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TIMING AND RATE OF SKELETAL MATURATION IN HORSES, With Comments on Starting Colts and the State of the Industry

Introduction

One of the most widely-read and widely-requested pieces of information contained in our ESI Website has been the following article which we familiarly refer to as "the Ranger piece." By 2005, with our permission this article has been re-printed in more than 75 magazines and riding-club newsletters in countries as far away as South Africa, Scotland, and New Zealand. Without our permission it has also been posted on about a gazillion websites and "boards", and, I am sure – one way or another -- read by many thousands of people.

Originally posted on December 14th, 2001 as part of the old "conformation analysis" section of our website, it was taken off line in January of 2004 with the restructuring of the site that we did at that time. Here we post it again in the belief that you might appreciate having a downloadable copy, so as to more readily be able to share it with friends and neighbors whom you think might want or need to see it.

The discussion about "Ranger" arose when an ESI website visitor sent a photo of her two and a half year-old Tennessee Walker gelding to obtain my comments. We no longer have the original photo, but an exact tracing with the analytical marks on it accompanies this article, along with some other explanatory illustrations which have been added for this revised re-posting.

I began my reply to Ranger's owner with comments on his conformation, but soon got "sidetracked into the main issue," which is, at bottom, about how to make the best decision as to when a colt may be started under saddle.

A General Look at Ranger

The first thing to note is that as a two and a half year old, Ranger is a "teenager." He's not mature physically, nor will he be until he's at least six. Despite a nice development of chest and a fine long neck, there is that unmistakable lack of length and muscular fullness to the hindquarters and the little weakness or lack of arch at the base of the neck that smacks of the gawkiness of sub-adulthood. The withers are not as high as they will someday be, either. Note please however, that I have not said anything about Ranger having a big head - because he doesn't (compare length of head to length of neck; a horse's head is not to be considered "large" until it is longer than the underline of the neck). I like the so-called "old fashioned" head of the Standardbred, Morgan, Saddlebred, and Walking Horse. An Arabian head is fine - on an Arabian, but the Arabian head shape should not be the universal definition of "good" in heads. Ranger's is an excellent head with sharp bony definition, a good eye, and a real good expression. There are also solid reasons, having to do with the proper eruption and functioning of the teeth, for preferring a straight or slightly arched head, such as Ranger shows, to certain types of dished construction, and for preferring a longer face (as measured from eye to muzzle) to a foreshortened face.

All Horses of All Breeds Mature Skeletally at the Same Rate

Now I want to discuss the concept of skeletal maturity and deal with that concept thoroughly. Ranger is not mature, as I said, as a 2 ½ year old. This is not because Ranger is a "slow-maturing" individual or because he comes from a "slow maturing" breed. There is no such thing. Let me repeat that: no horse on earth, of any breed, at any time, is or has ever been mature before the age of six (plus or minus six

months). So, for example, the Quarter Horse is not an "early maturing" breed - and neither is the Arabian a "slow maturing" breed. As far as their skeletons go, they are the same. This information comes, I know, as a shock to many people who think starting their colt or filly under saddle at age two is what they ought to be doing. This begs discussion of (1) what I mean by "mature" and (2) what I mean by "starting".

When is a Horse Skeletally Mature?

Just about everybody has heard of the horse's "growth plates", and commonly when I ask them, people tell me that the "growth plates" are somewhere around the horse's knees (actually the ones people mean are located at the bottom of the radius-ulna bone just above the knee). This is what gives rise to the saying that, before riding the horse, it's best to wait "until his knees close" (i.e., until the growth plates convert from cartilage to bone, fusing the epiphysis or bone-end to the diaphysis or bone-shaft). What people often don't realize is that there is a "growth plate" on either end of every bone behind the skull, and in the case of some bones (like the pelvis, which has many "corners") there are multiple growth plates.

So do you then have to wait until all these growth plates convert to bone? No. But the longer you wait, the safer you'll be. Owners and trainers need to realize there's a definite, easy-to-remember schedule of fusion – and then make their decision as to when to ride the horse based on that rather than on the external appearance of the horse. For there are some breeds of horse – the Quarter Horse is the premier among these – which have been bred in such a manner as to look mature long before they actually are mature. This puts these horses in jeopardy from people who are either ignorant of the closure schedule, or more interested in their own schedule (for futurities or other competition) than they are in the welfare of the animal.

The Schedule of Growth-Plate Conversion to Bone

The process of converting the growth plates to bone goes from the bottom of the animal up. In other words, the lower down toward the hoofs you look, the earlier the growth plates will have fused; and the higher up toward the animal's back you look, the later. The growth plate at the top of the coffin bone (the most distal bone of the limb) is fused at birth. What that means is that the coffin bones get no taller after birth (they get much larger around, though, by another mechanism). That's the first one. In order after that:

Short pastern - top and bottom between birth and 6 months.

Long pastern - top and bottom between 6 months and one year.

Cannon bone - top and bottom between 8 months and 1.5 years

Small bones of the knee - top and bottom of each, between 1.5 and 2.5 years

Bottom of radius-ulna - between 2 and 2.5 years

Weight-bearing portion of glenoid notch at top of radius - between 2.5 and 3 years

Humerus - top and bottom, between 3 and 3.5 years

Scapula - glenoid or bottom (weight-bearing) portion – between 3.5 and 4 years

Hindlimb - lower portions same as forelimb

Hock - this joint is "late" for as low down as it is; growth plates on the tibial and fibular tarsals don't fuse until the animal is four (so the hocks are a known "weak point" - even the 18th-century literature warns against driving young horses in plow or other deep or sticky footing, or jumping them up into a heavy load, for danger of spraining their hocks).

Tibia - top and bottom, between 3 and 3.5 years

Femur - bottom, between 3 and 3.5 years; neck, between 2.5 and 3 years; major and 3rd trochanters,

between 2.5 and 3 years Pelvis - growth plates on the points of hip, peak of croup (tubera sacrale), and points of buttock (tuber ischii), between 3 and 4 years.

And what do you think is last? The vertebral column, of course. A normal horse has 32 vertebrae between the back of the skull and the root of the dock, and there are several growth plates on each one, the most important of which is the one capping the centrum. These do not fuse until the horse is at least 5 ½ years old (and this figure applies to a small-sized, scrubby, range-raised mare. The taller your horse and the longer its neck, the later the last fusions will occur. And for a male - is this a surprise? - you add six months. So, for example, a 17-hand Thoroughbred or Saddlebred or Warmblood gelding may not be fully mature until his 8th year - something that owners of such individuals have often told me that they "suspected").

Significance of the Closure Schedule for Injuries to Back and Neck vs. Limbs

The lateness of vertebral "closure" is most significant for two reasons. One: in no limb are there 32 growth plates! Two: the growth plates in the limbs are (more or less) oriented perpendicular to the stress of the load passing through them, while those of the vertebral chain are oriented parallel to weight placed upon the horse's back. Bottom line: you can sprain a horse's back (i.e. displace the vertebral physes - see Figs. 5 and 8) a lot more easily than you can displace those located in the limbs.

Here's another little fact: within the chain of vertebrae, the last to fully close" are those at the base of the animal's neck (that's why the long-necked individual may go past 6 years to achieve full maturity - it's the base of his neck that is still growing). So you have to be careful - very careful - not to yank the neck around on your young horse, or get him in any situation where he strains his neck (i.e., better learn how to get a horse broke to tie before you ever tie him up, so that there will be no likelihood of him ever pulling back hard. For more on this, see separate article in this issue).

Relationship of Skeletal to Sexual Maturity

The other "maturity" question I always get is this: "so how come if my colt is not skeletally mature at age 2 he can be used at stud and sire a foal?" My answer to that is this: sure, sweetie, if that's how you want to define maturity, then every 14 year old boy is mature. In other words, the ability to achieve an erection, penetrate a mare, and ejaculate some semen containing live sperm cells occurs before skeletal maturity, both in our species and in the horse.

However, even if you only looked at sperm counts or other standard measures of sexual maturity that are used for livestock, you would know that considering a 2 year old a "stallion" is foolish. Male horses do not achieve the testicular width or weight, quality or quantity of total ejaculate, or high sperm counts until they're six. Period. And people used to know this; that's why it's incorrect to refer to any male horse younger than 4 as a "stallion," whether he's in service or not.

Peoples' confusion on this question is also why we have such things as the Stallion Rehabilitation Program at Colorado State University or the behavior-modification clinic at Cornell - because a two year old colt is no more able to "take command" on a mental or psychological level of the whole process of mating - which involves everything from "properly" being able to ask the mare's permission, to actually knowing which end of her to jump on, to being able to do this while some excited and usually frightened humans are banging him on the nose with a chain - than is a 14 year old boy.

What Does it Mean to "Start" a Young Horse?

Let us now turn to the second discussion, which is what I mean by "starting" and the whole history of that. Many people today - at least in our privileged country - do not realize how hard you can actually work a

mature horse - which is very, very hard. But before you can do that without significantly damaging the animal, you have to wait for him to mature, which means - waiting until he is four to six years old before asking him to carry you on his back.

What bad will happen if you put him to work as a riding horse before that? Two important things - and probably not what you're thinking of. What is very unlikely to happen is that you'll damage the growth plates in his legs. At the worst, there may be some crushing of the cartilages, but the number of cases of deformed limbs due to early use is tiny. The cutting-horse futurity people, who are big into riding horses as young as a year and a half, will tell you this and they are quite correct. Want to damage legs? There's a much better way - just overfeed your livestock (you ought to be able to see a young horse's ribs - not skeletal, but see 'em - until he's two).

Structural damage to the horse's back from early riding is somewhat easier to produce than structural damage to his legs. There are some bloodlines (in Standardbreds, Arabians, and American Saddlebreds) that are known to inherit weak deep intervertebral ligament sheathing; these animals are especially prone to the early, sudden onset of "saddle back". However, individuals belonging to these bloodlines are by no means the only ones who may have their back "slip" and that's because, as mentioned above, the stress of weightbearing on the back passes parallel to its growth plates as well as parallel to the intervertebral joints. However, despite the fact that I have provided a photo of one such case for this posting, I want to add that the frequency of slipped backs in horses under 6 years old is also very low.

So, what's to worry about? Well...did you ever wish your horse would "round up" a little better? Collect a little better? Respond to your leg by raising his back, coiling his loins, and getting his hindquarter up underneath him a little better? The young horse knows, by feel and by "instinct", that having a weight on his back puts him in physical jeopardy. I'm sure that all of you start your youngstock in the most humane and considerate way that you know how, and just because of that, I assure you that after a little while, your horse knows exactly what that saddle is and what that situation where you go to mount him means. And he loves you, and he is wiser than you are, so he allows this. But he does not allow it foolishly, against his deepest nature, which amounts to a command from the Creator that he must survive; so when your foot goes in that stirrup, he takes measures to protect himself.

The measures he takes are the same ones you would take in anticipation of a load coming onto your back: he stiffens or braces the muscles of his topline, and to help himself do that he may also brace his legs and hold his breath ("brace" his diaphragm). The earlier you choose to ride your horse, the more the animal will do this, and the more often you ride him young, the more you reinforce the necessity of him responding to you in this way. So please - don't come crying to me when your six-year-old (that you started under saddle as a two year old) proves difficult to round up. Any horse that does not know how to move with his back muscles in release cannot round up.

Bottom line: if you are one of those who equates "starting" with "riding", then I guess you better not start your horse until he's four. That would be the old, traditional, worldwide view: introduce the horse to equipment (all kinds of equipment and situations) when he's two, crawl on and off of him at three, saddle him to begin riding him and teaching him to guide at four, start teaching him maneuvers or the basics of whatever job he's going to do - cavalletti or stops or something beyond trailing cattle - at five, and he's on the payroll at six. The old Spanish way of biting reflected this also, because the horse's teeth aren't mature (the tushes haven't come in, nor all of the permanent cheek teeth either) until he's six.= This is what I'd do if it were my own horse. I'm at liberty to do that because I'm not on anybody else's schedule except my horse's own schedule. I'm not a participant in futurities or planning to be. Are you? If you are, well, that's your business. But most horse owners aren't futurity competitors. Please ask yourself: is there any reason that you have to be riding that particular horse before he's four?

Futurities

A "futuraity" is a contest for prize money for horses that are two or three years old. The primary country today where futurities are held is the United States. If asked to name a famous futurity, most people here would name "the Snaffle Bit" or "The Lazy E" or a "World championship" in some breed or other. But the branch of equine competition in which futurities first began - in the last half of the 19th century - is racing; and the futurity series which is now almost the oldest as well as easily the most famous in the world is the Triple Crown. You see, the Thoroughbred was invented in the late 17th century by James II of England, who instigated the world's first performance testing for horses. The king's object was to induce his subjects to produce a horse that could carry speed over a distance of ground. To achieve this objective, he set forth the following rules and invited all the noblemen and horse breeders to bring any horse they thought could win under the following conditions:

The horses shall run four miles (over undulating terrain, on turf), and the winner shall be recorded.

They shall then rub for half an hour.

They shall then run a second heat of four miles, and rub for half an hour.

They shall then run a final heat of four miles, and the overall winner will be the best two of three.

The horses shall carry 80 stone apiece (approximately 160 lbs.)

Breeding horses that could meet and exceed these requirements is what created the world's greatest equine athlete - the Thoroughbred.

Where are all the four mile races today? They began to go extinct shortly after the "futuraity" concept was invented, in the late 19th century - not because racing mature horses four or twelve miles is cruel (as is sometimes claimed today), but because futurities were invented as a marketing ploy to give prospective bettors and investors a peep at what was supposedly coming up from the studs.

Those old horsemen knew that you can't run a two- or three-year-old four miles; you'd kill him. So they shortened the distance to something between 7/8ths and 2 miles. Betting interest in these races was so great - the marketing ploy worked - that they simply outcompeted the longer "standard" races by becoming the contests that best fed the tracks. Today, though, this has been forgotten, so that many perfectly well-intentioned investors simply do not know that a three year old is not a mature horse and that two year olds have absolutely no business whatsoever at the racetrack (if all the two year olds were taken off the track tomorrow, 90% of the illegal drugs and training techniques would disappear tomorrow, too).

Of all the Thoroughbred horses on record that raced as two- or three-year-olds, and then continued to race until age six or older, only a handful of them ever posted faster times as youngstock than they did as six year olds. The horse reaches his physical prime at age six and (if well managed) maintains that prime until he's about twelve. In other words - obviously, modern horseracing is not about speed. Results after each race at the track are not posted in miles per hour or meters per minute! They don't want the bettor or racing fan to focus on it. What they care about is astute handicapping that favors the track (the unsuccessful \$2 bet is what keeps tracks in business); in short, the focus is not on speed but rather on contest -- which is merely the appearance of speed.

And the same may be said for any other division of competition: what organizers, spectators, commentators and participants care about is contest, excitement, today's champion against the up-and-coming contender, whether any horse present is any good compared to universal standards of quality or not. My point is that YOU - the majority reader here - are very likely not in that game. My main objective is to help you get free of imitating your neighbor who may in fact be trapped in those economics.

There is one last consideration before I go back to direct discussion of Ranger's physique. When I say "start" a horse I do not equate that with riding him. To start a young horse well is one of the finest tests (and proofs) of superior horsemanship. Anyone who does not know how to start a horse cannot know how to finish one. You, the owner, therefore have the following as a minimum list of enjoyable "things to accomplish" together with your young horse before he's four years old, when you do start him under saddle:

Comfortable being touched all over. Comfortable: not put-upon nor merely tolerating, but really looking forward to it.

This includes interior of mouth, muzzle, jowls, ears, sheath/udder, tail, front and hind feet. Pick 'em up and they should be floppy.

Knows how to lead up. No fear; no attempt to flee; no drag in the feet; knows that it's his job to keep slack in the line all the time.

Manners enough to lead at your shoulder, stop or go when he sees your body get ready to stop or go; if he spooks, does not jump toward or onto you, will not enter your space unless he's specifically invited to do so.

Leads through gate or into stall without charging.

Knows how to tie, may move to the side when spooked but keeps slack in the line all the time.

Knows how to be ponied.

Carries smooth nonleverage bit in mouth. Lowers head and opens mouth when asked to take the bit; when unbridled, lowers head and spits the bit out himself.

Will work with a drag (tarp, sack half filled with sand, light tire, or sledge and harness).

Mounts drum or sturdy stand with front feet.

Free longes - comes when called and responds calmly to being driven forward; relaxed and eager.

When driven, leaves without any sign of fleeing; when stopped, plants hind feet and coils loins; does not depend on back-drag from your hand to stop him.

Familiar with saddle, saddle blanket, and being girthed and accepts it quietly.

Backs easily, quietly and straight in hand, "one step at a time".

Loads quietly in horse trailer, unloads by stepping backwards from inside horse trailer without rearing or rushing.

Various people might like to add to this list. Please feel free, just so long as what you're asking your young horse isn't more than he can physically do. Getting the horse "100% OK" mentally and emotionally - those are the big areas in successful early training; most of the physical and athletic skills can come later, when it is fitting.

I've had people act, when I gave them the above facts and advice about starting youngstock, like waiting four years was just more than they could possibly stand. I think they feel this way because the list of things which they would like to include as necessary before attempting to ride is very short. Their whole focus is on riding as why they bought the animal, and they think they have a right to this. Well, the horse - good friend to mankind that he is - will soon show them what he thinks they have a right to.

The Bottom Line for Ranger

What's left to say about Ranger? By the time he's fully mature, he'll have a more muscular neck, which he will want (if he's allowed in the training process) to arch more at the base but carry lower at the poll. His back will be a little longer than it now is, the withers will definitely be higher, and the loins a little broader. His pelvis will be longer and the musculature covering it will be much fuller. He has (typical of Walking Horses) already a tremendous shoulder and a wonderful long arm - he'll have a very long, flowing forward reach. He has good crisp hocks and is not more crooked in the hind limb than I think

proper for his breed - he's only slightly more angulated/long in the hind limb than I would ideally like. He's got adequate "bone" and good-sized, well-shaped hoofs.

Ranger's back is held a little stiffly and I'm sure the owner knows why by now. Many folks who own gaited breeds complain that they (TWH, Pasos, ASB, Rocky Mtn., etc.) have a "tendency" to hard-pace rather than four-beat gait, and this also comes from the habitual stiffening of the back. Gaiking (all forms of it) has the same footfall order and basic mechanism as the ordinary walk. But no horse can walk in good rhythm with good "reach" and good "nod" unless his back is free to oscillate both up and down and (especially) from side to side in time with the motions of his legs. Take away the emotional worry and mental concern...teach the animal to release the muscles of his topline and those of the crest of his neck...and all your concerns with whether he has a good "nod" or why he is maybe pacing are going to fade right away.

Thanks for writing in, and please give ol' Ranger a little scratchin' in his favorite spot for me.

Best wishes,
Dr. Deb