

CASE REPORT



3D virtual planning of temporomandibular joint ankylosis using computed tomography a case report in a 4-year-old female patient

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Abstract

Ankylosis is a Greek word meaning a stiff joint. Temporomandibular joint (TMJ) ankylosis is the development of complete or incomplete limitation of movement of the TMJ by bone or fibrous tissue. The etiology and treatment of TMJ ankylosis have been well documented in the literature, with trauma and infection being the leading causes. Radiographically, ankylosis presents features that facilitate the diagnosis. However, its visualization is not precise involving conventional radiographic technique. With the evolution of radiographic techniques, computed tomography (CT) became an essential tool in the diagnosis of the ankylosis of TMJ and presented a valid reconstructed image of an ankylosis. The aim of this paper is to report a case of TMJ ankylosis in a 4-year-old girl and describe the importance tomographic images related ankylosis of TMJ by three-dimensional (3D) CT, using several slices as axial, coronal, and 3D reformatted images as a guide for presurgical treatment planning of an ankylosis.

Introduction

Temporomandibular joint (TMJ) ankylosis is a structural disease that can cause asymmetry resulting in severe facial disfigurement as well difficulties in eating, breathing, and speech when occur before facial growth is completed, ankylosis produces micrognathia, especially if the disease is bilateral.

TMJ ankylosis was classified by Kazanjian as either true or false. True ankylosis is a condition that results in osseous or fibrous adhesion between the surfaces of the TMJ, within the limits of the articular capsule. False ankylosis results from diseases not directly related to the joint. Various factors can cause TMJ ankylosis including trauma, systemic and local infections, and neoplasms in the area. A higher incidence of post-traumatic ankylosis in children was reported by Laskin.^[1,2]

Management of TMJ ankylosis is through a surgical intervention as soon as the condition is recognized. Early surgery can minimize the severity of the restriction of facial growth basic techniques for surgical correction of ankylosis include the gap arthroplasty (resection of the bony mass without interpositional material); joint reconstruction by bone grafts or joint prosthesis; or interpositional

arthroplasty (resection of the bony mass with interposition of a biological material or non-biological material).^[3-5]

Costochondral grafts are the preferred biological material for TMJ reconstruction in children because it may allow additional mandibular growth. The interpositional arthroplasty with a temporal muscle flap is indicated by several authors.

According to Laskin,^[6] the principles of treatment of TMJ ankylosis are:

- Operate as early as possible
- Keep the ramus high
- Prevent recurrence by using an interpositional material in growing patients, to replace the condylar growth center
- Maintain a post-operative program of active physiotherapy.

Case Report

A 4-year-old girl by name Priyanka [Figure 1] came to our institute with a chief complaint of difficulty in opening his mouth. Patient's mother gave a history of fall from the stairs of her house 2 years back. On further questioning, patient did not

give the history of bleeding from the ear. On examination, mouth opening was restricted and measured around 0.5 mm. Extra orally patient showed typical “bird face” appearance seen in TMJ ankylosis. Intra orally all teeth were present in the upper arch. In the lower arch, all deciduous teeth were present.

The children are known to get distracted thereby make severe movements and create an uneasy situation for the diagnostic procedures. In the present case, to position the patient for plain radiography was near to accept a challenge. Plain radiography will not sufficiently reveal any diagnostic information as it is only a two-dimensional (2D) view of the anatomy associated with the pediatric skull.

Moreover, plain radiography constitute with problems like patient position, blurred image, etc. In order to overcome this issue, the patient was advised for a computed tomography (CT) scan under the influence of a sedative drug. The CT scan showed clear images in all the three planes namely the axial, coronal, and the sagittal with the three-dimensional (3D) reconstruction. The 3D version of the CT scan [Figures 2-6] showed a unilateral left side bony ankylosis with TMJ.



Figure 1: Patient

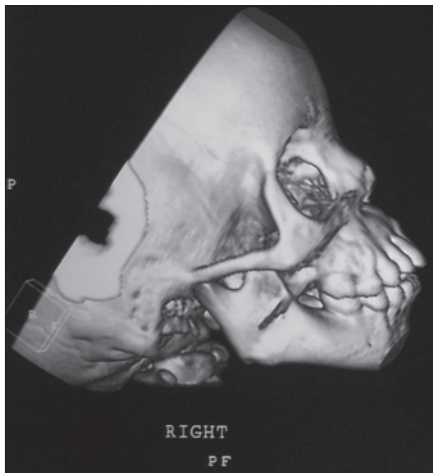


Figure 2: Three-dimensional reconstructed right sagittal view

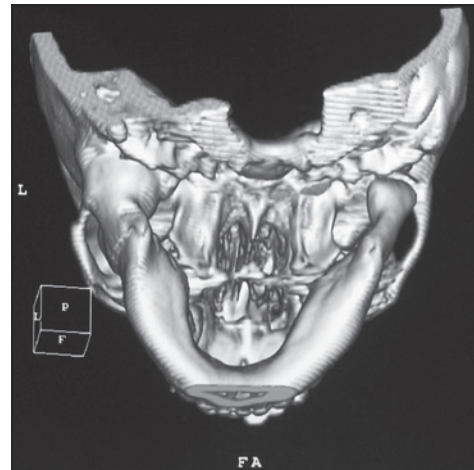


Figure 3: Three-dimensional reconstructed axial view

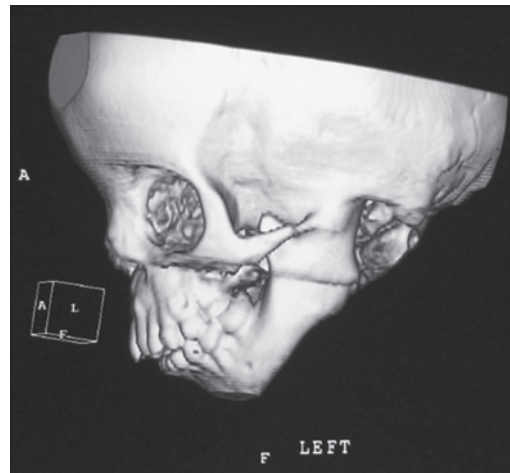


Figure 4: Three-dimensional reconstructed left sagittal view

Discussion

Diagnosis and treatment planning of any pathological conditions firstly requires sound knowledge about the difference between the normal and the abnormal structures. Second, it requires the knowledge about the anatomy pertaining to the area of the pathology that will include the skeletal anatomy, the nerves, and the blood vessels. The vital structures surrounding the pathology have to be taken care with much interest as to avoid any emergency while exploring the pathology. The plain radiography is a readily available tool for diagnostic radiology and is very useful for the diagnosis of many orofacial pathological conditions related to the bone and teeth. The main disadvantages of the plain radiography are the overlapping of the anatomical structures, magnification of the images and lastly, the messy processing of the radiographs in the darkroom. Over the period of the time, the diagnostic radiology has improvised on the quality and the technology with the advent of digital imaging. 3D CT scan is one among the fastest growing technologies in the field of medical diagnostic radiology. 3D CT provides a 3D view



Figure 5: Contrast-enhanced axial view

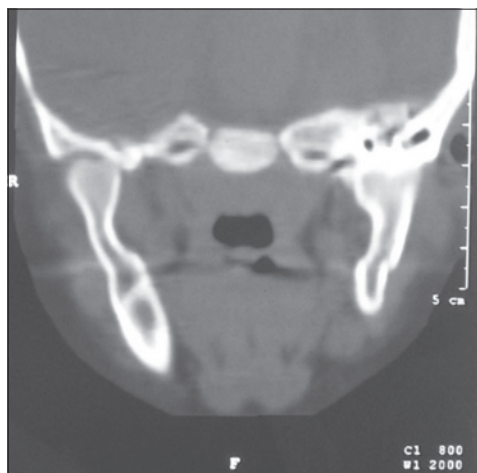


Figure 6: Plain computed tomography axial view

mainly in the coronal, sagittal, and axial planes with the help of the softwares which are specifically designed for the 3D CT. The accuracy with 3D CT enables the surgeon to plan the treatment with a presurgical assisted planning with the oral radiologist. The softwares like i-CAD and dolphin provide an option for virtual treatment planning via 3D reconstructed images.^[7,8]

The unilateral cases of ankylosis show clinical evidence of the hypoplastic mandibular body and the ramus. The 3D CT also confirms clearly the prominent mandibular angle and extinction of the antegonial notch along with reduced vertical height of the ramus. In long standing cases of ankylosis, the axial or coronal CT views did not show any apparent elongation of the coronoid process. The elongated coronoid process is generally discovered on the surgical access for ankylosis and thus, the mouth opening will be achieved by coronoidectomy. In the bilateral cases of TMJ ankylosis, there will be a lack of growth with the mandible resulting in severe micrognathia and an extraoral bird face appearance. The panoramic imaging also gives a 2D information regarding the ankylosis with mesial and distal extensions.

The panoramic image shows complete or partial obliteration of the joint space but fail to provide the actual extent of the pathology. Panoramic images fails to differentiate between bony and fibrous ankylosis and also the surrounding vital structures as compared to the 3D CT scan. Thus, the panoramic imaging can be used as a screening aid rather than a diagnostic tool for TMJ ankylosis. The diagnostic accuracy with the 3D CT scan for the TMJ ankylosis depends mainly on the coronal and axial views. The coronal CT view provides an accurate measure of the bony mass and helps the radiologist to differentiate between bony and fibrous ankylosis. The post contrast CT helps the radiologist to differentiate between the vital structures, especially the blood vessels surrounding the ankylosis.

Axial CT was of great value in illustrating the relation of the important structures especially the blood vessels situated below the skull close to or within the ankylotic mass. In some cases, the lateral pterygoid plate appeared elongated and fused to the ankylotic bony mass. It was not possible to restore mouth opening after condylectomy without releasing the fusion between the lateral pterygoid plate and the mandible. In cases of recurrence, coronal CT revealed that the cause could be attributed to the inadequate resection of the ankylosed segment, with an insufficient gap between the two bone ends.^[8]

The inability of the plain and panoramic radiography to provide additional to the extent of the ankylosis. This was proven by Sanders *et al*, as he stated the conventional plain radiography possess inadequate information regarding the extent of the ankylosis as noted clinically at the time of surgery. The views expressed by helms *et al*. suggests CT is a valuable diagnostic tool for evaluation of TMJ ankylosis.^[9,10]

A suggested new classification which is based on post contrast axial and coronal CT. We propose that ankylosed joints can be grouped according to the relation of the ankylosed bone mass to the important structures present below the skull near to its base as follows:^[11,12]

- Class I: Indicates a fibrous ankylosis involving either one or both the sides of TMJ. The glenoid fossa and the condyle sustain their original shape, and the maxillary artery retains its normal anatomical position to the ankylosed mass.
- Class II: The condyle and the temporal bone may show a bony ankylosis may be a unilateral or bilateral. The maxillary artery retains its normal anatomical position to the ankylosed mass.
- Class III: The distance will be slightly reduced on the ankylosed than compared to the normal side i.e. between the maxillary artery and the medial pole of the condyle. Thus, the maxillary runs within the bony ankylosed mass which is best seen on coronal CT.
- Class IV: The bony ankylosed mass lies fused to the base of the skull with extensive bone formation especially from the medial side of the condyle. The ankylosed mass of bone will be in close relationship with the important structures such as the pterygoid plates, the carotid, jugular foramen, and foramen spinosum at the base of the skull. These structures are seen more clearly with axial CT.

This new classification gives the surgeon the opportunity for controlled surgical planning and achieve better surgical results with minimum operative complications. The distance between the internal carotid, internal jugular vein, maxillary artery, and the medial side of mandibular condyle was less or decreased at the ankylosed side than compared to the normal side as stated by Metwalli. Hence, any surgical exploration over the ankylosed side requires a skilled hand and controlled technique to preserve these above mentioned vital structures. Thus, the coronal and axial CT are essential in identifying the relationship of these vital structures.^[13]

Conclusion

CT stands as an important diagnostic tool for any bone lesion associated with the head and neck region. Since 1972, the CT has seen several generations during its progression and currently is one among the most popular diagnostic tool in the field of medical radiology. The CT also enhances the image quality with the use of 3D softwares like i-CAT, dolphin, and Kodak imaging software systems and allows the image to be viewed in 360°. The CT is widely used in the field of dentistry with its new variant popularly known as the cone beam CT. The cone beam CT is an upgraded smaller version of CT specifically designed to image the head and neck region for presurgical planning of surgical pathologies and guides the surgeon for placement of dental implants. It is widely used in the field of dental radiology than compared to conventional CT.

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