

EQUINE DENTISTRY: A MAJOR INFLUENCE ON BIOMECHANICAL AND NEUROLOGIC FUNCTION

Judith M. Shoemaker, DVM

ABSTRACT

Equine dentistry is an important facet of equine care. The complex interaction of trigeminal nerve and temporomandibular joint (TMJ) function with whole body balance and physiology is a basic part of the integration of all modalities of treatment for medical issues as well as for lameness and performance problems. This presentation gives a brief overview of this vitally important part of structural and functional management.

INTRODUCTION

Dentistry is probably the single most important management practice we can provide for our animals. Properly done, it can prolong life, improve performance, balance body functions through autonomic input, prevent disease, and affect the quality of life more than any other care we give them. Conversely, poorly done dentistry and mouth problems can cause more pain, lameness, and neurologic imbalance than any other illness, injury, or poor management practice. The stomatognathic system can create signs of lameness and disease and can be used as an accurate tool for their diagnostic evaluation.

THE STOMATOGNATHIC SYSTEM

The stomatognathic system is a complex kinematic chain that involves the skull, jaw, hyoid, upper cervical vertebrae, sternum, dentoalveolar and temporomandibular joints. The functional and mechanical connections extend through the dura mater to the sacrum, coccyx, and pelvis as the dura is directly attached to the spinal skeleton in the skull, first two upper cervical vertebrae, the sacrum, and coccygeals. The skeletal/dural/spinal connection, through mechanical and neurologic means, is constantly affecting the entire spinal cord and therefore the whole body. The constant movement of the jaw and its connections - in eating, breathing, and gaing - acts as a gyroscopic balancing mechanism for the whole system. Dental abnormalities can create major faults in this mechanism and can manifest as dysfunction in any part of the body.

OVERVIEW OF FUNCTION

All input to the nervous system is modified and governed by certain interrelated priorities of the nervous system. The *first* priority of the body is to minimize dural torque and tension in order to keep the "central computer" uncompromised. The body will do whatever positioning is necessary in order to maintain neutral balance in the nervous system. *Secondly*, the body evaluates gravity, balance, and straightness in order to adjust head and upper body balance and righting mechanisms before it can, *thirdly*, be able to respond accurately to the environment and afferent input. A lower and less constant priority than the above is response to pain, especially low-grade or chronic pain. The first three functions are prerequisites for the body's ability or need to react to pain.

- First Priority** The “**computer**” (*brain and spinal cord*) must work for the animal to function in any way.
- Second Priority** Then, the “**computer housing and gyroscope**” (*stomatognathic system*) must work for him to be able to evaluate upright, balance, and move effectively.
- Third Priority** If he’s upright, balanced, and moving effectively, then he can “**stay away from the lions**” (*deal with the environment and afferent input*).

After he’s dealt with all of the above. then he can worry about whether or not he hurts.

Due to pathology or mismanagement, there may be extreme compensations necessary to achieve the first three priorities. These compensations can create chronic pain, lameness, or dysfunction which cannot be effectively addressed with symptomatic care. Uneven weight bearing and inappropriate placement caused by dural torque and balance problems are major causes of chronic lameness and overuse injuries. The underlying pathology or imbalance in the stomatognathic system and its skeletal/dural/spinal connections must be corrected for the chronic pain, lameness, or dysfunction to resolve.

Ninety percent of input to the thalamus is from joint and other mechanoreceptors whose major function is to evaluate the body’s interaction with gravity. Eighty percent (of that ninety percent) is from the second cervical vertebra and the joints rostral to it, including the skull – with the majority of that input coming from the innervation of the TMJ, the trigeminal nerve. Humans have ten times more functional neurons in the brain dedicated to trigeminal function than they have dedicated to the hands - even with five fingers and opposable thumbs!

The TMJ is the most complex and heavily innervated joint in the body. It is an encapsulated, compound, synovial joint with fibrocartilage surfaces for rapid remodeling and healing capabilities. It has two joint capsules separated by the articular disc and its attachments. The upper and lower joints act somewhat independently. The upper acts as a sliding joint, while the lower moves as a hinge joint. The lower jaw’s simplest movement and function is as a freely swinging pendulum to evaluate where “down” is.

The TMJ is functionally concentric with the curvature of Spee (the complex curvature of the occlusal surfaces). This is a profound concept because any change we make in the curvature through dental management will cause neurologic adaptation, cartilage and bone remodeling and concurrent functional change throughout the entire system. We can now appreciate how a tooth float can be a life changing experience!

The first priority of the TMJ and the dentoalveolar “joints” is to evaluate and neutralize prematurity of strike of teeth and/or restrictions of movement by careful “tuning” of the fan-like fibers of the masseter and temporalis muscles. Then it can evaluate its own movement and that of its attachments to hyoid, skull, and upper cervicals in reference to gravity without interference. This dynamic gyroscopic mechanism is a part of the body’s major balancing system and a modifier of posture and gaiting. The stomatognathic system and its neurologic connections integrate stabilizing support actions and gaiting proprioceptors for balance.

Muscle balance throughout the body is modified and controlled through the TMJ and the function of its suspending muscles. This is the mechanism of control through

bitting and the bridle. It is *not* just a simple *Flexible Flyer* sled steering mechanism! All postural and positional changes of the jaw have multiple effects on structure, function, and emotion.

A TMJ AWARENESS EXERCISE FOR YOU TO DO...

Stand up squarely and look up at the ceiling. Notice that your lower jaw swings back and your back is hollow. Next, lower your head and look at your feet. Notice that your jaw swings forward and your back is round. Now, look back up at the ceiling, let your jaw swing back, and this time, hold your jaw in that position and try to look at your feet. Notice that, even if you can manage to look at your feet with your jaw held back, that it is not as easy, that your back and neck muscles remain tight, and that your back does not round easily. This is because your TMJ position just told the rest of your body that your head was still looking upward! Think of the significance that this neurologic function has for performance horses, especially those with inappropriately managed parrot mouths, overbites, and other restrictions of jaw movement...

AFFERENT/SENSORY SIGNIFICANCE

The neurologic connections of the somatic afferent system through the trigeminal nuclei and pons and the modification of almost all sensory and mechanoreceptor input to the thalamus by trigeminal input are the mechanisms through which dental care can have massive effects on the whole animal.

Almost all proprioceptive information passes through trigeminally modified connections. Any dysfunction of the cranial, TMJ, upper cervical, or sacral system will profoundly affect the balance of the whole animal - mechanically, physiologically, and emotionally. ***Remember, if we put “garbage into the computer”, we will get “garbage out of the computer”!***

EFFERENT/MOTOR SIGNIFICANCE

Dysfunction of the cranium and the TMJ can cause compromise of cranial nerves IX (glossopharyngeal), X (vagus), XI (accessory), as they exit at the jugular foramen. These are the Somatic and Special Visceral Efferents to the pharynx, esophagus, palate, and the recurrent laryngeal nerve. The SVE neuronal cell bodies are located in the ventral grey columns through the whole length of the cervical spinal cord segments. They course ***cranially*** and exit through the jugular foramen to also innervate parts of the trapezius and portions of the sternocephalicus and brachiocephalicus muscles. SVE neuronal cells are vitally important in all tonic neck reflexes and righting mechanisms. When these cells are compromised, they cause the commonly known dysphagias and recurrent laryngeal paralysis. TMJ and upper cervical dysfunctions are associated with these medical problems, altered righting reflexes, and performance problems.

The functional relevance of the vagus nerve is overwhelming. Indeed, efferent dysfunction of this structure can have deadly consequences and it is profoundly affected by the function of the stomatognathic system and the trigeminal nerves.

ENDOCRINE AND REGULATORY SIGNIFICANCE

Cranial malfunction is considered by some to be the major cause of pituitary secretory disturbances and distribution problems from poor cerebro-spinal fluid flow. Goodheart, Shore, Magoun, and Southerland all cite clinical evidence that cranial dysfunction and corrections have major endocrine effects. Pituitary dysfunction can be

caused by mechanical restriction of dura and arachnoid membranes and cranial articular movement abnormalities. Restriction of the cranial-sacral respiratory system can be caused by cranial faults. Problems with normal motion of the skull and jaw caused by dental abnormalities *are* cranial faults.

COGNITIVE AND EMOTIONAL SIGNIFICANCE

Cranial function affects eyesight, coordination of ocular input, learning mechanisms, memory, arousal, and vestibular function. Mismatches of information from eyesight, TMJ, inner ear, and neck reflexes can lead to learning dysfunction, emotional disturbances, and stress-related disorders. Alterations in cranial and jaw positioning, resulting in facial expression change, create emotional change through feedback loops.

DIAGNOSTIC SIGNIFICANCE

Occlusal management, which includes control of prematurities of strike, imbalances, and movement restriction caused by overgrown teeth, caps, incisors, and developmental or conformational defects is vitally important in maintaining optimal health and performance. Their presence, especially if asymmetrical, can indicate imbalances in the rest of the skeletal/dural/spinal system. In fact, specific dental abnormalities of condition, wear, and motion correlate *very accurately* with certain lameness and medical conditions, and pelvic, spinal, and posture abnormalities.

MANAGEMENT SIGNIFICANCE

In the wild, horses browsing and grazing on more abrasive feedstuffs and soils, wear their teeth very differently than they do under domesticated management. The incisors are worn more because they must bite off their food, often with abrasive soils included. In eating with their heads down and shearing more abrasive foods with the premolars, they keep the front cheek teeth in greater wear. Molar processing is balanced with other mouth functions and chewing must be even for the teeth to last and the horse to remain symmetrical. In domestication, food is precut, often partially processed, and often eaten in habitually asymmetrical feeding stances, with the head up. This changes how the food is chewed and also changes the balance of the autonomic nervous system. When the horse raises his head, for whatever reason, he automatically stimulates the sympathetic system through the lower cervical sympathetic ganglia and down-regulates the parasympathetics in the upper cervical parasympathetic ganglia. Back cheek teeth end up with more wear unless accurate rebalancing of the front of the mouth is maintained. Waves, ramps, shears, overbites, parrot mouths, hooks, overgrowth of front cheek teeth, overwhelm of rear cheek teeth, and autonomic imbalance and associated disease (some chronic colic, ulcers, bronchoconstriction, and blood pressure disorders) are often exacerbated by unnatural feeding and have profound effects on balance, performance, and physiology.

Managing and balancing the trigeminal nerve and its connections accurately and effectively will have massive integrating influence on the entire animal. Dental procedures cause profound changes in the immediate and long-term sensory input to the trigeminal nerve. *Dentistry must be done accurately and with respect for the complexity of the system and its connections.*

PRACTICAL APPLICATION

Understanding the stomatognathic system and the influence of dentistry results in an intense appreciation that a good, sophisticated float is a humane necessity and that neglect or a bad (*or excessive*) float can be detrimental and even life threatening! One must be a careful observer of the causes and effects of dental dysfunction and be able to accurately prescribe or perform correction. This requires more knowledge, ability, and equipment than many practitioners have. Given the complexity of the stomatognathic system, specific education and training for its management are essential. There are many conditions of the mouth that interfere with balance and health. Often times, they are not addressed in routine dental care. These may include:

- ♦ Incisor malocclusion, all variations - diagonals, “smiles”, missing teeth, prematurities, impacted or retained deciduous teeth, often indicate head trauma or major body asymmetry and can make a horse “mouthy”.
- ♦ Over bites, under bites, parrot mouths - have major effects on balance, weight distribution, training, and back muscle development.
- ♦ Over bite hooks - front and rear - can be career ending, even life ending if allowed to contact the opposing arcade gum.
- ♦ Diagonal mismatches in rear teeth - are indicators of asymmetry elsewhere in the body or skull.
- ♦ Overgrowth and overwhelm of opposing teeth - can have many causes in management, individual tooth health, and balance.
- ♦ Wave mouth, pivot point formation - occur especially in response to skeletal (often pelvic) asymmetry and fractures.
- ♦ Gum and palate shearing by incisors and/or lower premolars - are caused by lack of wear and proper dental management.
- ♦ Overgrowth of canines - should be trimmed for everyone’s safety and ease of bridling.
- ♦ Obscure broken teeth - can cause low grade infections with huge systemic consequences, including heaves, autoimmune disease, “peripheral Cushing’s”, as well as performance and training problems.
- ♦ Concurrent cranial and cervical faults - can be either primary or secondary to dental faults, or iatrogenic from chemical and physical restraint.
- ♦ Biting, training, and riding problems - can be identified and addressed by a sophisticated dental practitioner.

CONCLUSION

Good dental management will have a greater influence on the long-term quality of life for your patient than any other health care service or treatment. In addition, other treatments for lameness and medical conditions may only be effective after *proper* dental care. Performance can be greatly enhanced by sophisticated dental work. Hopefully, conscious insight into the importance of the stomatognathic system and dentistry will encourage more integrated, refined, and accurate diagnosis and effective therapeutic management.

SOURCES AND FURTHER READING

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AUTHOR'S COMMENT

"Just a good broodmare float" is an oxymoron; all horses deserve complete dental care. A veterinary degree does not denote expertise in dentistry. The training currently available does not always address the profound neurologic significance of dental interventions and many currently accepted procedures are simplistic and not compatible with total body function and long-term success. As in the management of many other veterinary conditions, we should strive to "play chess instead of checkers" with dentistry.