Factors associated with arthritis in horses.

Acknowledgement

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Sammanfattning

Ledproblem, under vilket kotledsinflammation faller in, är ett mycket vanligt problem bland svenska ridhästar. Av de sjuka, försäkrade hästarna som slås ut, slås 56-57% ut på grund av problem med skelettmuskulaturen. Av dessa har 45 % problem med lederna. Kotledsinflammationer orsakas av en rad faktorer såsom träning, skoning och hästens exteriör. Hur och i vilken utsträckning dessa faktorer påverkar uppkomsten av skadan är dock osäkert och för att få inblick i detta utfördes en pilotstudie med syftet att finna vad som ligger bakom uppkomsten av kotledsinflammation. Studien bygger på en enkätundersökning som skickades ut till 200 hästägare i Agrias databas. Hälften har hästarna har fått diagnosen kotledsproblem, vilket den andra hälften inte har. Den sist nämnda hästgruppen utgör därigenom kontrollgrupp.

Svarsfrekvensen var olyckligtvis låg, 42% totalt sett, vilket gör resultaten osäkra. I kontrollgruppen svarade 51% och i gruppen med skadade hästar 33%. Hur hästen tränas, både som ung och senare i livet, tycks påverka uppkomsten av kotledsinflammation. Hästarna i den friska gruppen reds längre tid vid varje ridtillfälle och hoppades dessutom oftare. Vad gäller ryttarna fanns det fler fälttävlansryttare i gruppen med skadade hästar jämfört med i kontrollgruppen. Vidare hade signifikant fler skadade hästar deltagit i kvalitetsbedömningen. Osäkerheten i studien är emmellertid stor, dels på grund av den låga svarsfrekvensen, men också för att det är omöjligt att avgöra huruvida ägarna till de sjuka hästarna har uppgett hur dessa trändes innan skadan uppkom eller hur de tränades när studien utfördes. Detta innebär att svaren kan stå för hur hur hästen tränades efter att den varit skadad, vilket är ointressant. Det är förhållanden innan skadan uppstod som är relevanta, då de kan ha orskat denna. De skillnader som avslöjats i studien kan således bero på att hästen har varit skakdad.

Abstract

The reason for culling 56-57% of the unhealthy insured Swedish warmblooded horses was diseases in the musculoskeletal system. Of those 45 % had joint problems (Wallin *et al*. 2000a.). Arthritis in the fetlock belongs to diseases of the joints and is probably caused by a number of factors, such as training, housing, shoeing and conformation of the horse. How and to which extent theses factors influence the development of the disease is however uncertain and were therefore investigated in a pilot study. Questionnaire was sent to 200 horse owners, of which 100 had claimed insurance compensation for arthritis in the fetlock. The remaining 100 horse owners was used as a control group and their horses had never achieved the diagnosis arthritis. The results from this study, as well as a literature research on the subject, are accounted for in this paper.

Unfortunately the response rate was low, 42% in total, and therefore the results are uncertain. In the control group 51% returned the questionnaire and 33% in the group with injured horses. The training of the horse, both when young and later in life, seems to influence the development of the injury. It was seen that healthy horses was ridden for a longer period of time at each occasion and jumped more often. Concerning the riders more cross country riders had unhealthy horses. A significant result was found in regard to participation in the Swedish Riding Horse Quality Test, where more injured horses had participated. The uncertainty in the study is however large, partly depending on the low response rate, but also because it is impossible the determine whether the questionnaires are filled in according to how the horses in the injured group were trained before the injury was detected or according to how they were trained when the study was performed. This means that the answers from this group may account for the circumstances after the injury was detected and not for how the horse was housed, fed and trained in relation to the injury. Therefore the differences found in the study can be due to the fact that the horses had been injured.

Table of contents

Introduction

The horse has a long productive life compared to farm animals and a riding horse reaches its maximum potential at an age of 10-15 years. Very much time and money are spent on keeping and training horses. An injury is expensive from an economical point of view but also when considering the time it takes for recovery, time when the horse could have been training and in some cases competing (Wallin *et al*., 2000b). Seen from an ethical point of view it is also necessary that our horses are healthy. Many horses are not kept only for competition but for company and exercise and their owners feel a great affection for their animals. Consequently it is important that our horses live a long and healthy life and that efforts are made to avoid injuries.

When considering the reasons for culling unhealthy horses it was found that 56-57% of the culled, insured Swedish warmblooded horses was culled due to diseases in the musculoskeletal system. Of those 45 % had problems with the joints (Wallin *et al*. 2000a.). Inflammation of the joint and degradation of it falls under the diagnosis arthritis, which is a significant problem in athletic horses (McIlwraith, 1995). Arthritis can be found in many of the horses' joints and are commonly found in the carpal, fetlock, coffin and tarsal joints (Skiöldebrand & Sandgren, 1995) and affect most structures in the joint. Management, training and conformation of the horse are factors believed to affect the development of arthritis (Skiöldebrand & Sandgren, 1995; Stashak, 1987; Björck, 1983).

In this study arthritis will be examined in form of a questionnaire sent to horse owners in Agria's database who have claimed insurance compensation for arthritis in the fetlock. The management and training etc of these horses will be compared to a control group, consisting of horses that never have achieved the diagnosis arthritis. Focus is also put on the rider, what knowledge he/she has in horse management, feeding and riding. The aim of the study is to find factors associated with arthritis in the fetlock.

Literature

The fetlock joint *(Articulatio metacarpophalangea)*

The joints are, together with the muscles and tendons, the structures that make movement of the body possible by allowing the stiff skeletal bone to move in relation to each other. The demands of the joints are high; to allow the horse to move fast they are supposed to give maximal flexibility, but maximal stability is also necessary to prevent the big body of the horse from collapsing (Dalin, 1987). The stress on the fetlock is high. The speed in which the fetlock moves during a trotting race, 9,2 m/s, can be mentioned as an example of this. The fetlock joint is a hinge joint, which means that movement only can occur in one plane, that is flexion and extension. Some rotation and sideward movement can however occur in the fetlock joint (Dalin, 1987).

The fetlock joint consists of the distal part of the canon bone, the proximal part of the proximal phalanx and the proximal sesamoids (figure 1). The ligaments, which support the fetlock joint, are the collateral ligaments of the fetlock and the collateral ligaments of the sesamoids. Furthermore the interosseus muscle supports the fetlock joint and it also prevents too big break throw. The two different branches of the interosseus muscle attaches partly at each sesamoid lateral surface and the continuous parts pass the joint and attach in the surroundings of the pastern joint. There is also a lower interosseus muscle, which mainly supports the sesamoids (Stashak, 1987) (figure 2).

In a synovial joint, like the fetlock joint, many types of tissues are found; bone, cartilage and fluid (figure 3). The joint cavity is constricted by the joint capsule and the articular surfaces. In the cavity there is synovial fluid. The articular surfaces are formed in a way that makes them fit together and they are covered with articular cartilage (Dalin, 1987).

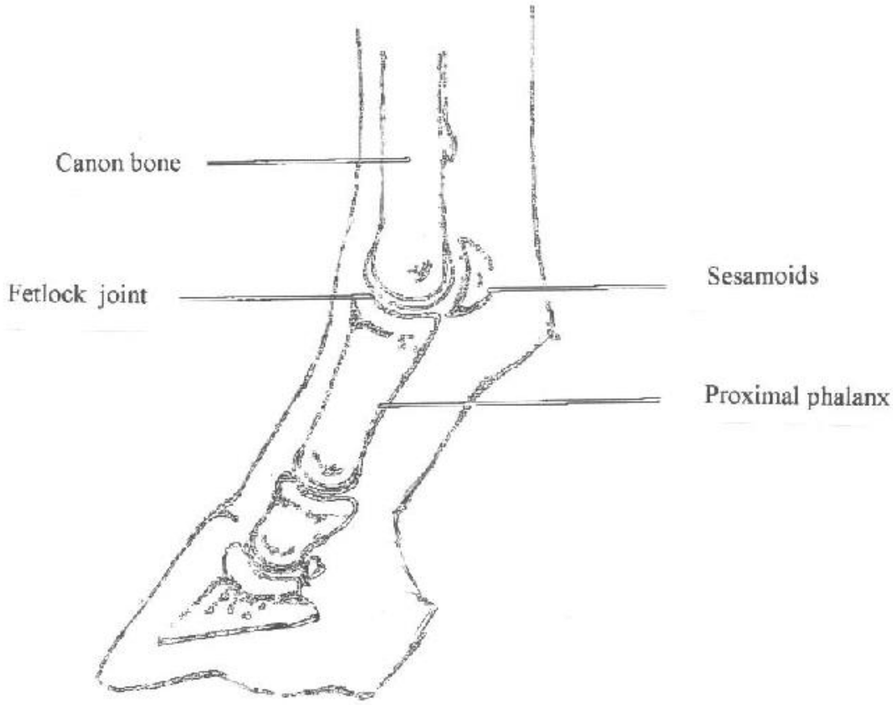

Figure 1. The fetlock joint (Sandgren, 1990)

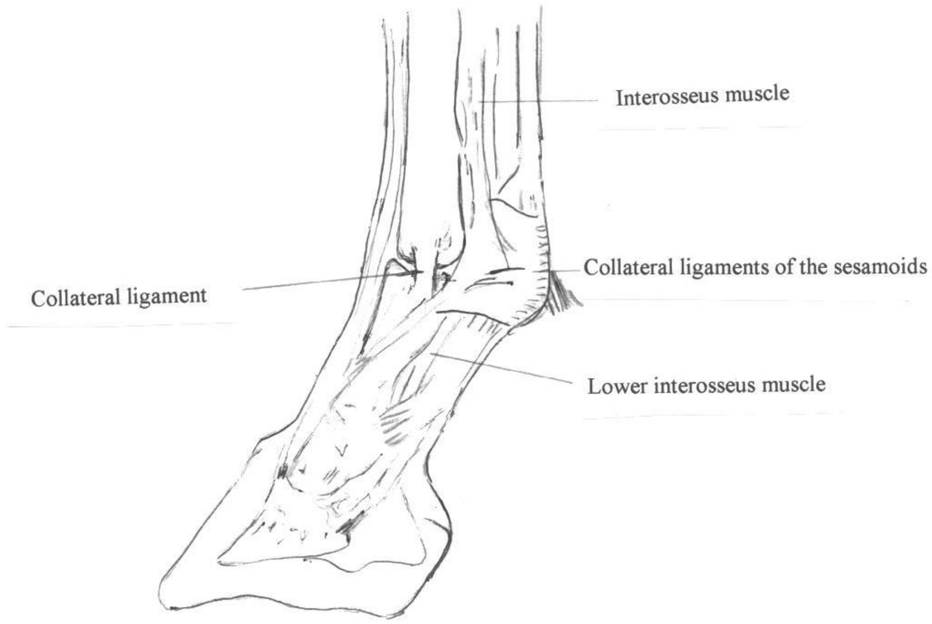

Figure 2. The supporting structures of the fetlock joint (Sandgren, 1990)

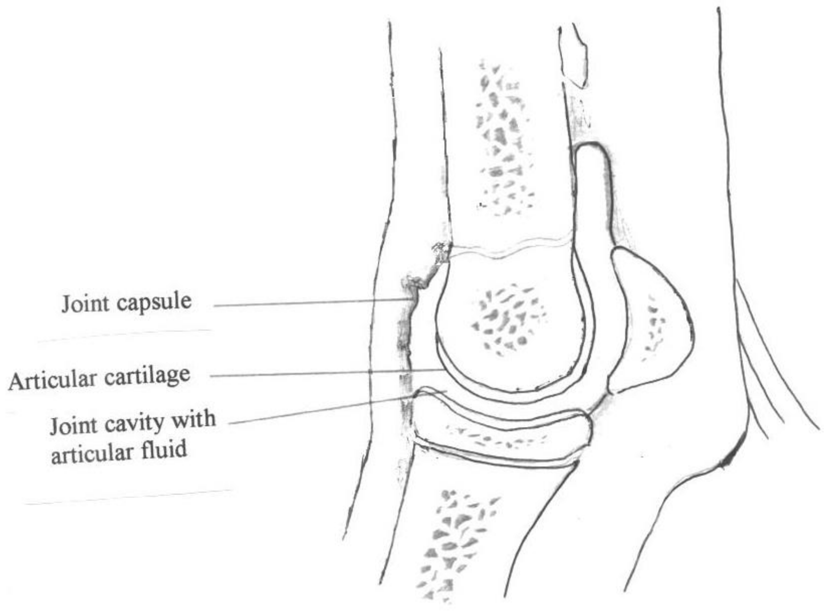

Figure 3. The synovial joint (Sandgren, 1990)

<u>The joint capsule</u>

The joint capsule attaches around the articular surfaces and restricts the joint from the surrounding structures. There are many blood vessels in this structure, which supports the different structures of the joint with nutrients. There is also a rich innervation of the joint capsule (Stashak, 1987).

The joint capsule consists of two different parts, which differ both structurally and functionally. The inner structure is the *synovial membrane,* which covers all structures in the joint cavity, except the articular cartilage (Dalin, 1987). Synoviocytes, cells of great importance to the biochemical environment in the joint capsule, are found in this membrane. These cells perform fagocytos of unwanted materials and regulate the protein and hyaluronate content of the synovial fluid (Stashak, 1987).

The fibrous joint capsule is the outer layer of the joint capsule and it is build up by collagen. Its main function is to give support to the joint capsule. It passes on into the periosteum of the bone, which gives a good fixation of the joint capsule to the bone. In the fibrous layer most of the nerves of the joint capsule is found, which makes this structure very sensitive to pain compared to the synovial membrane (Stashak, 1987).

When the joint moves the joint capsule must be flexible and able to stretch on one side and contract on the other. Gathering of the syvovial membrane can be seen dorsally when the joint is extended and palmarly/plantarly when it is flexed. The term redundancy refers to the ability of the synovial membrane to gather when the joint is extended or flexed (Stashak, 1987).

<u>The articular cartilage</u>
The articular cartilage covers the articular surfaces where the mechanical stress is as highest. To be able to endure the stress that the articular cartilage is put to, it lacks nerves and is thereby insensitive to pain. It also lacks blood vessels, which makes it total dependent of the nutrients coming from the joint capsule via the synovial fluid (Dalin, 1987). The articular cartilage can be compressed to half of it original size without being damaged, but further compression gives damages that are hard or impossible to repair.

Cartilage is connective tissue, consisting of chondrocytes and extracellular matrix (Ekman, 1995). The chondrocytes produce the compounds building up the matrix; collagen type II, proteoglycans and natrium hyalurante (Dalin, 1987). There are also small amounts of other compounds in the matrix, for example decorin, fibromodulin, PG-S1 (so called small proteoglycans), collagens type VI, IX, X and XI, cartilage oligomeric matrix protein, cartilage matrix protein, fibronectin, thrombospondin, osteonectin and collagen II carboxyl-terminal propeptide (Ekman, 1995). The amount of water in the matrix is high, 60-80% (Dalin, 1987). The metabolism of cartilage includes a continuous turnover of the molecules that build up the cartilage. Catabolic and anabolic process are therefore active all the time. Sometimes the balance between these two is altered, for example after exercise or injury (Ekman, 1995).

The collagen type II part makes up the largest amount of dry matter content in the cartilage. The main function of the collagen is to give strength. Collagen constitutes a network, where the proteoglycans are imbedded. The proteoglycans forms big aggregates with a molecule weight of one to four millions u. They are built up around a protein chain to which a great number of side chains are bound. The side chains are often made up of chondroitin sulfate and kertan sulfate. These compounds belong to the group glucosaminoglycanes, to which natrium hyaluronate also belong. Further the proteoglycans are bound to long natrium hyaluronate molecules. The side chains are negatively charged which make the proteoglycanes repel each other and thereby the complex tries to spread over an area as big as possible. This gives the cartilages its elastical properties. When the cartilage is compressed the fluid fraction in the cartilage is pressed out from the articular surface and the negative charges of the proteoglycanes gets closer to each other, which slows down the compression (Dalin, 1987).

The fact that the fluid fraction continuously is pressed out from the articular cartilage and sucked back again is crucial to the nutrition of the cartilage. When the compressing force declines the fluid fraction is sucked back in the cartilages again and this pump mechanism supply the chondrocytes with nutrients. The lack of blood vessels in the cartilage makes this the only way for the chondrocytes to get nutrients (Dalin, 1987). The properties of the synovial fluid is therefore of importance to the nutrition of the articular cartilage and if the composition of the synovial fluid change it will thus affect the nutrition of the articular cartilage.

<u>The synovial fluid</u>
One important function of the synovial fluid is to lubricate the joint and thereby reduce the friction arising when the joint is moving. Another is to function as a barrier to compounds that aren't supposed to get into the joint cavity (Stashak, 1987).

The synovial fluid is build up by natrium hyaluronate produced by the synoviocytes and materials coming from the blood vessels in the synovial membrane. Dalin (1987) equals synovial fluid with dialysate of bloodplasma with a supply of hyaluronate. Natrium hyaluronate has a high molecule weight and the long hyaluronate molecules wind around each other and form a network. This network function as a filter, where small molecules, for example glucose and electrolytes, can pass, but larger molecules, for example blood cells, are stopped (Dalin, 1987; Skiöldebrand & Sandgren, 1995). This filter protects the structures in the joint cavity from break down by leukocytes. Skiöldebrand and Sandgren (1995) points at the important properties of hyaluronic acid in the synovial fluid, as it also is responsible for the viscoelasity.

Traumatic arthritis

Traumatic arthritis includes synovitis, capsulitis, desmitis, direct articular damage, osteochondral fragmentation, ligamentous tearing and osteoasthritis (Skiöldebrand & Sandgren, 1995; McIlwraith, 1995). Stashak (1987) simply defines it as " inflammation of a joint". He divides it into three types.
1. Traumatic arthritis and capsulitis without
disturbance of articular cartilage and disruption of major supporting structures.
2. Disruptive trauma with damage to the articular cartilage or complete rupture of major supporting structures
3. Posttraumatic degenerative joint disease.

Traumatic arthritis is caused either by an acute injury or the result of a repeated trauma, which triggers different reactions that changes the biochemical environment in the joint (McIlwraith, 1995; Stashak, 1987). A dislocation of the fetlock is an example of a direct trauma that can cause the disease (Stashak, 1987). Another cause to an inflammation is damage to the articular cartilage, which starts processes that can lead to synovitis or capsulitis.

<u>Synovitis/Capsulitis</u>
Inflammatory processes in the soft tissues of the joint are often found in the synovial membrane (synovitis) or in the whole joint capsule (capsulitis). These two conditions are often associated with a repeated trauma. Capsulitis can often been seen as a result of

synovitis, but this is not always the case (Stashak, 1987). If the fibrous joint capsule is severely injured this can cause instability in the joint (McIlwraith, 1995). The inflammation process often arises where the fibrous layer attaches to the bone, which in many cases means that the bone also is affected (Stashak, 1987). Inflammations in the fibrous layer of the joint capsule cause pain because there are many nerves in this area. In the synovial membrane on the other hand there aren't as many nerves as in the fibrous layer and a consequence of this is that a small infammation in the synovial membrane can pass unnoticed, as the horse doesn't show any signs of pain (Stashak, 1987). The synovial membrane is not a stabilizing structure and damage here can for example affect the diffusion across the membrane (McIlwraith, 1995). Further the redundancy of the synovial membrane can be impeded by inflammation in this structure (Stashak, 1987).

Synoviocytes in the synovial membrane that are damaged mechanically can release degraditative enzymes and cytokines, which alter the biochemical environment in the joint. The enzymes produced have been shown to be active to both collagen and proteoglycans. Metalloproteinases are considered to be active in extracellular matrix degradation. Examples of metalloproteinases are collagenase, stromelysin and gelatinase. Substrate for collagenase is collagen and for stomelysin it is proteoglycans and some types of collagen. Stromelysin also activate procollagenase to collagenase. Some types of collagen, fibronectin and elastin are degraded by gelatinase. Normally there is a delicate balance between activators and inhibitors of the enzymes previously discussed. This balance can be disturbed by for example synovitis and the imbalance will affect the joint (McIlwraith, 1995). Further synovitis can lead to release of potent lysosomal enzymes to the environment (Stashak, 1987).

Due to increased permeability of the synovial membrane and increased protein synthesis of the synoviocytes synovial effusions can occur. The biochemical environment in the joint will be altered because of changes in protein content and composition (Stashak, 1987). Synovial effusions can also cause a higher intraarticular pressure and thus impair the blood supply of the joint. It is suggested that tension of a joint put under high pressure from an effusion can lead to the formation of oxygen-derived free radicals. These radicals are believed to cleave hyaluronic acid and proteoglycans. It also degrades collagen (McIlwraith, 1995). As a result of the degradation of hyaluronic acid the barrier function is affected, which means that compounds that normally should be kept outside the joint cavity, for example granulocyter, can get in (Stashak, 1987). If the blood is shunted it will affect the nutrient supply and decreased levels of oxygen can be seen (Stashak, 1987).

Changes of the synovial fluid in appearance, viscosity and protein content can be seen when the horse in affected by a joint disease. Clot formation, which do not appear in normal synovial fluid from a healthy horse, is one example. The reduction in viscosity of the synovial fluid leads to a lower lubrication effect (Stashak, 1987). The total amount of protein increases, probably due to leakage over the synovial membrane (Thorén-Tollinig *et al*., 1983).

<u>Osteoarthritis</u>
Inflammations in the soft tissues around the joint (for example synovitis and capsulitis), which are in progress for a long time, are believed to cause osteoarthritis (McIlwraith, 1995). Osteoarthritis can also be caused by a direct trauma to the articular cartilage. Osteoarthritis means destruction of the articular cartilage and leads to a decrease in the joint cavity.The articular cartilage is broken down by enzymes produced by the chondrocytes or the synoviocytes. Inflammatory joint diseases are, as mentioned above, believed to be an important mechanism when this happens. Cytokines, such as interleukin 1 and tumor necrosis

factor, are released from the synovium and stimulate the degradative activity of the chondrocytes (Lohmander, 1995). Prostaglandin E2 is also produced in inflamed joints. This compound impairs the articular cartilage by lowering the content of proteoglycans. Other effects of prostaglandin E2 is according to McIlwraith (1995) vasodilatation, enhancement of pain perception and bone demineralisation.

When the proteoglycans are broken down the elasticity is deteriorated. A consequence of this is that the pump mechanism, which supplies the articular cartilage with nutrients, is impeded. Lack of nutrients means that the chondrocytes aren't able to produce materials for the extracellular matrix in the same rate it is broken down. McIlwraith (1995) states that "avoidance of this change (destruction of extracellular matrix of articular cartilage) is one of the significant aims of treatment of any case of synovitis".

The diagnosis osteoarthritis is based on radiology and can only be made late in the disease. However, the disease is initiated long before the diagnosis is made and the earlier the treatment can begin the better. Therefore it is of importance to find the disease at an early stage. Another thing, which makes it necessary to find and stop the disease as soon as possible, is that the healing capacity of articular cartilage is poor (Stashak, 1987; Lohmander, 1995). However, Lohmander (1995) states that some cartilage regeneration can be seen in humans. One way of reveal breakdown of articular cartilage at an early stage in humans could according to Lohmander (1995) be to look for products from the breakdown in synovial fluid and perhaps even in other body fluids. Compounds that can be used as markers are for example glucosaminoglycans, hyaluronan, kertan sulfate, chondroition sulfate and proteoglycans. He emphasizes that a large variation between individuals among humans can be seen.

Lohmander (1995) means that the development of osteoarthritis has a multfactorial background. Genetics, joint malalignment, joint overload, trauma, obesity and aging are factors suspected to influence the development of osteoarthritis in humans.

<u>Symptoms of arthritis</u>

Acute arthritis is often connected with an evident lameness, but if it is chronic and/or both legs affected the lameness can be harder to notice. Signs of arthritis are swelling of the joint and in some cases sensitiveness to palpation and flexion (Stashak, 1987). Furthermore a synovial effusion can be caused by an inflammation in the joints. A synovial effusion means an increase in the amount of synovial fluid and doesn't necessarily mean something is wrong. A synovial effusion can be due to many different things, for example circulation disturbances because the horse spends much of its time standing still in the box. These effusions often disappear when the horse are allowed to move, ridden or let out in a paddock. Synovial effusions can also be a response to the work the horse has performed. If the effusion however arise in connection with swelling of the joint, warmth and pain this is a sign something is wrong. It is however important to know that big variations between animals regarding the amounts of synovial fluid in the joints can be seen (Dalin, 1987).

<u>Treatment of arthritis</u>

It is generally agreed that arthritis must be treated as early as possible for best result (Stashak, 1987; Lohmander, 1995). The main aim when treating synovitis is according to McIlwraith (1995) to reduce the immediate effects of the inflammation process by reduce pain and promote deteriorated flexibility of the joint. It is also of importance to promote permanent fibrosis. As previously discussed osteoarthritis is a possible consequence of inflamed joints and it is important to prevent the development of this degenerative joint disease. When doing this it is often spoken about "chondroprotection", sustaining chondrocyte metabolic activity and in the same time suppress processes and compounds that are harmful to the articular cartilage (McIlwraith, 1995).

Rest and immobilization is crucial when archieving the diagnosis arthritis (Stashak, 1987). It is however important that the horse is allowed to move daily partly because the articular cartilage is dependant of movement for its nutrition (Dalin, 1987), but also because muscle artrophy and adhesion formation within the joint are possible effects of a long period of immobilisation (Stashak, 1987).

Treatment of inflamed joints often includes intraarticular injections of hyaluronic acids. Effects of hyaluronic acid is said to be improved lubrication of the joint and regulation of permeability. It also stimulates the synoviocytes to increase the production of endogenous hyaluronic acid and the nutrient supply to the articular cartilage is improved. Hyaluronic acid also has anti-inflammatory effects by inhibiting phagocytic activity of granulocytes and lymphocyte activity. The release of prostaglandins and free radicals reduces and interleukin-I is inhibited (Skiöldebrand & Sandgren, 1995). Skiöldebrand and Sandgren (1995) examined the effects of intraarticular injection of hyaluronic acid and found that several inflammatory parameters were lowered. In their study some horses with symptoms of acute arthritis were treated with hyaluronic acid and some were not. It was found that horses that had been treated were capable to perform again after 3-4 weeks after the treatment without recurrence of lameness. The horses that weren't treated showed lameness after one week of training.

Intraarticular injections of corticosteroids are also common when treating arthritis. The major effect of corticosteroids is anti inflammatoric (Svanholm & Myrin, 1986).

Factors involved in the development of arthritis

Besides a direct trauma arthritis can develop as a result of many different things. There are several factors believed to be involved in the development of the disease: the training program, riding on unsuitable grounds, wrong performed shoeing and the conformation of the horse.

Training

Training and how it is performed is an important factor in the development of arthritis (Skiöldebrand & Sandgren, 1995; Björck *et al*., 1983). When Stashak (1987) discusses synovitis and capsulitis he refers to "use-traumas", indicating the injury in many cases is caused by the training of the horse. How large the damage to the joint will become depends on the duration and the intensity of the work the horse performs (Skiöldebrand & Sandgren, 1995). Jeffcott (1990) states that; "The principle aim of any training programme is to condition all the systems of the body to maximum athletic performance whilst achieving the minimum of damage." The question is how to accomplish this.

Skeletal bone is a dynamic issue, which undergoes continuous changes to give optimal strength and adapt to external forces. When the horse is trained and thus the demands of the bones and joints increase the body will respond by strengthen the skeleton (bone remodelling). This can be seen as an increase in bone density and low bone porosity (Jeffcott, 1990). The same applies for the opposite situation, when training load is decreased the bones decrease in density and increase in porosity. To maintain the training effect of the joints, it is thus recommended to exercise the horse daily. A to intense training program can however give pathological changes to the joints (Jefcott, 1990). It is therefore of importance to slowly increase the training load and thus give the skeletal bone a chance to adapt to the new requirements.

Magnusson (1985) states that horses are build for movements straight forward and not for sharp turns. He builds this statement on the fact that trotters were found to have more injuries in the left leg than in the right. He means that this is a consequence of the fact that trotters always runs in the same way when racing, which means that the stress on the inner (left) legs is higher. This theory is also supported by Drevemo (1986). He writes that the left leg is warmer than the right after a run, when measured termographically

It is found that the content and viscosity of the synovial fluid is changed in some situations for example when the horse is exercised or has a joint injury. (Whitton *et al*., 1995). Whitton *et al.* (1995) examined the effect of hard training on the midcarpal joints by letting horses undergo a hard training program of 31 weeks duration on a treadmill. They found that all horses showed signs of lameness when the training period was over. The levels of protein and xanthochromia were elevated. These two parameters were also significantly correlated with lameness. High levels of protein indicate synovitis. The level of xantochromia indicates a previous bleading, most likely in the synovial membrane. Furthermore there was a weak but significant correlation between total PSGAGs (polysulphated glucosaminoglycan) and the degree of cartilage damage at post mortem. Declination of PSGAGs is probably due to depletion of the cartilage proteoglycan. However, in this study the horses were trained more intense and prolonged than a normal racehorse is.

There is also a training effect on articular cartilage. When the horse is trained the cartilage increase in thickness and the pump mechanism, which supply the cartilage with nutrients, gets more efficient. If the training load however is increased to fast the effects will be the opposite and the function of the cartilage deteriorated (Dalin, 1987).

In a study carried out by Vigre *et al* (2002) factors influencing the risk of lameness in Danish Standardbred trotters were investigated. In the study 265 horses in training was monitored during five months. During this period 26 % of them interrupted the training program at least one time due to lameness. The most frequently cause to the lameness was joint problems and 39 % of them were located to the fetlocks. Age, sex, trainer of the horse and participation in races influenced the hazard of lameness. More geldings than mares became lame as did three years old horses compared to horses older than four years old. Some trainers had a higher frequency of injured horses than other. The risk of becoming lame was higher in the five days after a race.

Equine sports grounds

Many authors (Björck *et al*., 1983; Fredriksson *et al*., 1983) mean that the ground, on which the horse is trained, is of importance but little is done to investigate how. However Drevemo and Hjertén (1986 and 1987) has put some effort in this area.

When the hoof reaches the ground different forces arise between the hoof and the ground. The vertical load force mostly depends on the weight of the horse and the speed in which the horse is moving. This means that little can be done to minimize this force except lowering the speed and when considering for example racehorses this is not the purpose. There is also a vertical chock force that arises in the beginning of the stance phase. The size of this force depends on how hard the ground is, in which speed the hoof touches the ground and the angel of the leg when touching the ground. The only factor that is possible is to influence of these is the hardness of the tracks and riding schools. The chock force generates chock waves in the extremities. In humans it has been shown that exhaustion reduces the normal capacity of the leg to reduce the chock waves with 30 %. It is also believed that a combination of exhaustion and repetitive impact forces can cause changes in the synovial fluid, changes in the articular cartilage and osteoarthritis. It is therefore of importance to minimize the shock forces and this can in reality only be done by optimise the properties of the equine sports grounds (Drevemo, 1987). Hard tracks have been shown to give more injuries to the moving apparatus than soft ones do (Cheney *et al*., 1973). However, to thick and loose grounds increase the risk of strain and acute soreness of muscles (Drevemo & Hjertén, 1990).

Drevemo and Hjertén (1986) studied what material is best suited to be used when constructing a trotting track and they found that a layer of chippings from forestry under a thin layer of soil had shock absorbing properties. In a questionnaire study to trainers of racehorse chippings from forestry were considered to be the most lenient ground, compared to grass tracks and dirt tracks (Fredricsson *et al*., 1983). Often too much attention is paid to the top layer when it is the layer beneath that is of importance (Drevemo & Hjertén, 1990). One problem, according to Drevemo and Hjertén (1990), when considering how to construct good equine sports grounds, is that there are no "reliable quantitative data describing track properties and their importance for horse health and performance." A good equine sports ground is shock absorbing, bearing, good drainage, smooth, not slippery, free from irregularities and provides a limited forward sliding at impact (Drevemo and Hjertén, 1990). Another thing worth considering when constructing a racing track is how to dose the curves and how to construct the transitions between the curves and the straight stretches (Drevemo, 1987).

Conformation

That the conformation of the animal is correlated to the longevity is well known. In cattle as well as in swine there are much research carried out in this area. It is seen that several conformation traits are correlated with longevity in this two species (Cederberg, 1999; Vollema, 1996). Cederberg (1999) states that in sows "the effect of leg quality was one (of the conformation traits) that had the greatest influence on longevity." The heritability of conformation traits is believed to be high, which means that selection of animals with a favourable conformation will be advantageous (Magnusson, 1985).

There are conformation traits in horses, which are believed to be correlated with longevity. Example of such a trait is if the horse is tied in at the knees (further reading; Magnusson, 1985). Eleven percent of the injuries in a study carried out by Magnusson (1985) could be explained by conformational characteristics. Unfavourable conformation leads to higher stress on parts on the legs and when the horse is trained the stress is increased which can lead to the development of an injury.

Wallin *et al*. (2000b) have investigated how the conformation, correctness of legs (also included in conformation) and orthopaedic status of horses that participated in the Swedish Riding Horse Quality Test influenced the horses' longevity. It was found that all three parameters were significantly correlated with longevity. However, Wallin *et al*. (2000b), states that low scoring on these traits "doesn't make the horse unsound itself, but it could predispose the horse to disease later in life." The authors also points at the fact that the orthopaedic status of horses as young as four-year-olds, which only have been in training for about a year, can be a good measurement of longevity.

Holmström (1994) have investigated how the conformation of the horse influences performance later in life and they have found that a favourable conformation makes the possibility of succeeding larger. This statement is also supported by Magnusson (1985). Holmström (1994) further discuss the difficulties of judging the conformation, which traditionally is based on subjective judgements. He states that quantitative measurements, such as different angels of the bones for example the leaning of the scapula and elbow, could be used.

Shoeing

Correct performed shoeing is of importance to keep the horse healthy (Brega, 1995; Stashak, 1987). How to shoe a specific horse depends on a number of factors such as, conformation of the legs, how the horse moves and what the horse is used for (Stashak, 1987). Incorrect shoeing, for example if the hoof pastern axis is broken, will increase the stress on the joints and can thus cause problems (Brega, 1995). Furthermore long toes prolong the break-over phase and thus increase the stress on the fetlock. To prevent this a horse with the diagnosis arthritis should have a short, rolled toes and high heels (Brega, 1995). There are a number of different corrective shoes that can be used to facilitate break-over, for example shoes called "Roller Toe". Soles of chock absorbing materials can also be used to decrease the chock forces in the leg (Stashak, 1987).

Personality of the rider

It is possible that injuries occur because the owner has put its horse at risk. Some riders may be more likely to put their horse at risk than others as the case is in car driving, where it has been found that some drivers, for example young males, are more likely to have an accident than others (Underwood, 1997; Jonah, 1997; Rothengatter, 1999). Sensation seeking is a well known phenonomen and Jonah (1997) defines it as "the need for varied, novel and complex sensations and experience and the willingness to take physical and social risk for the sake of such experience". Example of sensation seeking behaviour in car driving are drinking and driving, non-use of seat bealts and speeding. It said that a "man lives as he drive" (Underwood, 1997) maybe you could say that a man/woman rides as he/she lives?

It is also known that personality of person who handle the animals influence the animals' performance. It has for example been shown that performance in a herd of dairy cows changes if there is a change of keeper (Seabrook, 1986). When comparing different herds living in similar systems it is found that the performance (measured as daily milk yield or daily live-weight gain) differs between the herds (Seabrook, 1986; Hemsworth *et al*., 1986). When using personality assessment techniques to study the workers, differences in personality between them were found. An important task for a good keeper is to discover small differences in the behaviour of the animal(s), a sign that something may be wrong (Seabrook, 1986).

Material and methods

Questionnaire was first constructed with starting point in factors described in the literature believed to cause arthritis. However, during this process it was found that another questionnaire about arthritis already was performed, but not analysed. In order to avoid duplication of that questionnaire and to be able to use a second questionnaire as a supplement to the first one it was decided to analyse the latter one. That questionnaire was carried out in 2002.

That questionnaire (appendix 1) was develop from the following hypotheses:

- How and where the training of the horse is performed is likely to affect the development of arthritis.
- Some horses are more likely to be injured than others, depending on for example conformation.
- Type of management, housing and feeding, both when young and later in life, is likely to influence the development of arthritis
- The horse owners' knowledge in how to house, feed and ride a horse probably affect the development of arthritis.

The questionnaire was divided into different sections with the following content:

A. General questions about the horse
B. General questions about the owner to the horse
C. Training of the horse
D. Feeding
E. Shoeing
F. Housing
G. Conformation
H. Housing and feeding when the horse was young

The horse owners with an injured horse also filled in a section concerning the injury.

During the summer of 2002 200 questionnaires had been sent out. Half of these were sent to persons in Agria's database, who had claimed insurance compensation for arthritis in the fetlock and the other half to insurance takers who had not claimed insurance compensation. The last half was used as a control group.

Result

Of the 200 questionnaires 84 were returned which gave a total response rate of 42 %. From the control group (C) 51 of the 100 that were sent out were returned and the response rate in this group was 51 %. In the group with the injured horses (I) the response rate was 33 %. Further all questions were not answered in a number of questionnaires and the response rate for each question is found in table 1.

Table 1. Response rate for the entire questionnaire and for each question

Question	Totally	C	I
Returned questionnaires, % *(n)*	42 *(84)*	51 *(51)*	33 *(33)*
Time having owned the horse, month, % *(n)*	35.5 *(71)*	44 *(44)*	27 (27)
Number of owners to the horse, % *(n)*	37 *(74)*	48 *(48)*	27 (27)
Height, cm, % *(n)*	39 *(78)*	50 *(50)*	28 *(28)*
Weight, cm, % *(n)*	30 *(60)*	37 *(74)*	23 *(23)*
Area of use of the horse (competition/training/exercise), % *(n)*	35 *(70)*	46 *(46)*	24 *(24)*
Discipline in which the horse is used, % *(n)*	40 *(80)*	50 *(50)*	30 *(30)*
Education level of the horse, % *(n)*	33 *(66)*	43 *(43)*	23 *(23)*
Riding experience, number of years in total, % *(n)*	41 *(82)*	49 *(49)*	33 *(33)*
Riding experience, number of years on a riding school, % *(n)*	39.5 *(79)*	46 *(46)*	33 *(33)*
Riding experience, number of years on an own horse, % *(n)*	39.5 *(79)*	46 *(46)*	33 *(33)*
Professional horse education, % *(n)*	41.5 *(83)*	50 *(50)*	33 *(33)*
Competition experience of the rider	40.5 *(81)*	48 *(48)*	33 *(33)*
Competition level on which the rider has participated, % *(n)*	36 *(72)*	43 *(43)*	29 *(29)*
Competition level on which the rider has been awarded, % *(n)*	37 *(74)*	45 *(45)*	29 *(29)*
Attending lessons for a riding instructor, % *(n)*	41.5 *(83)*	50 *(50)*	33 *(33)*
Instructors' education, % *(n)*	39.5 *(79)*	48 *(48)*	31 *(31)*
Riders experience of young horses, % *(n)*	41.5 *(83)*	50 *(50)*	33 *(33)*
Riding the horse on their own or with help, % *(n)*	39.5 *(79)*	49 *(49)*	30 *(30)*
Age of break in of the horse, % *(n)*	41 *(82)*	49 *(49)*	33 *(33)*
Person who broke in the horse, % *(n)*	40.5 *(81)*	49 *(49)*	33 *(33)*
Weekly training program, % *(n)*	40.5 *(81)*	51 *(51)*	30 *(30)*
Training place, % *(n)*	36 *(72)*	44 *(44)*	28 *(28)*
Training place when the horse was recovering, % *(n)*	25 *(25)*	----	25 *(25)*
Resting periods, % *(n)*	40 *(80)*	48 *(48)*	32 *(32)*
Use of special reins, % *(n)*	37 *(74)*	47 *(47)*	27 *(27)*
Use of special bits, % *(n)*	13 *(26)*	14 *(14)*	12 *(12)*
Participation in young horse evaluations, % *(n)*	41 *(82)*	49 *(49)*	33 *(33)*
Housing, % *(n)*	40.5 *(81)*	48 *(48)*	33 *(33)*
Housing of the horse when young, % *(n)*	35.5 *(71)*	45 *(45)*	26 *(26)*
Paddocks, % *(n)*	36.5 *(73)*	44 *(44)*	29 *(29)*
Shoeing interval, % *(n)*	39 *(78)*	47 *(47)*	31 *(31)*
Education of farrier, % *(n)*	40.5 *(81)*	48 *(48)*	33 *(33)*
Kind of shoes, % *(n)*	39 *(78)*	47 *(47)*	31 *(31)*
Feeding of the horse, % *(n)*	37.5 *(75)*	47 *(47)*	28 *(28)*
Feeding when the horse was young, % *(n)*	35 *(70)*	44 *(44)*	26 *(26)*
Feeding when the mare was pregnant, % *(n)*	32 *(64)*	38 *(38)*	26 *(26)*
Adjusting the daily feeding ratio when injured, % *(n)*	33 *(33)*	----	33 *(33)*

Description of the injury and the treatment of it, % *(n)*	28 *(28)*	----	28 *(28)*

Data of the horses in the study

The horses in the study were on average 164.7 cm in height and weighed 574 kg. Their owners had had them for 45.9 months on average and the horses had had 2.0 owners in total. The results from the different groups are found in table 2.

Table 2. Number of months the horse had been owned by the person in the study, total number of owners to the horse, height and weight of the horse.

	Totally	C	I	*p*-value
Number of month owned by the person in the study	45.9	40.9	51.3	0.12
Total number of owners	2.0	2.0	1.9	0.27
Height, cm	164.7	164.0	165.2	0.58
Weight, kg	574.3	574.5	573.9	0.98

Area of use

The horse owners were asked what the horse was used for, in which discipline the horse was used and education level. The use of the horses was mostly for competition (71.4%) and training (66.7%). Only 10.3% of the horses were only used for exercise and four horses (5.7%) were used on a riding school. Dressage was the most common discipline (80.0%), followed by jumping (60.6%), cross country (13.8%), driving (2.5%) and western (1.3%). Most horses, 55%, were used in more than one discipline. Concerning education level the majority of the horses were educated on an easy level, 60.6% in easy jumping and 56.1 in easy dressage. The results from the different groups are found in table 3, 4 and 5. Missing P values are due to few observations.

Table 3. What the horses were used for

Ways of use	Totally	C	I	*p*-value
Number of answers, n	70	46	24	
Competition, % *(n)*	71.4 *(50)*	71.4 *(34)*	66.7 *(16)*	0.52
Training, % *(n)*	67.1 *(47)*	63.0 *(29)*	75.0 *(18)*	0.37
Exercise, % *(n)*	10.0 *(7)*	6.5 *(3)*	16.7 *(4)*	0.17
Riding school, % *(n)*	5.7 *(4)*	6.5 *(3)*	4.2 *(1)*	------

Table 4. Discipline in which the horses were used

Discipline	Totally	C	I	*p*-value
Number of answers, n	80	50	30	
Jumping, % *(n)*	62.5 *(50)*	70.0 *(35)*	50.0 *(15)*	0.074
Dressage, % *(n)*	80.0 *(64)*	78.0 *(39)*	83.3 *(25)*	0.56
Driving, % *(n)*	2.5 *(2)*	2.0 *(1)*	3.3 *(1)*	0.71
Cross country, % *(n)*	13.8 *(11)*	12.0 *(6)*	16.7 *(5)*	0.56
Western, % *(n)*	1.3 *(1)*	0.0 *(0)*	3,3 *(1)*	-----
Only one discipline, % *(n)*	45.0 *(36)*	40.0 *(20)*	53.3 *(16)*	-----

Table 5. Education level of the horses

Level	Totally	C	I	*p*-value
Number of answers, n	66	43	23	
Jumping, 0,90 – 1,25 m, % *(n)*	60.6 *(40)*	60.5 *(26)*	60.9 *(14)*	0.97
Jumping, 1,30 – 1,40 m, % *(n)*	7.6 *(5)*	9.3 *(4)*	4.4 *(1)*	0.47
Jumping, 1,40 m - % *(n)*	1.5 *(1)*	2.3 *(1)*	0.0 *(0)*	0.46
Dressage, easy, % *(n)*	56.1 *(37)*	58.1 *(25)*	52.2 *(12)*	0.64
Dressage, medium, % *(n)*	18.2 *(12)*	18.6 *(8)*	17.4 *(4)*	0.90
Dressage, difficult, % *(n)*	4.6 *(3)*	2.3 *(1)*	8.7 *(2)*	0.24
Cross country, debutante – easy % *(n)*	12.1 *(8)*	9.3 *(4)*	17.4 *(4)*	0.34
Cross country, medium, % *(n)*	3.0 *(2)*	2.3 *(1)*	4.3 *(1)*	0.65

Data of the riders in the study

Riding experience

In total the riders had on average ridden for 21.0 years, 7.0 years at a riding school and 14.4 years on a horse of their own. The riders in the C group had ridden for 20.6 years, 6.6 years at a riding school and 14.3 years on an own horse. The corresponding numbers in the I group were on average 21.5 years, 7.6 at a riding school and 14.6 on an own horse. P-value for total number of years is 0.58, on a riding school 0.43 and on a horse of their own 0.82.

Professional horse education

In total 38.1% of the persons in the study had a professional horse education, 43.1% in the C group and 30.3% in the I group, P=0.237. Type of education was also asked for and the result is shown in table 6. The professional titles are Swedish ones.

Table 6. Kind of professional horse education

Type of education	C	I
Number of answers, *n*	50	33
Hippolog, % *(n)*	6.0 *(3)*	6.1 *(2)*
Ridlärare, % *(n)*	6.0 *(3)*	3.0 *(1)*
Beridare, % *(n)*	2.0 *(1)*	0.0 *(0)*
Ridledare, % *(n)*	8.0 *(4)*	15.2 *(5)*
RIK-00, % *(n)*	8.0 *(4)*	3.0 *(1)*
Hästskötarexamen, % *(n)*	8.0 *(4)*	0.0 *(0)*
c-tränare, % *(n)*	8.0 *(4)*	3.0 *(1)*
b-tränare, % *(n)*	2.0 *(1)*	0.0 *(0)*
Stallchef, % *(n)*	2.0 *(1)*	0.0 *(0)*
Veterinarian, % *(n)*	2.0 *(1)*	3.0 *(1)*

Competition experience

On the question about competition experience totally 90.2% said they had, 91.8 % in the C group and 87.9 % in the I group, P=0.55. In the same question the horse owners were also asked to fill in, in which discipline and on what level they had participated and been awarded. Most riders had participated and been awarded in easy classes. More detailed results are shown in table 7 and 8. Missing values are due to few observations.

Table 7. Level and discipline, in which the persons in the study had participated

Level	Totally	C	I	*p*-value
Number of answers, *n*	72	43	29	
Jumping, 0.90 – 1.25 m, % *(n)*	38.9 *(28)*	32.6 *(14)*	48.3 *(14)*	0.18
Jumping, 1.30 – 1.40 m, % *(n)*	13.9 *(10)*	18.6 *(8)*	6.9 *(2)*	0.16
Jumping, 1.40 m - , % *(n)*	2.8 *(2)*	2.3 *(1)*	3.5 *(1)*	0.78
Dressage, easy, % *(n)*	50.0 *(36)*	46.5 *(20)*	55.2 *(16)*	0.47
Dressage, medium, % *(n)*	15.3 *(11)*	18.6 *(8)*	10.3 *(3)*	0.34
Dressage, difficult, % *(n)*	9.7 *(7)*	9.3 *(4)*	10.3 *(3)*	0.88
Cross country, debutante – easy, % *(n)*	6.9 *(5)*	2.3 *(1)*	13.8 *(4)*	0.060
Cross country, medium, % *(n)*	4.2 *(3)*	2.3 *(1)*	6.9 *(2)*	0.34
Driving, easy, % *(n)*	2.8 *(2)*	2.3 *(1)*	3.5 *(1)*	----

Table 8. Level on which the riders had been awarded

Level	Totally	C	I	*p*-value
Number of answers, *n*	74	45	29	
Jumping, 0.90 – 1.25 m, % *(n)*	41.9 *(31)*	40.0 *(18)*	44.8 *(13)*	0.56
Jumping, 1,30 – 1,40 m, % *(n)*	10.8 *(8)*	13.3 *(6)*	6.9 *(2)*	0.56
Jumping, 1,40 m - , % *(n)*	1.4 *(1)*	0.0 *(0)*	3.4 *(1)*	----
Dressage, easy, % *(n)*	45.9 *(34)*	42.2 *(19)*	51.7 *(15)*	0.32
Dressage, medium, % *(n)*	13.5 *(10)*	17.8 *(8)*	6.9 *(2)*	0.27
Dressage, difficult, % *(n)*	4.1 *(3)*	4.4 *(2)*	3.4 *(1)*	0.84
Cross country, debutante – easy, % *(n)*	8.1 *(6)*	2.2 *(1)*	17.2 *(5)*	0.049*
Cross country, medium, % *(n)*	2.7 *(2)*	2.2 *(1)*	3.4 *(1)*	0.74
Not awarded, % *(n)*	12.1 *(9)*	13.3 *(6)*	10.3 *(3)*	0.94

Young horse experience

When asked if they had any experience of education of young horses 88.0% of the owners to a C horse said that they had and 81.2% among the owners to an I horse. How many young horses the riders in the two groups had educated can be seen in table 9.

Table 9. Number of horses educated by the riders to the horses.

Number of horses	C	I
Number of answers, *n*	50	33
None, % *(n)*	12 *(6)*	18,2 *(6)*
One, % *(n)*	22 *(11)*	18,2 *(6)*
Two – three, % *(n)*	32 *(16)*	30,3 *(10)*
Four or more, % *(n)*	34 *(17)*	33,3 *(10)*

Training for riding instructor

The persons in the study were also asked if they attended lessons for a riding instructor, which the majority did, 93.8 % in the C group and 93.6 % in the I group, P=0.981. In total 93.7% attended lessons for a riding instructor. It was found that several persons attended lessons for more than one instructor, 43 out of the 74 who have a trainer, attend lesson for more than one instructor. Three C horses were used in a riding school and one I horse. Next the persons in the study were asked to fill in what education the riding instructor had. The result is shown in table 10. The titles are Swedish ones.

Table 10. Education of the trainer

Education	C	I	*p*-value
Number of persons attending lessons, *(n)*	45	29	
Not educated instructor, % *(n)*	6.7 *(3)*	10.4 *(3)*	0.59
Ridlärare, % *(n)*	17.8 *(8)*	13.8 *(4)*	0.62
Ridinstruktör, % *(n)*	20.0 *(9)*	27.6 *(8)*	0.43
a-tränare, % *(n)*	42.2 *(19)*	34.5 *(10)*	0.53
b-tränare, % *(n)*	35.6 *(16)*	31.0 *(9)*	0.71
c-tränare, % *(n)*	6.7 *(3)*	1.8 *(4)*	0.30
More than one education, % *(n)*	28.8 *(13)*	27.6 *(8)*	-----

Training

Break in

Most horses were broken in at an age of three years. The age of break in of the horses can be seen in table 11, P=0.175.

Table 11. The age of break in

Age, years	C	I
Number of answers, *(n)*	49	33
Not known, % *(n)*	10.2 *(5)*	18.2 *(6)*
2.5 years, % *(n)*	6.1 *(3)*	18.2 *(6)*
3 years, % *(n)*	57.1 *(28)*	33.3 *(11)*
4 years, % *(n)*	18.4 *(9)*	24.4 *(8)*
Older than 4 years, % *(n)*	8.2 *(4)*	6.1 *(2)*

In the C group 45.8% had broken in their horse on their own and 33.3% in the I group. P-value=0.26. In total 40.7% had broken in their horses of their own. The remaining horses were either bought already broken in or the rider had sent it away to have it broken in.

Riders of the horse

The horse owners were asked if their horses were ridden by another person than themselves on a regular basis, which 39.5% of the horses in the study were. In the C group 44.9% said that their horse was and the corresponding number in the I group was 33,3 %, P=0.31.

Weekly training program

In total the horses in the study are ridden 5.9 times per week. The horses in the C group are ridden 5.8 times per week on average and in the I group 6.0 times per week, P=0.34.

One concern was to find out how the horses were trained and more specific how their weekly training programs looked like. In total 29.1% couldn't tell what their training program looked like, as it varied too much. In the C group this figure was 30.0% and in the I group 27.6%, P=0.820. The rest was asked to state how many minutes they walked, trotted and galloped when riding as well as how many times a week they jumped and/or were trained in dressage. The results from the both groups are shown in table 12 and 13. The horses in the study were on average ridden for 55.8 minutes per day; 26.8 minutes walking, 15.6 minutes trotting and 13.3 galloping. In average the horses jump 0.8 times per week and are trained in dressage 2.8 times per week.

Table 12. Number of minutes walking, trotting and galloping per riding occasion
Total riding time in minutes per occasion is also presented

	Walking	Trotting	Galloping	Totally
C	27.8	16.4	13.7	58.5
I	25.1	14.3	12.5	51.3
p-value	0.41	0.27	0.54	0.043*

Table 13. Times per week the horse jumps and is trained in dressage

	Jumping	Dressage
C	1.0	2.8
I	0.5	2.9
p-value	0.0075**	0.68

Some horses had days when they are only ridden in walk. In the C group on average 0.5 times per week and I horses 0.8 times per week. Every time the C horses walked 21.3 minutes and the I horses 29.8 minutes, P=0.2802. This gave a total number of 10.7 minutes of only walking for the C horses per week and 23.8 minutes for the I horses, P=0.1074.

Training place

Where the training took place during the seasons was asked for. In total the horses were trained on a riding school (outdoors or indoors) 56.7% of the time during the summer and 54.0% during the winter. Result for the different groups is shown in table 14.

Table 14. Where the training took place during summer and winter (in percent of the total riding time).

	Summer			Winter		
	Riding house, %	School, outdoors, %	Outdoors, %	Riding house, %	School, outdoors, %	Outdoors, %
C	12.5	41.6	46.0	41.4	14.0	44.7
I	7.8	46.0	46.1	44.8	6.7	48.5
p- value	0.2132	0.3713	0.9735	0.6017	0.0817	0.4808

Special reins and bits

Special reins were used by 35.1 % in the study. The number of riders using special reins in the C group were 29.8% and 44.4 % in the I group, P=0.20. The most frequently used rein was the running rein, which 57.7% of those who said they use special reins utilised. The use of another bit than a snaffle bit was in total 19.3 %, 25.0% in the C group and 9.1 % in the I group, P=0.13. The most commonly used bit, except the snaffle bit, was the Pessoa bit and the double bridle.

Resting periods

One interest was also to find out if the horses had longer periods during which they weren't trained at all, and if so how many times per year and how long these periods were. In total 75.0% of the horses in the study had resting periods. In the C group 68.8 % of the horses had resting periods, 27.1 % had not and 4.2% could not tell which. The corresponding number in the I group is 84.4 %, 12.5% and 3.1 %, P=0.27. In average C horses had 4.0 training free weeks per year and the I horses 5.5 (P=0.083). How many times per year the horses had resting periods can be seen in table 15, P=0.29.

Table 15. How many times per year the horses had resting periods

	C	I
Number of answers, *(n)*	48	32
Never, % *(n)*	25.0 *(12)*	6.3 *(2)*
1 time/year, % *(n)*	37.5 *(18)*	43.8 *(14)*
2 times/year, % *(n)*	35.4 *(17)*	46.9 *(15)*
4 times/year, % *(n)*	2.1 *(1)*	3.1 *(1)*

Participation in young horse evaluations

In total 38.3% of the horses had participated in some kind of young horse evaluation. Most common was participation in the test at three or four. Distribution between the groups concerning kind of evaluation can be seen in table 16. Missing P-values are due to few observations.

Table 16. Participation in young horse evaluations (%)

	C	I	*p*-value
Number of answers, *(n)*	49	33	
Participated, % *(n)*	32.7 *(16)*	45.5 *(15)*	0.54
Not known if had participated, % *(n)*	12.2 *(6)*	9.1 *(3)*	------
Three-years test, % *(n)*	18.4 *(9)*	21.2 *(7)*	0.78
4 year Swedish Riding Horse Quality Test, % *(n)*	16.3 *(8)*	36.4 *(12)*	0.043*
Four-years championate, dressage, % *(n)*	0.0 *(0)*	0.0 *(0)*	------
Four-years championate, jumping, % *(n)*	6.1 *(3)*	0.0 *(0)*	------
Five-years breeders, dressage, % *(n)*	0 *(0)*	6.1 *(2)*	------
Five-years breeders, jumping, % *(n)*	4.1 *(2)*	3.0 *(1)*	------
Six-years breeders, dressage, % *(n)*	2.0 *(1)*	0.0 *(0)*	------
Six-years breeders, jumping, % *(n)*	4.1 *(2)*	0.0 *(0)*	------
Five-years breeders, cross country, % *(n)*	2.0 *(1)*	0.0 *(0)*	------

Six-years breeders, cross country, % *(n)*	2.0 *(1)*	0.0 *(0)*	------

The horse owners were asked to tell how many points its horse had achieved when judging the conformation of the horse. Due to very few observations from many different kinds of evaluations the result will not be presented here.

Housing

In the study it was asked how the horses was housed and for how many hours a day the horse was let out in a paddock. In the C group 98.0 % of the horses were housed in a box and 2.0% in a stall. In the I group all horses were housed in a box. The size of the paddock was divided into two groups, small (size of a school) and big (bigger than a school). On average the horses in the study spent 7.8 hours per day in a paddock and 67.7 % of them had a paddock bigger than a school. The C horses spent 7.7 hours per day in a paddock and the I horses 7.9 hours per day, P=0.7713. 60.7% of the horses in the C group were kept in a big paddock and 73.9 % in the I group, P=0.320. What materials that were used in the paddocks were only answered by a few and the most common material was gravel.

<u>Housing when young</u>
It was also asked how the horses were housed when they were young, result in table 18 and 19. The most common way, in both age categories, to house the horses was in a loose box, followed by group housing. Six horse owners marked more than one alternative, indicating the horse had been housed in several ways when young.

Table 18. Housing of the horses when 0-1 year old (%)

	C	I
Number of answers, *(n)*	26	45
Loose box, % *(n)*	53.3 *(24)*	53.8 *(14)*
Stall, % *(n)*	4.4 *(2)*	0.0 *(0)*
Group housing, % *(n)*	28.9 *(13)*	19.2 *(5)*
Not known, % *(n)*	22.2 *(10)*	30.8 *(8)*

Table 19. Housing of the horses when 1.5-2.5 years (%)

	C	I
Number of answers, *(n)*	26	45
Loose box, % *(n)*	68.9 *(31)*	57.7 *(15)*
Stall, % *(n)*	4.4 *(2)*	3.8 *(1)*
Group housing, % *(n)*	22.2 *(10)*	15.4 *(4)*
Not known, % *(n)*	13.3 *(6)*	26.9 *(7)*

Shoeing

Shoeing of the horses took on average place with an interval of 7.4 weeks. They were to a large extent normal shoes and the majority of the farriers were educated. Results from the question about shoeing are found in table 20.

Table 20. Shoeing interval, kind of shoes and education of farrier.

	Totally	C	I	*p*-value
Shoeing interval, weeks	7.4	7.4	7.3	0.68
Horses with "normal shoes", %	72.1	77.5	64.3	0.23
Educated farrier, %	95.1	95.8	93.9	0.70

Feeding

One concern was how the horses in the study were fed. The horse owners were asked if their feed were analyzed and if formulation of daily ration was done. In total 60.0% analyzed their feed and 50.0 % formulated daily rations. In the C group 57.8 % analyzed their fodder and 63.3 % in the I group (P=0.630). A daily ration was formulated by 47.7 % in the C group and 53.6 % in the I group (P=0.629). In addition the persons in the study were asked to tell if they used energy, protein, calcium, phosphorous, and calcium/phosphorous-quota when formulating daily rations. The results are shown in table 21. Missing values are due to few observations.

Table 21. Percentage in the groups that claimed they use energy, protein, calcium, phosphorous and calcium/phosphorous quota when daily ration was formulated
The figures also show, in percent, how many that had given a value for the different parameters

	Number of answers, *(n)*	Used the parameter	Gave a value
C, Energy, % *(n)*	21	76.2 *(16)*	38.1 *(8)*
I, Energy, % *(n)*	15	66.7 *(10)*	20.0 *(3)*
p-value		0.69	----
C, Protein, % *(n)*	21	81.0 *(17)*	38.1 *(8)*
I, Protein, % *(n)*	15	66.7 *(10)*	20.0 *(3)*
p-value		0.48	----
C, Calcium, % *(n)*	21	61.9 *(13)*	28.6 *(6)*
I, Calcium, % *(n)*	15	53.3 *(8)*	13.3 *(2)*
p-value		0.73	----
C, Phosphorous, % *(n)*	21	61.9 *(13)*	28.6 *(6)*

S, Phosphorous, % *(n)*	15	40.0 *(6)*	13.3 *(2)*
p-value		0.25	----
C, Ca/P, % *(n)*	21	57.1 *(12)*	23.8 *(5)*
I, Ca/P, % *(n)*	15	40.0 *(6)*	13.3 *(2)*
p-value		0.55	----

Frequency of correct answered question

Number of correct filled in question in the two groups were calculated and 68.8 % in the C group and 50.0 % in the I group succeeded in filling in the feeding question correct, P=0.098.

Feeding during convalecens

The persons in the I group were also asked if they adjusted the daily rations when the horse was covalesent due to the decreased amount of exercise. All said they did. They were also asked to tell which parameters were used and give values of them. The result is shown in table 22.

Table 22. Feeding during convalecens

	Energy	Protein	Ca	P	Ca/P
Number of answers, *(n)*	33	33	33	33	33
Used the parameters, % *(n)*	39.4 *(13)*	36.4 *(12)*	9.1*(3)*	9.1 *(3)*	12.0 *(4)*
Gave a value, % *(n)*	6.1 *(2)*	6.1 *(2)*	0.0 *(0)*	0.0 *(0)*	3.0 *(1)*

Feeding when young and when the mare was pregnant

The horse owners were asked to tell, if they knew, how the horses were fed when young and how the mare was fed when pregnant. The majority did not know neither how the horse was fed when young nor when the mare was pregnant. Results from theses two question can be seen in table 23 and 24.

Table 23. Feeding of the horse when young (%)

	C	I
Number of answers, *(n)*	44	26
Not known, % *(n)*	43.2 *(19)*	53.8 *(14)*
Ad lib, % *(n)*	15.9 *(7)*	11.5 *(3)*
Individual, % *(n)*	22.7 *(10)*	15.4 *(4)*
Individual, analyzed feed, % *(n)*	4.5 *(2)*	7.7 *(2)*
Individual, analyzed feed and formulated daily ration, % *(n)*	13.6 *(6)*	11.5 *(3)*

Table 24. Feeding of pregnant mare (%)

	C	I
Number of answers, *(n)*	38	26
Not known, % *(n)*	55.3 *(21)*	69.2 *(18)*
Ad lib, % *(n)*	7.9 *(3)*	3.8 *(1)*
Individual, % *(n)*	21.1 *(8)*	7.7 *(2)*
Individual, analyzed feed, % *(n)*	2.6 *(1)*	7.7 *(2)*
Individual, analyzed feed and formulated daily ration, % *(n)*	13.2 *(5)*	11.5 *(3)*

Aethiology and convalecens

The owners to the horses that have had arthritis were asked to describe the problems leading to the detection of the injury. Further they were asked how the horse was treated and if the horse had had any relapses. In the following section their answers will be accounted for.

On average the horses were 6.5 years when treated for the first time. The persons who accounted for the events that made them suspect an injury mentioned vague symptoms, such as; The horses didn't "feel good" when riding, refused when jumping, showed stiffness in the hind legs and back and an impeded general condition. In some cases the riding instructor suspected something was wrong. Two persons said the horse showed an evident lameness.

Twenty-two out of the 25 who answered the question stated that one or both forelegs were affected. Three said they had problems only with the hind legs. Sixty-four percent of the horses in the study were affected in both forelegs and 72 % had problems with more than one joint.

On average the horse were treated 2,2 times by a veterinarian. The treatment almost always consisted of injections of hyaluronate and corticosteroids. Only three out of 24 were not treated with injections in the joint, instead laser, flushing with celeston and anti inflammatory drugs were used. Some of the horses were also treated by a chiropactor. All horses were recommended a resting period, free from exercise. The length of the resting periods however varied from a few weeks to several months.

Thirteen of the persons in the study mentioned what they thought caused the injury. Three of them thought the problems had something with themselves as rider to do and thus changed their training program after the injury. The other ten horse owners meant the injury was due to a dislocation of the joint, hard ground or poor conformation of the horse. One horse owner in the study claimed the horse was "useless and dangerous". The three persons in the study who had changed their training program had not had any relapses since they changed their training program compared to a relapse frequency of 67 % among those who thought the injury was due to the horse itself or the environment.

Two of the horses were culled, one of them due to other problems and one due to arthritis. One was not used as a riding horse any more and another was sold and only used for hacking nowadays. Three had not yet returned to their normal work, but were on their way to and two had not recovered when the study was carried out. Fifteen of the horses were back in their normal work. It was not known what have happened to the rest (9 horses).

Discussion

The low response rate in this study is a big problem. It is impossible to draw conclusions from a material were not even half of the questionnaires sent out were returned. The statistical tests used may not be valid test when there are few observations. The reasons for the low number of returned questionnaires can only be speculated in. The lay out of the questionnaires is important to consider, it should look applying and not be to long (Trost, 2002). Another thing worth thinking of, which also were commented by a few person, to whom the questionnaire was sent, is whether the horse in question is still alive. It may feel awkward to answer the question if your horse has been culled as a consequence of the injury.

It is impossible to determine whether the questionnaires returned from the I group are filled in according to how the horses are trained, housed and fed today or if it is filled in according to how it was before the injury appeared. We want to know how it was before detection of the injury and it is important in a follow up study to emphasize that it is the circumstances before the accident that are to be described. The difficulty in this is for the person, that are to fill in the questionnaire, to remember how the horse was trained, housed and fed before the injury as a long period of time may have passed since the injury was detected. One way to solve this problem would be to give the questionnaires to horse owners direct at the animal hospitals when the diagnosis arthritis is made instead of sending them to the owners. In this way you can be sure that the actual circumstances are described and not the way the horse was handled after the healing of the injury. This approach would probably result in a higher response rate as well as the questionnaires could be filled in while waiting at the animal hospital.

Questions about age and gender were totally missing in this questionnaire and this is crucial to include. Not knowing the age it is impossible to determine if the differences in for example training and education are due to differences in age or actual having something to do with the arthritis. It is natural that an older horse is more educated than a younger and in this study the average age in the two groups can’t be determined. Further it is impossible to say if there are any differences in gender distribution. Whether gender affects the frequency of arthritis can’t be answered in this study. In a study carried out by Vigre *et al* (2002) it was found that both sex and age influenced the hazard of lameness in Danish Standardbred trotters. In that study more geldings than mares were injured and more three years old horses than horses older than four.

Most of the results in the study was not significant and in the following significant result or result interesting from another point of view will be discussed.

Although there was no significant difference in how long the horse owners in the two groups have had their horses, there was a tendency that owners to I horses have had their horses for a longer period of time than owners to a healthy horse (P=0.1175). If there actually is a difference is hard to say, due too the low response rate and low numbers of questionnaires sent out. To confirm a difference a larger study is needed. It can only be speculated in the reason for a difference if there is any. It is possible the longer you own the horse the more confident you get and therefore you may take bigger risks and thus put the horse at bigger risk to become injured. Another explanation can be the longer you have your horse the more you get to know it and are therefore more sensitive to changes in the behaviour of the horse, which means you will detect an injury more easily.

The age of break in of the horses did not differ significantly between the groups, although P-value was quite low, 0.175. In this study more horses, 18.2 %, in the I group was broken in at an age of 2.5 years compared to the C group, in which the corresponding number was 6,1 %. Concerning horses broken in at an age of three, they were more numerous in the C group than in the I group, 57.1% versus 33.3 %. There were more I horses, 24.2%, broken in at an age of four, compared to the C horses, 18.4%. For horses broken in when they were older than four, the figures were; C group 8,2 % and I horses 6,1%. Some horse owners state they don’t know when the horse was broken in, 10,2% in the C group and 18,2 in the I group. Looking at the figures it seems that the I horses too a larger extent were broken in when they either was younger or older than three years old. It could only be speculated in the reasons for this. Perhaps the skeleton of a warmblooded riding horse, isn't enough developed at an age of 2,5 years for the stress it is put to when riding these horses. Waiting to long to break in the horse may not be good either. In order to strengthen the skeleton it has to get use to some load (Jeffcott, 1990; Dalin, 1987) and if waiting to long to break in the horse it is possible it is harder for the skeleton to stand the stress it is put to. More observations could either establish or reject the statement that the age of break in influence the frequency of injuries later in life.

In which discipline the horses is trained doesn't present any significant differences between the groups but there is a tendency more horses in the group of healthy horses jump more than the horses, which have had (or has) arthritis. Seventy percent of the owners to a healthy horse state they use their horse for jumping, compared to 50 % to an injured horse (P=0.074). This is also supported by the fact that horses in the C group are jumped significantly more often on a regular basis in the C group than in the I group. C horses jump in average 1.0 times/ week compared to I horses, which jump 0.5 times a week (P=0.0075). Important to remember is although the size of the study. In a study as small as this it all results are uncertain. Another problem is to determine if the difference is a consequence of the injury. Jumping is commonly believed to put high stress on the joints and maybe the riders to the horses in the I group have given up jumping to save the joints. It is therefore possible the horses in the I group were used as jumping horses to the same extent as those in the C group before the injury. This statement is however not supported when looking at the number of cross country horses in the different groups, 21.7% in the I group and 11.6% in the C group. This result is however not significant. Further the riders in the I group have participated and been awarded to a larger extent in cross country than riders in the C group(P=0.049). Cross country is a tough discipline and the demands on horses, competing in this discipline, are high, which may explain the higher number of cross country horses with the diagnosis arthritis. It is therefore fair to presume that riders would avoid cross country to save their horses if they are avoiding jumping for this reason. If the figures really stand for the circumstances before the diagnosis arthritis were made the explanation to the higher number of jumping horses in the C group may be that horses which are used for jumping is trained more varied, as jump horses also is trained in dressage to archive an obedient horse, in comparison to dressage horses, which doesn't necessarily jump. Variation in the training program may be to give a healthier horse, as it is common knowledge that monotone work gives rise to wear and tear injuries in humans (OBS!! Referens!? Nödvändigt?).

The healthy horses are ridden for a longer period of time each time they are trained (P=0,0433). It is however hard to say if this, as discussed above, depends on the injury. It seems likely that horses, which have been injured, are trained less than horses, which have remained healthy. The aim of the study was to find out how the horses were trained before the injury was detected, but, as mentioned before, it is impossible to say if the horse owners have filled in the questionnaires according to how they train their animals now or how they trained before. There were no significant differences in how long the horse was ridden in the different gaits or how many times per week the horse was trained in dressage.

Most of the persons in the study claim their horses have periods not ridden at all, 68,8 % in the C group and 84,4% in the I group. The result was not significant (P=0,272). There are no differences in how many days per week the horse in trained, in how many "walk days" they have or how long they walk these days. When multiplying the number of "walk days" with number of days walking there is a tendency horses in the I group spends more minutes only walk per week than C horses, 23.8 minutes per week for I horses and 10.7 minutes for C horses (P=0.1074). In average C horses had 4,0 training free weeks per year and the I horses 5,5 (P=0,0830). There is a tendency I horses are allowed longer periods of rest than C horses. The possible differences can however depend on the fact that I horses have been injured and thus haven't been trained. If there actually is a difference in how much the horse is ridden and if C horses are ridden more the reasons could only be speculated in. Dalin (1987) states that it is important to ride your horse on a regular basis. Bone remodelling (Jeffcott, 1990) could perhaps be involved when considering longer periods of rest. For example some persons in the study do not train their horses for 16 weeks in a row. In these cases the bone and joints have adapted to the lower training load. If not taking it slow when starting riding again the bone and joints are not strong enough to the stress they are put to and the horse might get injured.

When considering participation in young horse evaluations a significant difference was found. Significantly more horses in the I group had participated in the Swedish Riding Horse Quality Test (P=0.043). Arthritis is commonly due to excessive training (Stashak, 1987; Skiöldebrand & Sandgren, 1995) and it is possible that horses that are to participate in this young horse evaluation are trained more intense than horses not participating. The training load on these young horses may therefore be too large and this may predispose to injuries later in life. The fact that the training of the young horse, is of importance for its performance later in life, is also supported by Wallin (2000b). She found that orthopaedic status of four years old horses participating in the Swedish Riding Horse Quality Test was correlated with longevity. However there was no significant difference in participation in the evaluation at an age of three. Why there is a difference between the groups concerning evaluation at four and not at three is hard to explain. On the evaluation at three gaits are not judge when riding and therefore the riders may not have focus as much on riding when their horses are three years old as they do when they are four and gaits are judged when riding. Furthermore jumping is not judge when riding when the hoses are three years old, only without rider. By four years old on the other hand, the horses' jumping capacity can be evaluated when riding. This is not compulsory for participation in the test, but for advancement in the competition it is. The demands on the four-year old horses are thus much larger than on the three-year olds, a possible explanation to the result that significantly more horses in the I group have participated in the test at four.

Analyzing the feedstuff, and specially the roughage, is crucial if a formulation of a daily ration is to be done (Planck, 1997). The feedstuff is commonly analyzed for its content of energy, protein, Calcium and Phosphorous. Not knowing the content of energy and protein it is impossible to predict how much of the feedstuff the horse is to eat. It is also important to know the content of the minerals calcium and phosphorous, as is the relative amounts of them. Sixty percent of the persons in the study analyzed their feed and 50% formulated a daily ration. Concerning the question about feeding of the horse and the parameters used, there was a large confusion among the persons in the study how to fill in the questionnaires. Several stated they used the parameters given in the questionnaire but did not give values as they were asked to do. Others did not mark any of the parameters even though they claimed they did formulate a daily ration. The reason for this can be that the instructions in the questionnaire were vague and the horse owners therefore did not know how to fill in the question. Concerning the ones that had marked they use the parameters but did not fill in a value, it is possible they simply don't remember the values. Another explanation is that knowledge in horse feeding is poor and therefore the question was hard to understand and fill in. The percentage of questions correct answered in each group was counted to see if there was any difference between how the groups managed to fill in this question. The result was that 68.8

% in the C group and 50.0 % in the I group succeeded in filling in the feeding questions correct (P=0.098). However not significant result, there is a tendency knowledge in how to fill in the question, is better in the C group. This may be a consequence of better knowledge in horse feeding in the C group. If failure in answer the question is due to a vague formulation of the question or forgotten values among the horse owners it is fair to presume it would be equally as many failing to answer the question in the two groups.

There are too few observations for a chisquare test to be valid and therefore it is impossible to say if there actually are any differences between the groups, concerning values given for energy, protein, calcium, phosphorous and calcium/phosphorous-quota. Nevertheless the persons filling in a value for the parameters are more numerous in the C group than in the I group. It would be interesting to see if this difference still stands in another study with more observations. Values for calcium and phosphorous was given from 28.6 % in the C group and 13.3 % in the I group. Twenty-three point eight percent in the C group has filled in values for calcium/phosphorous quota and 13.3 % in the I group. Calcium and phosphorous is important for correct bone formation and therefore also for the joints (Frape, 1998). There is a delicate balance between theses minerals and therefore they must be considered together as uptake or loss of one of them will influence the other. It is seen that deficiency in these minerals can cause development of orthopeadic diseases in growing horses. In adult, working, horses lack of calcium and/or phosphorous can lead to lameness and fractures (Frape, 1998). If comparing to other species mineral deficiency is seen to cause skeletal problem in cattle, such as rickets and osteomalaci (Olsson, 1986). These two conditions are also seen in horses (Frape, 1998). Because of the effect of these minerals to bones and joints a more thorough approach in this area would be interesting.

The person owning a horse that have been injured was asked to fill in a section where the injury was to be describe and how it was detected and treated. The persons who accounted for the events that made them suspect an injury mention vague symptoms. Twenty-two out of the 25 who answered the question states that one or both forelegs were affected. Three say they had problems only with the hind legs. Many (64%) of the horse in the study were affected in both forelegs. A big proportion (72 %) had problems with more than one joint. That many joint often are affected was also seen in a study with Danish Standardbred trotters, indicating that the mechanisms of orthopeadic problems influence many joints at the same time (Vigre *et al*, 2002). If more than one leg is affected it is possible the horse doesn't show any evident lameness and may be it is hard to detect the injury for this reason. Not finding the injury in time and therefore continue training an injured horse can lead to the development of osteoarthritis (McIlwraith, 1995). This means it is of importance to find the injury at an early stage by being sensitive to small signals from the horse. The sensitiveness for noticing an injury may differ between persons. This is suggested by Vigre *et al* (2002), who carried out a study concerning risk factors for the hazard of lameness in Danish Standardbred trotters and found that the trainer of the horse affected the hazard of lameness. Even though they found significant differences between the trainers according the frequency of injured horses, they suggested that the trainer with more injured horses was not poorer in relation to keeping his horses healthy. They meant "the threshold for taking a horse out of optimal training varied between the participating trainers."

Thirteen of the persons in the study mentioned what they thought caused the injury. Only three of them thought the problems had anything with themselves as rider to do and thus changed their training program after the injury. The other ten horse owners meant the injury was due to a dislocation of the joint, hard ground, poor conformation or of the horse. One horse owner in the study claims the horse was "useless and dangerous". This is interesting to notice, as it is generally believed arthritis is due to excessive training (Stashak, 1987; Skiöldebrand & Sandgren, 1995). If the horse owners don't take the injury seriously and reconsider the training program it seems likely the horse will have a relapse. Is impossible to draw conclusions from such a little materials of horses but it is interesting to notice that the three persons in the study who have changed their training program have not had any relapses since they changed their training program compared to a relapse frequency of 67 % among those who think the injury was due to the horse itself or the environment. Here the importance of the personality of the rider is interesting to focus on. Having the self understanding to see that the injury may be caused by the training program and thus admit that he/she was wrong when constructing it is important. Change the training may be crucial if to avoid any relapses. Blaming the injury on the environment, the horse or an accident may result in continuing the training as before the injury and thus risk a relapse. The personality of the person has been shown to be of importance when considering car accidents (Underwood, 1997; Jonah, 1997; Rothengatter, 1999), but also the performance of farm animals (Seabrook, 1986; Hemsworth *et al*., 1986) and is therefore not unlikely to have anything to do with injuries in horses. Of course the conformation of the horse is of course of importance (Wallin, 2000b; Magnusson, 1985), but it is important to remember not to put higher demands on the horse than it can cope with. Not all horses are built to be trained equally as much or hard. Wallin (2000b) means that a bad conformation doesn't make the horse unhealthy itself but may predispose for injuries later in life. It is thus important to ride the horse in such a way that it can cope with the training program even though having a bad conformation. Further arthritis can be due to an direct trauma to the joint, for example a dislocation, but it seem unlikely that the horse have had a location on both fetlock joints at the same time as one person in the study suggests its horse has had.

Conclusions

It is hard to draw any certain conclusions as the response frequency is low. In general it can be said that the horses in the different groups don't differ in size or weight. Their owners have ridden for equally as many years and are equally as educated. Concerning housing and shoeing of the horses no differences between the control group and the group of injured horses can be found.

Some significant differences can be found when comparing how and in what discipline the horses are trained. It seems like healthy horses are ridden for a longer period of time each occasion they are ridden. Horses in the control group are also jumped significantly more often than in the group with sick horses. Experience and participation in cross country is also higher among the persons with an injured horse.

A significant result was also found when comparing how many horses in the groups having participated in the 4 year Swedish Riding Horse Quality Test. Significantly more horses in the group of injured horses had participated. However the sample size is small and a bigger test is needed to confirm the result.

Personality of the rider may be an important factor when considering arthritis in horses. In this study this approach was left out, but from the answers on the question about detection and treatment of the injury it was obvious that personality differences between the riders exist.

The solution to what causes arthritis in horses can probably be found in the training of the horse, both when young an older. It is also possible that personality of rider may be involved. To find out to which extent these factors influence the development of arthritis a bigger and more detailed study has to be carried out.

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