Why is 'Rollkur' Wrong? (part one)

Observations on the Report of the FEI Veterinary and Dressage Committees' Workshop on 'The use of over-bending ("Rollkur") in FEI Competition,' January 2006. The practice of bit-induced over-bending is reviewed and evidence of its harm provided.

Over-bending inflicts acute pain, chronic pain and nerve pain (neuralgia). Its victims exhibit fear and mental stress. In addition, by locking-up the neck, a horse is partially asphyxiated, unable to see properly and unbalanced. Over-bending increases the likelihood of accidents for both horse and rider. In the long-term, the practice probably causes permanent structural damage to many parts of the body, including the trachea, lungs and spine. Without question, it injures the bars of the mouth, teeth and skull. But if the practice of over-bending did no more than frighten a horse and cause it pain, it should be prohibited.

Reasons are given for the following recommendations:
1. A revision of the guidelines issued to judges and stewards at FEI sponsored competitions to ensure that standards of judging promote equine welfare.
2. An update of FEI rules and regulations
a) Prohibition of over-bending during warm-up at FEI sponsored competitions
b) Crank nosebands to be disallowed.
c) The cross-under design of bitless bridle to be permitted for dressage and other disciplines.

CONTENTS

The article is in seven parts

The full FEI report is available by clicking **here**

PART I: DEFINITIONS, RATIONALE AND BACKGROUND

Definitions

Definitions of three words or phrases are necessary...cruelty, over-bending and poll flexion

1. Cruelty: The current definition of cruelty, agreed by animal welfare workers internationally, is the infliction of avoidable pain and suffering (Cook et al 2006).

2. Over-bending: The FEI Report conceded, "a suitable form of words must be found to better describe 'Rollkur-like' techniques' as used in the training of horses for dressage and other disciplines." The delegates to the workshop chose to use the word 'hyperflexion' and agreed on a working definition but recognized that it needed "further work." They defined hyperflexion of the neck as "a technique of working/training to provide a degree of longitudinal flexion of the mid-region of the neck that cannot be self-maintained by the horse for a prolonged time without welfare implications." I agree with the delegates that this is inadequate. Apart from other more serious matters, it is not the mid-neck joints that are most involved but the very first joint of the neck. The collective range of movement of the vertebral joints in the mid-neck region is small compared with large range of movement that takes place at the atlanto-occipital joint. But the real problem is that the use of euphemistic language such as 'welfare implications' fails to nail the cruelty involved.

In the following article, I define 'Over-bending' (synonyms Rollkur, Hyperflexion and Low-Deep-and-Round) as a training method and warm-up routine that employs two bits and a chain to apply persistent pressure (or threat of pressure) to maintain a horse's head and neck in an unnatural position of maximum flexion (i.e., not just 'behind the vertical' but at the very limit of possible flexion) at the walk, trot and canter for significant periods of time, causing avoidable pain and suffering.

It follows from this definition that over-bending, as defined above, is cruel. The linkage is intentional and unavoidable. Some readers may protest that such a definition is inaccurate on the grounds that over-bending is only applied for short periods of time. The evidence, however, is against such an interpretation. But even if this was true, short periods of cruelty are still not acceptable. The above definition is founded on postjudice not prejudice. The purpose of the present article is to provide the evidence on which the definition is based and to recommend the method's prohibition.

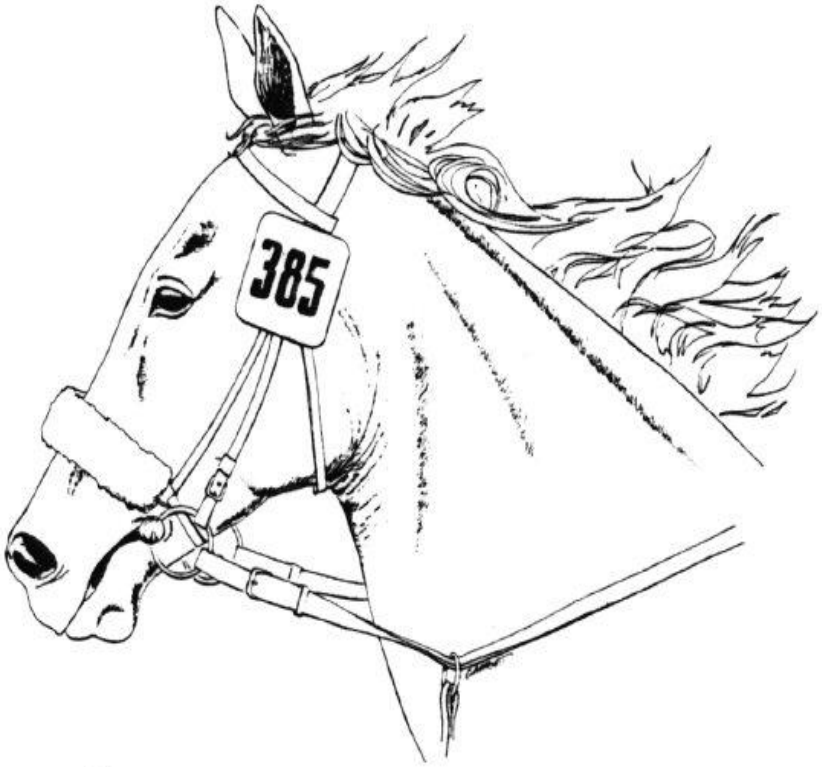
The above definition of over-bending would be incomplete without mentioning the likely training that will have preceded any public appearance. This will vary with trainers but the use of draw reins and/or side reins may have been part of the process.

The term 'over-bending' will be used in preference to 'Rollkur,' 'Hyperflexion' or 'Low, Deep and Round' as this will keep to the fore the true nature of the technique. It is, after all, not just bending but over-bending. We are referring to a

training technique that is incompatible with the physiology of the horse. It is a pathophysiological technique. There is no movement in dressage or any other discipline that justifies cruelty.

3. Poll flexion: A definition of what constitutes extension and flexion of the poll is also necessary. Movement at the poll depends on one joint in particular, the joint between the first cervical vertebra (the atlas) and the back of the skull (the occipital bone). Its anatomical name is the atlanto-occipital joint. I will refer to it as the breathing/balancing joint, as the degree of flexion or extension in this joint is critical in determining how easily a horse can breathe and balance.

The position of the breathing/balancing joint, whether it is flexed for balancing at slow exercise or extended for rapid breathing at fast exercise, can be identified by measuring the jowl angle (Fig 1). The resting or neutral position of the joint, when it is neither extended nor flexed, can be taken as that position of the head and neck in a stationary and alert horse when the jowl angle is about 90¼ (Fig 2c). Extension of the joint can be defined as an angle less than 90¼ (Fig 2a and b) and flexion by an angle greater than 90¼ (Fig 2d and e).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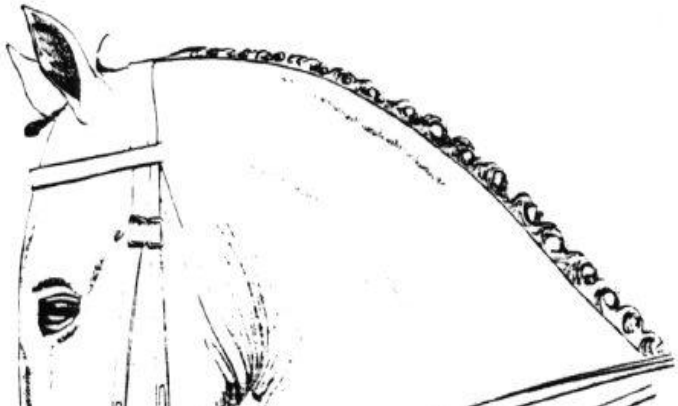
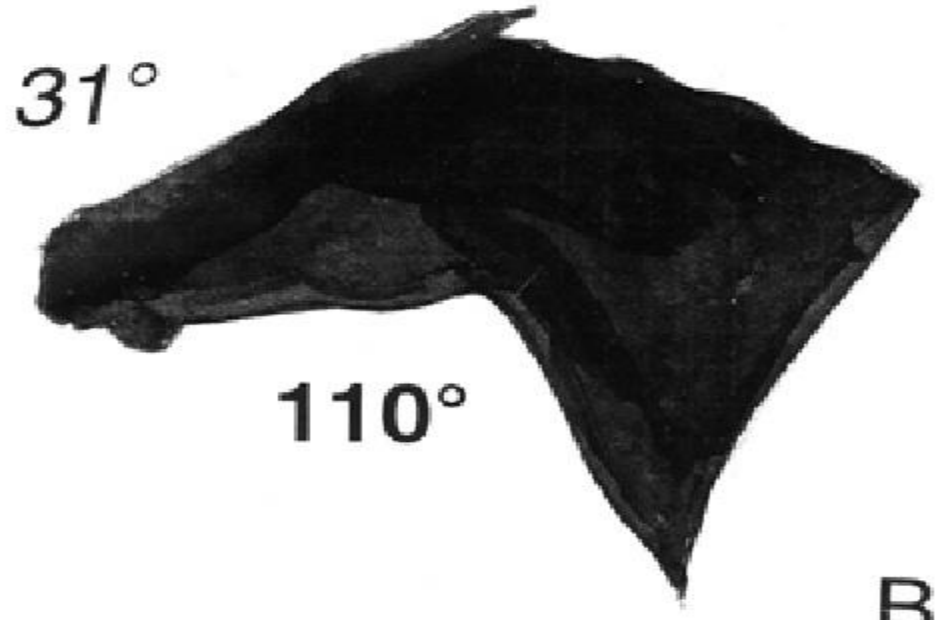


Fig 1. Drawings based on photographs of horses in action. From top to bottom, these exemplify racing, show jumping and dressage. The jowl angle is the angle at which the line of the jaw meets the line of the neck. From top to bottom, the angles are 95, 80 and 45 degrees. As the neutral angle is 90 degrees (see Fig 2c), this tells us that the racehorse is slightly extended (though not as extended as one might wish for an unobstructed airway), the show jumper slightly flexed and the dressage horse, 'on the vertical', severely flexed. The nasal profile angles from top to bottom are 49, 57 and 90 degrees.

A simpler but less accurate way of assessing the status of the breathing/balancing joint is to measure the angle of the front line of the horse's head, as seen in a side view, i.e., the nasal profile. When the jowl angle is 90¼, an imaginary line extended from the nasal profile to the horizontal, meets a flat ground surface at an angle of about 53¼ (Fig 2c). Using this as the base line, any nasal angle less than 53¼ constitutes extension of the joint and enlargement of the airway and any angle greater than 53¼ constitutes flexion and reduction of the airway.

A



B

Fig 2: Showing the full range of movement of the breathing/balancing joint. The jowl angles are shown in bold and the nasal angles in italics.
A: The position of extreme extension held fleetingly in the headshaking horse. A galloping horse at liberty will exhibit a similar jowl angle, though of course the bottom line of the jaw will be closer to the horizontal (readers should rotate the picture in their mind's eye in an anti-clockwise direction). Compared with the resting position of 90¼, the maximum extension of about 138¼ represents 48¼ of extension.
B: An example of a position of moderate extension (20¼ only) in the racehorse with jockey up. The jowl angle in 28 measurements ranged from 90¼ to 118¼ with an average of 103¼. These figures suggest that racehorses are commonly handicapped by having to work with a partially obstructed airway.
C: The neutral position of the joint, as in an alert horse at rest
D: A dressage horse 'on the vertical' has 45¼ of flexion, i.e. severe flexion and significant airway obstruction.
E: The over-bent dressage horse during warm-up exhibits 75¼ of flexion, which seriously obstructs the airway.

The range of movement on either side of this neutral position is large. For example, a galloping racehorse may have a jowl angle of 110¼ (20¼ of extension from the neutral position of 90¼) indicating a breathing joint that is moderately extended, whereas the same horse at the walk may have a nasal angle of 55¼ and be only extended by two degrees (Fig 3). Maximum extension is exhibited by a galloping horse at liberty and, momentarily, by a headshaking horse. At the moment of head tossing, the nasal profile range is "off the chart" as the nasal angle no longer meets the horizontal (Figs 2a & 9).

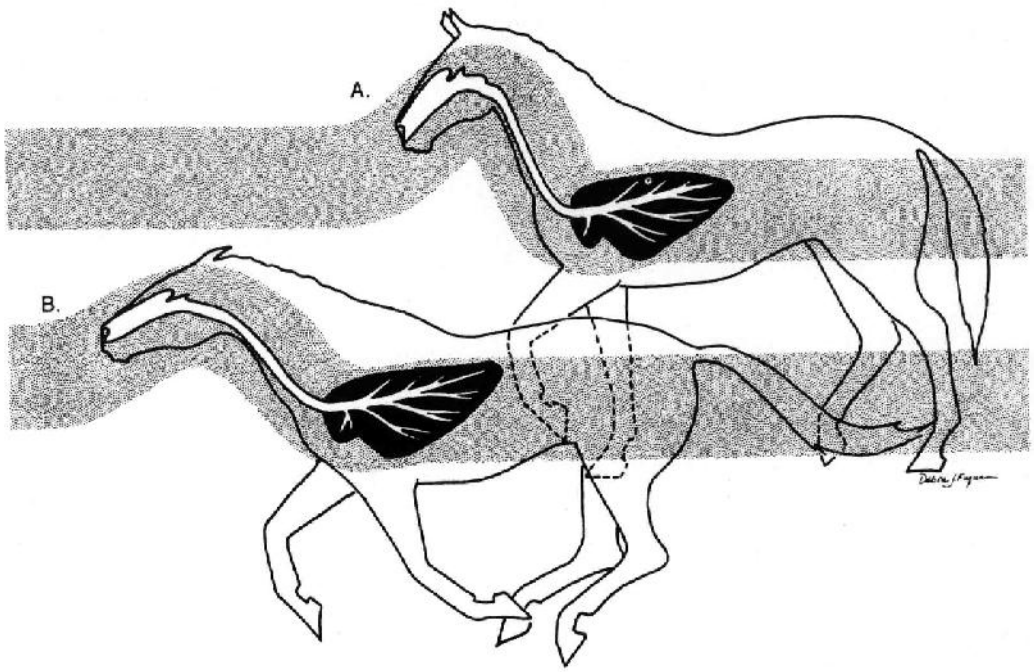


Fig 3. Showing how, when a ridden horse gallops, the kinks in its airway are straightened out to facilitate airflow, reduce resistance, and economize on the work of breathing. Diagram A shows the shape of the airway in a horse at a slow walk; diagram B the same horse at a gallop, when the head and neck are stretched out like the neck of a swan in flight. At the walk, the jowl and nasal profile angles are 78 and 58 degrees respectively (slight flexion at the poll); at the gallop, the same angles are 111 and 55 degrees respectively (moderate extension).

The range of motion in flexion is equally great. A dressage horse with its nasal profile vertical to the ground obviously has a 90¼ nasal angle (45¼ of flexion based on jowl angle). Such a horse during a dressage performance is already experiencing a severe degree of airway obstruction at the level of the throat. An over-bent horse with its chin on its chest may have a nasal angle of 128¼ (75¼ of flexion - see Fig 14). Such a position is natural enough in a stationary horse, if only held fleetingly and entirely voluntarily. When artificially maintained for either short or long periods at the walk, trot and canter, such a horse is - as I shall show - being asphyxiated.

For more information about the way the headset affects the anatomy of the airway and its openness at the level of the throat, see Cook and Strasser (2003).

Rationalization for over-bending

Three reasons are voiced, though there may be additional unspoken arguments

1. Proponents of the over-bending method of training for dressage maintain that they are suppling the horse's neck and 'rounding' the back. In practice, what I suggest they are doing - albeit unintentionally - is soring their horse's mouth. Rather than suppling the neck and making it flexible, lithe and relaxed, over-bending is more likely to produce muscle strain, skeletal damage and joint injury. 'Rounding of the back,' achieved by dropping the head and pulling on the nuchal and supraspinous ligaments, is not 'collection,' which is only achieved after years of athletic training. True collection is the result of the patient development of a horse's overall fitness and, in particular, fitness of its back and abdominal muscles. The objective of such training is to enable a horse that is naturally balanced at liberty, to remain balanced (i.e. 'collected') when (unnaturally) carrying the weight of a rider. As a sore mouth, a stiff spine, and the imbalance of over-bending are not helpful preliminaries to athletic performance, a secondary purpose of this article is to explore what it is about over-bending that explains its promotion as a training technique.

2. Another reason advanced in support of over-bending is to produce a horse with 'brilliance,' 'expression' and 'drama.' Such an aim is in direct contravention of the FEI Guidelines that call for a calm horse but apparently this is not what the judges are rewarding. It seems that 'spookiness' is considered to add drama to a performance and is a quality favored by judges. If this is what is required to win, then causing pain and/or the fear of pain by soring a horse's mouth is, I agree, a most effective way to make a horse 'spooky.' Over-bending will undoubtedly make a horse nervous and apprehensive far more successfully than it will supple a horse's neck. An over-bent horse is frightened to stretch out its neck, as it has learnt that this will result in a severe pain in the mouth. A pain in the neck is the lesser of two evils. But a frightened, nervous and anxious horse (often unfairly labeled as 'highly-strung') is insecure, unstable, and unsafe to ride. The pain of a bit in the mouth or the fear of such pain rings an alarm bell in the brain. Why riders should want to do this is mystifying unless it is to satisfy a sadly misjudged and faulty standard of performance.

3. A third reason stated is that because horse breeders in the last decade have succeeded in producing such large and powerful horses, new and more powerful methods are required for their control. This argument, born of a misunderstanding of horse behavior and the belief that greater pain equates with greater control, is no more valid today than it was in medieval times when it was thought that in order to control the big warhorses that had been bred, larger and fiercer curb bits were needed. Over-bending has a long history. It is repeatedly illustrated on the Bayeux tapestry, embroidered c.1080. But successful communication between horse and rider comes from cooperation not coercion. We should be seeking methods of communication, not control. The smallest of horses cannot be controlled by a rider's force or by conditions that are incompatible with equine exercise physiology and psychology.

4. An unstated reason that may be connected with the one above is that 30 minutes of warm-up exercise in the over-bent position will cause fatigue and render some horses easier to control in the arena.

The first Protection of Animals Act in the UK was passed in 1911. Nine amendments were subsequently made and the Acts have now been absorbed into the new Animal Welfare Act. Nevertheless, it is instructive to consider some of the original wording. The Acts made it an offence to cause unnecessary suffering to any domestic or captive animal. It was an offence, for example, "to cruelly beat, kick, ill-treat, over-drive, over-load, torture, infuriate, or terrify any animal." The horse's bit does not 'kick,' 'over-load,' or 'over-drive' a horse but I submit that it frequently does all the rest. If this wording had been further amended today, it might have been thought necessary to add, 'over-bend.'

Background

The over-bent position of the head is the end result of a training regime based on persistent bit pressure without release, coupled with the horse's understandable efforts to evade the bit. Evasion of the bit is not a vice. It is a horse's way of avoiding pain. In the absence of release from the rider, the over-bending method trains a horse to provide its own release. Initial pressure results in initial flexion. Persistent pressure results in increasing degrees of flexion, until finally the horse's chin is on its chest and has nowhere else to go (Fig 4). The pain of the bit may have been temporarily avoided at each stage, only to become permanent at the final stage and be accompanied by neck and back pain.

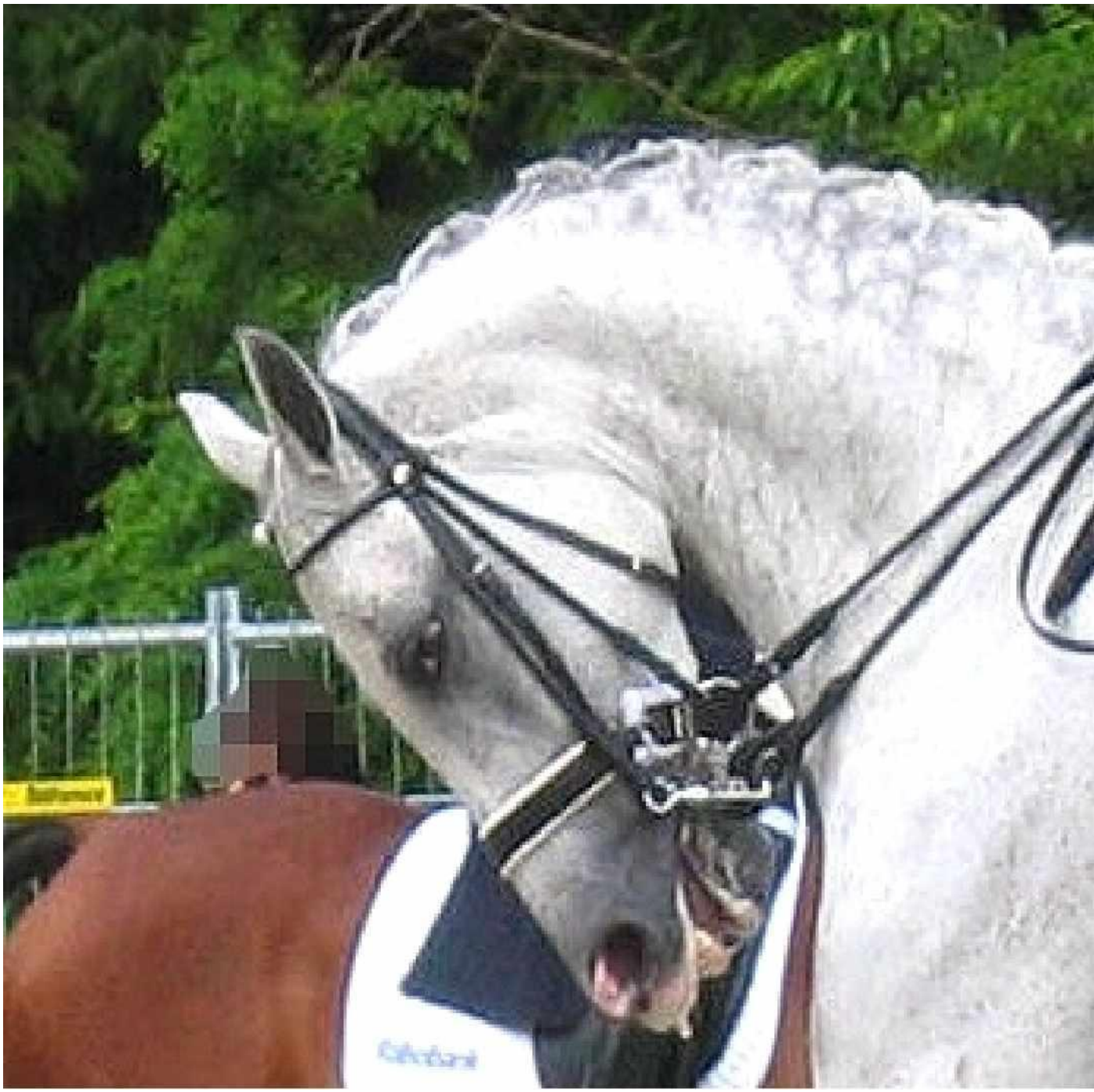


Fig 4a: Over-bending in a dressage horse during warm-up. Note the tension in both pairs of reins. The one thing that can be guaranteed is a 'hot' mouth and a pain in the neck. This represents cruel and unusual punishment for an animal that has done no wrong. [Photo credit: Lydia Nevzorov]

Fig 4b: Over-bending is also employed in the training of show-jumpers, event horses and racehorses. Shown here is over-bending in a two-year-old Thoroughbred racehorse during a training canter. The exercise rider is standing in the stirrups and immobilizing the short reins by fixing them against the horse's neck ('bridging' the reins).

The extreme head flexion is not a sign of increasing suppleness of the neck, so much as a result of the horse's patient but doomed efforts to avoid pain. A few horses will ultimately fight back, break-free and 'explode' in one way or another, by bolting, bucking, rearing, headshaking or otherwise retaliating. Some horses simply dig their toes in or even lie down. But, such is the forgiving nature of most horses that many submit to the practice, albeit in different ways depending on their characters. Over-bending is open to serious criticism on so many grounds that it is easy to forget that it causes pain and that the word pain derives from the Latin poena meaning penalty, punishment, hence torment. For this alone it should be prohibited.

Over-bending is a short cut to false collection. It does not provide true collection (synonymous with 'balance'), only the illusion of collection. If judges fail to distinguish between false collection and true collection they become accessories to a welfare crime.

The 'recommendations and conclusions' section of the FEI report on over-bending includes the following statement: "Evidence was presented that indicated in experienced hands there was no apparent abuse, improper welfare or clinical side effects associated from the use of hyperflexion. However, if not practiced correctly, there are serious concerns for welfare and possible clinical injury that will affect a horse's well-being and performance." The only interpretation that can be placed on the first sentence is that the evidence presented was incomplete. That this was so is apparent from the absence of any

reference in the report to the horse's mouth and the regrettable role of the bit. The long-established medical aphorism should be recalled here ...absence of evidence is not evidence of absence. Over-bending is, as I shall prove, abusive. I therefore respectfully submit that the first sentence of the above quoted statement is refutable. A fundamentally abusive method cannot be practiced 'correctly.' That point aside, I agree with the second sentence.

Predictably, if the word 'hyperflexion' in the first sentence of the FEI statement was replaced by 'the bit,' the same viewpoint would probably be expressed following a hypothetical workshop that might one day be held to consider the ethics of the bit method of training. It would almost certainly be argued in such a workshop that "in experienced hands" the bit was not abusive. In other words, the defense would be advanced that a master horseman can use a bit without hurting a horse.2 The similarities of the two situations are no coincidence. They confirm my belief that the workshop on over-bending should really have asked the question, "Is it humane for a rider to use the actual or threatened pressure of metal on bone, in a sensitive body cavity, to achieve prolonged and unnatural flexion of the horse's head and neck at exercise?" My own answer would have been an emphatic 'NO.'

Over-bending at exercise has a harmful effect on just about every bodily system, with the possible exception of the reproductive system. The effects on each system will be described in turn but, as all systems are interdependent, there will be some overlapping. As the tool whereby over-bending is made possible is inserted into the mouth, I start with the effect of over-bending on the digestive system. The horse's mouth is the location for the primary effect and the secondary effects, albeit still serious, cascade from this sensitive area. But as the number of harmful effects, both primary and secondary, are so numerous it is worth reiterating that over-bending is unacceptable on the single indictment that it causes avoidable pain and is, by definition, cruel.

PART II: DIGESTIVE SYSTEM

Proponents of over-bending warm-up their horse prior to a dressage test, for periods varying from a couple of minutes to more prolonged periods of ten to thirty minutes at a stretch, without relaxation. Using two bits and a chain (the mandatory double bridle) to over-bend their horse's neck, riders are, consciously or unconsciously, hyper-sensitizing ('soring') their horse's mouths. After prolonged and focused pressure, the vice-like grip of the curb and curb chain on the mandible will have generated a sore mouth and the sort of bone ache that lasts throughout the duration of the test and probably long after (Fig 5).

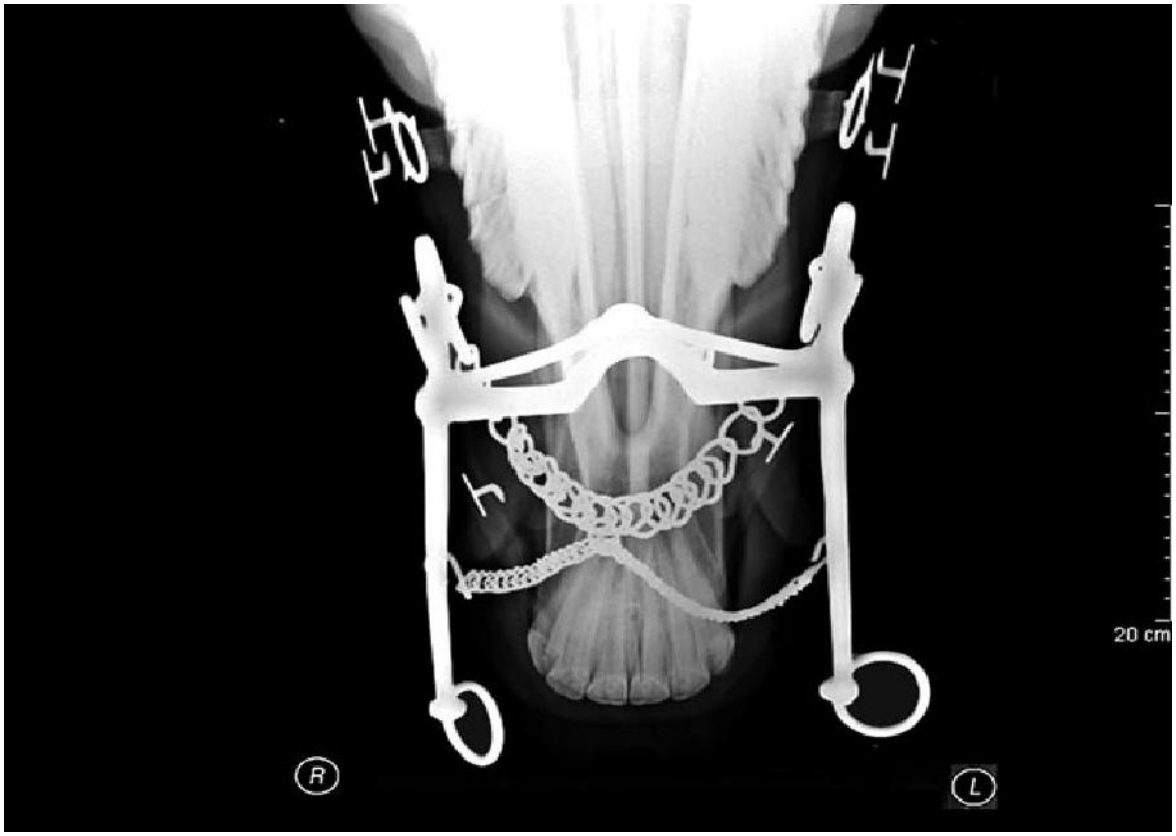


Fig 5. Being out of sight, the mouthpieces of a double bridle are often out of mind. A radiograph reminds us of the fundamental inhumanity of using a cumbersome metal instrument in the horse's tender mouth that embodies the likelihood of inflicting daily corporal punishment [Radiograph courtesy of Cummings School of Veterinary Medicine, Tufts University]

The thumbscrew, affectionately known as the thumbikins (presumably by the users rather than the victims), was an instrument of torture used largely by the Inquisition, whereby the thumbs were compressed between two bars of iron, by means of a screw. The curb bit of a double bridle works on the same principle. The lower jaw is compressed between the mouthpiece and the curb chain. In the absence of a screw, the compressing force is the leverage applied by rein pressure. Depending on circumstances, the force applied may range from zero or a few ounces to hundreds of pounds. Apart from the horse's tail, there is no portion of its skeleton that is so accessible to man's 'ingenuity.' The jaw at the level of the bars is the horse equivalent of the human thumb. Most horsemen will be surprised to learn that the cross-sectional size of the horse's jaw at this level is not much larger than a human thumb (Fig 7). Man applies his greatest force at one of the most vulnerable and weakest parts of the horse"

The bridoon will have added to the horse's discomfort by further soring the lips, tongue and bars of the mouth. Unlike a regular snaffle, the bridoon is narrower in cross-section and therefore more severe. A thin layer of gum covers the two

longitudinal knife-edges of the mandible that together constitute the bars of the mouth. Gum is the 'skin' of the bone, i.e. modified periosteum (Fig 6). Like the rest of the mouth, gum is highly sensitive tissue. It can be assumed, for example, that by comparison with the periosteum over the shin, it is far more sensitive. With reference to the outrageous practice of soring Tennessee Walking Horses, over-bending is to the mouth what soring is to the shin, only more so. The difference is that whereas proponents of shin soring do this with malice aforethought, proponents of over-bending may be unaware of the pain they inflict and the harm they cause.

When a bit bruises the gum it is bruising bone. Such bruising may cause both short and long-term effects. In the short-term horses can be expected to exhibit a hypersensitive and painful, sore mouth. It seems that the FEI administration recognize this as they warn their officials to be careful when checking a horse's equipment after a test, as many horses are shy ('touchy') about their mouths. In the long-term, bone spurs develop that remain sore from day to day, due to repeated bruising (Fig 8). Unlike leg splints that will become inactive and painless if the horse is rested, 'bar splints' are perpetuated by daily doses of further bruising. The constant and excruciating pain frequently triggers trigeminal neuralgia ('tic douloureux') the most common cause, in my experience, of the headshaking syndrome (Cook 1999 a, b, Cook & Strasser 2003). Unsurprisingly, in view of the popularity of over-bending, headshaking is a problem to which dressage-trained horses are particularly prone (Fig 9). Sadly, current FEI regulations do not permit the only solution to this problem (removal of the bit and its replacement with a painless method of communication), so trigeminal neuralgia is often a career-ending disease.

The combined effect of both curb and bridoon is to place a highly focused force on the bars of the mouth. Surveys that I have carried out in recent years of horse skulls in five Natural History Museums in the USA show that bone spur formation on the bars of the mouth is an extremely common lesion (Cook & Strasser 2003). From 74 skulls examined from five-year-old horses and over, 55 (74%) exhibited splint-like exostoses on the knife-edge bars. A smaller survey indicated that bit-induced dental erosion (of the first lower cheek teeth in particular) is also a common finding (Fig 8) (Cook et al 2006).

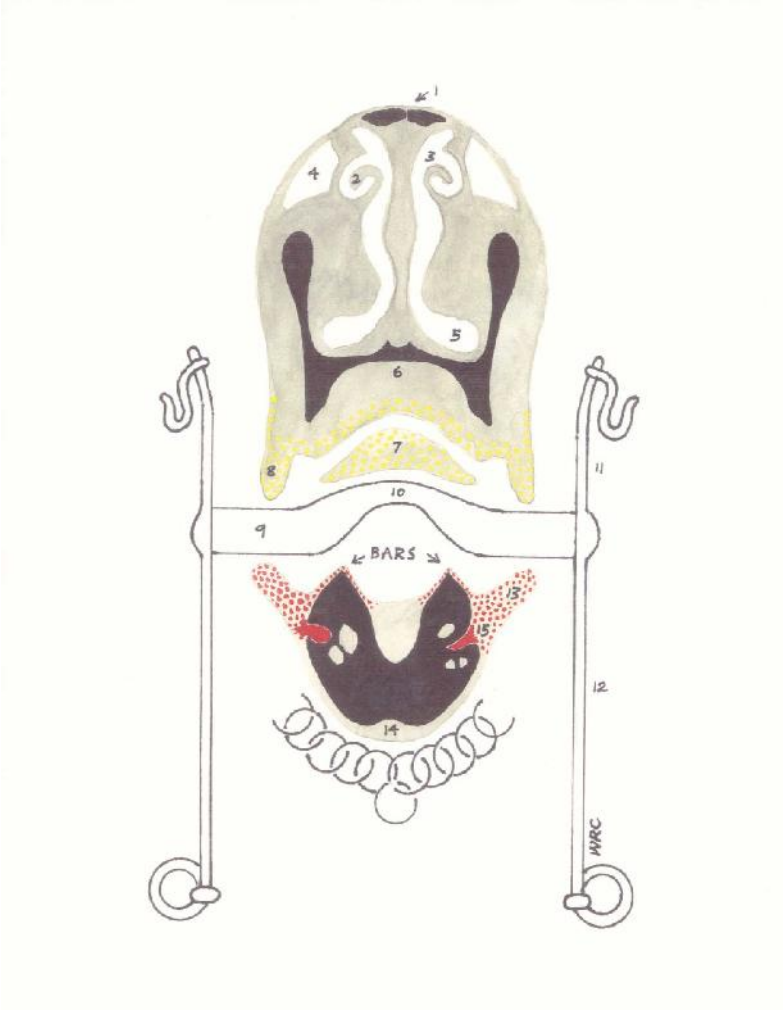


Fig 6. A cross-section through the head at the level of the bars of the mouth with a curb and chain in position, drawn to scale. The so-called 'bars' of the mouth are longitudinally disposed knife-edges of bone. Metal on bone is incompatible with good welfare.3 Note the proximity of the sensory (mental) nerve to the bars. Even in a draft horse, the mandible in cross-section at the level of the bars is no bigger than a mid-section through a standard hen's egg (Fig 7). When the tongue is over the bit, as in this diagram, a curb bit enables a rider to apply a compression force to virtually naked bone. When the horse's tongue gets trapped between the bit and the knife-edges of bone, the pain might be similar to the shock we get when we bite our own tongue.
KEY: black = bone; gray = soft tissue: red = sensation supplied by the mandibular branch of the trigeminal nerve; yellow = sensation supplied by the maxillary branch of the trigeminal nerve:
1 = peak of nasal bone; 2 = ventral turbinate bone: 3 = entrance to the sinuses; 4 = false nostril: 5 = ventral nasal meatus: 6 = hard palate: 7 = apex of tongue: 8 = upper lip: 9 = cannon: 10 = port: 11 = cheek bar: 12 = shank: 13 = lower lip: 14 = chin groove: 15 mental foramen and the emerging mental nerve of the mandibular branch of the trigeminal.

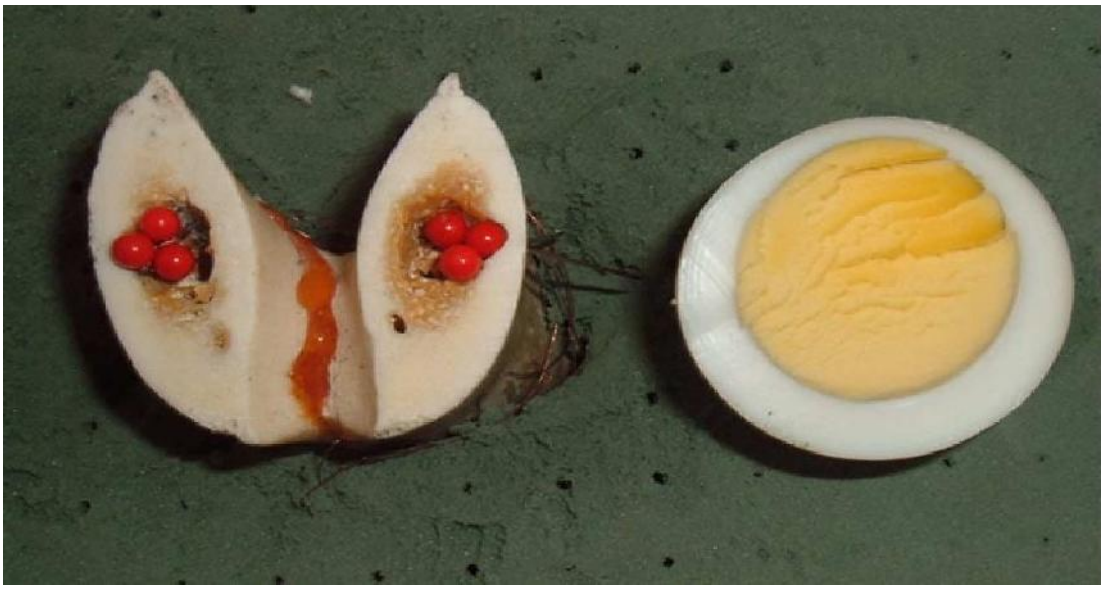


Fig 7: A photograph of a cross-section through an adult horse's jaw at the same level as the diagram in Fig 6, compared with a mid-section of a standard hen's egg. Note the knife-edges of the 'bars.' The red spheres represent the cut-section of the mandibular nerve just before it emerges from the bone to provide sensation to the bars of the mouth.

The erosion and sometimes the complete loss of the first lower cheek tooth occurs as the result of the bit being dragged between the teeth. In stable vernacular, the horse is blamed for "getting the bit between its teeth" but my interpretation is that, again unintentionally, the rider puts it there. The lips are highly elastic structures and a bit acts like a surgical lip retractor on the corners of the mouth. It takes relatively little rein tension for the lips to be stretched to twice their resting length. This results in the bit coming to lie at the level of the first cheek teeth, rather than the bars of the mouth. The horse now defends itself by biting down on the bit in order to immobilize a painful foreign body. As the incidence of bone spurs and dental erosion is high in a random sample of museum skulls, most of which were collected in the 19th century, I would expect the incidence of these same lesions to be even higher in dressage horses subjected to over-bending.

Fig 8. The jawbone in the foreground exhibits extensive damage to the bars of the mouth and the first three cheek teeth. Compare this diseased jawbone with the healthy jawbone in the background. Note the following evidence:
** Bone spurs on both bars of the mouth, immediately above the mental foramen where the mandibular nerve emerges from the bone (the dark elliptical spot on the side of the jaw*
** Severe erosion of the first three cheek teeth on both sides of the jaw. The crowns of these teeth should be rectangular in shape, as they are in the healthy jaw*
** Entire loss of the whole of the first cheek tooth on the right side, together with the front half of the second cheek tooth*
** Extensive roughening of the bone (periostitis) alongside the empty tooth socket of the first cheek tooth on the right side. This is evidence of the fact that loss of this tooth occurred during the life of the horse and was not a post-mortem artifact.*
** The incisor teeth are missing from the diseased jaw but these could have simply dropped out of the specimen after the death of the horse (i.e. a post-mortem artifact). This often happens, especially if a horse is old at the time of death, which this horse may have been.*

Fig 9. Illustrating two common signs of bit-induced trigeminal neuralgia: head tossing and head ducking with facial rubbing (see also Fig 20).

During the warm-up, the horse's mouth will often be slightly open, though use of a tightly cinched crank noseband limits the amount of gaping that can occur. A tight noseband actually ensures that maximum pressure is applied to the mouth and that the horse cannot evade the pressure by gaping. A tight noseband will also have the effect of applying prolonged pressure to the bone across the bridge of the nose and to the poll, further sources of pain.

A physiologically confusing situation is created because a bit triggers digestive system reflexes that are at cross-purposes with the respiratory and cardiovascular reflexes required for exercise (Cook 1981b, 1999a, 2000, 2005). When eating (i.e. grazing), a horse at liberty is stationary or moving at a slow walk, the head is down, lips are open, jaw mobile, salivary glands discharging, pulse rate low, respiratory rate slow and breathing shallow. The horse is in a relaxed frame of mind (parasympathetic dominance). For exercise (i.e. moving away from predators), the gait is anything from a brisk walk to a gallop, the head is up, lips are sealed, the jaw immobile, salivation in abeyance, pulse rate high, respiratory rate rapid and breathing deep. The horse is alert and pumping adrenaline (sympathetic dominance).

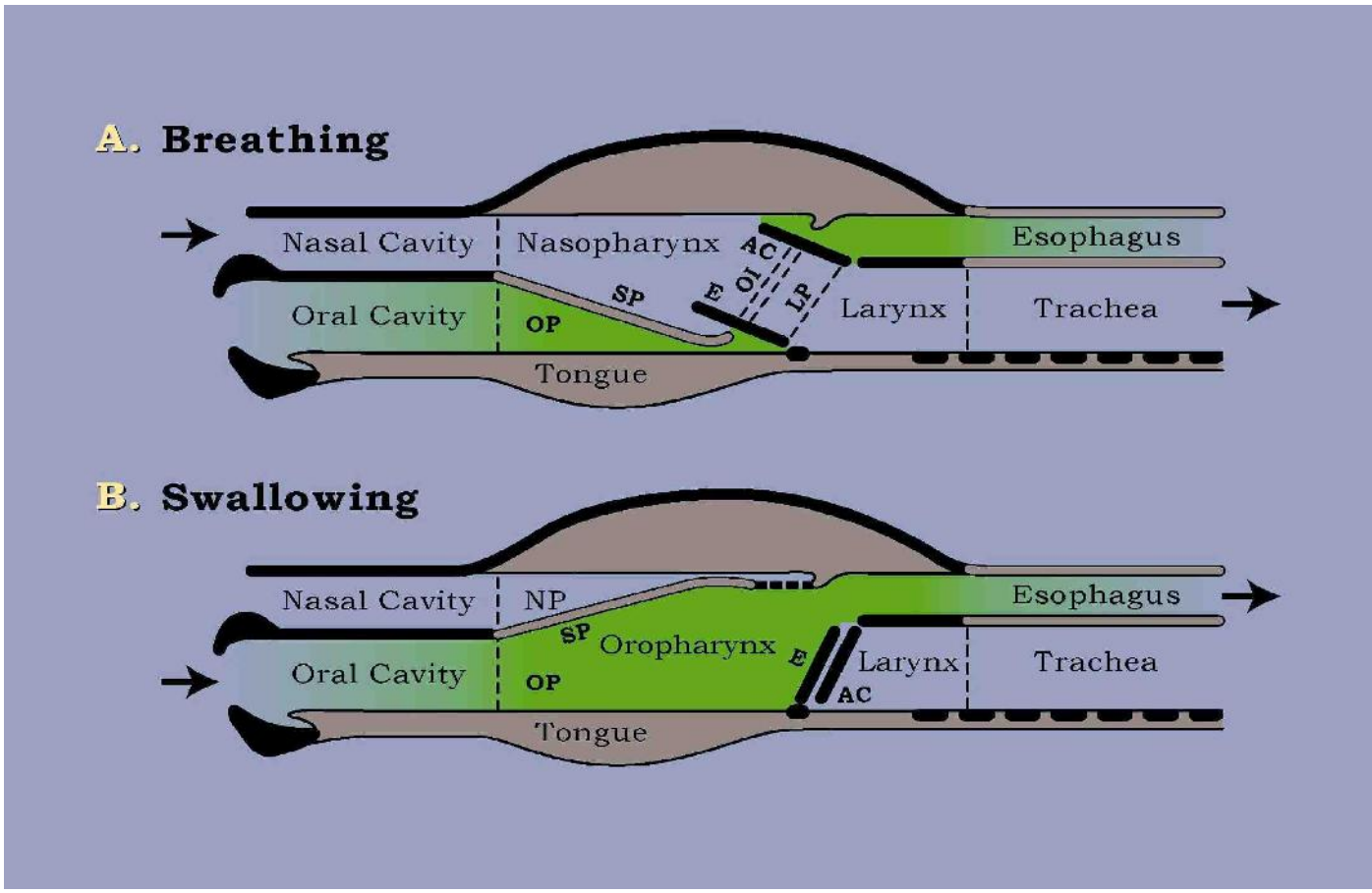


Fig 10. Schematic showing the switch-plate action of the soft palate and other structures in the throat that allow it to serve the dual function of either breathing or swallowing but not both at the same time. Unfortunately, the bit triggers digestive reflexes and favors the swallowing mode, a configuration that interferes with breathing. For the sake of clarity, the oral cavity is depicted as containing air. In reality, it is only a potential cavity as, for most of the time, it is fully occupied by the tongue and contains little or no air (see Fig 11).

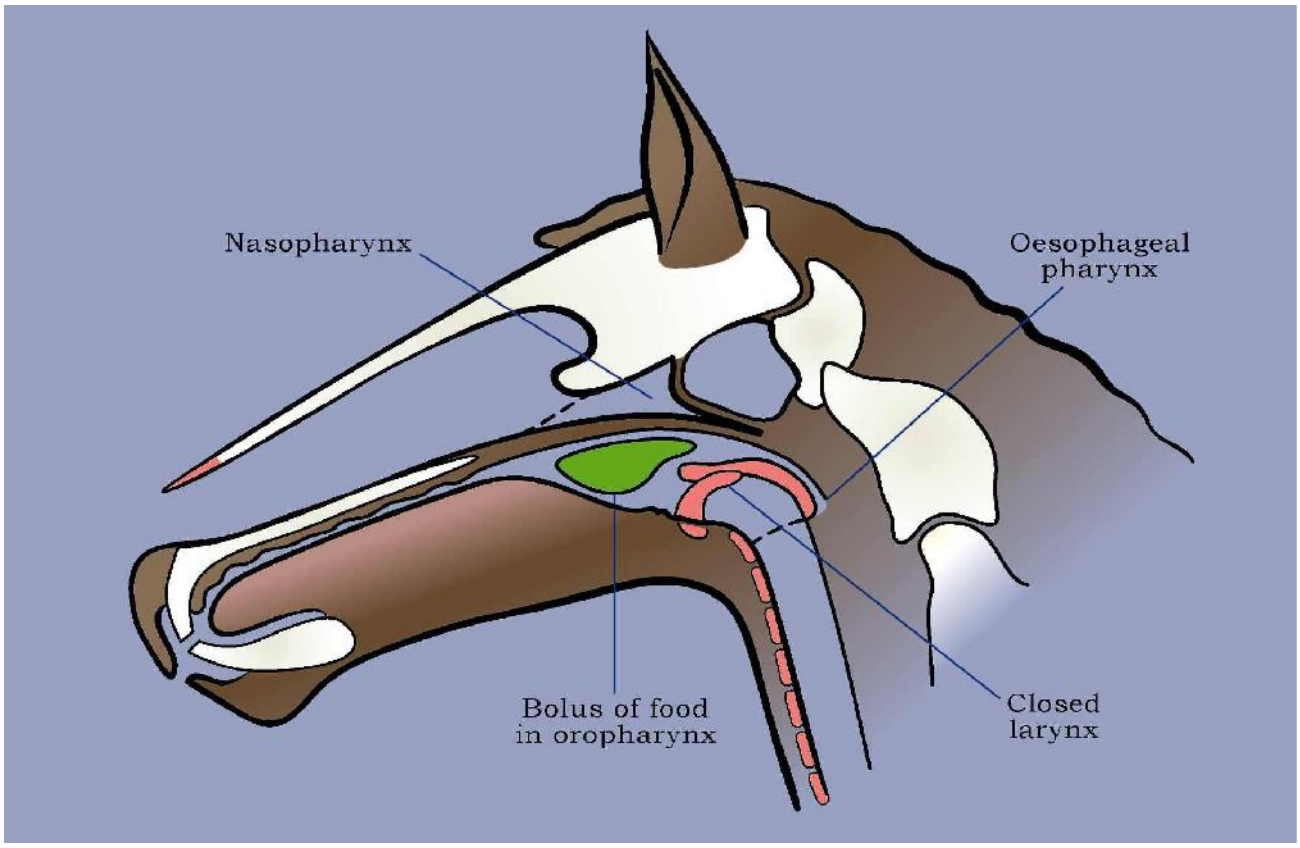


Fig 11 Showing how the gullet (esophageal pharynx) opens during the swallowing of dry food or liquid (e.g. saliva) and the voice box (larynx) closes to protect the lungs from inundation. Bit-induced salivation during exercise is an impediment for the horse. The need to swallow is incompatible with the need to breathe.

Fig 12: Open mouth, protruding tongue and salivation in a dressage horse during an over-bending warm up. And all this in spite of the rider using a crank noseband. [Photo courtesy of Dr. Ulrike Thiel]