



Incisor Malocclusions in the Equine Athlete: A Functional Review

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Equus360-Advancing Multidisciplinary Understanding of Equine Structure and Motion

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Abstract

Introduction

Equine dentistry has traditionally prioritised occlusal correction, the prevention of sharp enamel points, and restoration of mastication. However, recent literature and biomechanical research suggest that incisor occlusion plays a far more complex role within the stomatognathic and cranio-mandibular systems than previously recognised. This review explores incisor malocclusions from a functional and neurobiomechanical perspective, integrating current evidence on trigeminal feedback, temporomandibular mechanics, hyoid dynamics, and postural control. Understanding the incisor complex as part of a multi-system network rather than an isolated dental feature offers a paradigm shift in equine performance management and welfare.

The Stomatognathic System as a Functional Unit

The stomatognathic system encompasses the mandible, maxilla, temporomandibular joints (TMJ), hyoid apparatus, masticatory musculature, teeth, and associated soft tissues. In the horse, these structures function as a sensory-motor continuum, integrating mastication, respiration, proprioception, and postural regulation (Bonin et al., 2006; Carmalt, 2014). The equine TMJ acts as the biomechanical hinge and sensory centre linking the mandible to cranial posture and limb coordination. Incisor alignment directly affects the TMJ's articular balance and excursion path, meaning occlusal asymmetries at the incisors can propagate through the entire musculoskeletal chain (Clayton, 2013; Denoix, 1999).

Types and Aetiology of Incisor Malocclusion

Common malocclusions include overjet, underbite, smile or frown bites, diagonal or sheared planes, and excessive attrition. These may arise from developmental conformation, dietary texture, or functional asymmetry secondary to musculoskeletal imbalance (Dixon et al., 2010). Environmental factors, such as restricted grazing posture, modern feeding practices, and reduced lateral chewing cycles, exacerbate uneven incisor wear. Moreover, iatrogenic over-reduction can disturb the natural proprioceptive calibration that guides the mandible's range of motion (Townsend & Carmalt, 2014). While structural malocclusions may have genetic origins, the majority in athletic horses appear acquired and adaptive, reflecting compensatory responses to asymmetrical loading or TMJ dysfunction (May-Davis, 2018).

Neurofunctional Role of the Trigeminal System

The trigeminal nerve (cranial nerve V) serves as the principal sensory-motor pathway governing the equine chew cycle. Its mandibular branch (V3) innervates all major masticatory muscles and provides sensory input from the teeth, periodontal ligament (PDL), and TMJ. The mesencephalic nucleus of the trigeminal nerve is unique in that it houses primary afferent cell bodies within the central nervous system, allowing instantaneous sensory-motor feedback loops. During each chewing cycle, proprioceptive information from the PDL and muscle spindles is transmitted to brainstem nuclei, which regulate bite force, timing, and mandibular symmetry (Picard et al., 2008). This reflex mechanism is essential for coordinated mastication and contributes to global postural control through its integration with the vestibular and cervical systems (Gangloff et al., 2000; Forbes et al., 2021).

Cranio-Vestibular and Postural Integration

The cranio-vestibular system links the vestibular apparatus of the inner ear with trigeminal and cervical inputs to maintain head orientation, gaze stabilisation, and spatial awareness. In the horse, this system functions as a continuous calibration mechanism that aligns sensory data from the PDL, TMJ, eyes, and inner ear. Human and canine studies show that occlusal interference can significantly alter postural sway and head-neck alignment, mediated by trigeminal-vestibular interactions (Baratto et al., 2015). Equine data are emerging, but early evidence suggests that asymmetric incisor occlusion correlates with uneven cervical muscle tone and gait asymmetry (Mackechnie-Guire et al., 2020; Forbes et al., 2021). This connection may explain why horses with dental or sinus pain often present as "head shy," unsteady, or laterally stiff, clinical signs of altered sensory integration rather than pure discomfort.

Clinical and Functional Implications

For the equine athlete, incisor alignment influences more than mastication—it affects neuromotor coordination, bit acceptance, and locomotor symmetry. A functional calibration approach, involving conservative reshaping of occlusal surfaces to restore proprioceptive balance, is therefore preferable to aggressive mechanical correction (Klugh, 2010). Over-correction risks loss of functional reference points and disruption of

trigeminal feedback loops, leading to TMJ strain and postural compensation. The equine dental technician thus holds a key role in identifying whether a malocclusion is pathological (causing dysfunction) or adaptive (compensatory), and must evaluate dental findings in the context of whole-horse biomechanics. Interdisciplinary collaboration with veterinarians, farriers, and therapists supports sustainable, evidence-based management.

Conclusion

Incisor malocclusions in the equine athlete represent more than a local dental issue, they are biomechanical expressions of systemic function. The incisors act as proprioceptive sentinels, continuously informing the brain of mandibular position and bite force via the trigeminal network. Balanced occlusion therefore supports not only oral comfort but also neuromuscular harmony, postural stability, and performance efficiency. A holistic understanding of these interactions marks a pivotal step forward in functional equine dentistry, aligning with the broader goals of evidence-based practice and whole-horse welfare.

“Equine dentistry is not simply the restoration of occlusion, but the calibration of a sensory system fundamental to postural harmony and performance.” Lucinda Stockley (2025)

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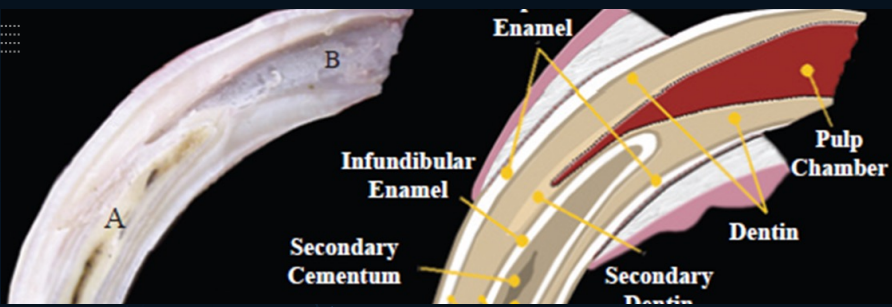
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Anatomy and Function

- Six incisors per arcade (Triadan 01–03): central, middle, corner
- **Hypsodont** structure – long reserve crown with continual eruption
- **Enamel**: hardest layer forming infundibulum and dental star
- **Dentine**: protects pulp; softer, wears faster than enamel
- **Cementum**: covers crown and root; adaptive shock absorber
- **PDL** (Periodontal Ligament): elastic, vascular, mechanosensitive
- Anchored within **alveolar bone** and integrated with the TMJ

Function Before Form

Incisors initiate mastication and guide mandibular motion (Schrock et al. 2013)

Maintain occlusal height and TMJ symmetry (Sterkenburgh et al. 2023)

Reflect whole-mouth functional balance

Malocclusion = indicator of neuromuscular imbalance

Structures adapt to the forces

