



TEMPOROMANDIBULAR JOINT MODEL: ANATOMICAL COMPARISON BETWEEN HUMAN AND RAT

*Vimal Adithyan K.R¹ and M.Karthik Ganesh²

¹Saveetha Dental College and Hospitals, Chennai

²Department of Anatomy, Saveetha Dental College and Hospitals, Chennai

ARTICLE INFO

Article History:

Received 10th December, 2016

Received in revised form 16th January, 2017

Accepted 26th February, 2017

Published online 28th March, 2017

Key words:

TMJ, human and rat, articular disc, articular eminence, TMJ models.

ABSTRACT

Aim: To compare the features of human and rat TMJ anatomically.

Objective: To analyze and evaluate human and rat TMJ from an anatomical point of view and make a comparison between them to set an alternate and easy model of TMJ.

Background: The human TMJ is a group of anatomical structures that with a special group of muscles, is responsible for the movement of the mandible during mastication. This joint has a unique structure and function as compared with other diarthrodial joints. TMJ disorders and other related pathologies are very common and little is known about their underlying pathogenesis. In vitro studies and animal models may be used for these purposes. In particular, rats may be used since they are easy to handle and inexpensive to maintain in a bioterium, making them a convenient animal for use in experimental studies.

Materials and Methods: Formalin fixed twelve adult male Wistar Albino rat specimens were used in this procedure. The various anatomical structures of TMJ were evaluated such as condyle, mandibular fossa, disc, articular tubercle and temporal bone of rat was compared to that of humans.

Results: The TMJ is surrounded by a thin capsule, consisting of fibrous tissue and a synovial lining. The mandibular angle has a prominent shape. The glenoid fossa is flat, with no eminences.

Conclusion: Morphologically the articular structure of rats is, on the whole, similar to that of humans. In these animals there is no articular eminence.

Copyright©2017 Vimal Adithyan K.R and M.Karthik Ganesh. This is an open access article distributed under the Creative Commons Attribution License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

INTRODUCTION

The human temporomandibular joint (TMJ) is a group of anatomic structures that, with a special group of muscles, is responsible for the movement of the mandible during mastication. It consists of the condylar process of the mandible, the mandibular fossa of the temporal bone, a thin articular disc, and a loose joint capsule, which is strengthened by a fibrous lateral ligament [1]. This joint, which is classified as a hinge-sliding joint, has a unique structure and function as compared with other diarthrodial joints [2].

Innumerable diseases, such as neoplasias, trauma, ankylosis and degenerative diseases may affect the TMJ and lead to the loss of its structures. This pathological condition of TMJ is regarded as the TMJ disorder. For all these diseases there are specific treatments, each of which has a wide range of success. As a result there is always a need for progress in the

treatment of some of these diseases. Furthermore much of the research in this area cannot be done on humans for ethical reasons. Studies *in vitro* and animal models may be used for this purpose [3]. In particular, rats may be used since they are easy to handle and inexpensive to maintain in a bioterium, making them a convenient animal for use in experimental studies, giving rise to new ideas in the quest for new treatments for TMJ diseases. However it is not known how similar the TMJ of the rat is to the human TMJ, which is important for the validation of the studies, realizing that these studies could be extrapolated to humans because of similar TMJ anatomical features.

MATERIALS AND METHODS

Formalin fixed twelve adult male Wistar Albino rat specimens were used for this study. TMJ in humans was analysed by dissecting cadaver specimens. The various anatomical structures of TMJ were evaluated such as condyle, mandibular fossa, disc, articular tubercle and temporal bone of rat was compared to that of humans. Dissection was then performed, using a surgical instrument, starting from the external surface,

*Corresponding author: Vimal Adithyan K.R
Saveetha Dental College and Hospitals, Chennai

observing all anatomic structures related to the TMJ. The following tissues were removed: skin, subcutaneous tissue, blood vessels, nerves, parotid gland, masseter muscle, temporal muscle and adipose tissue. Then the TMJ is exposed to show zygomatic arch, ramus of mandible, temporal bone, condylar process and articular eminence. All these structures were compared after dissecting the human TMJ.

RESULTS

The TMJ is surrounded by a thin capsule, consisting of fibrous tissue and a synovial lining. The mandibular angle has a prominent shape. The glenoid fossa is flat, with no eminences. The articular disc is biconcave, being less thick in the central area; and is made up of fibrous connective tissue. It divides the articular joint into two compartments: superior and inferior. In all specimens the anatomical characteristics were almost similar (Figure 1).

more prominent. The absence of the articular eminence may make the movement of the mandible highly specialized for extensive protrusive movements. The rounded condyle travels in a trough-like temporal fossa and the power stroke is in the protrusive direction with only a minor medial component¹. Since the mandibular symphysis is fibrous, rotation of the long axis may occur around this mobile symphysis [6,7].

CONCLUSION

Morphologically and anatomically, the articular structure of rat TMJ is, on the whole, similar to that of humans. Except in these animals there is no articular eminence. Other structures are similar depicting these species may be used for this purpose to model TMJ of rats.

References

1. Siéssere S, Vitti M, Semprini M, Regalo SCH,

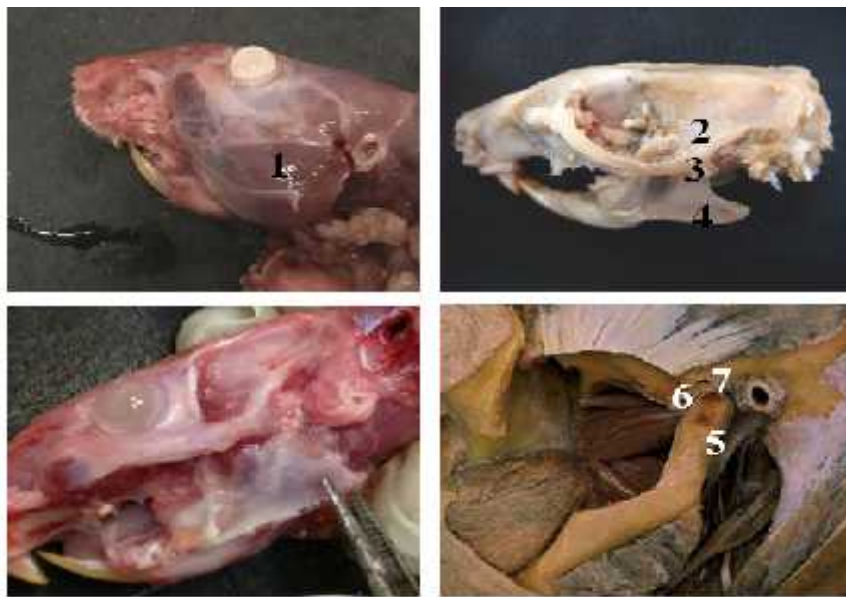


Figure 1 Photographs showing comparison of TMJ between rat and human
1. Masseter 2. Temporal bone 3. Zygomatic arch 4. Ramus of mandible 5. Condylar process 6. Articular eminence 7. Mandibular fossa

DISCUSSION

If there is a need for reconstruction of the TMJ, autogenous tissue and alloplastic material may be used. However, neither of the treatments is ideal, since both have their drawbacks [1]. Thus, studies dealing with the surgical treatment of diseases of the TMJ need to be conducted for the purpose of producing fresh ideas on innovative treatments. Many of these may certainly be performed on animals.

Innumerable species may be used for this purpose, such as monkeys, rabbits, sheep, goats and minipigs [5]. Study models in rats would therefore certainly represent an advance in terms of cost and ease of performance. Thus it is important to know how similar the TMJ's of rats and humans are.

As far as anatomical features are concerned, it is important to point out that the size of the rat joint is much smaller than the humans and the main difference between them is that there is no articular eminence in the rat TMJ. The position of the condyles is also divergent. In addition, the shape of the mandibular angle is different, since in the rats this angle is

Iyomasa MM, Dias FJ, Issa JPM, Sousa LG. Macroscopic and microscopic aspects of the temporomandibular joint related to its clinical implication. *Micron*. 2008;39(7):852-8.

2. Koolstra JH. Dynamics of the human masticatory system. *Crit Rev Oral Biol Med*. 2002;13(4):366-76.
3. Schek RM, Taboas JM, Hollister SJ, Krebsbach PH. Tissue engineering osteochondral implants for temporomandibular joint repair. *Orthod Craniofac Res*. 2005;8(4):313-9.
4. Cate ART. Oral histology: development, structure and function. 5 ed. St. Louis: Mosby-Year Book; 1998.
5. Herring SW. Animal models of TMJ research. *J Musculoskel. Neuron Interact*. 2003;3(4):391-4.
6. Weijs WA. Mandibular movements of the albino rat during feeding. *J Morphol*. 1975;145(1):107-24.
7. Weijs WA, Dantuma R. Electromyography and mechanics of mastication in the albino rat. *J Morphol*. 1975; 146(1):1-34.