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Milestones of temporomandibular joint

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Abstract

Objectives: Temporomandibular joint (TMJ) has many anatomic and functional features that makes it unique and complex joint amongst all the joint of human body. Age is one of the most significant factors in occurrence of TMJ changes. These changes have not been completely clarified as the etiological factors for TMJ disorders.

This review of literature, attempts to make age related changes of TMJ, comprehensible. The aim of this article is to access and understand changes which TMJ undergoes during different phases of life.

Methods: This article was made by dividing a human life in eight stages and stating the possible effects of age on TMJ, in each stage.

Results: We have formulated an analysis of all changes happening in TMJ at different stages of life, to make it a valuable tool for diagnosing different ailments with regards to TMJ.

Keywords: temporomandibular joint, morphologic changes of TMJ, Growth of TMJ, aged joint, disk atrophy

Introduction

Temporomandibular joint (TMJ) has many anatomic and functional features that makes it unique and complex joint amongst all the joints of human body. All Oral Surgeons must understand the functional anatomy of TMJ and their related age changes before they can effectively diagnose and treat the diseases of TMJ ^[1].

Condylar remodeling is an ongoing physiologic process that aims to adapt its functional demands. It is based on an interaction between the mechanical forces sustained by the TMJ and the adaptive capacities of the condyle ^[2]. However the changes in the human condyle with regard to ageing or occlusal loss have not been completely elucidated ^[2]. The adaptive or degenerative changes in the TMJ appear over a long period of time, it is understandable that the condylar changes increase with advancing age.

Materials and Methods

To recognize the age related changes of TMJ we have categorized the changes in eight stages as mentioned below. A review of English literature was done to procure this information. Ethical approval and Helsinki declaration, for this review was not required.

Discussion

Milestones of TMJ are-

Stage I - Intrauterine life (developmental phase)

The TMJ begins to develop by the 10th week of gestation from separate blastemas- one for the temporal bone component, and another for the condyle ^[1].

During prenatal phase TMJ develops in following three stages ^[3] -

- **Blastemic stage (7-8 week):** Organization of condyle, articular disc and capsule begins in this stage along with Intramembranous ossification of temporal squamous bone begins in this stage ^[3].
- **Cavitation stage (9-11 week):** At 9th week initial formation of inferior joint cavity and beginning of condylar chondrogenesis occur. Initiation of formation of superior joint cavity is seen in 12th week ^[3].

- **Maturation stage (12th week):** After 12th week of development maturation stage is seen [3].
- **Applied anatomy:** Hrdlicka postulated that obstructed blood supply of the condyle during development caused division of the condyle [4].

Stage II- At birth

Articular disc is a fibrous extension of the capsule that runs between the two articular surfaces of TMJ. At birth, articular disc will be flat but with time it will change to 'S' shape. Condylar cartilage is 1.5 mm thick but soon it will become thin to 0.5 mm. In contrast to the postnatal modification of the discomalleolar ligament, the anterior attachment to the superior head of the lateral pterygoid continues to exist after birth [3].

Applied anatomy: The forceps delivered group had a higher percentage of bruxism and TMJ pain and/or noise. Forceps delivery has also been ascertained as one of the cause for TMJ trauma [5, 6].

Stage III- At infancy (up to 3 months)

The neonatal joint is characterized by highly vascular joint components. The temporal portion is quite rudimentary, with a shallow fossa and the absence of an eminence [7].

Applied anatomy: Due to high vascularity the TMJ of infants it is more inclined towards heamarthrosis followed by trauma.

Stage IV- Childhood (up to 11 years)

There is considerable amount of growth prior to the completion of eruption of the primary molars. Development of the eminence occurs from birth to early adulthood. In 1968 Wright concluded that the developing eminence will achieve a mature's' shape by the age of two and one and a half years. Oberg *et al* in 1971 stated that eminence did not become well defined until between the ages of five and eight years. Humphreys in 1932 thought that the eminence remained rudimentary until age seven, eventually assuming a mature appearance by age 12. Maximum velocity of eminence development occurs prior to three years of age [7].

Applied anatomy: After three years of age, the development continues at a reduced rate till the late adolescent years. One study suggests that the percentage of temporomandibular disorders (TMDs) related symptoms and signs are quite high in children [8]. Internal derangement can range from 5% in children to 15% in teenagers [9].

Stage V- Adolescence/teenage (11-18yrs)

At age eighteen, the eminence development angle changes to 45 degree [7]. As mandibular condyle grow in posterior and superior direction and so by the time of late mixed dentition it will be in its mature phase [10].

Applied anatomy: At this stage, need for adapting the occlusion to the joints is important, rather than hoping for the joints to adapt the occlusion [11]. During this age, people tend to undergo orthodontic treatment and there can be possible association between malocclusion, orthodontic treatment and development of TMDs (up to 15%) [9], which can directly or indirectly affect TMJ [12-15]. Orthodontic treatment has been variously cited both as protective and harmful factor in TMD etiology [16]. The enlargement of the condyle happens in adulthood as part of adaptive changes in response to

overloading [1]. Condylar changes to be more prevalent in younger age group or showed condylar changes in all age groups [2].

Stage VI- Adulthood (18-40 years)

Now at adulthood articular disc will change to 's' shape [17]. By the age of 20 years, intramembranous ossification will be completely replaced by endochondrial ossification. In the center of the condyle, cartilage develops; this will become the secondary cartilage that remains in the condyle up to 27 years of age [1]. In adult TMJ, the ligament is made primarily of collagen, with elastic fibers only in its proximal two thirds.

Applied anatomy: Cruzoe Rebello *et al* and Isberg *et al* found that a greater number of individuals aged between 20 and 49 years showed TMJ changes [18]. TMDs are at a peak in Gaussian curve between ages 35-45 years [19].

Stage VII- Middle age (40-50 years)

Condyle becomes more flatten with age and fibrous capsule starts to become thicker. Stress is one of the most common causes for occurrence of TMJ changes. Abnormal stress may be transferred to the TMJs by malocclusion degenerative changes and by other psychological abnormalities [20].

Applied anatomy: Age was found to be a significant factor in prediction of TMJ arthrosis and disk perforation. The morphological changes of TMJ may be associated with lack of dentition in elderly individuals [21].

Stage VIII- Seniority (above 50 years)

In this stage, Osteoporosis of underlying bone and thinning or absence of cartilaginous zone of condyle is a common occurrence [18]. Condylar head decreases in convexity and reduction in condylar height. Resorbition occurs, more on lateral aspect than on medial. Flattening of articular fossa, decrease in articular eminence and reduction in vertical dimension of glenoid fossa is seen [22]. Flattening of s-curve Disc becomes thinner and shows hyalinization with chondroid changes. Synovial fluid becomes fibrotic with thick basement membrane. With progression of age walls of blood vessels are thickened and nerves decrease in number.

All these changes will lead to decrease in synovial fluid formation. Decrease in resilience during mastication and joint dysfunction in older patient, aged 80-89 years (of whom 58% had bone changes), the prevalence of bone changes increased according to age group [18].

Applied anatomy: In extreme cases condyle may disappear because of drastic changes. In older women disc is more vulnerable than in men [7]. Impairment of motion due to disuse of lesser masticatory activity is seen in old age [17, 23]. According to Alexious *et al*, patients in older age groups are expected to have more frequent and severe bone changes than those in younger age group [18].

Conclusion

The components of the TMJ are thought to retain their capacity for remodeling after growth has ceased, and to continue to change their structure and morphology. Correlations between morphological changes and age must be considered when evaluating panoramic radiographs. It has been suggested in earlier studies that morphologic alterations increase with age. This is an important observation because the number of patients with TMJ signs and symptoms appear

to decrease with age.

Although structural changes are thought to be related to TMJ dysfunction, the mechanism of these structural changes affected by such reactive processes as remodeling, aging, and osteoarthritis, still has not been completely clarified^[5].

However, the changes in the human condyle with regard to aging or occlusal loss have not been completely elucidated there is controversy as to whether or not the number of remaining^[5].

Compliance With Ethical Standards

Conflict of interest: Author A declares that she has no conflict of interest. Author B declares that she has no conflict of interest. Author C declares that she has no conflict of interest. Author D declares that he has no conflict of interest.

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“Ethical approval: This article does not contain any studies with human participants or animals performed by any of the authors./All applicable international, national, and/or institutional guidelines for the care and use of animals were followed./All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.”

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