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**SOME ANATOMICAL STUDIES ON
THE TEMPOROMANDIBULAR JOINT OF
THE ONE HUMPED CAMEL
(Camelus dromedarius)
(With 9 Figs.)**

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بعض الدراسات التشريحية على المفصل الصدغي الفكي السفلي
في الجمل وحيد السنم

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استهدف هذا البحث دراسة السطوح المفصالية المكونة للمفصل الصدغي الفكي السفلي وكذلك أكياس المحفظة المفصالية وتحديد نسب الأماكن لحقنها كما تم أيضا دراسة الأربطة المتصلة بهذا المفصل. وقد أجرى هذا البحث على اثنتي عشرة جمجمة لجمال - بالغة وغير بالغة - عوملت بطرق مختلفة لإيضاح التراكيب المختلفة المتعلقة بالتركيب المفصلي ، وقد استعين بصور الأشعة لإظهار علاقات العظام المكونة للمفصل. وتتخلص النتائج التي تم التوصل إليها فيما يلي: (١) السطوح المفصالية: يتكون السطح المفصلي المتواجد على العظم الصدغي من اللقمة المحدبة المفصالية والحفرة الفكية السفلية والتي تتواصل خلفيا ، على النتوء خلف المفصلي بينما يكون العظم الفكي السفلي النتوء ممتدا في الاتجاه المستعرض . ولوحظ وجود قرص مفصلي متوضع بين السطحين المتقابلين لكل من العظم الصدغي والعظم الفكي السفلي يعمل على موائمة كل منهما للأخر وتتصل حافته مع المحفظة المفصالية ، لذا فإن التجويف المفصلي ينقسم تماما إلى جزأين أحدهما علوي والأخر سفلي ويمثل الجزء العلوي أهمية إكلينيكية حيث يتم عن طريقه حقن المفصل أو أخذ عينات من السائل الزلالي لتحليلها معمليا وكذلك حقن العقاقير الطبية ، (٢) كما تبين أن المحفظة المفصالية ضيقة وقوية ويساندها الرباطين الوحشي والخلفي حيث يمتد الأول بانحراف عبر الجزء الأمامي من السطح الوحشي للمحفظة المفصالية ويلتحم معها تماما ويكون الرباط الخلفي حزمة مرنة تنشأ من النتوء خلف المفصلي إلى السطح الخلفي لعنق العظم الفكي السفلي. وربما تساعد الحركة الرئيسية -حول المحور المستعرض والحركة الزلالية- للمفصل الصدغي على تسهيل خروج الجولا - الخاصة بذكور الجمال البالغة .

SUMMARY

This work was conducted on the temporomandibular joint of twelve heads of one humped camel of different ages and sexes. The gross morphological features of the articular surfaces and capsule associated with the joint were thoroughly investigated using anatomical and radiological techniques. The temporal component of the articular surfaces was divided into a rostral horizontal surface and a caudal vertical area and the constituent of the condyle sloped caudalwards in a longitudinal plane. The later finding might be of great importance in the functional design. Meanwhile, it would be achieved that the gliding of the condyle with an upward and caudal displacement of the jaw joint resulted in the mechanical improvement occurred in the jaw which had been released from the requirements of predation; biting force and extrusion of the diula in the adult male camel. Also, in this study, it was proved that the rostral part of the joint cavity was inappreciable, therefore the suitable site for the injection and surgical approach was lateral and caudal. In addition, the present study suggested that the capsular construction of the joint as well as anatomical arrangement of the ligaments allowed a transverse movement of the joint that appeared in the camel. The results obtained were discussed with those of other domestic animals.

Key words: Temporomandibular joint, camel.

INTRODUCTION

The anatomy of the temporomandibular joint is highly specific and correlate with jaw and teeth function (Kreutziger and Mahan, 1975, as well as Fox, 1965). Moreover, in each available ecological niche adaptive modification of jaw joint occurred in each group of animals argued that each case gradually obtained greater benefit from food source available to it (Du Brul and Laskins, 1961 as well as Davis, 1964). However, apart from the concised idea given by Jamder (1961a) as well as Smuts and Bezuidenhout (1987) on the articular surface of the joint nothing could be traced concerning the anatomy of the temporomandibular joint in the camel.

The present study, is therefore, an endeavor to give some anatomical and radiological observation on the temporomandibular joint,

as an attempts to extend our knowledge in a matter which still virgin in the field of veterinary studies.

MATERIAL and METHODS

The work was conducted on six heads of adult camels as well as another six of which four were neonatal and two were young camels. The articular capsule of the joint, on both sides of the heads, were distended through an intra-articular injection of a coloured gum milk latex.

Site Of Injection For The Articular Capsule:

The optimum site for injection into the articular cavity of the temporomandibular joint was found to be the preauricular approach which was located in the area corresponding to the external part of the mandibular fossa. This area was found in a point midway between the rostral border of the base of the auricle of the external ear and the caudal orbital rim (Fig. 1). Another site for reaching the cavity could be also performed through the caudoventral pouch of the dorsal synovial sac (Fig. 8), by introducing the needle medial to the ramus of the mandible in an oblique fashion, halfway between the base of the auricle of the external ear and the ventral border of the masseter muscle. The specimens were then embalmed by 10% formaline to which 2% acetic acid was added for 3-4 days prior to dissection.

Radiographic examination of the temporomandibular joint was afforded on the whole skull, where the interpupillary line is at 45° to the film and the specimens were radiographed at 75 kvp, 200 Ma, 1/10S exposure factors with 80 cm.

The morphological features of the articular surfaces entering in the formation of the joint were studied on the bones left after dissection. Nomenclature used were adopted according to *Nomina Anatomica Veterinaria* (N.A.V., 1994).

RESULTS

Postural Position:

In the camel the postural position of the temporomandibular joint was located much more dorsally than the plane of the masticatory occlusal surface of the cheek teeth (Fig. 1).

Its gross dissection as well as radiographic examination, had revealed that, the condylar process of the mandible (Fig. 2/2) was

received into a deep depression on the squamous part of the temporal bone. The later depression was bounded cranially by the articular tubercle (Fig.3/4 & 4/1), caudally by the retroarticular process (Fig.3/5 & 4/2) and dorsally by the mandibular fossa (Fig.1/1&3/3). It was also observed that the articular surfaces of the bony elements entering in the formation of the joint were dissimilar in both form and size. So, an intervening articular disc was interposed between them.

Articular surfaces:

A-Condyle : Caput mandibulae:

The condylar process (Fig. 2/2) articulated with other components of the joint through the head of the mandible (Fig.3 A&B/1). The later carried a transversely elongated convex articular surface measuring about 7-8 cm mediolaterally and 3cm. rostrocaudally. The articular surface, in the greater part of its extent, faces craniodorsally, except caudally where it faces caudodorsally.

In all the examined specimens, it was observed that, the articular surface encroached considerably on the caudal aspect of the neck of the mandible. This encroachment is in the form of an inverted triangle (Fig.3/2) and articulated with the opposed surface on the cranial aspect; the retroarticular process of the temporal bone through the intervening articular disc.

B- Temporal component:

Tuberculum articulare and processus retroarticularis: The articular surface on the temporal component of the temporomandibular joint consisted of two distinct parts separated from each other by a transversely elongated synovial fossa (Fig.4/3). The cranial part; tuberculum articulare (Figs. 3/4 & 4/2), representing the surface of the articular tubercle assumed the shape of a crescent with convex borders joined ventrally and cranially. The caudal part was tall and in the form of an inverted triangle with the angle rounded off. It covered the greater part of the cranial aspect of the retroarticular process (Fig.4/2).

Discus articularis:

It had the form of a complex ovate structural sheet (Fig. 5) with two surfaces. The dorsal surface is moulded upon the temporal bone being wide cranially and narrow caudally. It is convex in both the long and transverse axis. The convexity of the surface increased caudally, where it was reflected ventrally to become moulded on the cranial part of the retroarticular process. The ventral surface is concave in adaptation to the condylar surface of the head of the mandible. It is relevant to point out that the thickest part of the disc was centrally and gradually thinned

out towards its periphery. It was also noticed that the circumference of the articular disc was notched opposite to the caudodorsal part of the condylar process of the mandible, as well as the outer boundary of the temporal fossa.

V Capsula articularis:

The fibrous capsule (Fig.7) was tight and relatively thick on the side aspects of the joint, where it consisted of fasciculated groups of short fibers extending between the articulating bones. Elsewhere, specially caudally, the articular capsule was thin and consisted of slender groups of fibers loosely dispersed on the synovial stratum. Dorsally; the fibrous capsule was attached around the margins of the articular surfaces of the temporal component of the joint, while ventrally the attachment was about 0.5-1.0 cm. from the articular margins. It must be added that, the fibrous capsule was attached to the entire edge of the articular disc; via dorsal and ventral strata; as it passed between the articulating bones forming the joint.

On distension, the synovial stratum was observed to form two completely separated articular compartments, dorsal and ventral. The dorsal compartment (Fig. 8/1) was relatively the larger, specially caudally where it forms small ventrally directed pouch.

In this connection it might be relevant to point out that, the fibrous capsule was reinforced on its lateral and caudal aspects by condensation of some fibers, which might be regarded as the lateral and the caudal ligaments. The former ligament (Fig. 8/2) was extended from the ventrolateral aspect of the zygomatic arch at the rostral dorsal extent of the articular capsule and progressed caudally and ventrally to attach the lateral border of the condylar neck. The latter ligament (Fig. 9), appeared as stout slender fibrous band extended caudally from the caudal border of the condylar neck; distal to the articular area; to the retroarticular process.

DISCUSSION

Regarding the topographical position of the temporomandibular joint, as indicated in the present findings, was nearly parallel with that given in other herbevorous animals by Nickel, Schummer Wille and Wilkens (1986) who stated that the temporomandibular joint was placed at a higher level than that of the masticatory surface of the cheek teeth. This direction must be taken into consideration during the radiographic examination of the joint (Schebitz and Wilkens, 1977 and

1978). In this respect, Erasha, Ragab and Ahmed (1992) added that, the 45° oblique lateral view was choosed as it gave superior visualization of the articular surfaces as well as the joint cavity. In this concern, several authorities (Smith and Savage, 1959, storch,1968 and Scapino, 1972) proposed that such position increased the mechanical advantages of the musculature. On the other hand, Badoux (1975) Seiferle and Frewein (1986) as well as Zayed (1996) suggested that the shearing mechanism of the temporomandibular joint of the dog may be due to the same level of both the joint and the masticatory surface of the cheek teeth.

In the camel, as also in the ox (Raghavan and kachroo, 1964; Erasha *et al.*, 1992 as well as Tyagi and Singh, 1993) and horse (Sisson, 1975 as well as Schebitz and Wilkens, 1978) the mandibular component of the temporomandibular joint was in the form of a transversely elongated convex articular surface. Moreover, in the camel the surface encroached caudally on the caudal aspect of the neck of the mandible. This encroachment was in the form of an inverted triangle which articulated with the retroarticular process of the temporal bone through the mediation of the intervening part of the articular disc. Furthermore a striking feature of the articular surface of the temporal component of the joint was its interruption by a transversely elongated synovial fossa which intervened between the articular surface on the tubercle and that on the cranial aspect of the retroarticular process. In ruminants (Kummer, 1959 and Erasha *et al.*, 1992) recorded that, the articular tubercle was well distinct and flat in both direction. On the contrary, Zietzschmann (1943) in horse and Zayed (1996) in donkey stated that it was relatively small, so that the lateral movement was less developed than in ruminants. In dog Baum and Zietzschmann (1936) as well as Evans (1993) denied the presence of articular tubercle, as a result, the hinge like movement predominated in this animal. The present investigation described the common picture of the disc as an ovate structure and it was thickest centrally and gradually thinned out toward its periphery, where it was attached to the joint capsule. This simulated that of other domestic animals (Bradely and Graham, 1947 in horse; Kanan,1990 in ox as well as Ommer and Harshan,1995 in different domestic animals). In this respect, Trichmann (1923) stated that the disc was stronger periphery than centrally in both dog and pig. Furthermore, the present study decided that the convexity of its dorsal surface was much more pronounced caudally where the disc is reflected ventrally to intervened between the surface of the mandibular fossa and the retroarticular process. In accordance with Vau (1936) and Van (1970)

the existence and nature of the disc was not only depending on the articular surface, but also it could be strongly influenced phylogenetically. For this reason the disc is relatively plane in the young camel subjects, changes in the shape of the articular surfaces resulted in a definitive appearance of the disc in the adult camel. It was evident from this investigation, that the fibrous capsule was tight and relatively thick on the side aspects of the joint. The strengthen and tightness of the articular capsule revealed in the present work was also recorded in the ox (Zietzschmann, 1943 and Sisson, 1975) and horse (Sisson and Grossman, 1969 as well as Nickel *et al.*, 1986).

Distension of the synovial stratum, had revealed that the joint cavity was divided into two unequal dorsal and ventral compartments. The former had a mere cleft caudally and inappreciable in its rostral part. Thus, the caudal part of the articular capsule was the most favourable site for injection and the surgical interference of the joint.

The condensation of the fibers at the caudal aspect of the joint could be compared favourably with the caudal ligament detected in other ruminants (Zietzschmann, 1943 and Erasha *et al.*, 1992); equines (Sisson, 1975) and cat (Reighard and Jennings, 1929), though Sisson (1975) denied the presence of such ligament in ruminants and carnivora. Similarly, the condensation of the fibers which occurred on the lateral aspect of the articular capsule, revealed in the present findings corresponded favourably with the lateral ligament of other domestic animals (Nickel *et al.*, 1986 and Schievely, 1987); in ox (Raghavan and Kachroo, 1964 as well as Erasha *et al.*, 1992) and equines (Sisson and Grossman, 1969). Possible movements occurred at the joint were suggested.

From the obtained results, it may be deduced that, the anatomical arrangement of the ligaments and the capsule allowed a transverse movement in the joint. In this respect, the lateral ligament helped to stabilize the condyle on side of the laterotrusion.

Furthermore, the possible movement suggested at the joint might play a great role in the activity of the incisor and canine by the biting process. Moreover, the activities associated with gaping is achieved by the temporomandibular joint as given by Hiimae (1967) and Dyce, Sack and Wensing (1996). This relationship might be primarily concerned in the depression of the lower jaw that seen during the projection of the palatine diverticulum –duula in the adult male camel.

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LEGENDS

- Fig. 1:** Photographic representation of the suitable site for injection of the temporomandibular joint (Arrow)
- Fig. 2:** Radiograph showing the position of the temporomandibular joint in the camel:
- 1- Mandibular fossa.
 - 2- Condylar process.
 - 3- Coronoid process of the mandible.
 - 4- Occlusal surface of the teeth.
 - 5- Cranial cavity.
 - 6- Mandible.
- Fig. 3:** Photograph showing the two components of the caput mandibulae and the articular surface at the base of the zygomatic arch (lateral aspect):
- A- Fresh specimen (In situ),
- B- Dried specimen
- Rostral component of the caput mandibulae:
- 3- Mandibular fossa.
 - 4- Tuberculum articulare.
 - 5- Processus retroarticularis.
- Fig. 4:** Temporal component of the articular surface viewed from below:
- 1-Tuberculum articulare.
 - 2- Retroarticular process.
 - 3- Synovial fossa.
- Fig. 5:** General appearance of the temporomandibular joint disc. Viewed from front and laterally:
- 1-The small rostral part.
 - 2- The large caudal part.
- Fig. 6:** Attachment of the articular disc to the fibrous capsule
- 1- Dorsal stratum.
 - 2- Ventral stratum .
- Fig. 7:** Curve line incision of the articular capsule (grasped by a forcipis) to expose both the joint cavity and the disc (asterisk).
- Fig. 8:** Right temporomandibular joint. Lateral view. Notice that, the fibrous capsule was removed and the lateral ligament (2) was incised to demonstrate the wide dorsal synovial compartment (1) of the joint and its ventral pouch (i).
- Fig. 9:** Photograph of the temporomandibular joint . caudolateral view showing the caudal ligament.





