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TREATMENT FOR ADULT MAXILLOFACIAL SURGERY (MANDIBULAR CONDYLAR PROCESS FRACTURES): SYSTEMATIC ANALYSIS OF CLINICAL TRIALS

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Abstract

The jawbone is the long bone that covers the chin and the corners of the face to the ears on both sides of your face. The ends of the jawbones (vertebrae), on either side of the face, are rounded into a ball that forms the part of the jaw joint that is just in front of your ears. Jaw fractures are the third most common facial fractures after nose and cheek fractures. Maxillofacial surgery fellowships are one of the ten specialties in dentistry. This specialty includes the diagnosis and treatment of diseases, injuries and defects related to both functional and aesthetic aspects, including hard and soft tissue in the head and neck. The scope of this expertise is very wide. The scope of this expertise is from tooth extraction to the treatment of complex facial fractures. This type of surgery is performed both in private hospitals and in public maxillofacial surgery hospitals. Oral and maxillofacial surgery specialists are able to perform surgery and correct the injury site according to the type of trauma caused to the face, mouth, or jaw. In this surgery, incisions are made by the surgeon in the jaw bones, and after placing them in the correct position, it does not leave any marks or scars.

Keywords: Maxillofacial Surgery, Mandibular Condylar Process Fractures, Treatment of Diseases, Jaw Bones.

INTRODUCTION

In more than 50% of cases, a jaw fracture occurs in at least two parts, a direct fracture where the jaw is impacted and an indirect fracture that occurs elsewhere along the jaw. In most cases, this second fracture occurs near one of the ends of the jaw, near the jaw joint. The best age for maxillofacial surgery is when the jaw bone is fully developed. For this reason, after puberty, i.e., at the age of 18 to 25 years, it is the best time for jaw and face surgery. Because the growth of the jaw is complete at this age and stops after that, but in some cases where the patient's jaw has a serious and acute problem, the maxillofacial surgeon does not consider the age of the applicant and focuses on improving the problem of his condition.

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Jaw Fracture in Children and Adolescents

Fracture of jaw bones is the most common type of jaw fracture in children. This fracture usually occurs when a child falls and their chin hits the floor or other hard surface. Jaw fractures in teenagers occur mostly on the side of the face and in a part closer to the chin because this area is often hit during fights and attacks.

RESULTS AND BENEFITS OF MAXILLOFACIAL SURGERY

Correcting the alignment of your jaw and teeth through maxillofacial surgery has amazing effects on your life and appearance. Some of the benefits of maxillofacial surgery include:

- ✓ Improving the appearance and balancing the face after jaw correction.
- ✓ Improving the function of teeth and jaw.
- ✓ Improve breathing.
- ✓ Improvement of speech and speech disorders.
- ✓ Improve sleep.
- ✓ Improving the condition of swallowing and chewing food.
- ✓ Increasing self-confidence, beautifying the face.

Search Strategy and Selection of Articles

Search in Scopus, Google scholar, PubMed databases and by searching with keywords such as "Nursing Services"," Medical Services", " Diabetes" and “High Blood Pressure” to obtain articles related to the selected keywords [15-17]. Case report articles, editorials, and articles that were not published or only an introduction of them were available, as well as summaries of congresses and meetings that were in languages other than English, were ignored. Only the original research articles that evaluated the effectiveness of different drugs in the treatment of COVID-19 using standard methods were studied (figure 1) [1].

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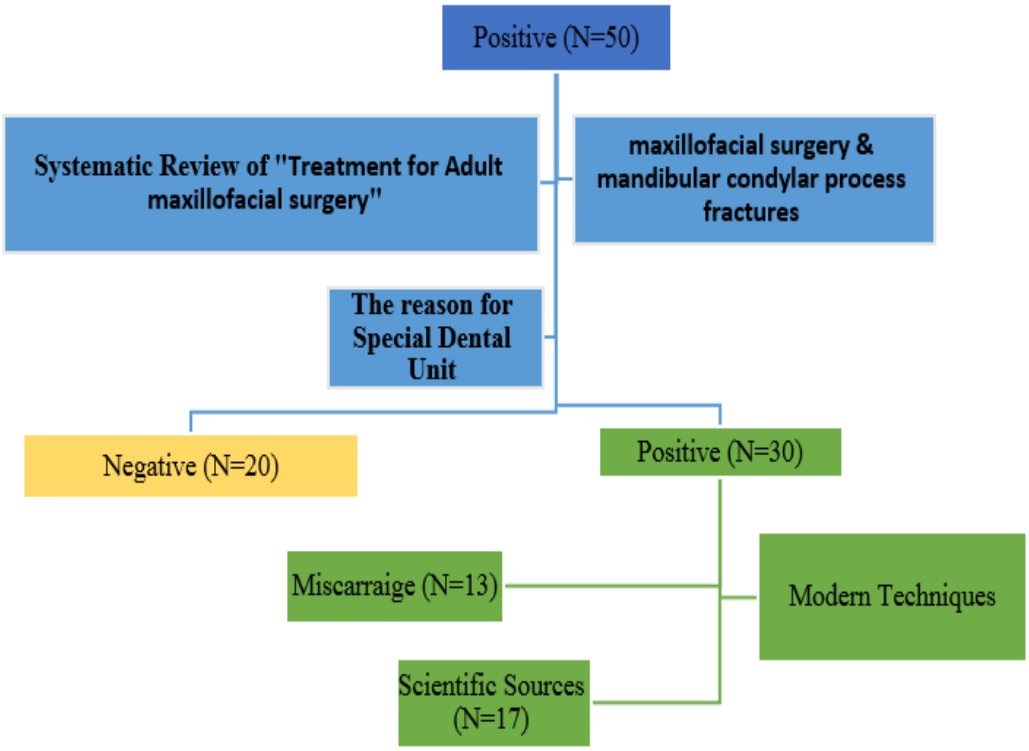

Figure 1: Flow Chart of Included Subjects

Procedures Before and After Orthognathic Surgery

Usually, the patient is treated by an orthodontist before the surgery so that the teeth get the ideal shape and position for the surgery, and then the jaw and face surgery is performed. Before preparing for maxillofacial surgery, the patient must undergo a period of 9 to 14 months of dental orthodontics.

Besides, after the surgery, the patient again needs an orthodontic course, the duration of which is different for each person. After jaw surgery, the patient is hospitalized for one to three days, and one of the most important measures after surgery is jaw movement control. Because there is a possibility that the jaw will return to its previous state and you must take the necessary precautions to prevent this issue. Orthodontic devices are used to take care of jaw control after the operation, and these devices are removed from the patient's mouth nine months later, and replaced with removable plates.

The patient should take the prescribed medicines regularly and on time, avoid brushing the teeth in the newly operated areas. Avoid heavy physical activities and avoid eating foods that are too white and harmful to the mouth and teeth. It is better to have a light diet after surgery to avoid possible risks (Figure 2).

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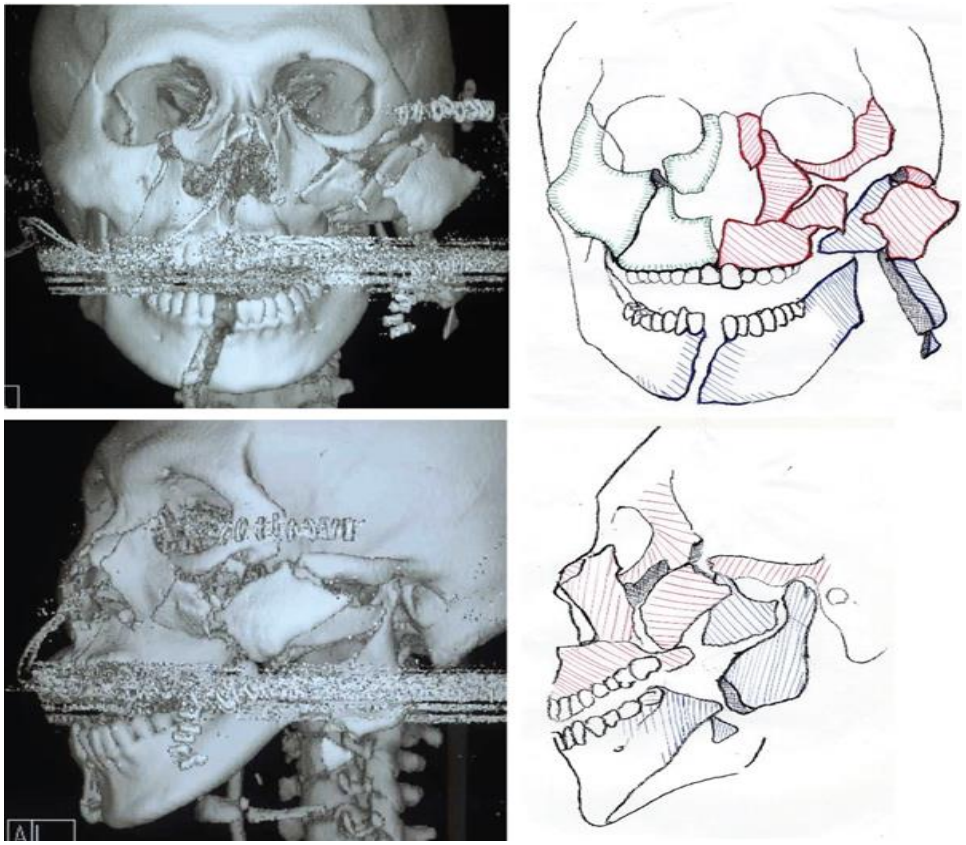

Figure 2: A Multidisciplinary Approach to Malocclusion Caused by Facial Multiple Fracture

Temporomandibular Joint Surgery

In situations where other, more conservative treatment methods are not effective, your doctor may recommend surgery, which can include joint replacement surgery, to reduce the pain of temporomandibular joint disorders.

In what case do we need jaw surgery?

Jaw and teeth disorders may have genetic, congenital or developmental causes. Therefore, they are with a person since birth or during growth. In addition, jaw joint injuries and tumor growth can cause jaw and tooth deformities at any age.

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Some of the reasons why a person with jaw and teeth abnormalities need jaw surgery are:

- ✓ Mouth ulcers.
- ✓ Respiratory problems.
- ✓ Facial asymmetry.
- ✓ Disorders of the jaw joints.
- ✓ Abnormal growth of both jaws.
- ✓ Jaw joint damage due to impact.
- ✓ Not placing the teeth on each other.
- ✓ Inability to eat and chew properly.
- ✓ Common structural abnormalities of the jaw and teeth.
- ✓ Dental implants and removal of bone lesions.
- ✓ Removal of damaged and irretrievable teeth.
- ✓ The presence of infection in the oral cavity, salivary glands, jaw and neck.
- ✓ Birth defect.
- ✓ Reconstruction after tumor treatment in the face, jaw, mouth and neck.

At What Age, is Jaw Surgery Appropriate?

The right age for jaw surgery is 18 to 25 years old. Because the growth of the jaw at this age has reached its final stage and stops. Changing the face through jaw surgery should be done at the same age when the person has passed his bone maturity, but if the patient's jaw has an acute problem, the jaw surgeon focuses on improving the problem in the jaw and the age of the applicant It is not an important issue.

Advantages of Jaw Surgery

Jaw surgery is definitely performed for necessary treatment, after which there are many advantages for the patient:

- ✓ Jaw surgery gives a pleasant beauty to the face and increases a person's self-confidence.
- ✓ It makes eating easier.
- ✓ Jaw surgery reduces tooth wear.
- ✓ Improves oral function.
- ✓ Jaw abnormalities can also cause problems in breathing, which jaw surgery leads to improved breathing.
- ✓ It makes oral and dental hygiene easier and thus reduces the occurrence of gum diseases and tooth decay.

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The cost of jaw surgery depends on many factors. In fact, several factors such as the location of the surgery, the skill of the surgeon, the severity of the jaw disorders, the cost of anesthesia and prescribed drugs, determine the final cost for the patient. In addition, the reason for the surgery, which can be done for medical or cosmetic reasons, affects the patient's insurance coverage. Note, if you want to know more about the cost of jaw surgery, you must visit a doctor to be examined. The doctor can give you detailed information after examining and checking your condition.

Length of Jaw Surgery Treatment

The surgery time takes between 1 and several hours, which is determined by considering the amount and type of abnormality and the patient's condition. After the surgery, the patient is admitted to the hospital for two days and his condition is checked thoroughly and frequently during these two days. After discharge from the hospital, it is necessary for the patient to rest at home and follow the instructions correctly until the recovery period is over. The possibility of bleeding is normal for about two weeks after the operation, and the pain and swelling will be there for about a week, which will decrease with the use of painkillers. After a week of surgery, the patient went to his surgeon's office to have his conditions checked. For about two months after the surgery, the patient should eat only soft foods, and after that, he can include foods such as salad or ground foods in his diet. If the patient follows the care process correctly, after about 4 months, a complete recovery is achieved and after 6 to 12 months, the patient should return for the second period of orthodontic treatment.

TYPES OF JAW SURGERY

The major surgeries performed on the jaw include:

A) Open bite correction: To correct the deformity related to the jaw, first by making an incision on the jaw, a part of the upper bone that is placed on the tooth is removed. Then it is fixed in place with screws and plates. There are different types of open bite modifications, which include:

1) **Correction of jaw protrusion:** If the lower jaw is protruding, the bone located at the back of the jaw is separated from the front area and corrected, which is called lower jaw surgery. In this surgery, the part of the jaw where the tooth is placed is moved back. With this method, the position of the jaw is changed and completely aligned with the upper jaw.
2) **Correction of jaw recession:** the bone located in the lower part of the jaw is separated from the base and corrected. Then a part of the lower jaw on which the tooth is placed and a part of the chin is moved forward.
3) **Upper jaw osteotomy:** This surgery is performed by making an incision in the upper jaw gum. The jaw is then broken in a controlled manner and moved to a new location determined by dental models before surgery. Then, a small plastic piece is attached to the teeth to determine the new position of the upper jaw, which is then secured in place with small metal plates and screws. These plates and screws are made of titanium, which is a very ineffective

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metal and its use in the body is safe. Finally, the gum is sutured using absorbable sutures.

4) **Mandibular osteotomy:** This surgery, like the upper jaw osteotomy, is performed through an incision at the end of the mouth in the gum adjacent to the large molars, and with the help of access, the lower jaw is cut diagonally and broken in a controlled manner to Move the new location determined by dental models before surgery. A small plastic piece is then attached to the teeth to determine the new position of the lower jaw, which is then secured in place with small metal plates and screws. Finally, the gum is sutured using absorbable sutures.
5) **Genioplasty:** Genioplasty is a minimally invasive surgery designed to correct chin receding and achieve a desirable and beautiful facial structure. The genioplasty method involves making an incision through the chin bone, and by releasing the problematic bone, the surgeon can change this area to the desired position. A small titanium plate is used to secure the chin in its new position on the jawbone. Small screws are used to permanently hold the plate in place. This simple method can dramatically improve the balance, proportion and harmony of the facial components.
6) **Upper jaw height surgery:** In other cases where a person has a gummy smile, the height of the upper jaw is too high, which reduces the appearance of the gums by reducing the upper jaw, removing extra bone and fixing it in the desired location. It will be a smile (Figure 3).

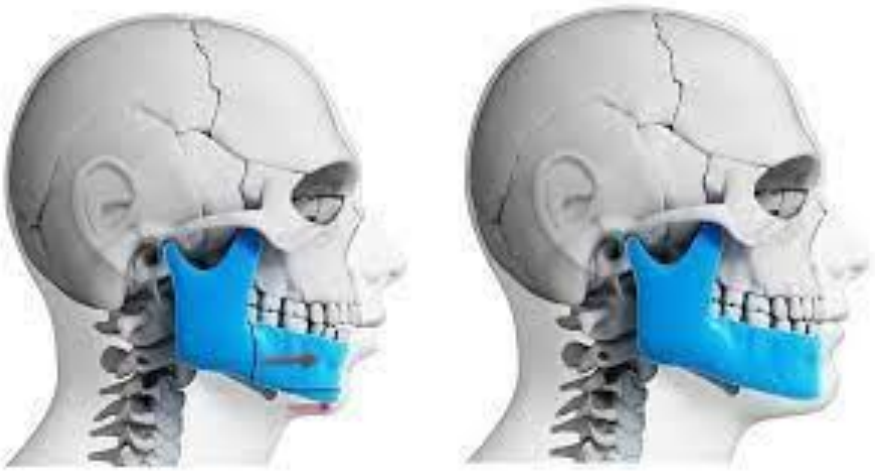

Figure 3: Orthognathic Surgery

In general, jaw surgery is a long and complicated operation, and the surgeon must have full knowledge and experience in jaw, mouth and teeth correction. The surgeon must carefully check the function of the mouth and teeth so that it is correct. If these things are not paid attention to, the patient will face problems in the functioning of his mouth and teeth after the operation. In general, the process of jaw surgery starts with a consultation and a visit where the dentist performs the initial steps to perform the operation. After preparing the required

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radiology photos and scans, the surgeon determines the operation strategy. Although jaw surgery is difficult and the recovery period is not so difficult, it is worth going through this period.

In general, an experienced and skilled jaw surgeon examines all the complexities of the jaw and face structure well and then performs jaw surgery. So, the lack of skill of the jaw surgeon is the most important cause of complications. However, we will explain some of the problems and complications of jaw surgery in the following article.

1) **Bleeding:** Minor bleeding after jaw surgery is normal and you may experience nosebleeds one to two weeks after jaw surgery. Bleeding into the soft tissue leads to bruising and can be very extensive. In the early stages, the bruise covers the jaw, but if it spreads, it will also cover the lower neck and upper chest. Abnormal bleeding is when a blood transfusion is needed during surgery. However, sometimes the patient may need a blood transfusion. Some patients donate their blood before surgery and use it if needed during surgery.
2) **Infection:** There is a possibility of infection in all surgeries. For this reason, both during and after the surgery, you will be given antibiotics so that if an infection develops, it can be easily treated.
3) **Numbness:** After jaw surgery, you will experience numbness in the areas around the jaw. If the upper jaw has been operated, the top of the teeth will be numb, and if the lower jaw has been operated, the lower lip and chin will be numb, and you will experience a tingling sensation as the nerve fibers are healing. Feeling normal will usually return in 6 months or less.
4) **Nasal congestion:** Nasal congestion can be caused by the tubes placed inside the nostrils during surgery, or it can happen after upper jaw surgery. When the nose gets blocked, this problem can be solved by using special nasal cleaning sprays. Cotton soaked in warm water can also be useful for removing nasal secretions. Nasal congestion will usually continue for one to two weeks after the surgery and then it will go away.
5) **Weight loss:** At the beginning of the post-surgery period, weight loss of up to 2.5 kilos is expected. In most cases, weight loss is due to loss of appetite, which is related to wearing elastics. After the first week, your appetite should improve enough to compensate for the weight loss.
6) **Jaw stiffness and the sound of the jaw joints:** After orthognathic surgery, the jaw joints will be stiff for several months. The best exercise to overcome joint stiffness is normal jaw activities such as chewing. Sometimes, there may be a grinding noise in the joints when the jaw begins to move. These sounds may be permanent, but do not affect the use of the jaw.
7) **Swelling:** Swelling is one of the prominent characteristics of the recovery period after jaw surgery. Putting ice on the face for the first 48 hours is effective in reducing swelling. After that, external heat in the form of heating pads or warm compresses helps to reduce the swelling.

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Necessary Care after Jaw Surgery

- ✓ It is recommended that the patient take absolute rest after jaw surgery.
- ✓ Avoid eating hard and chewy foods.
- ✓ After 6 to 8 weeks, you can eat normal foods.
- ✓ Smoking is prohibited.
- ✓ Avoid doing any heavy activities.
- ✓ Take the medicines prescribed by the doctor on time.
- ✓ Use a cold compress to reduce swelling.
- ✓ Use salt and water solution for washing and disinfection.
- ✓ Avoid brushing your teeth for a day.

Frequently Asked Questions

1) **How much time does jaw surgery require?** Normally, jaw surgery time is about 1-2 hours, which may be longer depending on the condition of each patient. If both jaws are operated, the operation takes about 6 hours.
2) **How much is the pain of jaw surgery?** After jaw surgery, there are limitations in speaking or eating normally for the patient. Also, there will be pain and swelling for about 1-2 weeks, which will be resolved over time by taking painkillers and following the doctor's recommendations.
3) **Who performs jaw surgery?** If the patient needs jaw surgery, a specialist dentist or dental surgeon will refer the patient to a maxillofacial surgeon who specializes in moving jaw bones.
4) **How long after jaw surgery can the patient engage in sports activities?** After jaw surgery, the patient should rest for a few days and limit heavy activities (Figure 4). After about 10 days, he can follow his normal activities, but heavy activities should be avoided for several months.

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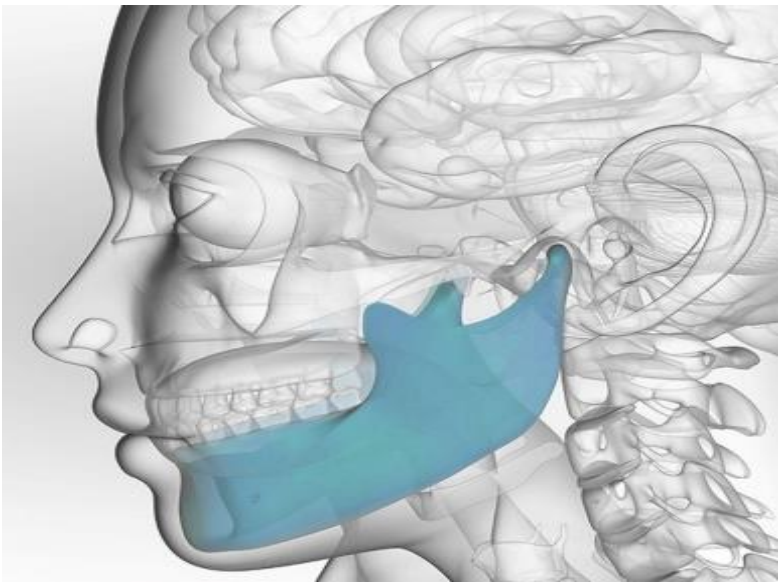

Figure 4: Jaw Surgery (Orthognathic)

Preservation and promotion of human health as the axis of sustainable development has long been considered by scientists in various fields of science. Acquiring knowledge and acquiring skills in the field of using different tools to serve mankind, especially for early diagnosis of diseases and their timely treatment, is and is the daily concern of medical scientists. The production and progress of science and technology has not only provided huge changes in this direction, but has also significantly increased the human desire to use technology.

It is necessary to know how to establish and function the body's organs in normal conditions and their changes due to illness in order to understand and justify the occurrence of signs and symptoms. Although anatomy or the knowledge of internal organs and systems through direct contact and cutting the human body provides comprehensive information to doctors and medical scholars, it is limited to the exclusive use of this method to know the physical and functional state of the tissue. Not only is it not always possible, but it can also cause considerable damage to humans. Using previous experiences on corpses and generalizing individual findings is also not possible due to the considerable differences in the anatomy of the human body.

Therefore, the use of tools and technology to obtain accurate information from the inside of humans has been one of the never-ending ideals of medical scholars. Throughout history, the idealism of medical scholars in obtaining more complete information from the inside of the human body has led them to create, develop and use technology. In 1895, the German scientist Konrad Rongten discovered the existence of X-rays for the first time and accidentally discovered the unique capabilities of this ray in imaging the internal organs of the body, especially bones.

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In this way, a new beginning was made in the field of medical imaging. Although conventional radiology has helped medicine a lot and even today it is used in many cases, but the following weaknesses made its transformation and progress inevitable:

- ✓ High and uncontrolled dose of X-rays that are harmful to the body (Figure 5).
- ✓ Adapting the three-dimensional volume of the body on a two-dimensional image makes the organs overlap in the image and lowers the accuracy of the doctor's diagnosis.
- ✓ The low contrast of the image is due to the diffusion of the radiation source and the lack of completely parallel rays.

Figure 5: Application of Multidisciplinary Team (MDT) in the Treatment of Severe Maxillofacial Trauma: a Retrospective

Artifacts in CT

After the invention of CT, image reconstruction with FBP method was introduced for physical applications. To date, FBP remains the most widely used image reconstruction method in CT. This method is called a so-called conversion method. Because it is based on the assumption that the measurements, the Radon transform of the linear attenuation coefficient distribution and the analytical inverse of the Radon transform are a direct solution for image reconstruction.

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If this algorithm is applied to ideal projections, that is, to an unlimited number of measurements with unlimited narrow beams and no noise. Then this solution is ideal, but in practice it is not like this. Because first, the measurements are read with a limited number of detectors in a limited rotation interval and using limited wide beams. Second, the x-ray tube emits a continuous spectrum resulting from beam hardening. Third, the measurements are noisy and include scattered radiation. There are many other differences between the actual measurements and the Radon transformation, all of which cause artifacts in the reconstructed images, but usually the errors caused by these approximations are relatively small and the FBP results are satisfactory. In addition, artifacts can be reduced by applying corrections before or after applying FBP.

Hardening of the Rays

In the image reconstruction process, it is assumed that monochromatic X-rays are used, but in practice, the X-rays used have a wide energy spectrum. Therefore, when a group of rays is irradiated to objects, those rays that have a higher attenuation coefficient, that is, a low energy spectrum, are removed from the group of rays sooner. Therefore, the average energy of the beam increases and its penetration ability increases. Generally, those rays whose energy spectrum is in the range where they are weakened more easily are called soft X-rays and those that penetrate more into objects are called hard X-rays. Therefore, the phenomenon of beam hardening can be seen as the loss of soft X-rays from a group of X-rays with a wide energy spectrum, the rest of which will be hard rays. The amount of hardening of the rays depends on the extent of the range of their energy spectrum as well as the composition of the material that passes through it. As a result, the rays passing through denser materials such as metals will make them harder. Therefore, the amount of attenuation of these rays decreases and when they reach the receiver, they will be more intense than expected, which will appear as bright lines in the image.

Lack of Photons

When X-rays pass through metallic areas, they will be greatly attenuated and not enough photons will reach the receivers. The result will be creating an image with a lot of noise at certain angles. If at these angles, the current passing through the generator tube is increased in order to increase the intensity of these rays, the problem of this distortion will be solved, but the disadvantage of this will be that the patient will receive more X-rays in scanning other angles (Figure 6).

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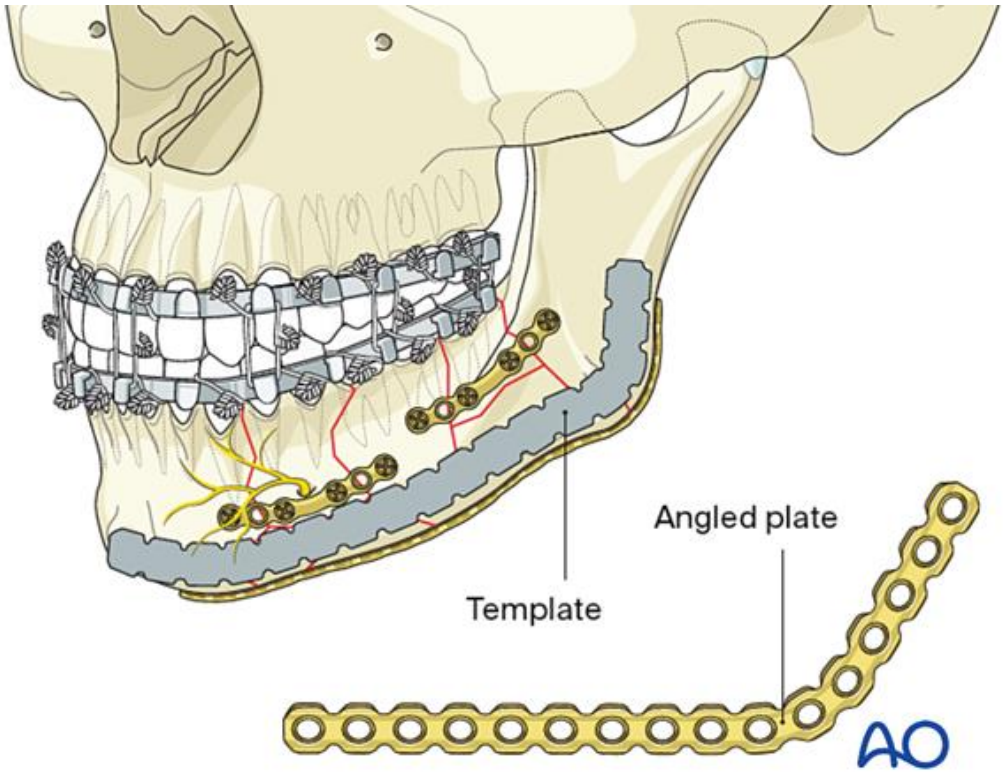

Figure 6: Load Bearing Plate with or without Simplification for Body

Dispersion

Many X-ray photons that penetrate an object are subjected to Compton scattering. In this type of scattering, a radiation photon with relatively high energy hits a free electron from the outer layer of the atom and removes it from its orbit. The said photon is deflected and moves in a new direction as a scattered ray. Almost all scattering comes from this collision. The probability of a Compton collision is influenced by the energy of the beam and the density of the absorbing material.

It is obvious that these photons are useless for image reconstruction and care should be taken not to use them in reconstruction.

Relative volume effect

The distortion caused by this effect occurs when a high-density object is incompletely placed in a section and the rest of it is not located in that section. As a result, when this object is placed in the path of the ray, its density is displayed lower than the real limit. If only one object is partially placed in the section, the measurement error is the same in all sections, but if two or more objects with high density are partially placed, then the measurement error is non-linear and in the form of radii that they pass through these objects and it is displayed in the image. This non-uniform information creates a linear artifact.

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History of CT scan

Obtaining the dimensions, size and shape of a three-dimensional object using several two-dimensional images of that object was considered one of the mathematical and geometric problems in the 19th century. Until 1917, an Austrian scientist named Radon was able to formulate and solve this problem.

These formulas were used 50 years later in the reconstruction of the first CT images. In 1940, a new idea from a scientist named Gabriel Frank became the basis of the main idea of today's CT scans, but until then, the ability to record the signal extensively and perform processing on it did not exist. Until 1963, a scientist named Cormark in South Africa and Hansfield in England simultaneously worked on the computer reconstruction of images from different projections, and finally the first generation of today's CT scans by Hansfield and his colleagues at the EMI Research Institute. England was built in 1967.

1- **X-ray lamp:** It is one of the most important parts of a CT scan machine and its task is to produce and control X-rays and send them to the imaging area. This lamp usually consists of an anode and a cathode which is placed in a vacuum chamber. A strong potential difference of about 20 to 150 kV causes the electron to be pulled from the cathode and accelerate it and finally collide with the anode. This collision causes X-rays to be emitted from the anode and pass through several filters to exit the glass chamber in a parallel beam with standard intensity.

2- **X-ray detectors:** It is a part of the CT scan machine that is responsible for converting the X-rays emitted from the body into an electrical signal. The detectors used up to the third generation of CT scans were xenon gas detectors, and in the fourth generation onwards, solid state detectors were used. Xenon gas detectors consist of two separate and parallel conductive metal plates filled with xenon gas. X-ray passing through xenon gas creates a potential difference on its two side plates, and this potential difference is measured and recorded. Solid state detectors consist of two parts: scintillator and photodetector. The scintillator is a solid compound that emits visible light due to X-ray radiation, and then this visible light is converted into an electrical signal by a photodetector.

3- **Data collection unit (DAS):** analog signals produced in detectors are converted into digital signals in this unit and recorded and stored.

4- **High voltage generation unit:** In this unit, a very strong electric voltage pulse, 20 kV to 150 kV, with a suitable duty cycle is used to feed the X-ray lamp.

5- **Patient bed:** It is a mobile bed on which the patient lies and moves forward or backward to take images of different cross-sections of the body. This movement is mostly discrete and with a specific step, except for spiral generations, which is done continuously and at a constant speed.

6- **Image reconstruction and production unit:** This unit is a very powerful supercomputer that is responsible for processing the information collected in DAS and producing the final image.

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7- **Display console and user interface:** the device communicates with the operator from this unit and includes a keyboard and mouse to enter information and a monitor to display it.

8- **The central controller computer:** it is responsible for coordinating and applying the settings of all other parts of the device (Figure 7).

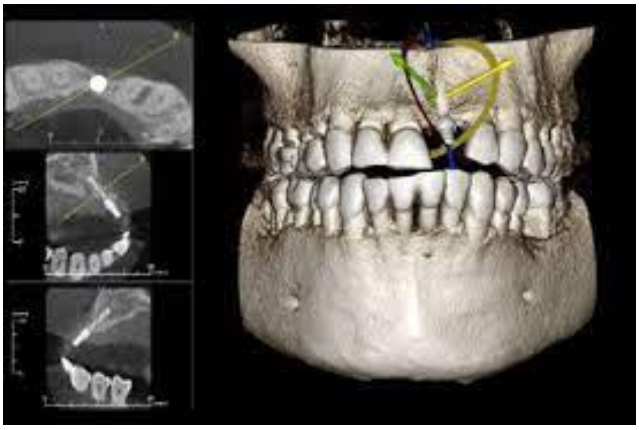

Figure 7: Dental CT Scans

Different Generations of CT scan Machines until Today

Over the past 40 years, with the advancement of hardware and software science, we have witnessed a significant transformation and increase in the capabilities of CT scan devices. So that today's CT scans are not comparable to the early generations in terms of processing speed and resolution of images and accessories.

1) **The first generation:** As it was said, the first generation of CT scan devices was made at the EMI Research Institute in England in 1971 and uses a radiation source and a detector. Therefore, to cover a cross-section of the body, the radiation source and the detector must move simultaneously, so that they are always facing each other. Therefore, in this generation, a linear movement and a rotational movement were considered, so that the source and the detector first sweep the section with discrete linear movement. Then the frame containing the source receiver and the detector, the gantry, is rotated one degree and the linear movement is repeated again, and this work continues until 360 degrees are covered. It should be noted that the linear movement is discrete and at each stop, the source emits only one beam of light and after passing through the body, the detector absorbs it. Then the source is turned off until the next stop. The shortcomings of the first-generation CT scans can be summarized as follows:

   - ✓ Existence of mechanical limitations and energy supply due to two rotary and linear movements.
   - ✓ Long data recording time due to the use of one beam at a time and two types of mechanical movement.

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- ✓ The presence of artifacts caused by the movement of the patient during imaging due to the longtime of data recording.
- ✓ The longtime of information processing and the low resolution of the final image due to the weakness of the hardware and software of that time.

2) **2- The second generation:** In this generation, there were two linear and rotational movements, but due to the simultaneous use of several fan-shaped beam beams and the same number of detectors, the time of recording information was greatly reduced.

3) **The third generation:** Although the second generation was able to reduce the scanning time relatively, the need for higher speeds was still felt. Especially in the imaging of the heart, much less time was required to stabilize the image than the time of a complete beat. In this way, the third generation of CT scans were introduced and soon became the most widely used generation of these devices, so that they are still used in many medical centers. The main innovation in this generation compared to the second generation was the use of arc-shaped detector array and fan-shaped beam handle and the complete elimination of linear movement, which caused a significant increase in speed, two seconds for each scan.

4) **The fourth generation:** in this generation, in addition to the features of the third generation, a major change took place, and that was the completion of the arc of the detector array in the shape of a circle. Therefore, there is no need to move the entire gantry anymore, and it is only enough that the source of radiation, the X-ray lamp, has a continuous rotational movement. Since the detectors were generally heavy, this significantly reduced energy consumption and mechanical limitations, as well as increased speed. In addition, due to the stability of the detectors during the scan and the continuous movement of the radiant source, the image resolution actually depends on the data sampling rate behind the detectors, the data collection unit, and is independent of the size of the detectors and the movement step in previous generations. and this is considered a good thing. Despite all these advantages, due to the expensive detectors and financial considerations, the production of this generation was stopped very soon.

5) **The fifth generation:** The third and fourth generations, in the best case, were able to achieve the necessary speed to image the heart, but since the heart valves move very fast, higher speeds are still needed to image the heart valves. This need was answered by the next generations of CT scans, including EBCT.

In this generation, all mechanical movements are removed and only the X-ray moves. Here, the X-ray lamp is expanded, so that the electron gun (cathode) is outside the gantry and the tungsten alloy (anode) is located in a 180-degree arc inside the gantry. After the electron gun produces the beam, a coil is responsible for focusing it. The output beam is then deflected by another set of coils, so that it hits the tungsten arc. All this process is done in a bubble of vacuum so far.

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The X-rays produced by the anode are directed to the body after being filtered and perceived by the detectors on the other side. In this generation, due to the complete elimination of mechanical movement and hardware progress in the data collection unit, the time of a scan has been reduced to 20 milliseconds. Considering the role of CT scan in the diagnosis of diseases and the importance of improving the resulting images, efforts and studies to reduce the impact of various distortions, including distortions caused by the presence of metallic tissues in the body, have long been considered.

The most basic and simplest proposal to reduce metal artifacts was proposed by Ibrahim in 1990, who instead of using metal prostheses in orthopedics used another kind, but this proposal is for cases where the distortion is caused by an object other than the prosthesis. In 1987 Mr. Callender et al presented a technique to reduce distortions caused by metal implants in CT scans.

In this technique, first an initial image is formed from the main distorted sinogram. Then, an operator draws the approximate border of the implant with a light pen according to high intensity values. After that, this boundary is automatically defined in the sinogram matrix. Considering that these areas in the sinogram cause distortion in the image, they are removed from the sinogram or replaced with new data. The success rate of this method depends on the complexity of the skeleton of the body. Because when the implant and other structures with high contrast are placed on top of each other, inhomogeneity is created in the image.

In 2003, Liu and his colleagues proposed a method in which the areas related to metal textures are separated from the rest of the areas in the sinogram and the image of these two areas is formed separately. After forming the images related to each of the sinograms, these two images are combined with each other to form the final image. To determine the points related to the metal texture in the sinogram, first approximately the points whose values can be related to the values of the metal texture are determined based on a threshold limit.

Then, by using the sinusoidal properties of the curves related to the metal texture in the sinogram, the areas related to the metal are separated from other points. Although this method significantly reduces the distortions caused by the metal texture, studies are still ongoing in cases where there are several textures instead of one metal texture. Because in these cases, the algorithm to automatically remove these sinusoids from the sinogram becomes very complicated.

Mr. Manken points out in a theory in 2003 that it can be reconstructed by using the weighted sum of sinogram values in the neighboring points of a desired point. Neighborhood points, by definition, is a window centered on the desired point. It is also stated that the coefficients of this weighted sum are only a function of the distance of each point from the center of the window.

Although in this method, more healthy points participate in the reconstruction of each point, but the implementation of this method does not maintain the continuity of the structure of the reconstructed points and therefore increases the risk of increasing noise. Meanwhile, in his activity, Dr. Yazdi presents an algorithm for interpolation and reconstruction of lost points, by

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which the structure of the points close to the reconstructed points is preserved. In this algorithm, the goal is that the interpolation is done between two areas that are related to the same texture, instead of between two points located in the same column. In 2005, Dr. Yazdi and colleagues designed a three-step method to reduce metal artifacts caused by hip prosthesis (Figure 8).

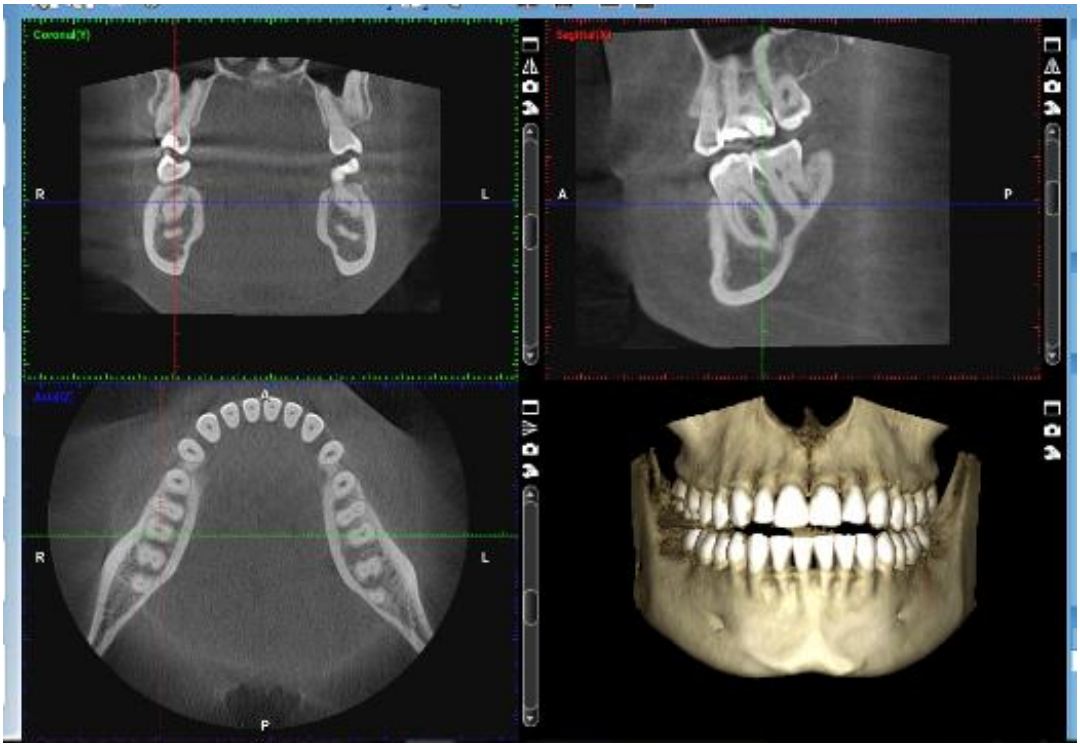

Figure 8: CBCT scan (Cone beam CT scan)

This method includes an automatic algorithm for metal implant detection, a correction algorithm for projections and a new and optimal algorithm for interpolation. Finally, the improved raw data is transferred to the scanner to create the improved image. In 2006, Dr. Yazdi and colleagues proposed a method to remove distortions in CT scan images. In 2009, Hui Xue et al proposed a method to reduce metal artifact in dual-energy CTs based on active contour methods. In this method, assuming that the sinogram consists of two regions, one of metallic texture and the other of non-metallic texture with continuity of intensity in the regions, the proposed geometric active contour method is used to separate the boundary of metallic regions.

After separating and setting the intensity of the found areas to zero, the sinogram is improved with the point interpolation algorithm called TV painting and the final image is formed from it. Among the disadvantages of this method is that the mentioned active contour is not suitable for sinograms that have heterogeneous intensity, and on the other hand, the separation accuracy with only the active contour method is low. In 2010, Vetter et al focused on accurate and optimal separation of metal regions only in the sinogram image to reduce the metal artifact. They believed that direct separation in the sinogram image is optimal and different from other

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separation methods on reconstructed images with Radon transformation. This method is based on the use of Bayesian techniques and Markov random model. After separating the metal regions, the interpolation method is used to recover and improve the sinogram.

By examining the mentioned activities, it can be said that the general process of the methods is the same. In this way, the direct or indirect separation of metal textures in the raw data image is first done using different methods. Then, using different interpolation algorithms, the found areas are replaced with new values to improve image quality (Figure 9).

Figure 9: Forest Plot Showed Treatment for Adult Maxillofacial Surgery (Mandibular Condylar Process Fractures)

CONCLUSION

The prevalence of fractures and their causes are different in developed and developing countries. It is obvious that the lack of timely diagnosis and treatment of facial fractures can cause developmental abnormalities, facial deformities and loss of teeth. Although today, cone beam computed tomography (CBCT) is a suitable imaging method for better diagnosis of facial and skull bone fractures (2, 10-12). The treatment plan for maxillofacial fractures in trauma patients, conventional prescribed radiographs were used.

According to the results of the present study, multiple fractures were about 2.72 times more than single fractures of the jaw and face. The main etiology of jaw and facial fractures, both single and multiple, were also related to motor vehicle damage. Falling and assault were ranked

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next. Considering that in this study, the fracture of each tooth and its bone was considered as a separate fracture and in many cases the fracture involved several teeth, therefore, the higher prevalence of multiple fractures than single fractures can be justified. The higher prevalence of fractures due to traffic accidents in illiterate and under-diploma people (85%) can be related to the cultural, social, economic and young age of these people, which leads to lack of awareness and familiarity with traffic laws and compliance with the principles It becomes safety.

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