and discomfort and altered gaits visible to observers.

Phase XI. Use of 2, 4 and 6 Ounce Chains

The objectives of this study were to evaluate the use of 2, 4 and 6 ounce chains in Tennessee Walking Horses, without using any other chemical or mechanical technique to induce inflammation. Use of 2, 4 and 6 oz. chains did not cause any detectable pain, tissue damage. Thermographic and pressure evaluation did not change significantly. Thus, it was concluded that the use of 2, 4 and 6 oz. chains for a duration of 2to 3 weeks did not produce any harmful effects to the horses' legs, with exception to some loss of hair from 6 oz. chains in the pastern areas.

Phase XII. Use of Non-Steroid Anti-inflammatory Compounds (Phenylbutazone Flunixin-Meglumine) to Enhance Healing after Soring with Mustard Oil and Chains

In this study horses were sored using mustard oil and 10 oz. chains described previously. Following soring one group of horses were treated with phenylbutazone twice a day and the other group was treated with Flunixin-Meglumine for 5 days. Steroid ointment was also applied locally in the area of inflammation for 5 days. Then treatments were discontinued. Normally it took about 3 to 6 weeks for complete healing after initial induction of inflammation without any treatment with anti—inflammatory compounds. But the use of phenylbutazone (IV) and local application of steroid ointment enhanced healing. Horses on phenylbutazone healed in about 10 days, whereas use of Flunixin—Meglumine use took about 15 days for complete recovery. Enhanced healing effects could actually be seen within 48 to 72 hours after initiation of treatment with anti-inflammatory drugs.

Phase XIII. Evaluation of Dimethyl Sulfoxide (DM50) Alone and In Combination with Gibson's Liniment, Applied to Limbs of Horses

To determine if DM50 alone or mixed with liniment would mask soring or otherwise interfere with thermography so that thermal patterns associated with sored feet and legs would not be detected. Two horses were used in this study. Gibson's liniment, 90% strength

DMS0, and oil of mustard were applied to determine the effects on the forelegs of horses. Thermovision, a Micron, a Carillon pressure device, a rectal thermometer were used to evaluate the effect of above stated compounds. DMSO and Gibson's liament were applied alone and in combination of 1:1 and 1:2 liament-DMSO. Amounts painted onto the legs and feet ranged from 10 to 20 cc. Rear legs and feet were used to increase the number of tests. Ten drops of oil of mustard were applied to the right leg of one horse. Fifteen cc of a 1-2 mixture of liament-DMSO was applied the next day after thermovision confirmed an elevated temperature pattern. Horses were exercised for 4 days and physical condition monitored in a routine manner. The horses were monitored and exercised 7 more times during an 18 day recovery period. Preliminary studies conducted revealed that DMSO, Gibson's liament, and mixtures of the two caused inflammation that was detectable by thermography and that caused a decline in pressure measurements. A study on one horse with DMSO—liament mixture yielded basically the same results. The heat pattern caused by oil of mustard did not subside when DMSO, liament or mixtures were applied. There were no detectable distortions of patterns that might confuse thermographic findings in sore horses.

Phase XIV. Use of Seven Commercial Compounds to Determine if they Can Mask Soring

Studies were done to determine if preparations containing silicone can alter or cover up thermal patterns obtained by thermography. Several Large Animal Clinic horses were used over a period of 5 days to determine the effects of various dilutions of silver nitrate and 5 hair sprays and a boat water-proofing liquid containing silicone. Normal thermal patterns were obtained before the preparations were applied as a spray or with a dauber to the legs and feet. The limbs were observed at different time intervals during the day with a thermovision camera and the next day before the material was washed off. Mustard oil was used on several feet to cause an abnormal thermal pattern. None of the compounds used masked or altered normal or mustard-oil-induced abnormal thermal patterns. Thus it was concluded that silicone containing substances and silver nitrate used in this study did not mask or alter thermal patterns in horses.

Phase XV. Preliminary Studies to Evaluate the Effects of Change in the Heel to Toe Ratio

The objectives of this study were to determine if deviation of hoof angle will alter the gait of Tennessee Walking Horses and to determine if tendonitis or other inflammation were caused by deviation of hoof angle. Two horses, # 22 and # 23 were placed under observation on 4/9/81 and monitored before and after 15-20 minutes of exercise with thermography, pressure device, Micron, rectal thermometer and visually by rider, technician and

veterinarian. Horse # 22 was shod from 'barefoot status to wedges, pads and shoes on 4/13. Horse # 23 had been shod similarly before 4/9/81. On 4/29 the heels of both horses were raised 8 degrees, before exercise and monitoring. On 5/11 the heels were dropped 12 degrees by removing wedges and the horses exercised and monitored. Horses were then exercised and monitored on 10 separate days during the period of 5/12 .6/1. No action devices or chemicals were applied to the feet or legs during the study.
Thermography study suggests that shoeing of the forefeet in pads and wedges from a barefoot status (horse # 20) causes a 1—2 degree rise in temperature in the superficial and deep flexor tendon area. Similarly, inflammation in this area was observed on thermography when the angle of the hoof was raised or lowered (both horses). When the heels were lowered on 5/11 and observed until 6/1 there was a gradual decrease of inflammation in the f1exor tendon area.
Pressure readings taken at the usual 6 points on the foot fluctuated to a minor degree, reaching their lowest levels 2 days after the heels were elevated 8 degrees in both horses. Raising the heels 8 degrees caused both horses to stumble and tire easily. They did not regain a sound gait for about 7 days. When the heels were dropped 12 degrees the horses gaited more soundly although there was swelling in the flexor tendons for about 7 days. Raising or lowering the heels of Tennessee Walking Horses and shoeing one with wedges and pads from barefoot status causes thermal patterns in the flexor tendon area that can be distinguished on thermography. These changes cause less fluctuation in pressure readings than the use of action devices or chemicals. Inflammation subsides about one week after the heels are raised or lowered 8 and 12 degrees respectively. Raising the heel causes a more observable change in the horses' gait than lowering the heel after it has been raised.

Phase XVI. Pressure Shoeing

Two horses were used for pressure shoeing technique. Horses' gaits can be altered by pressure shoeing. The degree of soreness from pressure shoeing depended on the techniques used. Soreness from pressure shoeing was not detectable in the pastern areas by physical examination or by thermographic technique in all cases, because pads obscure the solar surface of the foot. But obtaining thermographs of the sole after removal of pads, soreness was obvious due to inflicted inflammation to the solar surface of the foot.

Phase XVII. Comparison of Pressure Data Between Pelvic and Thoracic Limbs Before and After Exercise for 5 Continuous Days

The studies were done to evaluate the six point pressure data of the coronary band and pastern areas of both pelvic (hind) and thoracic (front) limbs in 6 horses to determine the variation in the front and back legs. there were no significant differences in pressure

data from the front to the back legs of these horses. Pressure values averaged between 30 to 40 psi, before and after exercise in all normal horses. Whereas in horses where acute inflammation was induced by chemical or physical means significant decrease in pressure values were recorded.

Phase XVIII. A Field Trial with 8 Horses in Murfreesboro, Tennessee, to Evaluate the Pressure Device, Micron Temperature along with Thermography

This study was done using 8 Walking Horses brought during the month of June, 9-11, 1981. Horses were brought in by owners and/or trainers for this study. A 3 day trial was performed in which all horses were examined before and after exercise by 3 veterinarians and 1 DQP. In some cases as many as 4 to 5 veterinarians may have examined these horses. Each individual was requested to submit his own report without consultation with others, to Dr. Purohit for final compiling of the data. After examination by the DQP and veterinarians, thermographic evaluation was done before and after exercise. The pressure data on the pastern area were collected, and a hand-held infrared gun was used to determine the temperature of the legs. Owners were allowed to use 10 oz. legal chains, but they were asked not to notify us if they used any chemical or other technique to sore the horse. During the 3 days of this study, 3 horses at one time or another did show sensitivity to the physical examination and the same horses were classified as having inflammatory reaction on thermography and pressure device. Whereas 4 horses were not considered sore by all criteria used in' this study. Thermography technique was able to detect inflammation, on 2 horses even before they were exercised on day 1. Of the 3 sored horses 2 showed only selected areas of inflammation. One horse by day 3 showed acute inflammation on thermography. This horse was used with 10 oz. chains. Of the 8 horses, 1 horse in this study was very difficult to handle and several veterinarians and 1 DQP had considerable difficulty in examining this animal. The difficulty extended even to the point of the horse not allowing the use of the infrared Mikron thermometer. This horse had normal pressures on day 1 before exercise, with exception to the pocket and bulb of the heels, which were sore both on pressure and thermography technique. There was an excessive drop in pressure after exercise on day 1. Thereafter, the only sensitive areas noted were the backs of both front legs, especially in the pocket and the bulb of the heels. It was concluded that 3 of the 8 horses were sore, 1 was questionable, and 4 were considered not sore. There were some discrepancies among veterinarians, but after overall evaluations, only 1 horse which was questionable created the controversy, due more to the behavior of the horse.

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