PADDOCK SIZE AND EXERCISE ©
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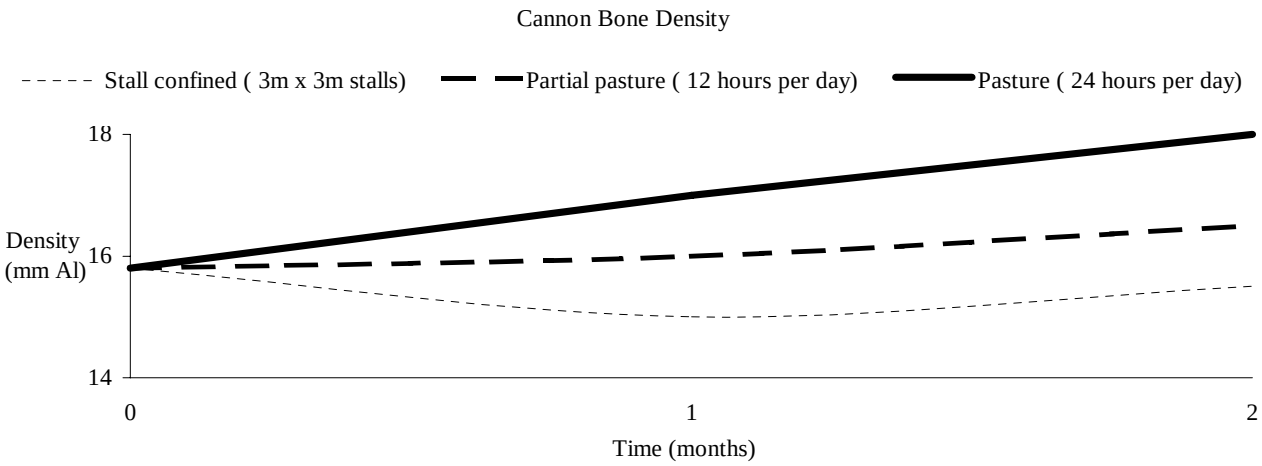
Exercise permits the development of a superior athlete and also has a protective effect against OCD. Confinement to a stable or yard has been shown to have an osteoporotic effect in young horses, whereas paddock exercise has been shown to increase bone strength and cortical thickness.
Factors such as speed, impact and strain rate are more important for bone density than duration of exercise. Under natural conditions, horses travel up to 25km a day and at pasture, growing horses gallop on average for 3.5 minutes per 24 hours, divided into approximately 40 sprints. Free pasture exercise also produces the highest glycosaminoglycan content in joints and tendons of growing horses. Recent studies have found an ideal paddock length of 40 metres allows foals to run at a speed that stimulates bone density and produces permanent increases in tendon and joint strength.
It is not uncommon for yearlings to be stabled for several months in preparation for sale presentation. However, comparison of stabled and non-stabled yearlings has shown that yearlings kept in stalls for 2 months have a decreased rate of bone formation, increased bone resorption and decreased bone mineral content compared to yearlings allowed 12 hours access to pasture per day and yearlings kept at pasture.



Alterations to this growth phase have been shown to have a large impact on bone strength in later life. Exercise stimulates bone formation at points of increased loading to ensure that bone can withstand subsequent loading forces. Lack of loading produces bone that is ill-prepared for the rigours of training and pre-disposes to bone-related injuries.

Maximum mineral content of the cannon bone may not be reached until 6yo. When training starts, a decrease in bone density occurs between 0 and 64 days, remains low and then gradually increases from day 104 to day 244. Cannon bone radiographs have shown that exercised yearlings are better prepared for the future mechanical stresses placed upon them, whereas yearlings stabled for 3 months lost bone mineral content and bone density. Pasture exercise seems best

for an optimal development of the musculoskeletal tissues. The combination of short bouts of heavy exercise superimposed on a basic box rest regimen appears to have adverse effects on long term viability of the tissues and may lead to an impaired resistance to injury. Yearling horses exercised on a treadmill demonstrated an increase in bone density.

Growth and radiographic studies of young horses have found similar weight and whither height gains, but differences in cannon bone circumference between exercised and stabled weanlings and yearlings. Exercise during this period was shown to improve the stress-bearing characteristics (radiographic bone density and metacarpal circumference) of the third metacarpal without affecting the weight and height. There is a tendency for more severe OCD lesions of both the hock and the stifle in foals whose exercise has been restricted.

There is a link between above average weight gains and the onset of bone diseases. Monitoring growth in terms of height and weight is a useful management practice to aid in maximising athletic potential while minimizing risks associated with deviations from normal growth. The major period of bone growth is from 3 months before birth until 15 months of age. For muscle, the major growth period in terms of achieving genetic potential for muscle fibre size and number is from 2 to 24 months of age. For stifle OCD there is a positive correlation with weight gain between the 3rd and the 5th month of age, which coincides with the period in which most stifle lesions become apparent.

A recent study of 2698 records that tracked changes in body shape, leg volume and density shows an s-shaped growth curve. Some current monitoring programs recommending a smooth growth curve can lead to erroneous estimates of growth data.

Correctly fed yearlings achieve greater gains in whither height, reach mature height earlier and deposit less fat. Two horses may be gaining similar amounts of weight, but one may be building bone and lean muscle mass and another depositing fat. Although weight and height measure growth, they are not sensitive enough to reveal the effects of lowered amino acid absorption on skeletal or muscle development. Analysis of diets of yearlings that are laying down too much cover - instead of gaining in height and muscle development - have revealed essential amino acid deficiency. A close watch must be kept on weekly weight gain as well as height.

Protein and mineral deficiencies in this age group, impact in the first instance on bone density, strength and height, and secondly on muscle development. Weanlings and yearlings are sensitive to the quality of dietary protein, i.e. the amino acid supply. Lysine and threonine have been indicated as the two first-limiting amino acids for growth, although requirements are influenced by ambient temperature and the type of energy source fed. Diets need to be formulated on the basis of digestibility. High quality forage can provide significant amounts of protein and amino acids, but the protein digestibility is only 60%.

Minerals such as iron, manganese, cobalt and iodine are critical for bone mineralization. Recent studies have found that the addition of copper and zinc to the diets of yearling horses did not increase bone mineral deposition because a complete trace mineral balance is required. Yearlings on recommended trace mineral intakes deposit more bone than those fed suboptimal levels and that when minerals are supplied as chelated proteinates instead of as salts, hoof growth is significantly increased.

In a 14 week study, hip height was higher in yearlings fed an extruded concentrate versus yearlings fed a pelleted concentrate. Although eating less

feed, those on the extruded concentrate grew taller and deposited less fat than the pellet fed yearlings, reflecting higher protein digestibility and increased bioavailability of nutrients in extruded feed.

	Extruded concentrate	Pelleted concentrate
Energy (Mcal/kg)	3.96	2.97
Feed intake (kg/day)	3.53	4.83
Weight gain (kg)	35.5	43.5
Croup fat (cm)	1.5	2.9
Hip height (cm)	4.3	2.9

Other nutrients such as magnesium, boron and silicon are important, as is the ratio of calcium:magnesium, zinc to manganese and zinc to copper. Studies on magnesium deficiency in other animals have shown normal weight gain and appearance, but reduced bone density – indicating that 'growing normally' means they look normal on the outside and reach normal size – but their bones were not normal. This is a good example of the difference between 'adequate' and 'optimal' nutrition.

Gait and behaviour differences have also been found between confined and paddocked yearlings. Pasture exercise leads to a normally developed locomotion pattern. Although velocity is similar between pastured and stabled weanlings, pastured foals have a smaller range of motion of the shoulder and hip joint and less maximal step height of both fore and hind hooves. Paddocked foals trot the same distance with less joint motion and more efficient coordination than confined weanlings.

Studies have shown that stalled yearlings become quite active, (running, bucking and rearing) approximately 3 weeks after being confined. Stabled weanlings and yearlings spent more time engaged in aberrant behaviours such as licking, kicking or chewing the wall, pawing, rearing and bucking. Paddocked yearlings display a time budget more like feral horses with more time spent moving and less time lying. Interestingly, foals of low- or middle-ranking mares were less likely to develop abnormal behaviour than foals of dominant mares Crib-biting was initiated by 10.5% of horses at median age 20 weeks, weaving by 4.6% of horses at median age 60 weeks, box-walking by 2.3% of horses at median age 64 weeks and wood-chewing by 30.3% of horses at median age 30 weeks. Wood-chewing developed at a lower rate in horses born to subordinate or mid-ranking mares than in horses born to dominant mares and at a higher rate in stabled horses compared to those kept at grass after weaning.

Since the muscular and cardiovascular systems respond to training much faster than the skeletal system, horses often appear to be ready for racing before their bones have sufficient strength to prevent skeletal failure. The musculo-skeletal system begins its development while the foal is in-utero and rapid development of bone, joints and tendons continues for the first 12 months. It is essential that this early growth is nurtured and supported by exercise and correct nutrition, because it influences the final strength of these structures. The importance of exercise cannot be over-emphasized for future athletic achievement and periods of restricted exercise should be minimized for weanlings and yearlings.