STRUCTURE & FUNCTION OF THE EQUINE TEMPORO-MANDIBULAR JOINT

The unique design of the temporo-mandibular or "T-M" joint governs the horse's style of mastication. Traumatic damage to the jaw joints instantly and permanently alters the three-dimensional motion of the jaws during chewing, and thus the wear pattern of the teeth. Likewise, alterations in the shape of the chewing surfaces of the teeth strongly impact the T-M joint. It follows from this that we must understand, and seek to protect, the T-M joints during all equine activities, including examination procedures, dental treatments, feeding, and the selection and use of bits and nosebands.

Close apposition of two bony surfaces creates the T-M joint. Above is a shallow cup, the **glenoid fossa** of the temporal bone of the skull. Into this cup fits the lozenge-shaped **condyle** of the mandible or jawbone. The condyle and the glenoid fossa are broad, facilitating hinge-like opening and closing motions of the jaws. Transverse, oblique, and rotatory motions are, however, necessary to normal chewing in the horse, and these are made possible by the rounded contours of the bones (Fig. 1).

Rotatory and oblique-transverse jaw motions are also facilitated by the comparative looseness of the joint. As in most joints, the opposing bones of the T-M are held together by strong **collateral ligaments**. These are not at all stretchy but they are long enough to permit the joint to "hang open" slightly when the animal is not eating. The glenoid fossa itself is also spacious; the lateral portions are open and the post-glenoid process forms a "stop" over only the medial half of the joint. The anterior aspect is so open that it actually forms a convex roller (Fig. 1). This is in great contrast to, for example, the T-M joint of the badger *(Taxidea taxus)* (Fig. 2), whose biting grip is legendary but whose masticatory biomechanics permit only up-and-down action of the jaws. We definitely do not want to turn our horses into "badger equivalents": anything that acts to jam the horse's lower jaw back against the post-glenoid process, or that limits the free excursion of the jaws from side to side, will sooner or later traumatize the T-M joint. Mild to moderate joint pathology, evidenced by flattening of the medial portion of the jaw condyle, is extremely common among ridden horses (Figs. 3 and 4). Severe trauma is uncommon but where present prevents normal mastication.

Functioning of the T-M joint is mediated not only by the bones, but also by an intra-capsular **meniscus or "disk"**. This is a bursa of about the thickness of a piece of felt, and adapted in shape to the width of the joint. It is composed of a fibro-cartilagenous outer shell enclosing a thin inner chamber containing a drop of synovium. A similar though larger intra-capsular meniscus is found in the stifle (true knee) joint, but the meniscus of the jaw differs in that it is not firmly attached to any bone. Instead, it is suspended by means of very stretchy capsular sheets that form balloon-like chambers (Fig. 5).

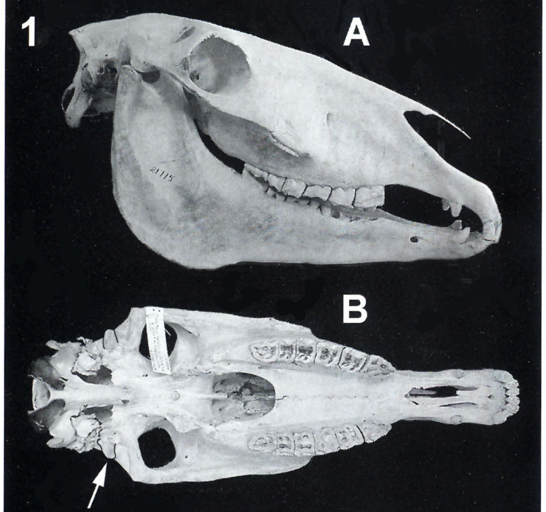

Fig. 1. Univ. New Mexico specimen UNMNH-21715, a geriatric individual showing the sinuous surfaces and open contours of the T-M joint in the equine. The post-glenoid process (arrow) covers only the medial half of the joint. Note the A-P wedge in the dentition, which tends to force the jaws back against the post-glenoid "stop". This along with pressure from nosebands and reins creates faceting of the condyles. Our studies show that pathology of the condyles is far more common than of the glenoid fossae.

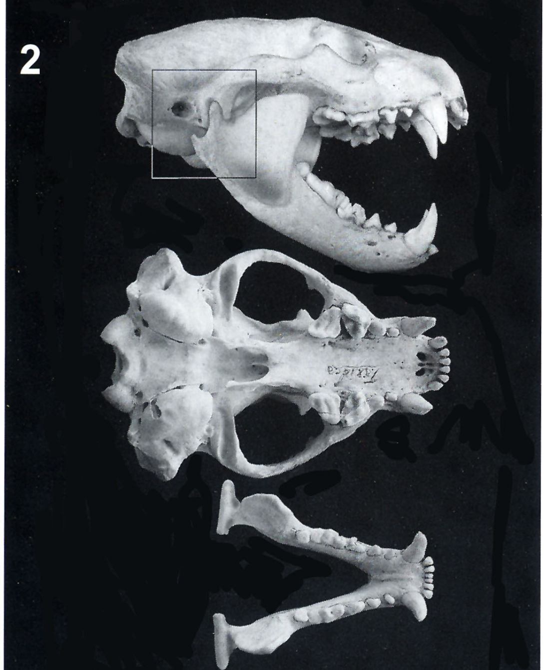

Fig. 2. Lateral and occlusal views of badger skull *(Taxidea taxus)* to show tight, enwrapping T-M joint. This design permits up-down motions almost exclusively, very efficient for slicing meaty food. The badger's dentition is adapted to this chewing style.

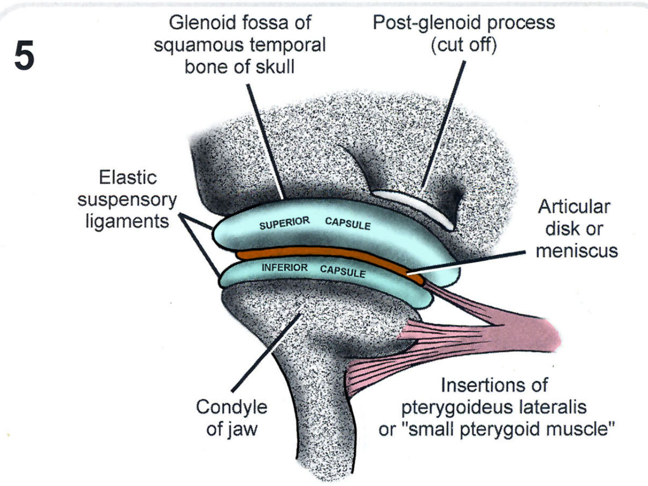

Fig. 5. Diagram of the equine T-M joint, posterior view with capsules inflated for clarity.

The function of the meniscus is to cushion the joint as forces generated by the big masticatory muscles (mm. temporalis, pterygoideus medialis, and masseter) bring the bony surfaces together during each chewing stroke. Since these forces are large – on the order of hundreds of pounds – and as the chewing motion is repeated thousands of times per day – the correct positioning of the "floating" jaw-joint menisci becomes crucial to preserving the smooth functioning of the joint over the lifetime of the animal.

To make certain that each meniscus is in just the right position at all times between opposing bony surfaces, there is a **tensor** of the stretchy suspensorium in which the menisci are embedded. This tensor is the **pterygoideus lateralis or "small pterygoid muscle",** a pinkie-sized fusiform band that originates upon the lateral part of the pterygoid process of the skull (Fig.6). Travelling obliquely

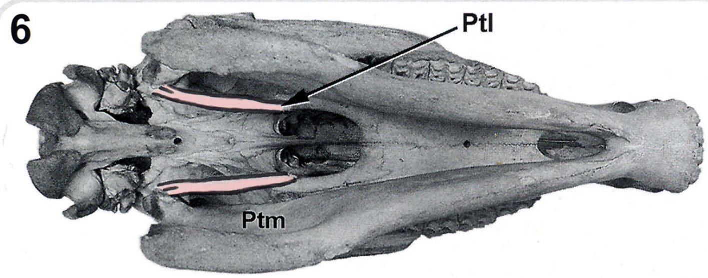

Fig. 6. Ventral view of a horse skull with articulated jaws, showing origin and insertions of the lateral or small pterygoid muscle (marked Ptl). The large pterygoid muscle (Ptm) originates along the whole of the pterygoid crest of the skull, and fills the deep medial fossa of the jaw.

upward and backward, it reaches the medial aspect of the jaw joint. There it splits, giving off two tendons of insertion. One of these goes to the neck and medial part of the jaw condyle; the other invests the meniscus itself. The condylar tendon acts as an anchor to steady and regulate the action of the meniscal branch which, as the articular space closes with each chewing stroke, "tweaks" the meniscus to position it ideally. The stretchiness of the suspensory tissues permits the meniscus to move.

The small pterygoid muscle works in coordination with the larger muscles of mastication, and it receives its signal to begin contracting when the jaws reach the position of maximum lateral excursion. If the small pterygoid muscle does not receive this signal, it will not contract at precisely the right moment with each chewing stroke, and the tissues of the suspensorium -- or the meniscus itself -- will be pinched. It takes only a few instances of trauma to press a crease or **plica** into the suspensorium, a condition well recognized in human dentistry. Repeated trauma to the meniscus creates inflammation and soreness which the equine dentist detects by palpating directly over and just below the T-M joint. Unrecognized and untreated, chronic trauma to the joint may result in necrosis of the meniscus and/or fusion of all or part of the meniscus to either of the bony surfaces composing the joint. These processes may be accompanied and exacerbated by proliferative exostosis of the T-M joint which may progress to osteo-arthritis.

Obvious culprits that prevent the proper coordination of the small pterygoid muscle include fractures of the jaws or condyles from kicks, and *any dental condition that blocks the free lateral excursion of the jaws*. Freedom of the jaws to move fore and aft is also crucial to preventing T-M joint trauma, and feeding the horse at ground level is one easy solution. However, common rider practices including the use of tight nosebands, dropped nosebands, and heavy continuous contact continue to be common and can do just as much damage to the jaw joints over the long term. (For more information on this subject, including three-dimensional color illustrations of upper neck, throat, hyoid, tongue and mouth anatomy, please see "The Inner Horseman" vol. 5, no. 2, July 2001. Current and back issues are available online at www.equinestudies.org).

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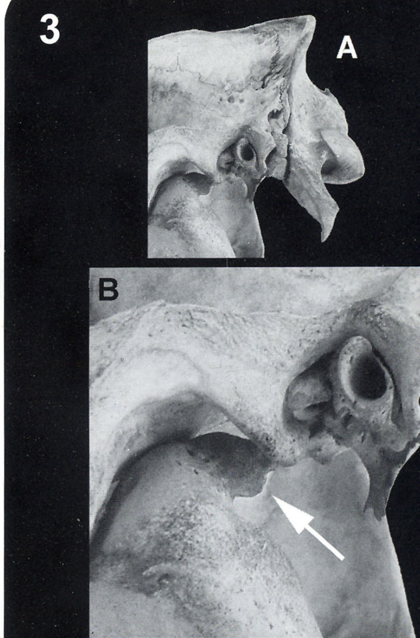

Fig. 3 Skull of "The Flying Dutchman", Australian Museum specimen no. 1324, collected 1913. This stallion was a famous steeplechaser and timber-racer bred in Tasmania. The enlargement (B) shows extreme flattening and faceting of the medial part of the jaw condyle, consistent with firm back-pressure upon the jaws.

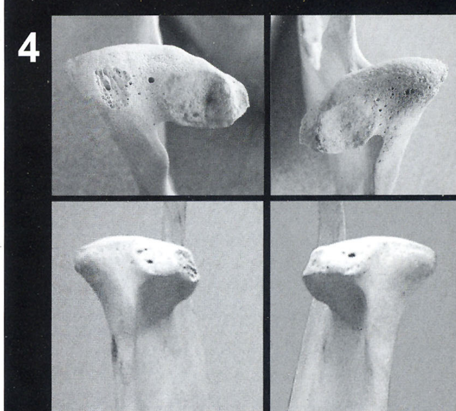

Fig. 4 Above: left and right condyles of Univ. New Mexico specimen UNMNH-21715, showing faceting of the postero-medial aspect of the condyle. Generally, pathological condyles also expand medially, partly in response to increased effort of the small pterygoid muscle to position the articular disk. Below: left and right condyles of Los Angeles County Museum of Natural History specimen LACM-31129, donated by the Kellogg Arabian Ranch, showing the plump shape of normal condyles. The horse above was ridden throughout a long lifetime; the Arabian died as an unridden three year old.