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Evaluation of Dysfunction of Temporomandibular Disc

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Abstract: ***Introduction: The most often derangement is disc malposition in relation with mandible condyle and temporal bone. The aim of the study: The aim of this study is to explain the histological changes in loaded and malposition temporomandibular disc in patients with jaw joint disorders.Material and Methods: The examination is done over a group of four female patients with temporomandibular joint disorders. Discussion: Disc malposition known also as disc dislocation is characterized with disc dislocation in joint space when jaws are in close or near closed position. Conclusion: Changes in the organization and composition of the malpositioned disc and posterior attachment tissues are secondary to abnormal loading which induces cell-driven processes of degradation and reassembly of the extracellular matrix.***

Keywords: temporomandibular joint, articular disc, histological changes

1. Introduction

One of the most common jaw arthropathies is the internal derangement designated as disc displacement. Patients with this disorder are treated in different ways and many different types of treatment have been associated with diminution of symptoms. Understanding the physical nature of the disease is basic to planning the treatment of these patients. Many temporomandibular joint structures can be subject of changes, so disc as a structure can be a subject to change, in internal joint derangement. The most often derangement is disc malposition in relation with mandible condyle and temporal bone. This wrong and inadequately position of the disc is known as disc malposition.

2. Literature Review

Many authors are interesting about the problems connected with disc dysfunction and in the below text some observations will be discussed.

Jonssonet al[1] concluded that increase in soft tissue thickness is interpreted as an adaptive mechanism to maintain the condyle path and withstand excessive loading at interposition of the temporomandibular joint components.

Alkhaderet al[2] examined jaw joint with MR images and they conclude that disc dysfunction is characterized by the presence of osseous abnormalities in the jaw joint. For further changes examination cone beam technology has to be done.

Internal derangement of the temporomandibular joint is due to an abnormal relationship of the articular disc to the mandibular condyle, glenoid fossa and articular eminence, stated Loreto et al[3]

Murphy et al[4] research the collagen alignment via polarized light and scanning electron microscopy.

Deregibus et al[5] in their study stated that magnetic resonance imaging (MRI) is the method of choice for examining soft tissue pathology and with this method many useful characteristic can be observed.

Tvrdyet al[6] stated that treatment using occlusal splint is one of the most frequently used methods of conservative treatment. The same authors pointed that arthrocentesis of the temporomandibular joint is used not only of acute closed lock but also in the treatment of various temporomandibular disorders.

Abidiet al[7] put their accent on the use of oral splints with responsibility to manage TMDs is quite popular even though its mechanism of action and efficacy remains unclear.

3. The Aim of the Study

The aim of this study is to explain the histological changes in loaded and malposition temporomandibular disc in patients with jaw joint disorders.

4. Material and Methods

The examination is done over a group of four female patients with temporomandibular joint disorders. The mean age was 34 years; all of them suffer from severe problems in normal function of masticatory system.

5. Results and Discussion

Criteria for disc malposition determing. Disc malposition known also as disc dislocation is characterized with disc dislocation in joint space when jaws are in close or near closed position. For a diagnosis of disc displacement the disc must be malpositioned with respect to the condyle. Sometimes the disc may be abnormally related to the temporal bone. On fig. 1 are presented some disc relations to the temporal bone.

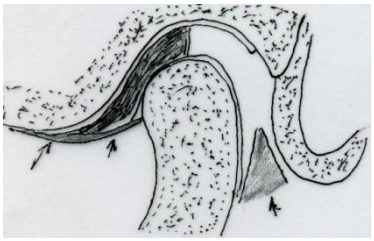

Figure 1: Jaw closed condyle-disc relationship in normal joint

Malposition of the disc may be manifested in different ways. When the disc is located in front of the condyle it is said to be anteriorly displaced. The disc is also commonly located anterior to the condyle and therefore said to be anterolaterally or antyeromedially displaced. Posterior disc displacements are rare but have been reported. Partial displacements may also occur. In the most common case the disc is laterally malpositioned in the joint. If upon jaw opening the malpositioned disc assumes an essentially normal position it is said to reduce. A nonreducing disc remains malpositioned when the jaws are opened. The disc that becomes reduced at one mediolateral level of the joint but not at another is said to be partially reduced.

Disc malposition is associated with abnormal loading of the disc and its attachments. Because of this tissue changes occur which can be noticed by artrographic and MRI investigations. The important point is that for both reducing ornonreducing discs the joint tissues are habitually under abnormally directed loads for long periods. Direction and duration of the anomalous load rather than its magnitude are responsible for the dramatic tissue alterations observed.

Tissue Alterations in Malpositioned Disc

The tissue changes observed in disc derangements can be discussed using the same terminology applied to other synovial joints. Term remodeling used here is accompanied with mechanical loading and because of it the change in tissue organization occurs. Remodeling processes in joint tissues are often distinguished as progressive or regressive. Progressive remodeling is regarded as a proliferative process which may be recognized by the presence of an increase volume of tissue containing an increased density of cells and increase in number of cells having a certain phenotype. Regressive remodeling is recognized by decreased tissue volume and cellularity as well as other signs of tissue degeneration. The density of the cells may be decreased while tissue volume is increased and increased production of extracellular matrix.

Remodeling will be used here to designate a process which the extracellular matrix of a tissue is degraded and resynthesized in an organization that is new in some way with the tissue being recognised as healthy but not of an organization normal for the tissue side. Remodeling may involve changes in cell number and phenotype within the tissue along with changes in composition and organization of the extracellular matrix.

Microscopy of the normal disc and posterior attachment

The disc is composed of a dense collection of collagen fascicule, cartilage-like proteoglycans (CPG) and a fine branching system of elastic fibers. Cell phenotypes vary from fibrocytes to chondrocytes.

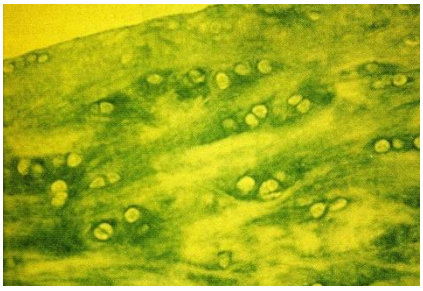

Figure 2: Upper surface of the posterior band in a normal specimen having an usual concentration of chondrocytes. Anterior is on the left side. The collagen fibers are unstained and appear white. The cartilage-like proteoglycan is localized in the blue-stained matrix

Type I collagen fibers predominate, but type II collagen is present chiefly in the regions where cartilage-like proteoglycans is present. The collagen fascicule in the intermediate zone of the disc is oriented more or less perpendicularly to the mediolateral axis of the disc. Another group of fascicule pass antreriorly and posteriorly into the anterior and posterior bands of the disc.

Considerable variations are observed in the collagen fiber organization of disc displacement tissues both regionally within and between specimens. The descriptions below are generalizations on commonly seen collagen fiber patterns. They apply best to specimens in which the disc is located anteriorly, anteromedially or anterolaterally to the condyle.

Overloading patterns associated with disc displacement

When the posterior band of the disc is located in front of the condyle, the anterior part of the posterior attachment becomes located in the interval between the articulating surfaces of bones (see Fig. 1.). When the mandible is at rest the posterior band in this position is subjected to habitual loading from behind rather than from the normal, inferosuperior direction. During the initial stages of jaw opening in a case of reducing disc and throughout opening in a case of nonreducing disc the posterior band is subjected to loading from the rear. The intermediate zone and anterior band of the disc in their displaced positions are also removed from habitual inferosuperiorly directed loading and are subjected to forwardly directed forces via the posterior band. The joint tissues react to these abnormal loading regiments in characteristic ways.

In disc reduction where the disc returns to an essentially normal position and loading regiment it may be expected that the tissue reactions induced by the abnormal loading would be generally different from those observed in disc displacement without reduction.

In the reducing disc the amount of time the disc spends in the reduced state is apparently insufficient to induce tissue

organization that is generally different from that of the nonreducing disc.

Progression of Disc Derangement

Malposition of the disc is associated with characteristic differences in shape, dimension and tissue composition and organization. Additionally while the tissue changes that characterize disc displacement are often recognizable at all mediolateral levels of many specimens this is not universally the case.

Anatomy and microscopy of derangements of the disc and its attachments

In the text below anatomic and microscopic characteristics of disc derangements and its attachments will be presented via remodeling process. Remodeling of the posterior attachment posterior band union. The normal radioation of collagen fibers of the CPA into posterior band along its posteroinferior border becomes replaced by a fascilular pattern in which the fibers run parallel to the surfaces of the posterior attachment penetrating into the band at approximately their level of departure from the posterior attachment.

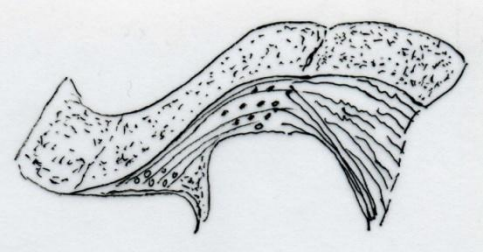

Figure 3: Principal collagen fiber patterns in the normal disc and posterior attachment (block section cut through the disc perpendicularly to its transverse axis)

Remodeling within the anterior part of the posterior attachment. The posterior attachment is longer in disc displacement specimens. The collagen fibers immediately behind the junction of the posterior band and posterior attachment have a more rectilinear orientation and are of larger caliber than is present in normal posterior attachments.

Remodeling in the posterior band

In parasagittal sections the remodeled posterior band of the disc is recognized as a thicker region located between the thinner, fibrotic posterior attachment posteriorly and thinner intermediate zone anteriorly.

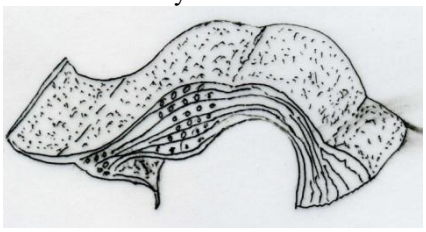

Figure 4: Principal collagen fiber patterns in a disc displacement specimen. The lines and circles represent longitudinally and cross-sectionally cut collagen fibers

While the cartilage-like glycosaminoglycans content of the tissue may be reduced it is consistently present in association with cells that have the phenotype of chondrocytes.

Remodeling of the anterior band, its attachments and the intermediate zone

As in the case of posterior band the normal shape of the anterior band and the organization of the collagen fibers within it are often modified, but a detailed study of the architectural abnormalities within the anterior band has not been done. In the latter case a fibroproliferative tissue is often observed in intimate adherence to the disc surface. A recognizable intermediate zone may be present at one mediolateral level of the disc but not at another.

Pathosis

In any sizeable sample of disc derangement joints it is possible to find specimens in which features of remodeling and dysplasia alone are present without any accompanying pathologic condition. The pathosis associated with disc derangements will be treated summarily here.

Disc

The surfaces of the disc especially in more advanced derangements may exhibit fissuring fibrillation and fraying. Signs of degeneration in the extracellular matrix of the discs include a regional increase or decrease in cell number, chondromalacia, loss of collagen fiber birefringence, decrease in elastic fiber content cystic and myxomatous lesions, dystrophic mineralization, metaplastic bone, neovascularization and perforation.

Posterior attachment

Both acute tissue injury and degenerative pathosis are observed in the posterior attachment observation of extravasated red blood cells in the posterior attachment of discectomy specimens is common and in many cases may be attributable to injury of vessels at the time of surgery. Other reported observations include narrowing of the lumina and thickening of the media of small arteries; proliferation of small vessels; connective tissue hyperplasia, perivascularly located myxomatous degeneration, occasional dystrophic mineralization, variable presence of mononuclear inflammatory cells and perforation usually at the junction of the posterior band and posterior attachment.

Articular tissues of the temporal and condylar components of the joint. Degenerative changes in the articular tissues are commonly observed in association with disc derangements and the derangements have been thought to be cause of the arthrosis. Disc derangement and arthrosis may exist independently.

Are All Malpositioned Discs Pathologic?

It has been argued that anterior disc position is a variant of normal and indeed the insistence that abnormal disc position be defined solely by location of posterior band anterior to the condylar crest has been challenged. Not all disc so located are associated with disc derangement or other joint pathosis. The characteristically altered collagen-fiber organization in the disc and posterior attachment described

above is not observed in joints in which the disc is habitually loaded beneath by the mandible condyle. Differences in the differently positioned tissues are identified and the mechanism by which they arise become understood.

Progression of Disc Derangement

The idea that disc derangements arise and progress has been around for a long time. It is common to find in histories of patients that the first sign of disc derangement was the appearance of sounds in jaw-ear areas during jaw function. The loudness of the noise may be reported to increase over time and to be associated with the increasing frequency of transient jaw locking. Later the transient jaw locking becomes permanent. Pain and jaw dysfunction may or may not be reported over the course of the above events.

It is possible that the disc and attachment tissues in subjects with occult derangements never pass through stages that would fulfill the criteria of normality. Evidence on this is lacking. It has also been argued that disc deformity arises by a plastic deformation induced by abnormal loading.

Scenario on the mechanism of disc displacement

In the most common malposition the disc in the jaw closed state is located relatively forward of the condyle. The cells in the extracellular matrix of the posterior band normally subjected to superiorly directed loads and accordingly respond by degrading and resynthesizing the matrix. The deposition of transverse collagen fibers may occur in a superoinferior direction thickening the posterior band and in an anterior direction encroaching into the intermediate zone region, lengthening the posterior band and shortening the intermediate zone as a recognizable structure. These changes occur over time. The thickening posterior band may at some point form an obstruction to anterior condylar movement.

The abnormal loading of the posterior band is also accompanied by anomalous loading of the posterior attachment. The abnormal loading of the posterior band is also accompanied by anomalous loading of the posterior attachment. Except for the condylar part which normally may be under compressive load when the condyle is nearing its full closed position, the remainder of the posterior attachment normally undergoes large volume fluctuations as the condyle amd the disc are moving about generating tensile stresses in its fibrillar elements. These stresses are transmitted to the attachment sites of the fibers, one of which is the posterior band of the disc. Forward malposition of the disc brings the anterior part of the posterior attachment under abnormal compressive loading. At its union with the posterior band the attachment becomes thinner infiltrated with larger-caliber collagen fibers and a cartilage-like matrix. The collagen fiber orientation is generally in line with the direction of the displacement and thus the normal orientation is generally conversed.

The condylar part of the anterior band would be excepted to come under added tensile stress as the above transformation occur. In some cases there is less elongation and the disc becomes flexed at the intermediate zone. Collagen fiber patterns on the acute side of such flexures are quite varied and no simple morphogenetic mechanism can be invoked to explain the organizations observed.

6. Conclusion

According to the investigations done in this study we can conclude that:

1) Changes in the organization and composition of the malpositioned disc and posterior attachment tissues are secondary to abnormal loading which induces cell-driven processes of degradation and reassembly of the extracellular matrix.
2) During the initial stages the posterior attachment may be converted into a disc-like structure which may render it better able to withstand abnormal loading. This conversion may not be manifest in all anomalously loaded sites and some frank pathosis is usually present.
3) Relative malposition of the condyle and disc may initiate these processes, the end result may be as much the consequences of remodeling as actual disc displacement.

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