

## The Mechanisms of Traumatic Ankylosis of Temporomandibular Joint. Experimental Animal Study on Growing Dogs

**Abdul Ilah Touleimat\***

*Professor, Department of Maxillo Facial Surgery, University of Pittsburgh Dental School, USA*

**\*Corresponding Author:** Abdul Ilah Touleimat, Professor, Department of Maxillo Facial Surgery, University of Pittsburgh Dental School, USA.

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### Abstract

Temporomandibular joint ankylosis presents a great challenge to the Maxillofacial surgeons, orthodontics, patients' family and the patient himself. Many have said about the hypothesis of mechanisms of this lesion. The aim of our study is, If possible to find the real mechanisms, that might help us in reducing or eliminating the problem through taking our precautions Dealing with a trauma that might be a leading cause to this unpleasant situation.

Our study was done using 24 young growing dogs. Trying to represent a different type of injuries to the joint element's that might have its effect on predisposing to the ankylosis.

**Keywords:** Ankylosis; Temporomandibular Joint; Trauma; Disk; Condyle; Fracture; Fixation; Children

### Introduction

A huge number of articles have been written about this subject. Going over few of such, you can find that the mechanisms of traumatic ankylosis goes also to many directions.

Here are few examples discussed below.

The temporomandibular joint (TMJ) ankylosis involves fusion of the mandibular condyle to the base of the skull. It is a debilitating condition usually effecting children and young adults. It causes problems in mastication, digestion, speech, appearance and oral hygiene [1].

Temporomandibular joint ankylosis is defined as bony or fibrous adhesion of the anatomic joint components accompanied by a limitation in opening the mouth, causing difficulties with mastication, speaking and oral hygiene as well as inadvertently influencing mandibular growth.

Minor damage to the glenoid fossa only led to fibrous ankylosis. Recently, it has been shown in rats that protein-energy malnutrition may be a predisposing factor for TMJ fibrous ankylosis [2].

For bony ankylosis, Yan., *et al.* emphasized the key role of primary severe trauma to the glenoid fossa [3].

Discectomy and injury to both articular surfaces are the prerequisites of TMJ ankylosis [4,5].

Restricted jaw movement is not the determinant factor, but rather the promoting agent for ankylosis. Prolonged immobilization of the mandible and disc displacement are prone to developing ankylosis. In addition, close contact of the 2 injured articular surfaces, which results in a shorter distance for bone healing, also plays an important role in the development of ankylosis [6,7].

According to animal models, the typical pathological feature of fibrous ankylosis is abundant fibrous connective tissue occupying the joint space with or without cartilage on the traumatic articular surfaces.

It is noteworthy that fibro-osseous ankylosis, not fibrous ankylosis, is the intermediate form of bony ankylosis according to animal studies [3,8].

The histological characteristic of fibro-osseous ankylosis, enabling distinction from fibrous ankylosis, is the presence of plenty of cartilaginous tissue in the joint space which ultimately forms the bony bridge between the condyle and the temporal bone, namely bony ankylosis [9].

The injection of blood into the joint space is different from an intra-articular haematoma caused by the impaction of the condylar head against the articular fossa. In the latter, the underlying bone marrow space of the condyle is exposed, which may deliver mesenchymal stem cells (MSCs) into the joint space for osteoblastic differentiation.

According to the literature and our careful observations, the computerized tomographic features of bony ankylosis can be summarized as follows: bony fusion is mostly located in the lateral part of the joint, whereas the atrophic condylar head and rudimentary joint space can often be seen in the medial part of the joint [10,11].

In the bony fusion area, the glenoid fossa and condyle demonstrate osteosclerosis with a decreased or absent bone marrow cavity. In the non-bony fusion area of the joint, bone mineral density and the morphology of the bone marrow cavity are similar to the normal bone [11].

Temporomandibular joint (TMJ) ankylosis is often described as either fibrous or bony, and, in traditional opinion, fibrous ankylosis can progress into bony ankylosis [12].

The most common aetiology of TMJ ankylosis is trauma, mainly condylar fracture [12,13].

Although a close relationship exists between condylar fracture and TMJ ankylosis, the pathogenesis of the disease remains ill-defined, and very few publications have investigated the issue [14].

Temporomandibular joint (TMJ) ankylosis is a disease that severely affects the human health. Although it is well known that trauma is the most common cause of TMJ ankylosis, the mechanisms by which the traumatic TMJ ankylosis develops are unclear. The existing hypothesis is not convincing in explaining the genesis of traumatic TMJ ankylosis. We make a hypothesis that the distraction osteogenesis (DO) of the lateral pterygoid muscle combining with the dislocated and damaged disc is an important factor in genesis of traumatic TMJ ankylosis. If this hypothesis is verified, it will be helpful for the prevention of traumatic TMJ ankylosis and change the principle of management of sagittal fracture of mandibular condyle (SFMC).

The reason for the occurrence of traumatic TMJ ankylosis is still a mystery, partly due to the low incidence of ankylosis after TMJ trauma and the long latent period between the cause and effect. Laskin generalized the factors related to disease, including the age of the patient, severity of trauma, pattern of condylar fracture, duration of immobilization, and location of the disc [15,16].

According to animal models, the typical pathological feature of fibrous ankylosis is abundant fibrous connective tissue occupying the joint space with or without cartilage on the traumatic articular surfaces. It is noteworthy that fibro-osseous ankylosis, not fibrous anky-

losis, is the intermediate form of bony ankylosis according to animal studies. The histological characteristic of fibro-osseous ankylosis, enabling distinction from fibrous ankylosis, is the presence of plenty of cartilaginous tissue in the joint space, which ultimately forms the bony bridge between the condyle and the temporal bone, namely bony ankylosis [17,18].

Dissectomy and injury to both articular surfaces are the prerequisites of TMJ ankylosis [19,20].

According to animal models, the typical pathological feature of fibrous ankylosis is abundant fibrous connective tissue occupying the joint space with or without cartilage on the traumatic articular surfaces. It is noteworthy that fibro-osseous ankylosis, not fibrous ankylosis, is the intermediate form of bony ankylosis according to animal studies. The histological characteristic of fibro-osseous ankylosis, enabling distinction from fibrous ankylosis, is the presence of plenty of cartilaginous tissue in the joint space, which ultimately forms the bony bridge between the condyle and the temporal bone, namely bony ankylosis [21,22].

We believe that animal studies will contribute to verification of the predisposing factors noted by clinical observations and after reviewing many other articles we decided to run a study that might put end to these confusions.

### Methodology

#### Study

24 growing dogs were used in our study. These were divided into three groups (8 of each).

Through a simple surgical procedure to reach the joint capsule. Using intraoral intubation Nembutal IV anesthesia. A vertical 10 mm long incision was made through the capsule.

1. The first group (No. 1) of 8 dogs were used to create intracapsular bleeding.
2. The second group of dogs (No. 2) used to create a fracture at the neck of the right-side condyle, using a chisel.
3. The third group of dogs (No. 3) and through the same capsule incision a traumatic wound was made close to the center of the joint disc.
4. Two stitches were used to close the capsule incision, then the main flap was closed using 000 silk.
5. Leaving the LEFT SIDE On all doge for observation and comparison.
6. All dogs left to continue their life with no special attention.
7. Half the number of each group (4) were sacrificed after 6 months, taking the joint area of both sides for microscopic study.
8. The other half were sacrificed after one year.

### Results

#### Microscopic finding

##### After 6 months

Group No. 1: Three specimens; There was no signs of any pathology and the joints of the study side were clear same as in the joints on the other side.

One specimen showed field with few bundles of fibers.

Group No. 2: The four joints showed partial resorption of the heads of all condyles with osteoclastic activities.

At the same time one joint, and at the mandibular body side showed some kind of growth and remodeling at the created fracture area.

Group No. 3: A new and irregular bony structure was growing at the top of the condyle where the disk was perforated, that was noted in three joints.

The one disk showed a good sign of repair to the area where the damage was performed.

### Results after one year

Group No. 1: All joints locks clear and normal, as it was seen on the other sides. with some of mature scar tissue on the inner side of one of the joints capsules.

Group No. 2: Three joints showed a complete resorption of the head of the condyles, with semi condyle formation at the fractured side of the mandible.

One joint showed more resorption of the head of the fractured condyle with osteoclastic activities, beside limited area of bone formation at the fractured side.

Group No. 3: Three joints showed more deposit of irregular new formed bony mass penetrating the disk were the damage was made.

One showed good signs of healing.

### Discussion

There are few point should be taken into consideration for better understanding to the problem.

1. The condyle is a center growth of the jaw.
2. The disk plays an important role guiding and controlling this growth.
3. Operating on the TMJ as a treatment for ankylosis most the time we can clearly separate the mass from the glenoid fossa to find that the disk is impacted between the normal bony fossa and the mass.
4. The disk blood supply in babies reaches its center to reseed gradually to its surrounding after the third year of age. That means its ability to withstand or repair itself is reduced with the child growing.
5. Applying a force to the mandible, especially in anteroposterior direction, will be transferred to the condyle and the disk. If this force is big enough it will either cause a fracture of the condyle at its weak point, the neck or for this force will damage the disk at almost its center.
6. Physically the condyle fracture will absorb the rest of the force, protecting the disk from being damaged.

For the condyle to lose its guidance of growth for sure ankylosis will be accompanied with mandibular deformity, since this start most the time in the early age this will has its effect also on the growth of the upper jaw. The safety of the disk staying in good health condition

is very important. Many schools advice that the jaw should be immobilized after any kind of trauma, for at least ten days, by any kind of support, considering that this will help the disk and give it chance to repair itself and so prevent the joint from being ankylosed. For young patient having a condyle fracture that reduce the possibility of getting an ankylosed joint if treated well. That will take us to the point that Immobilizing the jaw will never lead or predispose to ankylosis. Using force to have the child moves his jaw after trauma might predispose to ankylosis.

### Conclusion

For the TMJ to function normally, all its elements should be in good state of healthy normal condition and functional relation.

The disk plays the most important part regulating this relation. Any kind of abnormality or position of this disk will lead to malfunction of this joint.

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