Comparative Analysis of Dual-Energy X-Ray Absorptiometry and Ortho-panoramic X-Ray for Monitoring Jawbone Health before Dental Implant

Protocol of thesis submitted to the

Medical Research Institute

University of Alexandria

In partial fulfillment of the

Master Degree

in

Bio-Medical Physics

Biophysics Department

By

HASSAN MOSTAFA HASSAN

ABOSHALL

B.D.S.

Faculty of DENTISTRY

University of Alexandria - 2002

Medical Research Institute

University of Alexandria

2009

SUPERVISORS

Prof. Dr. Michael M. Mosaad

Professor of Medical Biophysics

Head, Department of Biophysics

Medical Research Institute

University of Alexandria

Prof. Dr. ABBAS ALSAID ALLAM

Professor of Prothesis

Department of Prothesis

Faculty of Dentistry

University of Alexandria

Prof. Dr. Ehab I. Mohamed

Associate Professor of Medical Biophysics

Department of Biophysics

Medical Research Institute

University of Alexandria

Comparative Analysis of Dual-Energy X-Ray Absorptiometry and Ortho-panoramic X-Ray for Monitoring Jawbone Health before Dental Implant

THESIS

By **HASSAN MOSTAFA HASSAN ABOSHALL**

B.D.S.Faculty of DENTISTRY

University of Alexandria – 2002

In partial fulfillment of the

Master Degree

in

Medical Bio Physics

EXAMINATION COMMITTEE **APPROVED**

Prof. Dr.AHMED MOHAMMED RASHAD
Professor of Oral Surgery
Head, Department of Oral surgery
Faculty of Dentistry
University of Alexandria

Prof. Dr. SAHAIR MAHAMOUD ELKHOLY
Professor of Medical Biophysics
Department of Biophysics
Medical Research Institute
University of Alexandria

Prof. Dr. ABBAS ALSAID ALLAM
Professor of Prothesis
Department of Prothesis
Faculty of Dentistry
University of Alexandria

Prof. Dr. Ehab I. MOHAMED
Associate Professor of Medical Biophysics
Department of Medica Biophysics
Medical Research Institute
University of Alexandria

SUPERVISING COMMITTEE

Prof. Dr. Michael M. Mosaad ....

Professor of Medical Biophysics

Head, Department of Biophysics

Medical Research Institute

University of Alexandria

Prof. Dr. ABBAS ALSAID ALLAM ....

Professor of Prothesis

Department of Prothesis

Faculty of Dentistry

University of Alexandria

Prof. Dr. Ehab I. Mohamed ....

Associate Professor of Medical Biophysics

Department of Biophysics

Medical Research Institute

University of Alexandria

ACKNOWLEDGEMENT

I humbly thank the Almighty Allah, greatest of all, for giving me the ability and effort to perform this work. I wish to thank each member of my family for all their help, support, encouragement and patience, without their support this work would have never been completed.

It is a great pleasure to express my deepest gratitude and indebtedness to prof. Dr. Michael Moussa Mossaad, Professor of Medical Biophysics Department of Medical Biophysics, Medical Research Institute, Alexandria University, and I would like to ex press my deep appreciation and sincere thanks for designing the work and for his great supervision, immense help throughout the course of this work. Also, his continuous encouragement, advice and criticism, and great effort and long time he invested in this study are appreciated. I deeply express my appreciation and thanks to him.

It is with great pleasure, deep satisfaction and gratitude that I acknowledge the supervision and help of Prof. Dr. Abbas Alsaid Allam, Professor of Prosthesis, Faculty of Dentistry, Alexandria University, for suggesting the research problem, unlimited effort, continuous cooperation and his supervision. I am also indebted to his for her generosity with his time, effort and materials required during this investigation.

It is a great pleasure to express my deepest gratitude to Prof. Dr. Ehab I. Mohamed, Associate Professor of Medical Biophysics Department of Medical Biophysics, Medical Research Institute, Alexandria University, as a supervisor who patiently devoted much of his precious time for completing this work and for his continuous encouragement, great effort, sincere support and wise advices during every step of this work.

CONTENTS

LIST OF TABLES

LIST OF ABBREVIATION

3D……………………………………………………Three Dimensional

ABMD…………………………………………A real Bone Mineral Density

BFM……………………………………………………Body Fat Mass

BMAD……………………………………Bone Mineral Apparent Density

BMC……………………………………………Bone Mineral Content

BMD……………………………………………Bone Mineral density

BMI………………………………………………Bone Mineral Index

CAT…………………………………Computer Assisted Tomography

CT………………………………………………Computer Tomography

D…………………………………………………………………Distance

D.I…………………………………………………………Dental Implant

DPT……………………………………Dental Panoramic Tomography

DXA……………………………………Dual x-rays absorbtiomatry

IAN…………………………………………Inferior Alveolar Nerve

KV…………………………………………………………………Kilo voltage

KVP……………………………………………………………Kilo voltage Peak

LBM……………………………………………………………Lean Body Mass

MA………………………………………………………………Mlli Amarage

MM………………………………………………………………Milli Meter

QCT………………………………………………Quantative computer tomography

R…………………………………………………………………Coreletion coefficient

R2………………………………………………………Determination coefficient

T……………………………………………………………………………Time

VC………………………………………………………………Critical voltage

TMT…………………………………………………Tempromandibuler joints

INTRODUCTION

Many pathological and clinical causes (e.g., trauma, recurrent caries and filling, and periodontal disease) may lead to teeth losses.[1] Orthodontics aims at replacing these missing teeth using mainly removable or fixed prosthesis, which have been shown to have many problems affecting the soft tissue, bone, and the remaining teeth used as abutment.[1, 2] The relatively new method of replacing missing teeth by dental implants, represents an ideal candidate for overcoming these drawbacks.[3, 4]

However, one of the most common problems before using implants, is to determinethe jawbone quantity and quality, which may affect the osseointergation (i.e., the formation of bone chips between implant surface and surrounded bone).[3, 4]

one of the important issues for an orthodentist (implantologist), is to find a fast and non-invasive technique for investigating jawbone health status before carrying on with the implant.[5]

Orthopanoramic X-ray radiograms and ridge mapping are currently being used for determining jawbone quantity, yet there is still a need for a determining its quality.[6, 7]

REVIEW OF LITRATURE

REVIEW OF LITERATURE

I-1 BACKGROUND

Orthopanoramic X-ray radiograms and ridge mapping are currently being used for determining jawbone quantity, yet there is still a need for a determining its quality.[6, 7]

I-2 LITERATURE REVIEW

Normal jaw skeleton The mandible and maxillary bones form in membrane and are unusual in that they contain odontogenic epithelium and neurovascular bundles within their substance. Most diseases arising in the jaws are of odontogenic origin, but both non-odontogenic local and systemic disorders may affect the jaws. [8,9]

I-2-1 ANATOMY OF JAWS

The mandible is formed of a cortex and rather coarse trabecular medulla. A depression into the cortex may form around the submandibular salivary gland during development. It can give rise to a radiolucent area at the angle of the mandible, referred to as Stafne's cavity It is important to be aware of this normal structure, which appears below the inferior alveolar nerve canal on radiographs, to avoid confusion with bone cysts another important normal structure is the torus mandibularis.

Tori are smooth bone prominences found on the lingual aspect of the mandible below the canine/premolar teeth they are often bilateral and may consist of single, double or triple prominences. [9]

The maxilla is often extensively pneumatised to form the maxillary sinus. The hard palate forms by elevation and fusion of embryonic shelves. A bony prominence may form in the midline, which is referred to as torus palatinus. Both the torus palatinus and pterygoid hamulus can be discovered by anxious patients and reassurance may be required.

At a histological level, bone is composed of mineralized collagenous matrix containing osteocytes. It is organised into an outer cortex and an inner cancellous (trabecular) structure, which is adaptive to stresses . Endosteal surfaces are lined by bone lining cells; remodelling is achieved by the coordinated. [10,11]

I-2-2 GUIDED BONE REGENERATION

For over the past fifteen years, dental clinicians and researchers have developed the ability to regenerate bone around teeth and on edentulous jaw ridges in association with implant reconstruction. This technical advancement, termed "Guided Bone Regeneration", has allowed millions of people to restore health to diseased teeth which would have been condemned to extraction in the past. In other cases, this remarkable therapy has given patients who have already lost teeth a second chance to enjoy the benefits of "permanent teeth" with the help of dental implant reconstruction. In all cases, patients experience an enhanced quality of life as a direct result of improved health, function and appearance. [12,13,14]

I-2-2-1 Biological principles of treatment

It is known that bone heals more slowly than the gum tissues in the mouth. Without Guided Bone Regeneration techniques, the faster healing gum would prevent the bone from maximizing its full healing potential following surgical procedures. The concept of treatment is simple. A biocompatible membrane is placed between the gum and bone which acts as a barrier. This barrier prevents downgrowth of the gum into the underlying bone as it heals. Oftentimes, a bone graft is placed into the underlying bony irregularities, under the membrane, to help the body grow new bone.(Figure 1,2) Membranes around teeth are typically designed to dissolve away, or resorb, after several weeks of healing have passed. Membranes used to restore bony ridges in association with implant therapy are typically non-resorbable, and must be removed at a later date. [14,15]

SEQUENCE OF EVENTS DURING TREATMENT

TREATMENT AROUND TEETH

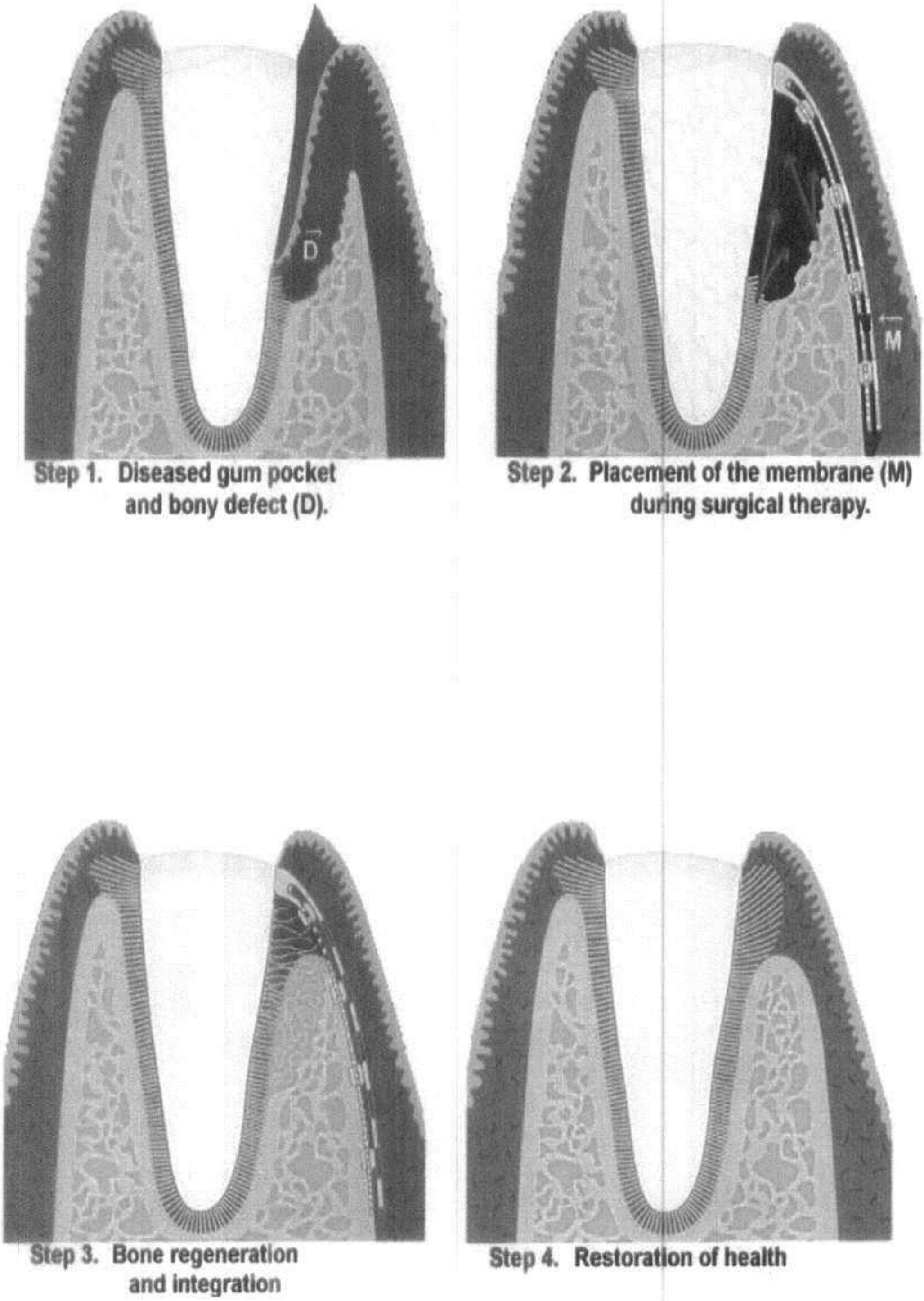
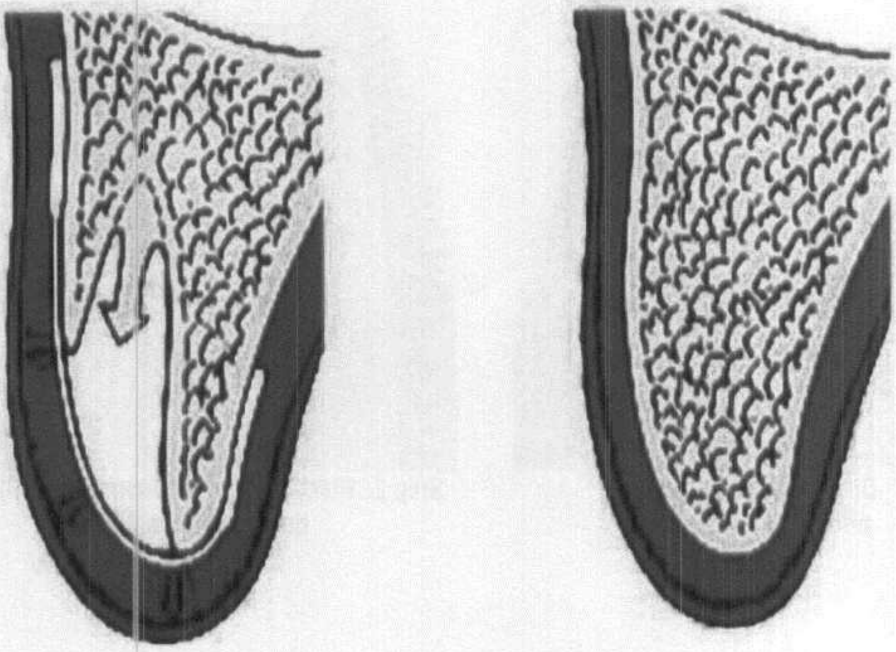


Figure 1

TREATMENT IN CONJUNCTION WITH IMPLANT THERAPY

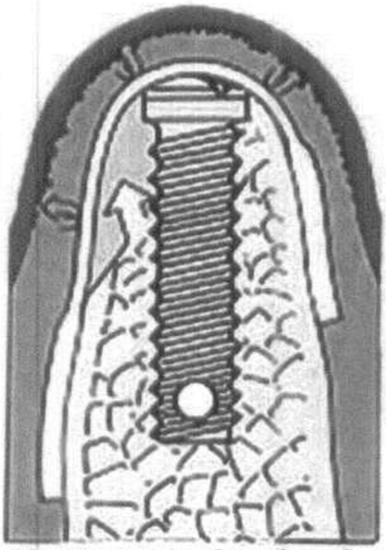


Bone defect with membrane surgically placed under the gum

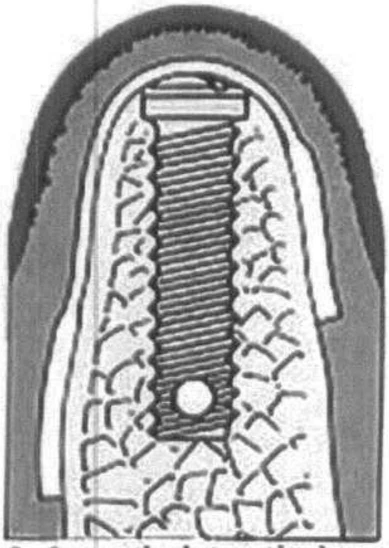
Healthy bone ridge 6 - 9 months later, membrane has been removed

Figure 2

RESTORATION OF THE BONY RIDGE AT THE SAME TIME AS IMPLANT PLACEMENT



Membrane is placed at the same time as the dental implant to promote bone regeneration of a deficient bony ridge



6 - 9 months later, the bone has healed around the implant. The membrane is removed when the implant is uncovered for placement of abutment post

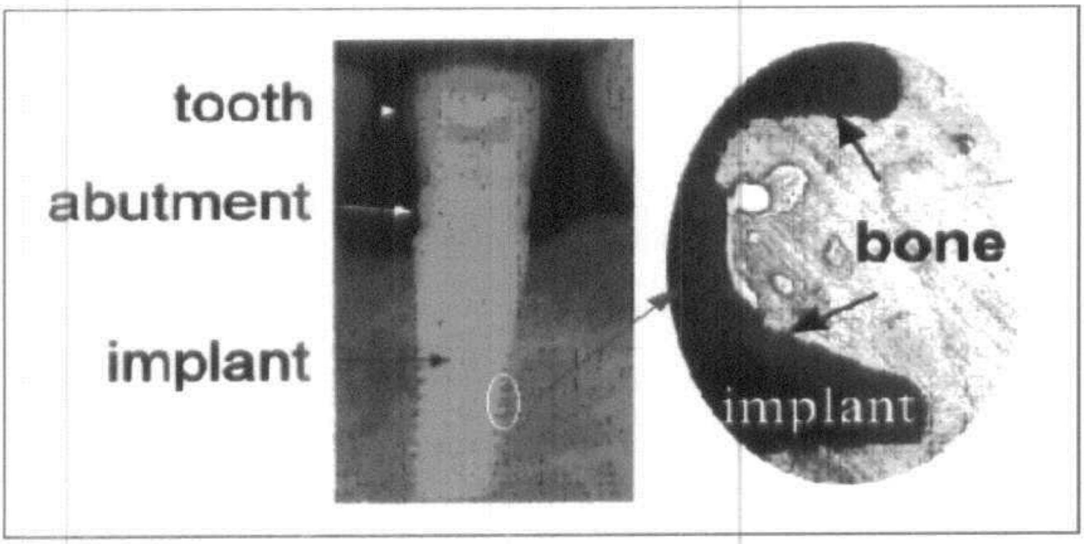


Figure 3

RESTORATION OF THE BONY RIDGE PRIOR TO IMPLANT PLACEMENT.

I-2-3 DENTAL IMPLANT

dental implant is an artificial tooth root replacement and is used in prosthetic dentistry to support restorations that resemble a tooth or group of teeth. There are several types of dental implants. The major classifications are divided into osseointegrated implant and the fibrointegrated implant. Earlier implants, such as the subperiosteal implant and the blade implant were usually fibrointegrated(Figure3). The most widely accepted and successful implant today is the osseointegrated implant, based on the discovery by Swedish Professor Per-Ingvar Brånemark that titanium can be successfully fused into bone when osteoblasts grow on and into the rough surface of the implanted titanium. This forms a structural and functional connection between the living bone and the implant. A variation on the implant procedure is the implant-supported bridge, or implant-supported denture. [14,16]

I-2-3-1 History of dental implant

The Mayan civilization has been shown to have used the earliest known examples of endosseous implants (implants embedded into bone), dating back over 1,350 years before Per Brånemark started working with titanium. While excavating Mayan burial sites in Honduras in 1931, archaeologists found a fragment of mandible of Mayan origin,. This mandible, which is considered to be that of a woman in her twenties, had three tooth-shaped pieces of shell placed into the sockets of three missing lower incisor teeth. For forty years the archaeological world considered that these shells were placed under the nose in a manner also observed in the ancient Egyptians. However, in 1970 a Brazilian dental academic, Professor Amadeo Bobbio studied the mandibular specimen and took a series of radiographs. He noted compact bone formation around two of the implants which led him to conclude that the implants were placed during life. [14]

In the 1950s research was being conducted at Cambridge University in England to study blood flow in vivo. These workers devised a method of constructing a chamber of titanium which was then embedded into the soft tissue of the ears of rabbits. In 1952 the Swedish orthopaedic surgeon Brånemark, was interested in studying bone healing and regeneration, and adopted the Cambridge designed 'rabbit ear chamber' for use in the rabbit femur. Following several months of study he attempted to retrieve these expensive chambers from the rabbits and found that he was unable to remove them. Per Brånemark observed that bone had grown into such close proximity with the titanium that it effectively adhered to the metal. Brånemark carried out many further studies into this phenomenon, using both animal and human subjects, which all confirmed this unique property of titanium. [15]

Although he had originally considered that the first work should centre on knee and hip surgery, Brånemark finally decided that the mouth was more accessible for continued clinical observations and the high rate of edentulism in the general . [17]

population offered more subjects for widespread study. He termed the clinically observed adherence of bone with titanium as 'osseointegration'. In 1965 Brånemark, who was by then the Professor of Anatomy at Gothenburg University in Sweden, placed the first titanium dental implant into a human volunteer, a Swede named Gösta Larsson[17].

. All dental implants currently available are axilly symmetric (cylindrical form) and do not fit precisely in the individual tooth socket. For this reason additional risky and costly interventions are regularly required to fill the gaps between the implant and bone.[18]

The latest development in immediate dental implantology are root analogue Zirconia implants, which fit better into the extraction socket. Long term studies are lacking.[17,18]

I-2-3-2 Procedure

A typical implant consists of a titanium screw which resembling a tooth root with a roughened or smooth surface. The very first implants were made out of commercially pure titanium, however since it was discovered that the $TiAl_6V_4$ alloy offered the same osseointegration level as commercially pure titanium, more and more implants were made out of $TiAl_6V_4$ alloy due to its better tensile strength and thus fracture resistance. Today most implants are made out of the $TiAl_6V_4$ alloy and treated either by plasma spraying, etching or sandblasting to increase the surface area and, thus the integration potential of the implant. An osteotomy or precision hole is carefully drilled into jawbone and the implant is installed in the osteotomy.[18]

Implant surgery is typically performed as an outpatient under general anesthesia or with local anesthesia by trained and certified clinicians including general dentists, oral surgeons, and periodontists. An increasing number of general or cosmetic dentists as well as prosthodontists are also placing implants in relatively simple cases. The most common treatment plan calls for several surgeries over a period of months, especially if bone augmentation or bone grafting is needed to support implant placements. At the other end of the surgery scale, some patients can be implanted and restored in a single surgery, in a procedure labeled "immediate function" and "teeth in an hour.[19]

A single implant procedure that involves an incision and flapping of the gingiva to expose the jawbone takes about an hour, sometimes longer; multiple implants can be installed in a single surgical session lasting several hours. At the conclusion, the patient goes through a period of recovery, returns to consciousness and is sent home with a relative or friend.[19]

Healing and integration of the implant with jawbone occurs over several months in a process called osseointegration. At the appropriate time, the restorative or cosmetic dentist or prosthodontist uses the implant to anchor crowns or a prosthetic restoration containing several teeth. Since the implants supporting the restoration are integrated, which means they are biomechanically stable and strong, the patient is immediately able to masticate normally. [19,20]

In an immediate function procedure, the gingiva is Flapless. Instead, the surgeon removes a small plug of gingiva directly over the drilling site. The site is drilled and the implant is installed. Then a crown is immediately added. Patients are cautioned to give their new teeth in an hour unless healing and integration time takes from 12 to 24 weeks before attempting normal mastication. [12]

I-2-3-3 Classification of dental implant

There are different approaches to place dental implants after tooth extraction[21]. The approaches are;

1. Immediate post-extraction implant placement.
2. Delayed immediate post-extraction implant placement (2 weeks to 3 months after extraction).
3. Late implantation (3 months after tooth extraction).

According to the timing of loading of dental implants, the procedure of loading could be classified into;

1. Immediate loading procedure.
2. Early loading (1 week to 12 weeks).
3. Staged loading (3-6 months).
4. Late loading (more than 6 months).

I-2-3-4 Surgical procedure

Most patients need the longer treatment plan, which has an excellent history going back many years Before surgery, with the patient fully awake or during an earlier office visit, a prudent clinician planning mandibular implants will conduct a neurosensory examination to rule out altered sensation, thus setting a base line on nerve function. Also prior to surgery, a panoramic X-ray will be taken using a metal ball of known dimension so that calibrated measurements can be made from the image (to accurately locate "vital structures" such as nerves and the position of critical anatomical features such as the mental foramen, which is the transit point in the jawbone for the nerve which innervates the lip and chin. [21]

At edentulous jaw sites, a pilot hole is bored into the recipient bone, taking care to avoid vital structures (in particular the inferior alveolar nerve or IAN within the mandible). A zone of safety, usually 2 mm, is the standard of care for avoiding vital structures like the IAN. When computed tomography (3D X-ray imaging) is used preoperatively to accurately pinpoint vital structures, the zone of safety may be reduced to 1 mm through the use of computer-aided design of surgical guides. [11,17]

Drilling into jawbone usually occurs in several separate steps. The pilot hole is expanded by using progressively wider drills (typically between three and seven successive drilling steps, depending on implant width and length).

Care is taken not to damage the osteoblast or bone cells by overheating. A cooling saline spray keeps the temperature of the bone to below 47 degrees Celsius (approximately 117 degrees Fahrenheit). The implant screw can be self-tapping, and is screwed into place at a precise torque so as not to overload the surrounding bone (overloaded bone can die, a condition called osteonecrosis, which may lead to failure of the implant to fully integrate or bond with the jawbone). [21,22]

Typically in most implant systems, the osteotomy or drilled hole is about 1mm deeper than the implant being placed, due to the shape of the drill tip. Surgeons must take the added length into consideration when drilling in the vicinity of vital structures. [10]

Once properly torqued into the bone, a cover screw is placed on the implant, then the gingiva or gum is sutured over the site and allowed to heal for several months for osseointegration to occur between the titanium surface of the implant and jawbone.

After several months the implant is uncovered in another surgical procedure, usually under local anesthetic by the restorative dentist or prosthodontist, and a healing abutment and temporary crown is placed onto the implant. This encourages the gum to grow in the right scalloped shape to approximate a natural tooth's gums and allows assessment of the final aesthetics of the restored tooth. Once this has occurred a permanent crown will be fabricated and placed on the implant. [23]

An increasingly common strategy to preserve bone and reduce treatment times includes the placement of a dental implant into a recent extraction site. In addition, immediate loading is becoming more common as success rates for this procedure are now acceptable. This can cut months off the treatment time and in some cases a prosthetic tooth can be attached to the implants at the same time as the surgery to place the dental implants. [15,18]

In all of these approaches, computer-based guidance has thrust itself onto the treatment stage. Not only will 3D digital imagery yield critical treatment guidance, the digital data can be used to manufacture precision drilling guides, virtually eliminating surgical errors. [24]

I-2-3-5 Complamentry procedure

I-2-3-5-1 Sinus lifting is a common surgical intervention. A dentist or specialist with proper training such as an endodontist, periodontist, prosthodontist, or oral surgeon thickens the inadequate part of atrophic maxilla towards the sinus with the help of bone transplantation or bone expletive substance. This results in more volume for a better quality bone site for the implantation.

I-2-3-5-2 Bone grafting will be necessary in cases where there is a lack of adequate maxillary or mandibular bone in terms of front to back (lip to tongue) depth or thickness; top to bottom height; and left to right width. Sufficient bone is needed in three dimensions to securely integrate with the root-like implant. Improved bone height which is very difficult to achieve is particularly important to assure ample anchorage of the implant's root-like shape because it has to support the mechanical stress of chewing, just like a natural tooth. If an implant is too shallow, chewing may cause a dangerous jawbone crack or full fracture. [23,24]

Typically, implantologists try to place implants at least as deeply into bone as the crown or tooth will be above the bone. This is called a 1;1 crown to root ratio. This ratio establishes the target for bone grafting in most cases. If 1;1 or better cannot be achieved, the patient is usually advised that only a short implant can be placed and to not expect a long period of usability. [23]

A wide range of grafting materials and substances may be used during the process of bone grafting / bone replacement. They include the patient's own bone (autograft), which may be harvested from the hip (iliac crest) or from spare jawbone; processed bone from cadavers (allograft); bovine bone or coral (xenograft); or artificially produced bonelike substances (calcium sulfate with names like Regeneform; and hydroxyapatite or HA, which is the primary form of calcium found in bone). The HA is effective as a substrate for osteoblasts to grow on. Some implants are coated with HA for this reason. [24]

Bone graft surgery has its own standard of care. In a typical procedure, the clinician creates a large flap of the gingiva or gum to fully expose the jawbone at the graft site, performs one or several types of block and onlay grafts in and on existing bone, then installs a membrane designed to repel unwanted infection-causing microbiota found in the oral cavity. Then the gingiva is carefully sutured over the site. Together with a course of internal antibiotics and external antibiotic mouth rinses, the graft site is allowed to heal which takes several months. [25]

The clinician typically takes a new panoramic x-ray to confirm graft success in width and height, and assumes that positive signs in these two dimensions safely predicts success in the third dimension, depth. Where more precision is needed, usually when mandibular implants are being planned, a 3D or cone beam X-ray may be called for at this point to enable accurate measurement of bone and location of nerves and vital structures for proper treatment planning. The same X-ray data set can be employed for the preparation of computer-designed placement guides.

Correctly performed, a bone graft produces live vascular bone which is very much like natural jawbone and is therefore suitable as a foundation for implants. [25,26]

I-2-3-6 Considerations

For dental implant procedure to work, there must be enough bone in the jaw, and the bone has to be strong enough to hold and support the implant. If there is not enough bone, more may need to be added with a bone graft procedure discussed earlier.

Sometimes, this procedure is called bone augmentation. In addition, natural teeth and supporting tissues near where the implant will be placed must be in good health.

In all cases, what must be addressed is the functional aspect of the final implant restoration, the final occlusion. How much force per area is being placed on the bone implant interface? Implant loads from chewing and parafunction can exceed the physio biomechanic tolerance of the implant bone interface and/or the titanium material itself, causing failure. This can be failure of the implant itself (fracture) or bone loss, a "melting" or resorption of the surrounding bone. (19,21)

The dentist must first determine what type of prosthesis will be fabricated. Only then can the specific implant requirements including number, length, diameter, and thread pattern be determined. In other words, the case must be reverse engineered by the restoring dentist prior to the surgery. If bone volume or density is inadequate, a bone graft procedure must be considered first. The restoring dentist may consult with the periodontist, endodontist, oral surgeon, or another trained general dentist to co-treat the patient. Usually, physical models or impressions of the patient's jawbones and teeth are made by the restorative dentist at the implant surgeons request, and are used as physical aids to treatment planning. If not supplied, the implant surgeon makes his own or relies upon advanced computer-assisted tomography or a cone beam CAT scan to achieve the proper treatment plan. (27)

Computer simulation software based on CAT scan data allows virtual implant surgical placement based on a barium impregnated prototype of the final prosthesis. This predicts vital anatomy, bone quality, implant characteristics, the need for bone grafting, and maximizing the implant bone surface area for the treatment case creating a high level of predictability. Computer CAD/CAM milled or stereo lithography based drill guides can be developed for the implant surgeon to facilitate proper implant placement based on the final prosthesis occlusion and aesthetics. (25,26)

Success rates of dental implant success is related to operator skill, quality and quantity of the bone available at the site, and also to the patient's oral hygiene. Various studies have found the 10 year success rate of implants to be between 90 and 95%. Patients who smoke experience significantly poorer success rates. (14,15)

Failure of a dental implant is often related to failure to osseointegrate correctly. A dental implant is considered to be a failure if it is lost, mobile or shows peri-implant (after implant) bone loss of greater than 1.0 mm in the first year and greater than 0.2mm a year thereafter. (14,16)

Dental implants are not susceptible to dental caries but they can develop a periodontal condition called peri-implantitis. The cause may be infection that was introduced during surgery; or failure by the patient to follow correct oral hygiene routines. In either case, inflammation in the bone surrounding the implant causes bone loss (recession) which ultimately may lead to failure, often evidenced by the ability to "spin" an implant. (20)

Peri-implantitis is often dealt with pre-emptively by clinicians who prescribe a course of antibiotics in the days prior to surgery; and post-surgically with another course of antibiotics and special oral rinses. Since peri-implantitis is generally easy to see on standard panoramic and periapical X-rays, prudent clinicians who suspect the problem will take an X-ray soon after surgery, and again at staged intervals post-operatively.

Risk of failure is increased in smokers. For this reason implants are frequently placed only after a patient has stopped smoking as the treatment is very expensive. More rarely, an implant may fail because of poor positioning at the time of surgery, or may be overloaded initially causing failure to integrate. If smoking and positioning problems exist prior to implant surgery, clinicians often advise patients that a bridge or partial denture rather than an implant may be a better solution.

I-2-3-7 Contraindications

There are no absolute contraindications to implant dentistry, however there are some systemic, behavioral and anatomic considerations that should be considered.

I-2-4 The DUAL-ENERGY X-RAY ABSORPTIOMETRY (DXA)

The Dual-energy X-ray Absorptiometry (DXA) is employed for evaluating bone mineral density (BMD) of different sites of the human body, which is widely accepted as a reference measure of bone health status in many pathological cases.(28) Based on DXA scans, the BMD measurements of a patient can be compared with standard BMD measurements for a reference healthy population, which helps predicting a patient's risk for fracture.(28) Thus, these evidences propose the possibility of its routine use for frequently evaluating jaw BMD.(29)

Dual-energy x-rays absorbtiomatry (DXA) ; To accurately detect osteoporosis, physicians commonly use the DXA technique to asses segmental and total BMD. DXA is a quick, painless procedure for measuring bone calcium loss. Measurement of the lower spine and hips are most often used to diagnose osteoporosis, a condition that often affects women after menopause but may also be found in men. Osteoporosis involves a gradual loss of calcium, causing the bones to become thinner, more fragile and more likely to break. DXA is also effective in tracking the effects of treatment for osteoporosis and other conditions that cause bone loss.The DXA test can also assess an individual's risk for developing fractures.

I-2-4-1 Bone density testing is strongly recommended ;

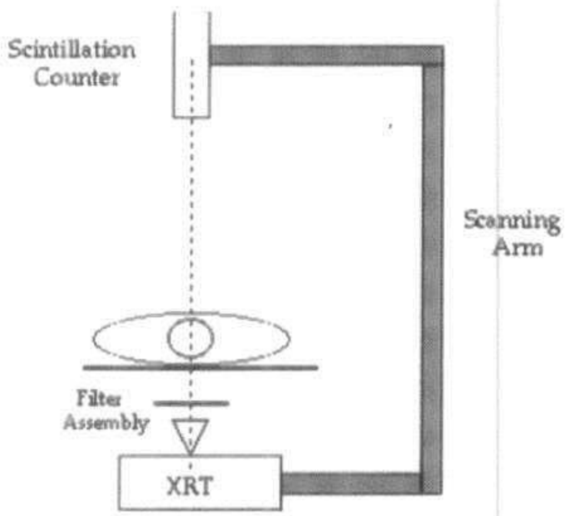
- post-menopausal woman and not taking estrogen.
- having a personal or maternal history of hip fracture or smoking.
- a post-menopausal women who are tall (over 5 feet 7 inches) or thin (less than 125 pounds).
- men with clinical conditions associated with bone loss.
- use medications that are known to cause bone loss, including corticosteroids such as Prednisone, various anti-seizure medications such as Dilantin and certain barbiturates, or high-dose thyroid replacement drugs.

- having type 1 diabetes (formerly called juvenile or insulin-dependent), liver disease, kidney disease or a family history of osteoporosis.
- having high bone turnover, which shows up in the form of excessive collagen in urine samples.
- having a thyroid condition, such as hyperthyroidism
- having a parathyroid condition, such as hyperparathyroidism.
- having experienced a fracture after only mild trauma.
- having had x-ray evidence of vertebral fracture or other signs of osteoporosis. .

I-2-4-2 Prepare for DXA measurements ;

- Refrain from taking calcium supplements for at least 24 hours beforehand.
- Wear comfortable clothing and avoid garments that have zippers, belts or buttons made of metal.
- Let your technologist know if you've recently had a barium examination or have been injected with a contrast material for a CT or radioisotope scan.
- Let your technologist know if there is a possibility you are pregnant.

Depending on the equipment used and the parts of the body being examined(Figure 4), the test takes between 10 and 30 minutes. [29]



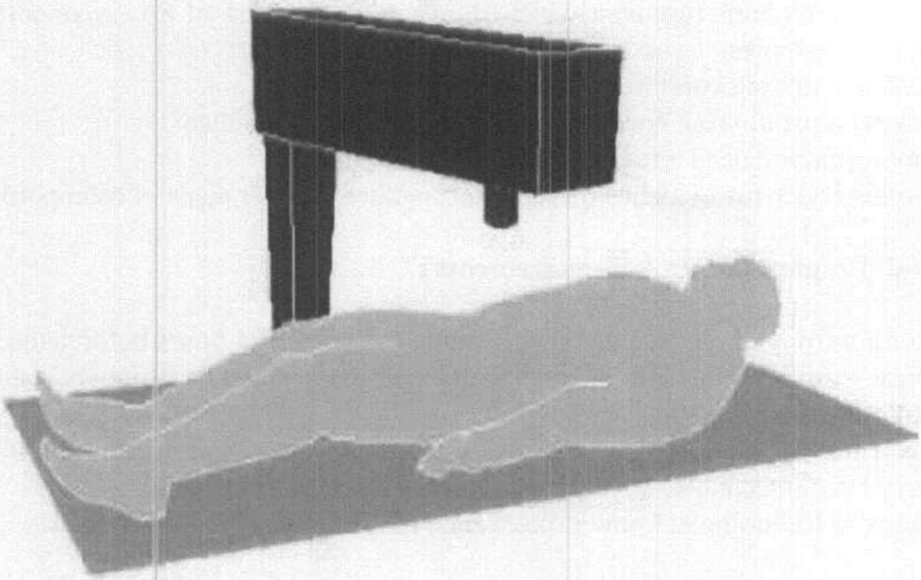


Figure 4

Digram illustrate mechanism of action of DXA

- You may be asked to undress and put on a gown.
- You'll lie on a padded table with an x-ray tube below and a detector (an imaging device) above. It is important that you remain as still as possible during the procedure to ensure a clear and useful image.
- Bone loss in the spine and hip are where most osteoporosis-related fractures happen;
  - During an examination of the spine, your legs will be supported on a padded box to flatten your pelvis and lower (lumbar) spine.
  - During examination of the hip, the technologist will place your foot in a brace that rotates the hip inward.
- The detector is scanned over the area, generating images on a computer monitor.

What will I experience during this exam?

DXA bone densitometry is a simple, painless, and non-invasive procedure. Once on the examination table, you will be asked to remain still for a short period of time while the machine takes measurements. [30]

I-2-4-3 Who interprets the results and how do I get them?

The results of a DXA bone density exam are interpreted by one of our radiologists and forwarded to your doctor. Your test results will be in the form of two scores; [30]

T score - This number shows the amount of bone you have compared to a young adult of the same gender with peak bone mass. A score above -1 is considered normal. A score between -1 and -2.5 is classified as osteopenia, the first stage of bone loss. A score below -2.5 is defined as osteoporosis. It is used to estimate your risk of developing a fracture. [31]

Z score - This number reflects the amount of bone you have compared to other people in your age group and of the same size and gender. If it is unusually high or low, it may indicate a need for further medical tests. [28,29]

I-2-4-4 Mechanism of action

. Dual energy X-ray absorptiometry DXA is a means of measuring bone mineral density (BMD). Two X-ray beams with differing energy levels are aimed at the patient's bones. When soft tissue absorption is subtracted out, the BMD can be determined from the absorption of each beam by bone. Dual energy X-ray absorptiometry is the most widely used and most thoroughly studied bone density measurement technology. A T-score of -2.5 or less is indicative of osteoporosis. This test is very reliable. [30,31]

DXA scans can also be used to measure total body composition and fat content.

Special considerations are involved in the use of DXA to assess bone mass in children. Specifically, comparing the bone mineral density of children to the reference data of adults (to calculate a T-score) will underestimate the BMD of children, because children have less bone mass than fully developed adults. This would lead to an overdiagnosis of osteopenia for children. To avoid an overestimation of bone mineral deficits, BMD scores are commonly compared to reference data for the same gender and age (by calculating a Z-score). [31]

Also, there are other variables in addition to age which are suggested to confound the interpretation of BMD as measured by DXA. One important confounding variable is bone size. DXA has been shown to overestimate the bone mineral density of taller subjects and underestimate the bone mineral density of smaller subjects. This error is due to the way in which DXA calculates BMD. In DXA, bone mineral content (measured as the attenuation of the X-ray by the bones being scanned) is divided by the area (also measured by the machine) of the site being scanned. [28]

Because DXA calculates BMD using area (aBMD; areal Bone Mineral Density), it is not an accurate measurement of true bone mineral density, which is mass divided by a volume. In order to distinguish DXA BMD from volumetric bone-mineral density, researchers sometimes refer to DXA BMD as an areal bone mineral density (aBMD). The confounding effect of differences in bone size is due to the missing depth value in the calculation of bone mineral density. Despite DXA technology's problems with estimating volume, it is still a fairly accurate measure of bone mineral content. Methods to correct for this shortcoming include the calculation of a volume which is approximated from the projected area measure by DXA. DXA BMD results adjusted in this manner, are referred to as the bone mineral apparent density (BMAD) and are a ratio of the bone mineral content versus a cuboidal estimation of the volume of bone. Like aBMD, BMAD results do not accurately represent true bone mineral density, since they use approximations of the bone's volume. Other imaging technologies such as Computed Quantitative Computer Tomography (QCT) are capable of measuring the bone's volume, and are therefore not susceptible to the confounding effect of bone-size in the way that DXA results are susceptible. [32]

BMAD is used primarily for research purposes and is not yet used in clinical settings.

DXA uses X-rays to assess bone mineral density. However, the radiation dose is approximately 1/10th that of a standard chest X-ray.

The quality of DXA operators varies widely. DXA is not regulated like other radiation based imaging techniques because of its low dosage.

It is important for patients to get repeat BMD measurements done on the same machine each time, or at least a machine from the same manufacturer. Error between machines, or trying to convert measurements from one manufacturer's standard to another can introduce errors large enough to wipe out the sensitivity of the measurements[31,32]

I-2-5 DENTAL X-RAYS

I-2-5-1 REVIEW OF LITERATURE

The use of X-rays is an integral part of clinical dentistry, with some form of radiographic examination necessary on the majority of patients. As a result, radiographs are often referred to as the clinician's main diagnostic aid. The range of knowledge of dental radiography and radiology thus required can be divided conveniently into four main sections; [33,34]

- Basic physics and equipment the production of X-rays, their properties and interactions which result in the formation of the radiographic image
- Radiation protection the protection of patients and dental staff from the harmful effects of X-rays

• Radiography the techniques involved in producing the various radiographic images
• Radiology the interpretation of these radiographic images.
Nature of the radiographic image

The image is produced by X-rays passing through an object and interacting with the photographic

emulsion on a film. This interaction results inblackening of the film. The extent to which the emulsion is blackened depends on the number of X-rays reaching the film, which in turn depends on the density of the object. The final image can be described as a twodimensional picture made up of a variety of black, white and grey superimposed shadows and is thus sometimes referred to as a shadowgraph Understanding the nature of the shadowgraph and interpreting the information contained within it requires a knowledge of;

• The radiographic shadows
• The three-dimensional anatomical tissues
• The limitations imposed by a two-dimensional picture and superimposition. The radiographic shadows The amount the X-ray beam is stopped (attenuated) by an object determines the radiodensity of the shadows;

• The white or radiopaque shadows on a film represent the various dense structures within the object which have totally stopped the X-ray beam.
• The black or radiolucent shadows represent areas where the X-ray beam has passed through the object and has not been stopped at all.
• The grey shadows represent areas where the X-ray beam has been stopped to a varying degree.
The final shadow density of any object is thus affected by;
• The specific type of material of which the object is made
• The thickness or density of the material
• The shape of the object
• The intensity of the X-ray beam used

. Positioning of the film, object and X-ray beam
The position of the X-ray beam, object and film needs to satisfy certain basic geometrical requirements. [34] These include(Figure5)

• The object and the film should be in contact or as close together as possible
• The object and the film should be parallel to one another
• The X-ray tubehead should be positioned so that the beam meets both the object and the film at right angles.

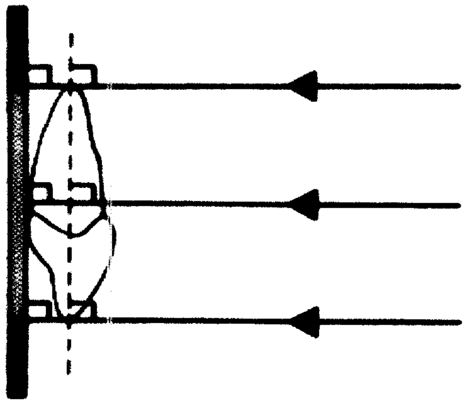


Figure 5

Diagrams showing the effect on the final image of varying the position of the film, the object and the X-ray beam. [35,36]

X-ray production are produced when energetic (high-speed) electrons bombard a target material and are brought suddenly to rest. This happens inside a small evacuated glass envelope called the X-ray tube .[35] (Figure6)

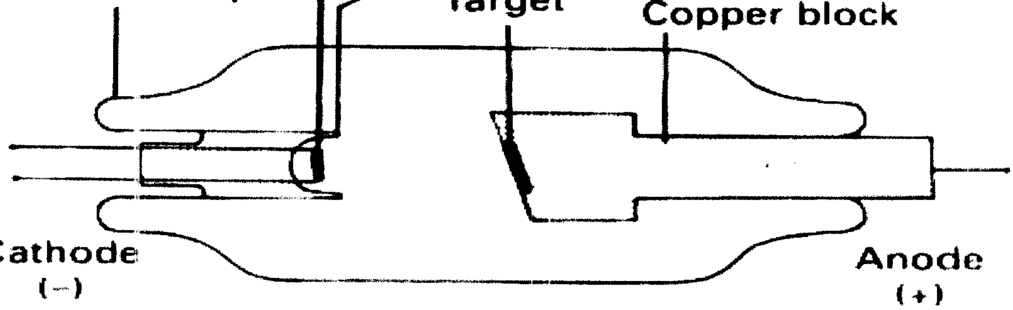


Figure 6

Diagram show structure of x-rays tube

I-2-5-2 Main features and requirements of an X-ray tube(Figure6)

• The cathode negative consists of a heated filament of tungsten that provides the source of electrons.
• The anode positive consists of a target a small piece of tungsten set into the angled face of a large copper block to allow efficient removal of heat.
• A focusing device aims the stream of electrons at the focal spot on the target.
• A high-voltage kilovoltage, kV connected between the cathode and anode accelerates the electrons from the negative filament to the positive target. This is sometimes referred to as kVp or kilovoltage peak,
• A current milliamperage, mA flows from the cathode to the anode. This is a measure of the quantity of electrons being accelerated.
• A surrounding lead casing absorbs unwanted X-rays as a radiation protection measure since X-rays are emitted in all directions.
• Surrounding oil facilitates the removal of heat
Practical considerations the production of X-rays can be summarized as the following sequence of events; (34)
1. The filament is electrically heated and a cloud of electrons is produced around the filament.
2. The high-voltage called potential difference across the tube accelerates the electrons at very high speed towards the anode.
3. The focusing device aims the electron stream at the focal spot on the target.
4. The electrons bombard the target and are brought suddenly to rest.
5. The energy lost by the electrons is transferred into either heat (about 99%) or X-rays (about 1%).
6. The heat produced is removed and dissipated by the copper block and the surrounding oil.
7. The X-rays are emitted in all directions from the target. Those emitted through the small window in the lead casing constitute the beam used for diagnostic purposes. Interactions at the atomic level

I-2-5-3 Types of collisions

The high-speed electrons bombarding the target are involved in two main types of collision with the tungsten atoms; (37)
• Heat-producing collisions
• X-ray-producing collisions.
Heat-producing collisions
• The incoming electron is deflected by the cloud of outer-shell tungsten electrons, with a small loss of energy, in the form of heat
• The incoming electron collides with an outer shell tungsten electron displacing it to an even more peripheral shell (excitation) or displacing it from the atom (ionization), again with a small loss of energy in the form of heat .
• Heat-producing interactions are the most common because there are millions of incoming electrons and many outer-shell tungsten electrons with which to interact.

• Each individual bombarding electron can undergo many heat-producing collisions resulting in a considerable amount of heat at the target.
• Heat needs to be removed quickly and efficiently to prevent damage to the target. This is achieved by setting the tungsten target in the copper block, utilizing the high thermal capacity and good conduction properties of copper.
X-ray-producing collisions
• The incoming electron penetrates the outer electron shells and passes close to the nucleus of the tungsten atom. The incoming electron is dramatically slowed down and deflected by the nucleus with a large loss of energy which is emitted in the form of X-rays .
• The incoming electron collides with an inner-shell tungsten electron displacing it to an outer shell (excitation) or displacing it from the atom (ionization), with a large loss of energy and subsequent emission of X-rays .

I-2-5-4 X-ray spectra

The two X-ray-producing collisions result in the production of two different types of X-ray spectra; [38]
• Continuous spectrum
• Characteristic spectrum.
• Combined spectrum.

I-2-5-4 -1 Continuous spectrum

The X-ray photons emitted by the rapid deceleration of the bombarding electrons passing close to the nucleus of the tungsten atom are sometimes referred to as bremsstrahlung or braking radiation. The amount of deceleration and degree of deflection determine the amount of energy lost by the bombarding electron and hence the energy of the resultant emitted photon. A wide range or spectrum of photon energies is therefore possible and is termed the continuous spectrum [36,38]
• Small deflections of the bombarding electrons
are the most common, producing many lowenergy photons.
• Low-energy photons have little penetrating power and most will not exit from the X-ray tube itself. They will not contribute to the useful X-ray beam .This removal of low-energy photons from the beam is known as filtration .
• Large deflections are less likely to happen so there are relatively few high-energy photons.
• The maximum photon energy possible (E max) is directly related to the size of the potential difference (kV) across the X-ray tube.

I-2-5-4 -2 Characteristic spectrum

Following the ionization or excitation of the tungsten atoms by the bombarding electrons, the orbiting tungsten electrons rearrange themselves to return the atom to the neutral or ground state. This involves electron 'jumps' from one energy level (shell) to another, and results in the emission of X-ray photons with specific energies. As stated previously, the energy levels or shells are specific for any particular atom. The X-ray photons emitted from the target are therefore described as characteristic of tungsten atoms and form the characteristic or line spectrum .The photon lines are named K and L, depending on the shell from which they have been emitted . [35,37]

• Only the K lines are of diagnostic importance since the L lines have too little energy.
• The bombarding high-speed electron must have sufficient energy (69.5 kV) to displace a K-shell tungsten electron to produce the characteristic K line on the spectrum. (The energy of the bombarding electrons is directly related to the potential difference (kV) across the X-ray tube,
• Characteristic K-line photons are not produced by X-ray tubes with tungsten targets operating at less than 69.5 kV — referred to as the critical voltage (Vc).
• Dental X-ray equipment operates usually between 50 kV and 90 kV .

I-2-5-4 -3 Combined spectra

In X-ray equipment operating above 69.5 kV, the final total spectrum of the useful X-ray beam will be the addition of the continuous and characteristic spectra .

Summary of the main properties and characteristics of X-rays

• X-rays are wave packets of energy of electromagnetic radiation that originate at the atomic level.

Each wave packet is equivalent to a quantum ofenergy and is called a photon.

An X-ray beam is made up of millions of photons of different energies.The diagnostic X-ray beam can vary in its intensity and in its quality;

Intensity = the number or quantity of X-ray photons in the beam

Quality = the energy carried by the X-ray photons which is a measure of their penetrating power.

The factors that can affect the intensity and/or the quality of the beam include;

Size of the tube voltage (kV)

Size of the tube current (mA)

Distance from the target (d)

Time = length of exposure (t)

Filtration

Target material

Tube voltage waveform

Interaction of X-rays with matter When X-rays strike matter, such as a patient's tissues, the photons have four possible fates[39]. The photons may be;

• Completely scattered with no loss of energy
• Absorbed with total loss of energy
• Scattered with some absorption and loss of energy
• Transmitted unchanged.

Interaction of X-rays at the atomic level

I-2-5-5 Interaction at atomic level

There are four main interactions at the atomic level, depending on the energy of the incoming photon, these include;

• Unmodified or Rayleigh scattering pure scatter
• Photoelectric effect pure absorption
• Compton effect scatter and absorption

• Pair production pure absorption.
Only two interactions are important in the X-ray energy range used in dentistry;
• Photoelectric effect
• Compton effect.

I-2-5-5 -1 Photoelectric effect

The photoelectric effect is a pure absorption interaction predominating with low-energy photons.

1. The incoming X-ray photon interacts with a bound inner-shell electron of the tissue atom.
2. The inner-shell electron is ejected with considerable energy (now called a photoelectron) into the tissues and will undergo further interactions.
3. The X-ray photon disappears having deposited all its energy; the process is therefore one of pure absorption.
4. The vacancy which now exists in the inner electron shell is filled by outer-shell electrons dropping from one shell to another.
5. This cascade of electrons to new energy levels results in the emission of excess energy in the form of light or heat.
6. Atomic stability is finally achieved by the capture of a free electron to return the atom to its neutral state.
7. The high-energy ejected photoelectron behaves like the original high-energy X-ray photon, undergoing many similar interactions and ejecting other electrons as it passes through the tissues. It is these ejected high-energy electrons that are responsible for the majority of the ionization interactions within tissue, and the possible resulting damage attributable to X-rays. [35,38]

I-2-5-5 -2 Compton effect

The Compton effect is an absorption and scattering process predominating with higher-energy photons. [36]
1. The incoming X-ray photon interacts with a free or loosely bound outer-shell electron of the tissue atom.
2. The outer-shell electron is ejected (now called the Compton recoil electron) with some of the energy of the incoming photon, i.e. there is some absorption. The ejected electron then undergoes further ionizing interactions within the tissues (as before).
3. The remainder of the incoming photon energy is deflected or scattered from its original path as a scattered photon.
4. The scattered photon may then;
• Undergo further Compton interactions within the tissues
• Undergo photoelectric interactions within the tissues
• Escape from the tissues — it is these photons that form the scatter radiation of concern in the clinical environment.
5. Atomic stability is again achieved by the capture of another free electron.

I-2-5-6 Dental panoramic tomography

Implant positioning in the alveolar ridge is dependent on the location and morphology of the potential osseous receptor site and its contiguous structures. Because the contour and thickness of the oral mucosa can mask the actual dimensions of the underlying osseous structure, a thorough radiographic examination is essential for diagnosis and treatment. This examination is to make note of what is and is not radiographically present, with any deviation from normality duly recorded. [39,40]

Radiographic assessment it's a significant tool in evaluating the quantity of the alveolar bone, locating any anatomical landmarks, and/or detecting pathological lesions. It helps the clinician to visualize and judge the likelihood of executing the proposed treatment plan. In addition to determining bone dimensions accurately, the available technical advancements in radiography have helped improve case design and treatment planning, thus conferring upon clinical results a measure of predictability. This, in turn, has helped the dental team select the proper candidate for implant therapy; implant size and design; surface texture and angulation; and the surgical technique to be utilized for implant placement. [39] (Figure7)

There are numerous radiological techniques and views available, and each has its own merits and drawbacks. The clinician should be able to select the most suitable method for each patient particularly. Sophisticated radiography, as digital computed scans, is not mandatory for every single alveolar ridge evaluation. However, some patients require sophisticated radiographic investigations for assurance of attaining a successful treatment plan. [40,41]

Periapical and panoramic views are examples of two very commonly used views in dental treatment. They offer only a two-dimensional image, where bone height and density may be gauged. These views can also be helpful in evaluating the condition of the periodontium or pulp. They are also used to asses the location of the roots relative to the neighboring anatomical structures and/or a particular future implant receptor site. Acquiring periapical and panoramic x-ray views is cost effective, as the radiographic devices can be readily available in the dental office, are easy to use, and involve minimal additional expense for the patient. [38]

Dental panoramic tomography has become a very popular radiographic technique in dentistry the main reasons for this include;.

• All the teeth and their supporting structures
• The technique is reasonably simple
• The radiation dose is relatively low

Selection criteria

In the UK, the Selection Criteria in Dental Radiography booklet recommends a dental panoramic tomograph (DPT) in general dental practice in the following circumstances;

• As part of an orthodontic assessment where there is a clinical need to know the state of the dentition and the presence/absence of teeth

• To assess bony lesions or an unerupted tooth that are too large to be demonstrated on intraoral films
• Prior to dental surgery under general anaesthesia
• As part of an assessment of periodontal bone support where there is pocketing greater than 5 mm
• Assessment of third molars, at a time when consideration needs to be given to whether they should be removed or not. In addition, in dental hospitals DPTs are also used to assess;
• Fractures of all parts of the mandible except the anterior region
• Antral disease — particularly to the floor, posterior and medial walls of the antra
• Destructive diseases of the articular surfaces of theTMJ
• Vertical alveolar bone height as part of preimplant planning.

The Selection Criteria booklet specifically states that 'panoramic radiographs should only be taken in the presence of clinical signs and symptoms', and goes on to say that 'there is no justification for review panoramic examinations at arbitrary intervals'.

The theory of dental panoramic tomography is complicated. Nevertheless, an understanding of how the resultant radiographic image is produced and which structures are in fact being imaged, is necessary for a critical evaluation and for the interpretation of this type of radiograph The difficulty in panoramic tomography arises from the need to produce a final shape of focal trough which approximates to the shape of the dental arches. [41,42]

An explanation of how this final horseshoeshaped focal trough is achieved is given below. But first, other types of tomography — which form the basis of panoramic tomography -- are described, showing how they result in different shapes of focal trough. These include;
• Linear tomography using a wide or broad X-ray beam
• Linear tomography using a narrow or slit X-ray beam

Dental panoramic tomography Panoramic radiography is believed to be the standard technique for radiographic examination in the treatment planning for patients receiving dental implants. It shows the hard and soft tissue anatomy and the related structures of the maxilla and mandible in a single film. However, although it is considered the most popular two-dimensional view in oral implantology treatment, it has its own shortfalls; it fails to show the width of the object. Panoramic views also have lower resolution (especially in the anterior zone) than intraoral radiographs. Moreover, when, these radiographs are magnified to 15-22%, it is difficult to calculate the exact bone height, or mesiodistal distance, without performing a mathematical calculation to eliminate the magnification factor. In spite of its disadvantages, however, panoramic radiography will remain the radiographic examination tool of choice in dental implant treatments because of its simplicity and affordability. [42]

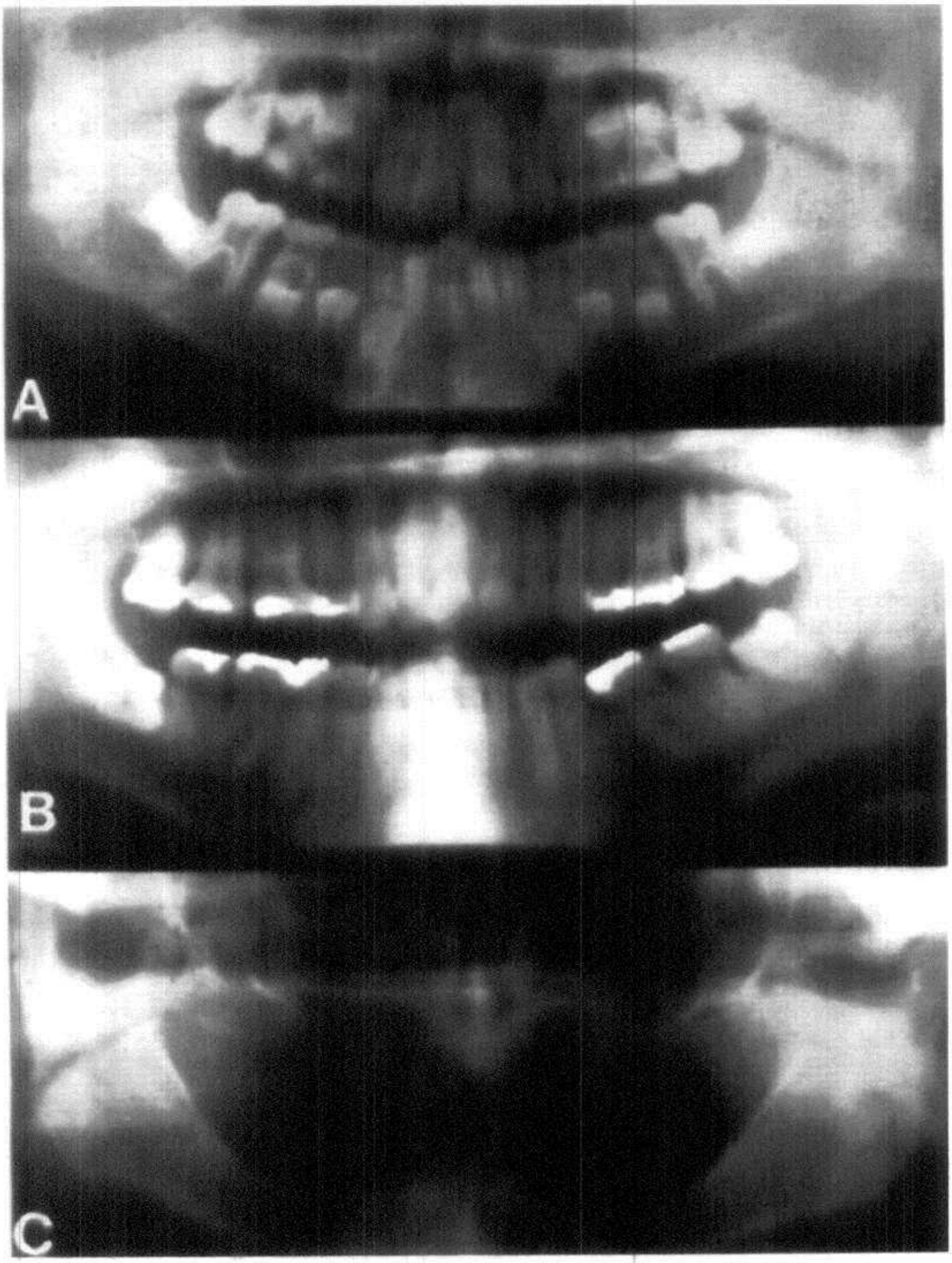


Figure7

Examples of dental panoramic tomographs (DPTs). A A child in mixed dentition. B A dentate adult. C An edentulous adult.

The dental arch, though curved, is not the shape of an arc of a circle. To produce the required elliptical, horseshoe-shaped focal trough, panoramic tomographic equipment employs the principle of narrow-beam rotational tomography[39,42], but uses two or more

centres of rotation There are several dental panoramic units available; they all work on the same principle but differ in how the rotational movement is modified to image the elliptical dental arch. Four main methods have been used including;

- Two stationary centres of rotation, using two separate circular arcs
- Three stationary centres of rotation, using three separate circular arcs
- A continually moving centre of rotation using multiple circular arcs combined to form a final elliptical shape
- Rotational tomography using a slit X-ray beam. Broad-beam linear tomography

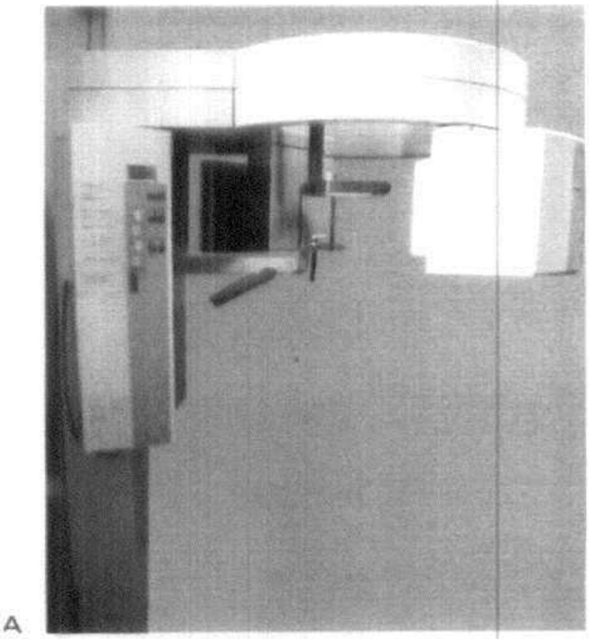
The synchronized plane, results in a straight linear focal trough. The broad X-ray beam expos movement of the tubehead and film, in the vertical es the entire film throughout the exposure. [41,42]

- A combination of three stationary centres of rotation and a moving centre of rotation. However the focal troughs are produced, it should be remembered that they are threedimensional. The focal trough is thus sometimes described as a focal corridor. All structures within the corridor, including the mandibular and maxillary teeth, will be in focus on the final radiograph. The vertical height of the corridor is determined by the shape and height of the X-ray beam and the size of the film As in other forms of narrow-beam tomography, a different part of the focal trough is imaged throughout the exposure. The final radiograph is thus built up of sections each created separately, as the equipment orbits around the patient's head. [43]

Equipment there are several different dental panoramic tomographic units available. Although varying in design, all consist of three main components, namely;

- An X-ray tubehead, producing a narrow fan-shaped X-ray beam, angled upwards at approximately 8° to the horizontal .
- A cassette and cassette carriage assembly
- Patient-positioning apparatus including light beam markers.

Examples of two typical machines are showen (Figure8). Almost all modern panoramic machines have a continuous mode of operation and produce a socalled continuous image showing an uninterrupted image of the jaws, as described below. However, one machine was developed that produced a socalled split-mode image because the radiographic image is split by a broad, vertical, white, unexposed zone, with duplication of the midline.The split-mode equipment is now onlyof historical interest, but split-mode images may still be encountered in patients' records. [43,44]



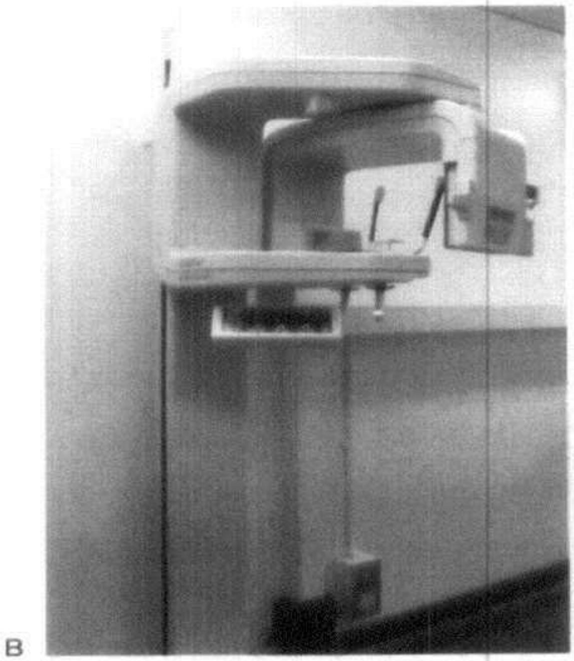


Figure 8

Examples of two dental panoramic tomography machines. The basic components common to both machines include the X-ray tubehead, cassette carrier and the patient positioning apparatus.

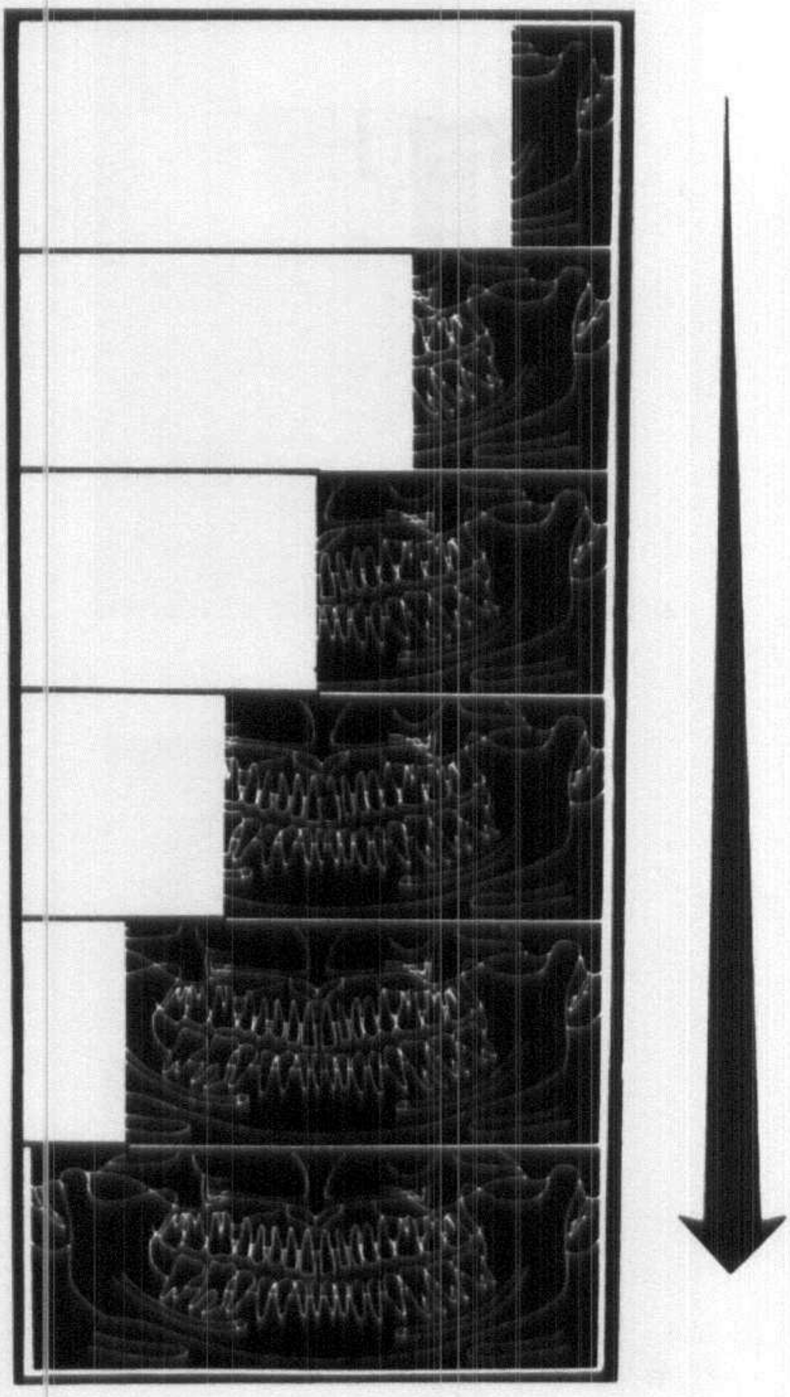


Figure 9

Diagram showing the gradual build-up of a panoramic tomograph over an 18-second cycle, illustrating how a different part of the patient is imaged at different stages in the cycle.

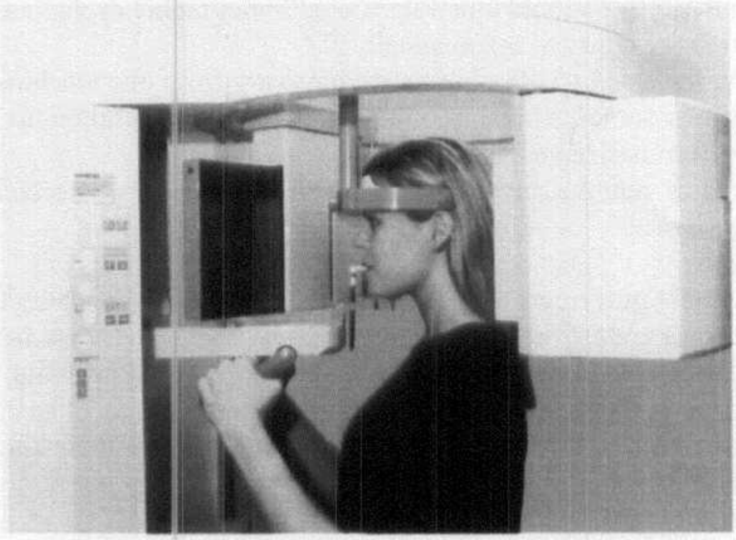
Continuous-mode equipment(Figure 9)

X-ray production is continuous throughout anuninterrupted tomographic cycle, during which the centres of rotation are adjusted automatically. [44]
Technique and positioning the exact positioning techniques vary from one machine to another. However, there are some general requirements that are common to all machines and these can be summarized as follows;
• Patients should be asked to remove any earrings, jewellery, hair pins, spectacles, dentures or orthodontic appliances.

• The procedure and equipment movements should be explained, to reassure patients. Patients should be placed accurately within the machines using the various head-positioning devices and light-beam marker positioning guides . (In some units the patients face away from the equipment and towards the operator and in others the patient faces the other way round.) Patients should be instructed to place their tongue into the roof of the mouth so that it is in contact with the hard palate and not to move throughout the exposure cycle (approximately 18 seconds). (Figure10)
• Appropriate exposure setting should be selected, typically in the range 70-100 kV and 4-12mA.

Panoramic tomography is generally considered to be unsuitable for children under 5 years old, because of the length of the exposure and the need for the patient to keep still. [43]

The positioning of the patient's head within this type of equipment is critical it must be positioned accurately so that the teeth lie within the focal trough.The effects of placing the head too far forward, too far back or asymmetrically in relation to the focal trough,. The parts of the jaws outside the focal trough will be out of focus. The fan-shaped X-ray beam causes patient malposition to be represented mainly as distortion in the horizontal plane, i.e. teeth appear too wide or too narrow rather than foreshortened or elongated. These and other positioning errors are shown later However accurately the patient's head is positioned, the inclination of the incisor teeth, or the underlying skeletal base pattern, may make it impossible to position both the mandibular and maxillary teeth ideally within the focal corridor.



A

B

Figure 10

A Patient positioned in the Siemens Orthophos. B Patient positioned in the Planmeca PM2002. Note the bite-peg, chin and forehead or temporal supports to facilitate positioning. Slight-beam marker lines are also provided as shown in B..

The normal anatomical shadows that are evident on panoramic radiographs vary from one machine to another, but in general they can be subdivided into;

• Real or actual shadows of structures in, or close to, the focal trough

• Ghost or artefactual shadows created by the tomographic movement and cast by structures on the opposite side or a long way from the focal trough. The 8° upward angulation of the X-ray beam means that these ghost shadows appear at a higher level than the structures that have caused them.Real or actual shadows

Important hard tissue shadows These include;

• Teeth• Mandible

• Maxilla, including the floor, medial and posterior walls of the antra

• Hard palate

• Zygomatic arches

• Styloid processes

• Hyoid bone

• Nasal septum and conchae

• Orbital rim

• Base of skull.

An additional real shadow is often cast by the vertical plastic head supports.

Air shadows

• Mouth/oral opening

• Oropharynx.

Important soft tissue shadows

• Ear lobes

• Nasal cartilages

• Soft palate

• Dorsum of tongue

• Lips and cheeks

• Nasolabial folds.

Ghost or artefactual shadows

The more important ghost shadows include;

• Cervical vertebrae

• Body, angle and ramus of the contralateral side of the mandible

• Palate.

Advantages and disadvantages

Advantages

• A large area is imaged and all the tissues within the focal trough are displayed on one film, including the anterior teeth, even when the patient is unable to open the mouth.

• The image is easy for patients to understand, and is therefore a useful teaching aid.

• Patient movement in the vertical plane distorts only that part of the image being produced at that instant.

• Positioning is relatively simple and minimal expertise is required.

• The overall view of the jaws allows rapid assessment of any underlying, possibly unsuspected, disease.
• The view of both sides of the mandible on one film is useful when assessing fractures and is comfortable for the injured patient.
• The overall view is useful for evaluation of periodontal status and in orthodontic assessments.
• The antral floor, medial and posterior walls are well shown.
• Both condylar heads are shown on one film, allowing easy comparison .
The radiation dose (effective dose) is about onethird of the dose from a full-mouth survey of intraoral films .
• Development of field limitation techniques with resultant dose reduction.

Disadvantages

• The tomographic image represents only a section of the patient. Structures or abnormalities not in the focal trough may not be evident .
• Soft tissue and air shadows can overlie the required hard tissue structures .
• Ghost or artefactual shadows can overlie the structures in the focal trough .
• The tomographic movement together with the distance between the focal trough and film produce distortion and magnification of the final image (approx. x 1.3).
• The use of indirect-action film and intensifying screens results in some loss of image quality.
• The technique is not suitable for children under 5 years or on some disabled patients because of the length of the exposure cycle.
• Some patients do not conform to the shape of the focal trough and some structures will be out of focus. Periapical and panoramic views are not the only views that are applicable in dental implantology. Lateral cephalometric radiographs are usually used in order to focus on the anterior maxilla and mandible. Here, the trajectory and angulation of the residual alveolar ridge are required. Therefore, cephalographs provide information regarding the angulation of the implants to be placed. They are, however, limited in their application in dental implantology to completely edentulous patients. [44]

Dental implants in general have benefited from computed dental radiography. Computerized tomography (CT), specifically, offers several advantages. It produces sharp images, eliminates the need for film processing utilizes a lower dose of radiation, presents precise measurements directly without magnification, and provides a digital image that can be stored on the computer for future comparisons. (Figure11)

Computerized tomography (CT) is based on a software program that constructs a three-dimensional model. It creates clear tomographic sections for the alveolar bone, and differentiates between soft and hard tissues clearly as never before. It reformats the image data to create a tangential and cross-sectional tomographic image of the future implant site; it also verifies the bone quality precisely. This three-dimensional model is computed using several radiographic views from specific angles. Because of its ability to provide a complete three-dimensional image, CT provides a highly sophisticated format for precisely defining jaw structure and locating critical anatomical structures. [44]

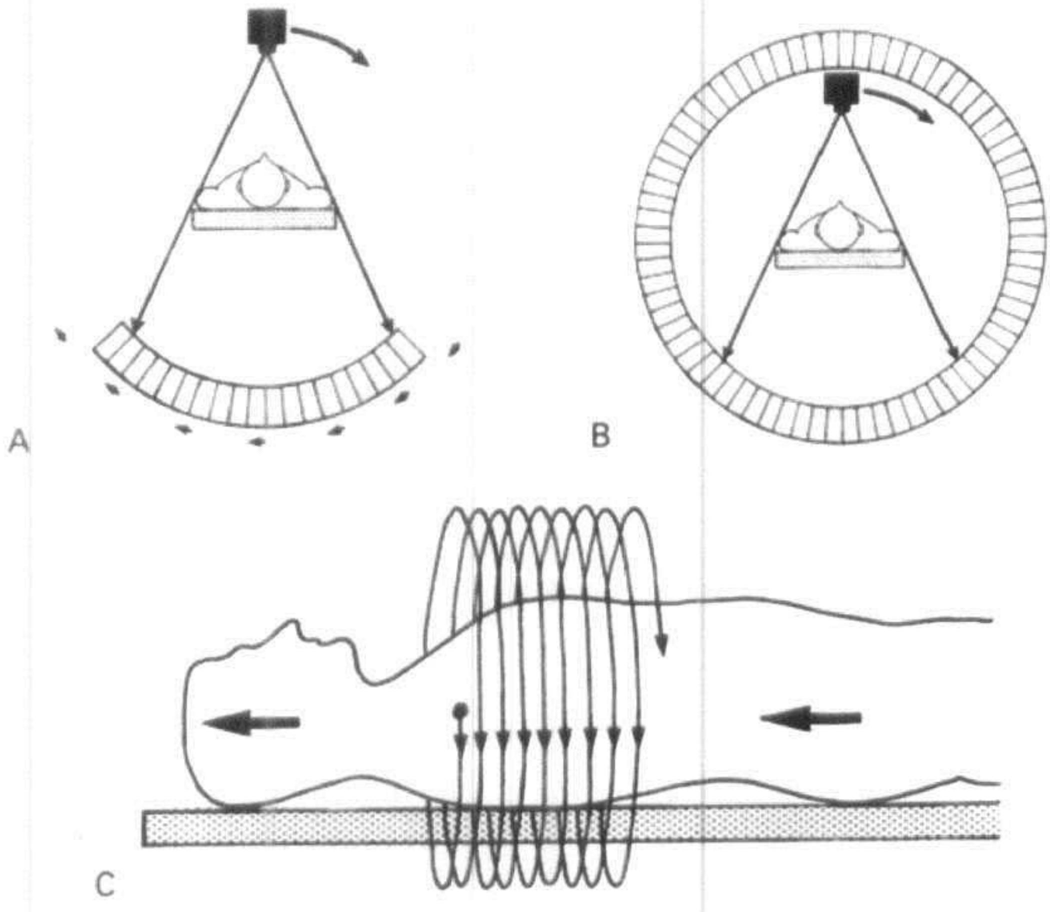


Figure 11

Diagrams showing the principles of A third-generation CT scanne.

Making sensible decisions is one of the most important daily activities of any clinician's practice. Currently obtainable data, statistical analysis methods, and technological advancements give the practitioner the facility to select a specific treatment path in a more thorough and predictable manner than ever before. When treating a partially or completely edentulous patient with dental implants, the primary target of the treatment should be determined; functional, aesthetic, or both. When aesthetics is a priority in the treatment plan, the patient should be actively involved in the details of the treatment plan.

According to radiological assessment ,amount and health of present amount of bone treatment plan will selected either conventional fixed bridges , adhesive bridges , removable denture or dental implant[43,44].

AIM OF THE WORK

AIM OF THE WORK

The objectives of the present study are to;

1) Monitor jawbone quality by evaluating its BMD for lack of calcium and first diagnosis of osteopenia or osteoporosis using the DXA technique before dental implants.
2) Monitor jawbone quantity and quality by evaluating its Orthopanoramic X-ray radiograms using a computerized system, which will be integrated on purpose for the study.
3) Compare and analyze between qualitative and quantitative measurements of both techniques and develop a standard protocol for dental implant.

SUBJECTS & METHODES

III.SUBJECTS AND METHODS

The study population was comprised of 80 subjects were divided into two groups. The first group (study group) consisted of 40 dentistry patients, of whom there were 20males and 20 females. Their age had a mean ($\pm$ SD) of 41.53 $\pm$ 12.63 yr, and ranged from 21.00 – 68.00 yr. The second group (control group) consisted of 40 healthy individuals, who were matched with the patients for age, height, and sex.

All study participants were asked to volunteer to the study. They also provided signed informed consent prior to their inclusion in the study. The study protocol was in conformity with ethical of the Medical Research Institute, Alexandria University, Egypt.

III.1. SUBJECTS

The study population consisted of patients with a diagnosis for dental implants(i.e., with missing tooth or teeth), who are meeting the following inclusion criteria; no para-functional habits, which are the most common cause of implant failure; good oral hygiene, no history of or controlled diabetes mellitus, available amount of bone, no risk for involving maxillary sinus, and accept to undergo surgical procedure for implants.

Subjects with following criteria had been excluded from the study; highly infectious diseases (e.g., AIDS and hepatitis), smokers because high risk for implant failure, poor oral hygiene , uncontrolled diabetes mellitus, and known cardiovascular diseases.

Participant patients will be free to volunteer and will be asked to provide signed informed consent prior to their inclusion in the study.

III.2. METHODS

; PATIENT RECRUITMENT

Patients were recruited from the City of Alexandria for participating in the present study. Standard paper datasheet for collecting general, clinical, and nutritional history for all participants was prepared, which will included the following ;voices

1. A computer generated random number.
2. Name ,job and address (for determining socio-economic level).

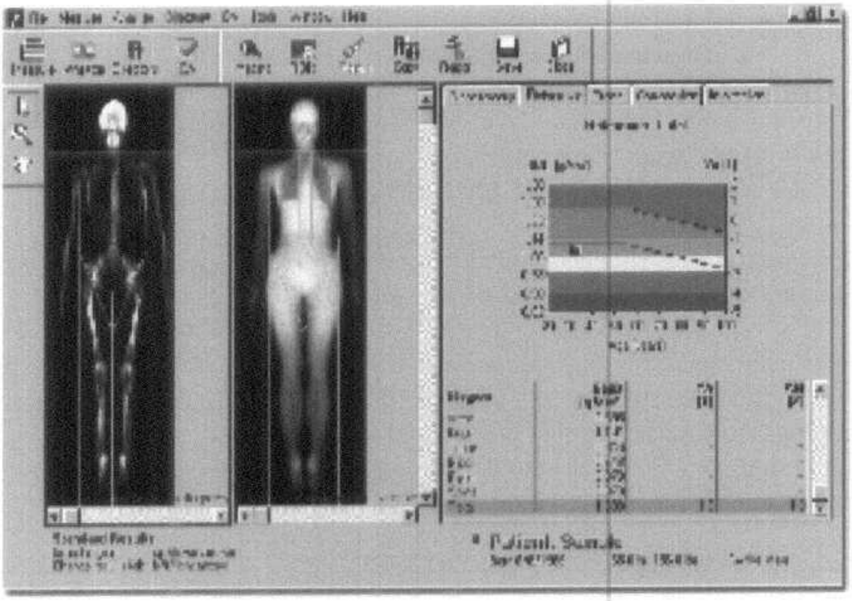


Figure 12
Show live picture of DXA and example of reporting system.

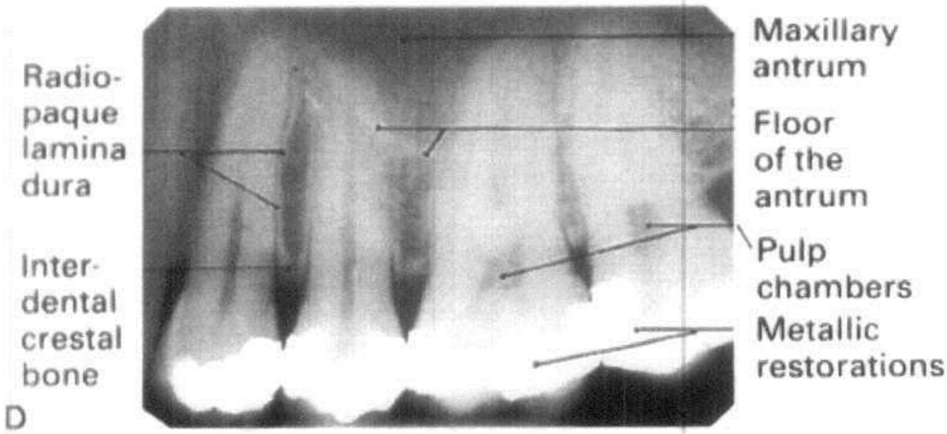


Figure 13
Example of perapical x-rays

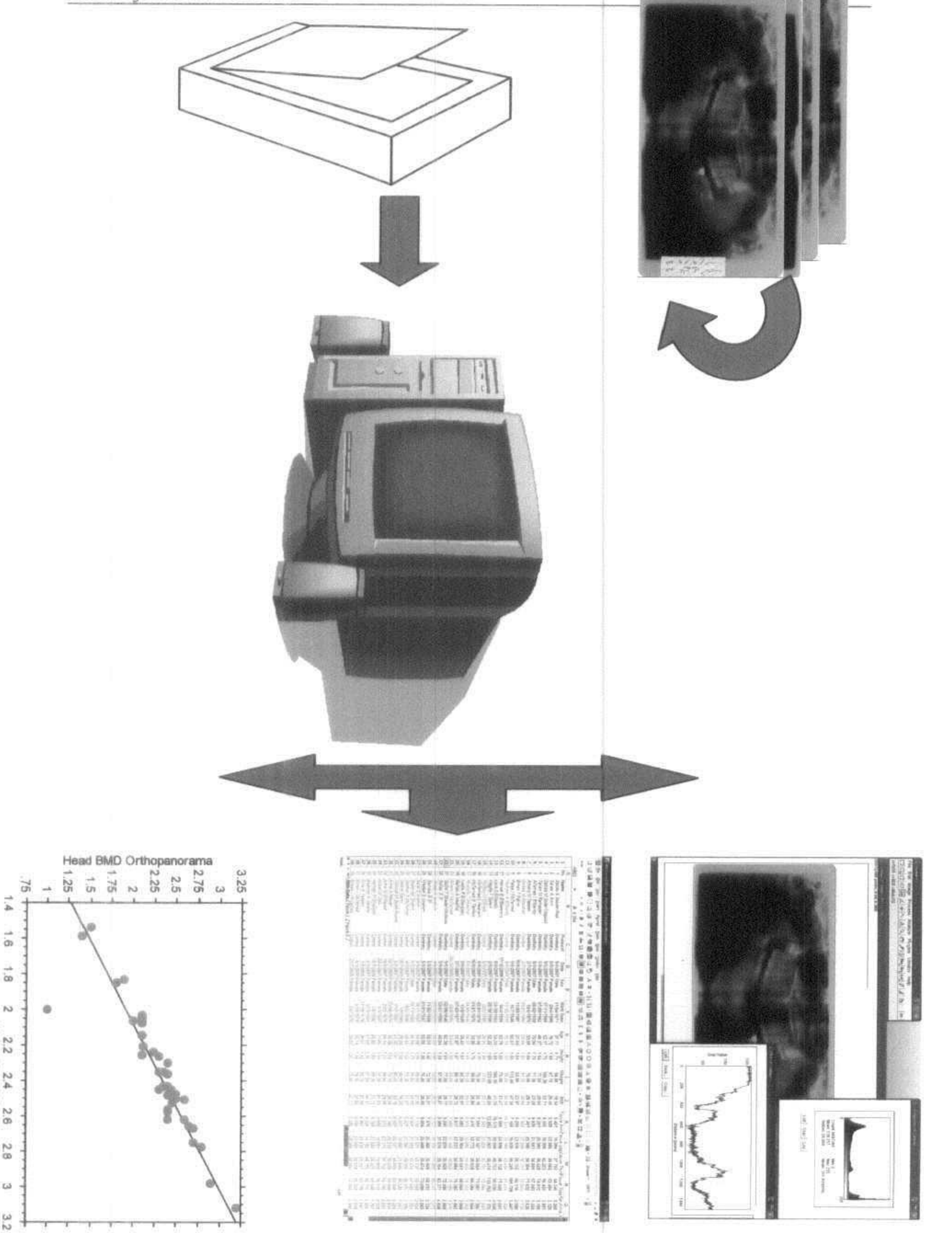


Figure 14

Illustrate hardware used for analysis of panoramic x_xays

RESULTS

IV .Results

Demographic variable and clinical diagnoses of dental disease data for the patients included in the study groups are listed in Table 2. Patients, compared to the healthy controls, were found to have significantly mean body weight (82.62 $\pm$ 17.17 vs. 74.02 $\pm$ 15.56 kg, $p<0.0001$) and BMI (31.44 $\pm$ 7.39 VS. 27.68 $\pm$ 5.06 KG/M^2, $P<0.0001$). No significant difference was found between patients and the control group in age (41.53 $\pm$ 12.63 year vs. 39.48 $\pm$ 15.23 year, $p>0.05$) or height (1.63$\pm$ 0.09 vs. 1.63 $\pm$ 0.13 m, $p>0.05$). (Table1)

DMF Index for Each Permanent tooth is examined and if it is decayed (D), missing due to caries (M), or filled (F), it is scored one. The total score of DMF index expresses the sum of decayed, missing and filled teeth per person. It is also called an individual,s dental caries experience. It ranges from 0 to 32, in a whole number. The average number of DMF teeth for a group is computed by dividing the total DMF scores of all persons in the group by the number of these persons, so the average score for a group can have decimal value. (Table1)

DMFS Index It is a sensitive measure of dental conditions. The unit measurement is the tooth surface. If a carious tooth has more than one lesion, they will not be detected by DMF index. To overcome this disadvantage we use DMFS so that changes in caries experience can still be seen easily in mouths having such high caries attack.

This index can also be used in clinical trials of caries preventing agents. The DMFS is calculated the same way as for DMF, except that tooth surfaces are counted instead of teeth.

Periodontal IndicesClinical diagnosis of gingivitis depends on change in colour, shape and texture of the papillary and marginal tissues. Diagnosis of more destructive periodontal disease is based on the same factors together with clinical and radiographic observations of pocket deepening and bone loss.

Some periodontal indexes measure the reversible stage of the disease, i.e. gingivitis; an inflammary condition which is reversible in its early stages. Some other measure the irreversible effect, that is, bone loss. However, the most commonly used indexes measure both reversible and irreversible conditions, i.e. composite indexes.

Although there are many indices for recording and quantitating periodontal disease the well known and widely used ones will be discussed. These indices can be classed according to the variable measured into;

1- Indices that measure the degree of inflammation of the gingival tissues e.g. the Papillary-Marginal-Attached (PMA) Index and Gingival Index (GI).
2- Indices that quantify the degree of periodontal destruction e.g. Russell,s Periodontal Index (PI).
3- Indices that assess treatment needs, e.g. Commmunity Periodontal Index of Treatment Needs (CPITN).
4- Indices that evaluate amount of plaque and calculus accumulation i.e. level of oral cleanliness e.g. Simplified Oral Hygiene Index (OHI-S) and Plaque Index (PLI).

missing teeth lead to mal digestion due to inability to chewing food so as observation found patient sever from missing teeth more liable to obesity specialy in legs & trunk and to some extent in arm

Dental patients had significantly higher T-and Z-Scores than the healthy controls (0.65 ± 1.28 VS. 0.56 ± 1.36 and 0.28 ± 1.03 VS. 0.41 ± 0.96 respectively , P<0.0001). (Table2)

Total BMD and BMD values at pelives and lumber spine more susceptible to fracture risk

The BC data for study groups are represented in figure 15 to 19. dental patients were significantly higher in their BFM than the healthy controls for the total body (35.06 ± 10.05 vs. 28.56 ± 12.04 kg) and the body segments-legs (14.07± 3.82 vs. 10.78 ± 4.85 kg) and trunk (16.86 ± 5.53 vs. 14.52 ± 6.71 kg) (p<0.001)(figure 13). The difference between the groups in segmental BFM for the arms was not statistically significant (3.30 ± 1.13 vs. 2.46 ± 1.30 kg, p>0.05)(figure 13).

The same trend of difference was also observed between the dental patients and healthy controls in their total and segmental LBM (Figure 16). dental patients were significantly lower in their LBM than the healthy controls for the total body (42.96 ± 9.0 vs. 41.78 ± 10.5 kg, p<0.001) and the body segments-legs (14.30 ± 3.0 vs. 14.37 ± 3.5 kg, p<0.001) and trunk (20.69 ± 4.5 vs. 19.29 ± 5.8 kg, p< 0.005). The difference between the groups in segmental LBM for the arms was not statistically significant (4.8 ± 1.5 vs. 5.5 ± 1.5 kg, p>0.05).

Dental patients were significantly lower in their BMC than the healthy controls for the total body (2.39 ± 0.45 vs. 2.66 ± 0.46 kg, p<0.001) and the body segments-legs (1.05 ± 0.25 vs. 0.92± 0.24 kg, p<0.001) and trunk (0.60 ± 0.23 vs. 0.80 ± 0.2 kg, p<0.001). The difference between the groups in segmental BMC for the Head was not statistically significant (0.51± 0.09 vs. 0.51 ± 0.1 kg, p>0.05)(Figure 17).

BMD was significantly lower in dental patient for the total body and for all body segments including the arms (Figure18). BMD values were for total body (1.17 ± 0.45 vs. 1.17 ± 0.46 kg, p<0.001) and the body segments-legs (1.20 ± 0.25 vs. 1.21± 0.24 kg, p<0.001) and trunk (0.60 ± 0.23 vs. 0.80 ± 0.2 kg, p<0.001).

Head BMD measured from orthopanorma of dentistary patients and healthy controls and head BMD by DXA technique calculated by this question (Figure19)

$$\textbf{Head BMD}_{\textbf{ORTHO}} = -0.22 + 1.069 \times \textbf{Head BMD}_{\textbf{DXA}}$$
$$\mathbf{R = 0.997,\ R^2 = 0.994,\ P < 0.0001}$$

R Coorelation coefficient **R^2** Determination coefficient

Table 1; Demographic and clinical data for study group (*n* = *40*) and controls group (*n* = *40*)

	Study	Control
Age *(year)*	41.53 ± 12.63	39.48 ± 15.23
Sex *(Male/Female)*	20/20	20/20
Height *(m)*	1.63 ± 0.09	1.63 ± 0.13
Weight *(kg)*	82.62 ± 17.17*	74.02 ± 15.56
Body Mass Index *(BMI, kg/m²)*	31.44 ± 7.39*	27.68 ± 5.06
;Dental scores(DMF)(GT)		
Tooth Decay	4	4
Missing teeths	5	2
Filling	3	6
Gingivitis index	1	1
T.M.J disorder	30%	25%

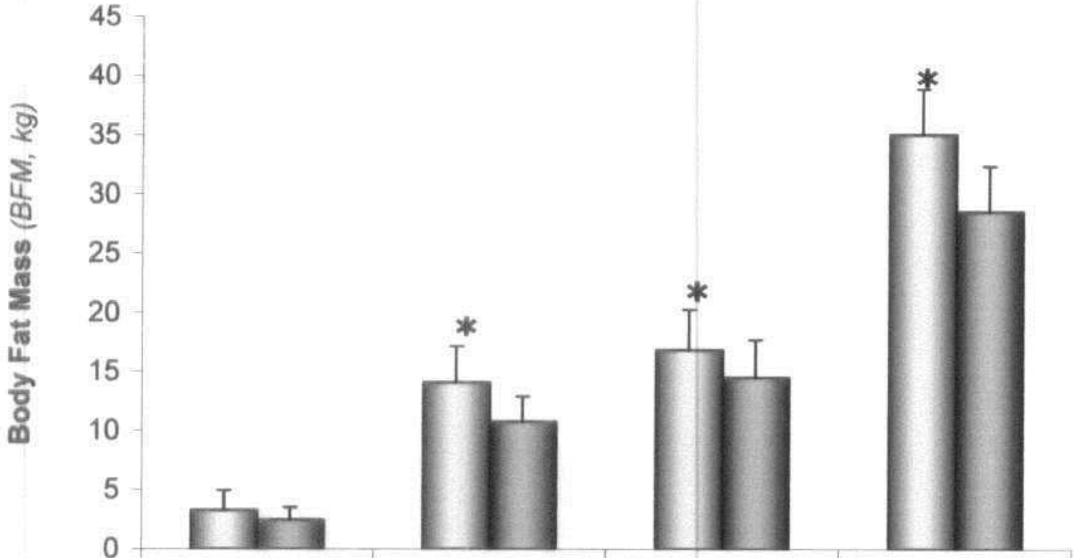
Values are *Mean ± SD.*
*P < 0.0001 as compared to the Control group.

Table 2; Segmental and total Bone Mineral Density (BMD, g/cm^2) data together with T- and Z-Scores for dentistry patients ($n = 40$) and healthy controls ($n = 40$).

	Dentistry	Control
Bone Mineral Density *(g/cm^2)*		
Head	2.37 ± 0.40	2.35 ± 0.32
Arms	0.87 ± 0.11	0.84 ± 0.11
Legs	1.20 ± 0.08	1.21 ± 0.19
Trunk	0.98 ± 0.11	1.00 ± 0.11
Ribs	0.77 ± 0.08	0.78 ± 0.09
Pelvis	1.16 ± 0.15	1.17 ± 0.18
Lumbar Spine	1.15 ± 0.17	1.20 ± 0.20
Total	1.17 ± 0.12	1.17 ± 0.14
T-Score	0.65 ± 1.28	0.56 ± 1.36
Z-Score	0.28 ± 1.03	0.41 ± 0.96

Values are *Mean ±SD.*

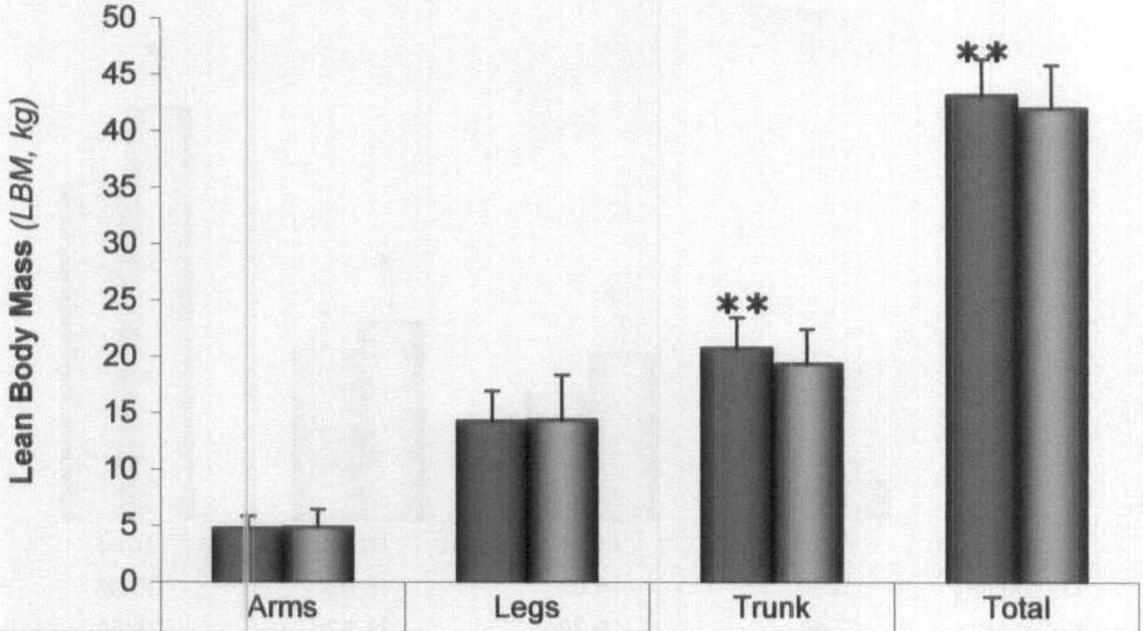
*P < 0.001 as compared to the Control group



	Arms	Legs	Trunk	Total
Dentistry	3.30	14.07	16.86	35.06
Controls	2.46	10.78	14.52	28.56

Figure 15

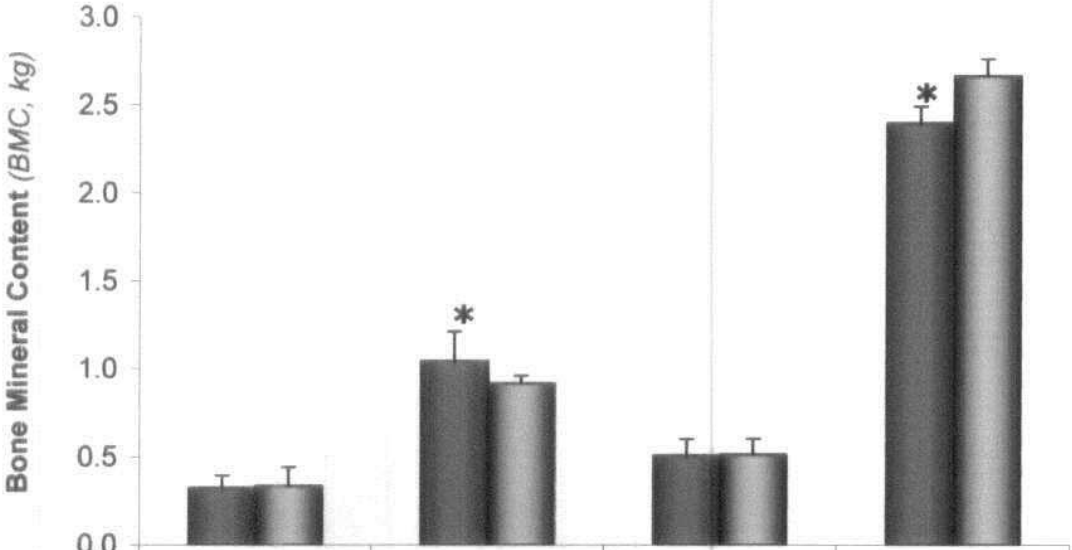
Segmental and total body fat mass (BMF;Kg) distribution for dentistary patient & healthy controls.jalnes are plotted as Mean ± SD .p significantly different ($p \leq 0.001$) from healthy controls.



	Arms	Legs	Trunk	Total
Dentistry	4.82	14.30	20.69	42.96
Controls	4.89	14.37	19.29	41.78

Figure 16

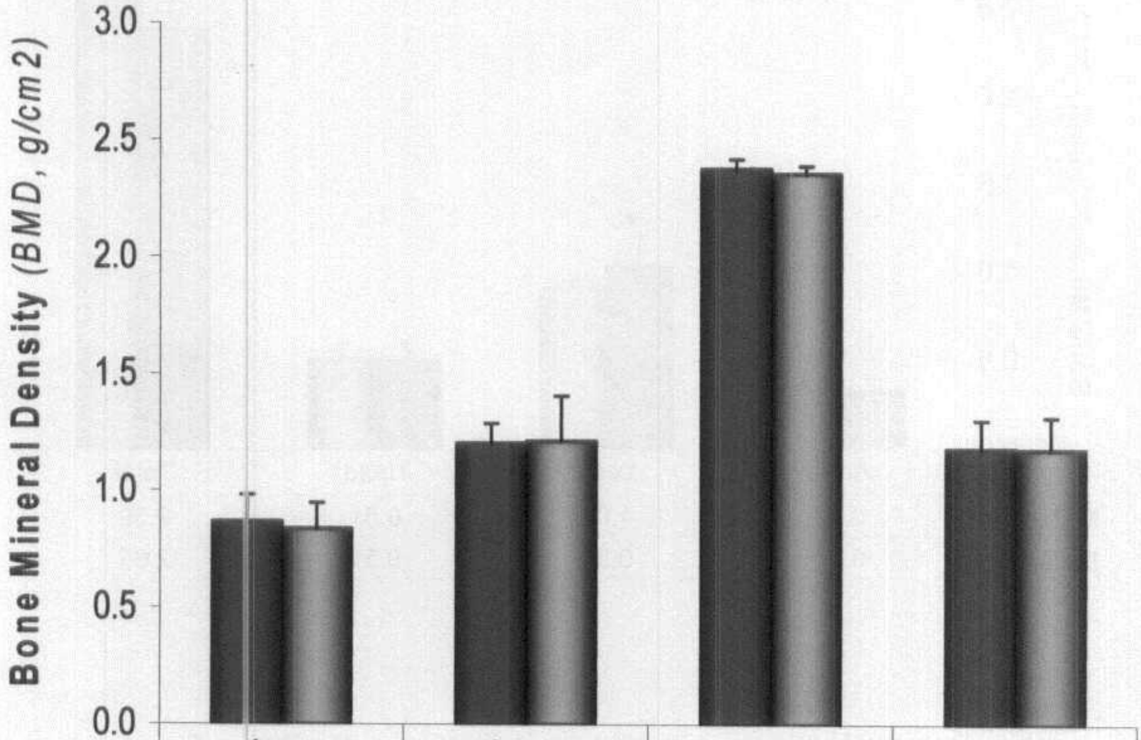
Segmental and lean body mass (LBM;Kg) distribution for dentistary patient & healthy controls.jalnes are plotted as Mean ± SD .p significantly different ($p \leq 0.001$) from healthy controls.



	Arms	Legs	Head	Total
Dentistry	0.32	1.05	0.51	2.39
Controls	0.34	0.92	0.51	2.66

Figure 17

Segmental and bone mineral content (BMC;Kg) distribution for dentistary patient & healthy controls.jalnes are plotted as Mean ± SD .p significantly different ($p \leq 0.001$) from healthy controls.



	Arms	Legs	Head	Total
Dentistry	0.87	1.20	2.37	1.17
Controls	0.84	1.21	2.35	1.17

Figure 18

Segmental and bone mineral density (BMD;Kg) distribution for dentistary patient & healthy controls.jalnes are plotted as Mean ± SD .p significantly different ($p \leq 0.001$) from healthy controls.

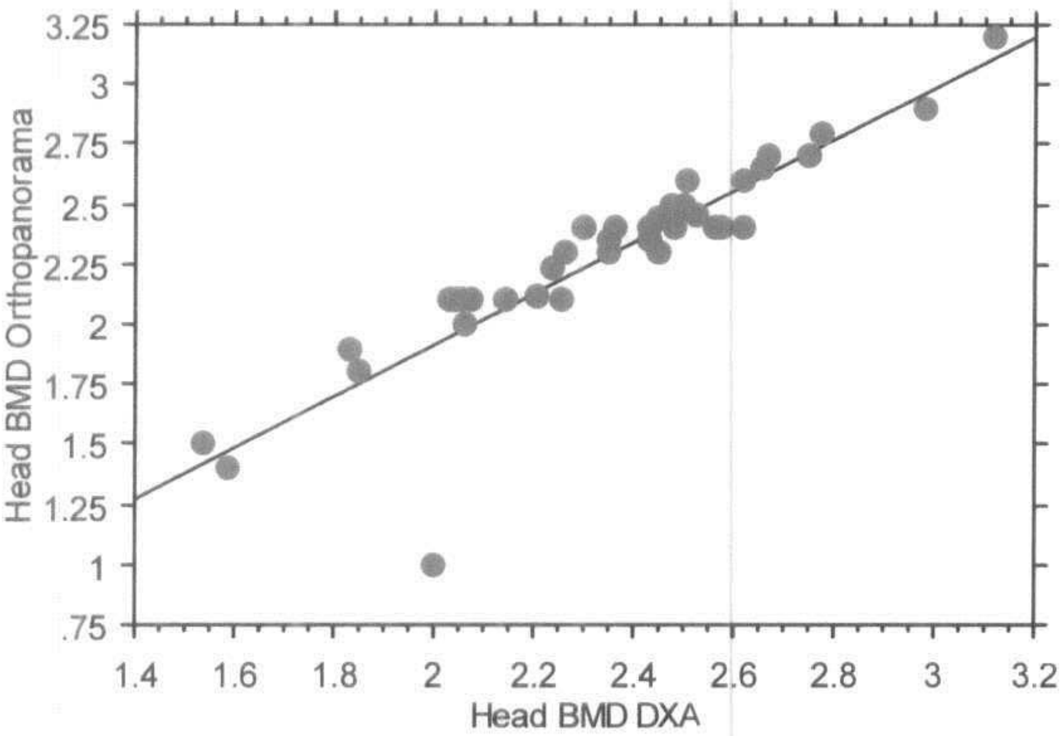


Figure 19

Scattered plot of head BMD measured from orthopanorma of dentistary patients and healthy controls and head BMD by DXA technique

$$\text{Head BMD}_{ORTHO} = -0.22 + 1.069 \times \text{Head BMD}_{DXA}$$

$$R = 0.997,\ R^2 = 0.994,\ P < 0.0001$$

R Coorelation coefficient **R^2 Determination coefficient**

DISCUSSION

V . DISSCUSION

Implant positioning in the alveolar ridge is dependent on the location and morphology of the potential osseous receptor site and its contiguous structures. Because the contour and thickness of the oral mucosa can mask the actual dimensions of the underlying osseous structure, a thorough radiographic examination is essential for diagnosis and treatment. This examination is to make note of what is and is not radiographically present, with any deviation from normality duly recorded. [11,15]

Radiographic assessment it's a significant tool in evaluating the quantity of the alveolar bone, locating any anatomical landmarks, and/or detecting pathological lesions. It helps the clinician to visualize and judge the likelihood of executing the proposed treatment plan. In addition to determining bone dimensions accurately, the available technical advancements in radiography have helped improve case design and treatment planning, thus conferring upon clinical results a measure of predictability. This, in turn, has helped the dental team select the proper candidate for implant therapy; implant size and design; surface texture and angulation; and the surgical technique to be utilized for implant placement. [18,19]

There are numerous radiological techniques and views available, and each has its own merits and drawbacks. The clinician should be able to select the most suitable method for each patient particularly. Sophisticated radiography, as digital computed scans, is not mandatory for every single alveolar ridge evaluation. However, some patients require sophisticated radiographic investigations for assurance of attaining a successful treatment plan.

Periapical and panoramic views are examples of two very commonly used views in dental treatment. They offer only a two-dimensional image, where bone height and density may be gauged. These views can also be helpful in evaluating the condition of the periodontium or pulp. They are also used to asses the location of the roots relative to the neighboring anatomical structures and/or a particular future implant receptor site. Acquiring periapical and panoramic x-ray views is cost effective, as the radiographic devices can be readily available in the dental office, are easy to use, and involve minimal additional expense for the patient. [39,41]

The periapical view has a unique advantage over other types and views of x rays. It is the only available method for routine monitoring of crestal bone levels around previously restored dental implants. It can also be a valuable reference that clinician can resort to at the time of surgery to determine the depth of drilling.

Conversely, periapical radiography has some inherent shortcoming. These inadequacies are represented in a slight magnification of images that is not consistent and that varies according to the technique used. Consequently, an image in a periapical film doesnot represent the actual size of an object. Another disadvantage is the small size of the film, which restricts the viewed area, thus limiting its clinical applications. Periapical radiographs, however, are considered valuable in the treatment planning for single tooth implants.

Modern periapical digital radiographs have reduced 90% of the radiation exposure. They have eliminated the need for films and subsequent film processing. The regular film is replaced with a sensor that is connected to a computer, where the image can be viewed instantaneously. The radiation reduction has benefited both the clinician and the patient, where digitalization has allowed for taking several views in a shorter time without fear of radiation hazard. It is thought to be cost effective in comparison with the regular radiographic .

Panoramic radiography is believed to be the standard technique for radiographic examination in the treatment planning for patients receiving dental implants. It shows the hard and soft tissue anatomy and the related structures of the maxilla and mandible in a single film. However, although it is considered the most popular two-dimensional view in oral implantology treatment, it has its own shortfalls; it fails to show the width of the object. Panoramic views also have lower resolution (especially in the anterior zone) than intraoral radiographs. Moreover, when, these radiographs are magnified to 15-22%, it is difficult to calculate the exact bone height, or mesiodistal distance, without performing a mathematical calculation to eliminate the magnification factor. In spite of its disadvantages, however, panoramic radiography will remain the radiographic examination tool of choice in dental implant treatments because of its simplicity and affordability.[(43,44)]

The Dual-energy X-ray Absorptionetry (DXA) is employed for evaluating bone mineral density (BMD) of different sites of the human body, which is widely accepted as a reference measure of bone health status in many pathological cases.[(28-30)] Based on DXA scans, the BMD measurements of a patient can be compared with standard BMD measurements for a reference healthy population, which helps predicting a patient's risk for fracture.[(28,29)] Thus, these evidences propose the possibility of its routine use for frequently evaluating jaw BMD.[(28-30)]

Selection of the most suitable radiographic view requires rational decision and sound judgment. Sophisticated and expensive radiographic procedures may sometimes not be helpful in detecting the various parameters needed to make a precise diagnosis, and the regular readily available radiographic techniques may be sufficient.

Making sensible decisions is one of the most important daily activities of any clinician's practice. Currently obtainable data, statistical analysis methods, and technological advancements give the practitioner the facility to select a specific treatment path in a more thorough and predictable manner than ever before. When treating a partially or completely edentulous patient with dental implants, the primary target of the treatment should be determined; functional, aesthetic, or both. When aesthetics is a priority in the treatment plan, the patient should be actively involved in the details of the treatment plan.

According to radiological assessment ,amount and health of present amount of bone treatment plan will selected either conventional fixed bridges , adhesive bridges , removable denture or dental implants. BMD shows significant differences among different ethnic groups, and is affected by age and gender. However, there has been neither a study to examine and correlate the immediate segmental and total body changes in volume of fluid compartments before and afterdental, nor a study to accept or reject the hypothesis that dental Egyptian patients are at increased risk for osteoporosis and in need for special care and management. Hence, this study was aimed to compare an ethnically uniform group of dental Egyptian patients to a matched control group of healthy individual in terms of their body composition and, in particular, total body and segmental BMD. [32]

The study population was comprised of 80 subjects were divided into two groups. The first group (study group) consisted of 40 dentistry patients, of whom there were 20males and 20 females. Their age had a mean (± SD) of 41.53 ± 12.63 yr, and ranged from 21.00 – 68.00 yr. The second group (control group) consisted of 40 healthy individuals, who were matched with the patients for age, height, and sex.

Segmental and total BC (i.e., BFM, LBM, BMC, AND BMD) were measured for all participants using DXA. DXA is the method of choice of BMD for the diagnosis of osteopenia/osteoporosis as recommended by the WHO. BMD was measured using DXA. DXA is a noninvasive method used for the quantification of BMD, and it has been shown to be a strong predictor of bone strength. Compared to the other methods, Which include periapical and panaromic x-rays , DXA systems are affordable, practical, require no active subject involvement and involve minimal radiation levels. The other methods, on the other hand, are costly, require highly trained staff for their operation and implementation, depended in part on subject participation, or involve exposure to moderate radiation doses.

Furthermore, DXA permits quantification of multiple whole body and segmental components. For these reasons, DXA is gaining international acceptance as a body-composition reference method.

In conclusion DXA was used and successfully could show the differences in BMD in dental patients in comparison with healthy controls. It should be used as ascreening test to assess BC and identify those patients with risk of osteoporosis .

SUMMARY

VI .SUMMERY

Radiographic assessment it's a significant tool in evaluating the quantity of the alveolar bone, locating any anatomical landmarks, and/or detecting pathological lesions. It helps the clinician to visualize and judge the likelihood of executing the proposed treatment plan. In addition to determining bone dimensions accurately, the available technical advancements in radiography have helped improve case design and treatment planning, thus conferring upon clinical results a measure of predictability. This, in turn, has helped the dental team select the proper candidate for implant therapy; implant size and design; surface texture and angulation; and the surgical technique to be utilized for implant placement.

Periapical and panoramic views are examples of two very commonly used views in dental treatment. They offer only a two-dimensional image, where bone height and density may be gauged. These views can also be helpful in evaluating the condition of the periodontium or pulp. They are also used to asses the location of the roots relative to the neighboring anatomical structures and/or a particular future implant receptor site. Acquiring periapical and panoramic x-ray views is cost effective, as the radiographic devices can be readily available in the dental office, are easy to use, and involve minimal additional expense for the patient.

The periapical view has a unique advantage over other types and views of x rays. It is the only available method for routine monitoring of crestal bone levels around previously restored dental implants. It can also be a valuable reference that clinician can resort to at the time of surgery to determine the depth of drilling.

Conversely, periapical radiography has some inherent shortcoming. These inadequacies are represented in a slight magnification of images that is not consistent and that varies according to the technique used. Consequently, an image in a periapical film doesnot represent the actual size of an object. Another disadvantage is the small size of the film, which restricts the viewed area, thus limiting its clinical applications. Periapical radiographs, however, are considered valuable in the treatment planning for single tooth implants.

Panoramic radiography is believed to be the standard technique for radiographic examination in the treatment planning for patients receiving dental implants. It shows the hard and soft tissue anatomy and the related structures of the maxilla and mandible in a single film. However, although it is considered the most popular two-dimensional view in oral implantology treatment, it has its own shortfalls; it fails to show the width of the object. Panoramic views also have lower resolution (especially in the anterior zone) than intraoral radiographs. Moreover, when, these radiographs are magnified to 15-22%, it is difficult to calculate the exact bone height, or mesiodistal distance, without performing a mathematical calculation to eliminate the magnification factor. In spite of its disadvantages, however, panoramic radiography will remain the radiographic examination tool of choice in dental implant treatments because of its simplicity and affordability.

The Dual-energy X-ray Absorptionetry (DXA) is employed for evaluating bone mineral density (BMD) of different sites of the human body, which is widely accepted as a reference measure of bone health status in many pathological cases.[8-10] Based on DXA scans, the BMD measurements of a patient can be compared with standard BMD measurements for a reference healthy population, which helps predicting a patient's risk for fracture.[11, 12] Thus, these evidences propose the possibility of its routine use for frequently evaluating jaw BMD.[8-10]

Selection of the most suitable radiographic view requires rational decision and sound judgment. Sophisticated and expensive radiographic procedures may sometimes not be helpful in detecting the various parameters needed to make a precise diagnosis, and the regular readily available radiographic techniques may be sufficient.

Making sensible decisions is one of the most important daily activities of any clinician's practice. Currently obtainable data, statistical analysis methods, and technological advancements give the practitioner the facility to select a specific treatment path in a more thorough and predictable manner than ever before. When treating a partially or completely edentulous patient with dental implants, the primary target of the treatment should be determined; functional, aesthetic, or both. When aesthetics is a priority in the treatment plan, the patient should be actively involved in the details of the treatment plan.

According to radiological assessment ,amount and health of present amount of bone treatment plan will selected either conventional fixed bridges , adhesive bridges , removable denture or dental implant

REFERENCES

REFERENCES

1. Hanada K, Dennis JE, and Caplan AL. stimulatory effects of basic fibroblast growth factor and bone morphogenetic protein-2 on osteogenic differentiation of rat bone marrow-derived mesenchymal stem cells. J Bone Miner 1997, [12]; 1606-14.

2. Hunt DR and Jovanovic SA. Autogenous bone harvesting; A chin graft technique for particulate and monocortical bone blocks. Int J Periodonttics Restorative Dent 1999, [19]; 165-73.

3. Simion M, Jovanic S, Trisi p, et al. Vertical ridge augmentation around dental implants using a membrane technique and autogenous bone allografts in humans int J periodent Rest Dent 1998, [18]; 8-23.

4. Boyne PJ. Use of carrier materials in delivery of bone inductor substances. In Wise DL, ed. Biomaterials Engineering and Devices; Human Application, vol. 1. Toowa, NJ; Humana press, Inc., 2000, pp. 251-6.

5. Boyne PJ. Maxillofacial surgical application of bone inductor materials. Implant Dent 2000, ;2-4.

6. Laurell L and Gottiow J. Guided tissue regeneration update. Int Dent J 1998, 48;386-98.

7. Lundgren D, Sennerby L, Taylor A, Gottlow J, and Nyman S. Bone augmentation at titanium implants using autoiogous bone grafts and abioresorabable barrier. An expermintal study in rabbit tibia. Clin Oral Implant Res 1997, [8]; 82-9.

8. Johnson K. A study of the dimensional changes occurring in the maxilla after tooth extraction. Part I; Normal healing. Aust Dent J 1963(8); 428-433.

9. Carlsson GE, Bergman B, and Headegard B. Changes in contour of the maxillary alveolar process under immediate dentures. A longitudinal clinical and x-ray cephalometric study covering 5 years. Acta Odontol Scand 1967(25); 45-75.

10. Jovanovic SA. Bone rehabilitation to achieve optimal aesthetics. Pract Periodont Aesthet Dent 1997(9); 41-52.

11. Jovanovic SA, Paul SJ, and Nishimura R D. Anterior implant-supported reconstructions; A surgical challenge. Pract Periodont Aesthet Dent 1999(11); 551-558.

12. Salama H, Salama MA, Garber D, and Adar P. The interproximal height of bone; A guidepost to predictable aesthetic strategies and soft tissue contours in anterior tooth replacement. Pract Periodont Aesthet Dent 1998(10);1131-1142.

13. Buser D, Dula K, Hirt HP, *et al*. Lateral ridge augmentation using autografts and barrier membranes; A clinical study with 40 partially edentulous patients. J Oral Maxillofacial Surgy 1996(54);420-433.

14. Javanovic SA, Spiekermann H, and Richter EJ. Bone regeneration on titanium dental implants with dehisced defect sites. A clinical study. Int J Oral Maxillofac Implants 1992(7);233-245.

15. Sumi Y, Miyaishi O, Tohnai I, and U EDA M. Alveolar ridge augmentation with titanium mesh and autogenous bone. Oral Med Oral Pathol Oral Radiol Endod 2000(89);268-270.

16. Boyne PJ, Nakamura A, and Shabahang S. Evaluation of the long-term effect of function on rhBMP-2 regenerated hemimandibulectomy defects. Br J Oral Maxillofac Surg 1999(37); 344-352.

17. Laurell L and Gottlow J. Guided tissue regeneration update. Int Dent J 1998(48)(Aug.); 386-398.

18. Lundgren AK, Lundgren D, Sennerby L, Taylor A, Gottlow J, and Nyman S. Bone augmentation at titanium implants using autologous bone grafts and a bioresorbable barrier. An experimental study in the rabbit tibia. Clin Oral Implant Res 1997(8); 82-89.

19. Lundgren D, Laurell L, Gottlow J, Rylander H, Mathisen T, Nyman S, and Rask M. The influence of the design of two different bioresorbable barriers on the results of guided tissue regeneration therapy. An intraindividual comparative study in the monkey. J Periodontol 1995(66); 605-612.

20. Becker W, Clokie C, Sennerby L, Urist M, and Becker B. Histologic finding after implantation, an evaluation of different grafting materials and titanium micro screws in extraction sockets; Case reports. J Periodontal 1998(69);414-421.

21. Gaggl A, Scultes G, and Karcher H. Vertcal alveolar ridge distraction with prosthetic treatable distractors; A clinical investigation. Int J Oral Maxillofac Implants 2000 15(5); 701-710.

22. Misch CE and Dietsh F. Bone-grafting materials in implant dentistry. Implant Dent 1993(2); 158-167.

23. Neville BW, Damn DD, Allen CM, Bouquot JE Oral and maxillofacial pathology. WB Saunders, Philadelphia 1995 ; 144-152.

24. Wood NK Review of diagnosis, oral medicine , radiology, and treatment planning. 4th edn. CV Mosby,St Louis 1999 ; 434-443.

25. McKinney RV Endosteal dental implants. Mosby Year Book, St. Louis 1991 ; 523-555.

26. Hutchinson IL, Hopper C, Conar HS Neoplasia masquerading as periapical infection. British DentalJournal 1990; 168;228-294 .

27. Proceedings of the second symposium on digital imaging in dental radiology, Amsterdam Dentomaxillofacial radiology 1992 ; 21;179-221.

28. Mohamed EI, Maiolo C, Linder R, Pöppl SJ, and De Lorenzo A. Artificial Neural Network Analysis; A Novel Application for Predicting Site-Specific Bone Mineral Density. Proceedings of The Sixth International Symposium "In Vivo Body Composition Studies" Acta Diabetol., 40 Suppl. 2003(1); S19-22.

29. Mohamed EI, Tarantino U, Promenzio L, Maiolo C, and De Lorenzo A. Predicting Bone Mineral Density of Postmenopausal Healthy and Cirrhotic Italian Women Using Age and Body Mass Index. Proceedings of The Sixth International Symposium "In Vivo Body Composition Studies" Acta Diabetol., 40 Suppl. 2003 (1); 323-328.

30. Casini A, Mohamed EI, Gandin C, Tarantino U, Di Daniele N, and De Lorenzo A. Predicting Bone Mineral Density of Postmenopausal Healthy and Cirrhotic Italian Women Using Anthropometric Variables. Digest. Liver Dis., 2003 ; 881-887.

31. Tothill P. Review: Dual-energy X-ray absorptiometry for the measurement of bone and soft tissue composition. Clin. Nutr. 1995 ; 14; 263–8.

32. Roubenoff R, Kehayias JJ, Dawson-Hughes B, Heymsfield SB. Use of dual-energy X-ray absorptiometry in body composition studies; not yet a ''gold standard.'' Am. J. Clin. Nutr. 1993; 58; 589–591.

33. Maisey M, Jeffrey P Clinical applications of positron emission tomography. British Journal of Clinical Practice1991; 45;265-72 .

34. Proceedings of the second symposium on digital imaging in dental radiology, Amsterdam Dentomaxillofacial radiology 1996 ; 21;179-221.

35. Proceedings of the third symposium on digital imaging in dental radiology,

Noorwijkerhout, The Netherlands 1995 Dentomaxillofacial radiology 1992 ; 24;67-106.

36. Hutchinson IL, Hopper C, Conar HS Neoplasia masquerading as periapical infection. British Dental Journal 1990 ; 168;228-294.

37. Lecomber AR, Downes SL, Mokhtari M, Faulkner KOptimisation of patient doses in programmable dental panoramic radiography. Dentomaxillofacial Radiology 2000 ; 29;107-12.

38. Napier I D. Reference doses for dental radiography. British Dental Journal 1999 186;8 392-396.

39. Frederiksen NL, Benson BW, SokolowskiTW Effective dose and risk assessment from film tomography used for dental implant diagnostics. Dentomaxillofacial Radiology1994 ; 23;123-7.

40. White SC Assessment of radiation risk from dental radiography. Dentomaxillofacial Radiology 1992; 21;118-26 .

41. Ferguson MM, Evans A Mason WN Continuous infusion pressure-monitored sialography. International Journal of Oral Surgery1977; 6;94-89 .

42. Rudolphy MP, van Amerongen JP, ten Gate JM Radiopacities in dentine under amalgam restorations. Caries research 1994; 28;240-45.

43. Palmer RM 2000 A clinical guide to implants in dentistry. 1997 ;131-142.

44. White SC. Pharoah MJ Oral radiology - principles and interpretation^* edn. CV Mosby, St. Louis; 2000 ; 326-354.

PROTOCOL

Comparative Analysis of Dual-Energy X-Ray Absorptiometry and Ortho-panoramic X-Ray for Monitoring Jawbone Health Before Dental Implant

تحليل مقارن لمقياس إمتصاص أشعة-إكس مزدوجة الطاقة و مصور أشعة-إكس البانورامى لدراسة صحة عظام الفك قبل الغرسات السنيه

Protocol of thesis submitted to the
Medical Research Institute
University of Alexandria
In partial fulfillment of the
Master Degree

in

Bio-Medical Physics
Biophysics Department

By

HASSAN MOSTAFA HASSAN ABOSHALL
B.D.S.
Faculty of DENTISTRY
University of Alexandria - 2002

Medical Research Institute
University of Alexandria
2007

خطة بحث مقدمة إلى
معهد البحوث الطبية
جامعة الإسكندرية
كإيفاء جزئى للحصول على
درجة الماجيستير

فى

الطبيعة الحيوية الطبية
قسم الطبيعة الحيوية

من

طبيب أسنان/ حسن مصطفى حسن ابوشال
بكالوريوس طب وجراحة الفم و الاسنان
كلية طب الاسنان
جامعة الإسكندرية - ٢٠٠٢

معهد البحوث الطبية
جامعة الإسكندرية
٢٠٠٧

SUPERVISORS | المشـــرفـــــون

Prof. Dr. Michael M. Mosaad
Professor of Medical Biophysics
Head, Department of Biophysics
Medical Research Institute
University of Alexandria

أ. د. ميشيل موسى مسعد
أستاذ الفيزيـــاء الحيويـــة الطبيـــة
رئيس قســم الفيزيـــاء الحيويـــة
معهـــــد البحـــوث الطبيـــة
جامعـــــــة الإسكنـــــــدرية

Prof. Dr. ABBAS ALSAID ALLAM
Professor of Prothesis
Department of Prothesis
Faculty of Dentistry
University of Alexandria

أ. د. عباس السيد علام
أستاذ الاستعاضـــه الاصطناعـــية
قســــــم الاستعـــاضـــــــه
كليـــــــة طـــــب الاسنان
جامعـــــــة الإسكنـــــــدرية

Prof. Dr. Ehab I. Mohamed
Associate Professor of Medical
Biophysics, Department of Biophysics
Medical Research Institute
University of Alexandria

أ. د. إيهاب إبراهيم عبده محمد
أستاذ م. الفيزيـــاء الحيويـــة الطبية
قســـم الفيزيـــــاء الحيويـــــة
معهــــــد البحـــــوث الطبيـــــة
جامعـــــــة الإسكنـــــــدرية

INTRODUCTION

Many pathological and clinical causes (e.g., trauma, recurrent caries and filling, and periodontal disease) may lead to teeth losses.[1] Orthodontics aims at replacing these missing teeth using mainly removable or fixed prosthesis, which have been shown to have many problems affecting the soft tissue, bone, and the remaining teeth used as abutment.[1, 2] The relatively new method of replacing missing teeth by dental implants, represents an ideal candidate for overcoming these drawbacks.[3, 4]

However, one of the most common problems before using implants, is to determine the jawbone quantity and quality, which may affect the osteointergation (i.e., the formation of bone chips between implant surface and surrounded bone).[3, 4] Thus, one of the important issues for an orthodentist (implantologist), is to find a fast and non-invasive technique for investigating jawbone health status before carrying on with the implant.[5] Orthopanoramic X-ray radiograms and ridge mapping are currently being used for determining jawbone quantity, yet there is still a need for a determining its quality.[6, 7]

The Dual-energy X-ray Absorptionetry (DXA) is employed for evaluating bone mineral density (BMD) of different sites of the human body, which is widely accepted as a reference measure of bone health status in many pathological cases.[8-10] Based on DXA scans, the BMD measurements of a patient can be compared with standard BMD measurements for a reference healthy population, which helps predicting a patient's risk for fracture.[11, 12] Thus, these evidences propose the possibility of its routine use for frequently evaluating jaw BMD.[8-10]

AIM OF THE WORK

The objectives of the present study are to:

1) Monitor jawbone quality by evaluating its BMD for lack of calcium and first diagnosis of osteopenia or osteoporosis using the DXA technique before dental implants.

2) Monitor jawbone quantity and quality by evaluating its Orthopanoramic X-ray radiograms using a computerized system, which will be integrated on purpose for the study.

3) Compare and analyze between qualitative and quantitative measurements of both techniques and develop a standard protocol for dental implant.

SUBJECTS AND METHODS

1. SUBJECTS

The study population will consist of 30 patients with a diagnosis for dental implants (i.e., with missing tooth or teeth), who are meeting the following inclusion criteria: no para-functional habits, which are the most common cause of implant failure; good oral hygiene, no history of or controlled diabetes mellitus, available amount of bone, no risk for involving maxillary sinus, and accept to undergo surgical procedure for implants.

Subjects with following criteria will be excluded from the study: highly infectious diseases (e.g., AIDS and hepatitis), smokers because high risk for implant failure, poor oral hygiene , uncontrolled diabetes mellitus, and known cardiovascular diseases.

Participant patients will be free to volunteer and will be asked to provide signed informed consent prior to their inclusion in the study.

2. METHODS

A. *PATIENT RECRUITMENT:*

Patients will be recruited from the City of Alexandria for participating in the present study. Standard paper datasheet for collecting general, clinical, and nutritional history for all participants will be prepared, which will include the following voices:

1. A computer generated random number.
2. Name and address (for determining socio-economic level).
3. Sex, age, weight, and height.
4. Systolic and diastolic blood pressure.

5. Menopausal age, time elapsed since last pregnancy, and any use of contraceptives and for how long.
6. Any structured physical activity and smoking habits.
7. Any known medical or nutritional condition or medication use known to affect body-composition measurements.
8. Any cardiopulmonary or metabolic diseases.
9. Eating habits and para-functional habits.

B. *PHYSICAL MODEL*:

Patients meeting the inclusion criteria will be included in the study and they will undergo clinical dental investigations (i.e., Periapical X-rays, Orthopanoramic X-rays, study cast, and ridge mapping), in addition to having their qualitative head BMD measured using DXA technique (General Electric, DXP lunar, USA).

An integrated computerized system for acquiring and analyzing Orthopanoramic X-ray radiograms will be integrated, which will be comprised of:

1) A computer (Machintosh G4, Cupertino, USA),
2) A flat scanner (Vuego Scan, 640P), and
3) An image analysis software package (Image v. 1.67, NIH, USA).

This system will be used to assess quantitative and qualitative jawbone in comparison with qualitative head BMD estimates using DXA.

C. *DATABASES AND DATA ANALYSIS*:

An electronic database using spreadsheets will be designed for storing all general, clinical, and anthropometrical data; result of Periapical and Orthopanoramic X-ray radiograms, qualitative head DXA scans before dental implants for further processing, tabulation, and statistical parametric and nonparametric analysis using specific software packages.

REFERENCES

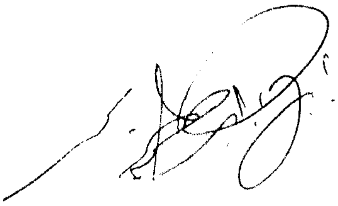
1. Hanada K, Dennis JE, and Caplan AL. stimulatory effects of basic fibroblast growth factor and bone morphogenetic protein-2 on osteogenic differentiation of rat bone marrow-derived mesenchymal stem cells. J Bone Miner 1997, [12]: 1606-14.
2. Hunt DR and Jovanovic SA. Autogenous bone harvesting; A chin graft technique for particulate and monocortical bone blocks. Int J Periodonttics Restorative Dent 1999, [19] 165-73.
3. Simon M, Jovanic S. Trisi p, et al. Vertical ridge augmentation around dental implants using a membrane technique and autogenous bone allografts in humans int J periodent Rest Dent 1998, [18]: 8-23.
4. Boyne PJ. Use of carrier materials in delivery of bone inductor substances. In Wise DL, ed. Biomaterials Engineering and Devices: Human Application, vol. 1. Toowa, NJ: Humana press, Inc., 2000, pp. 251-6.
5. Boyne PJ. Maxillofacial surgical application of bone inductor materials. Implant Dent 2000, :2-4.
6. Laurell L and Gottiow J. Guided tissue regeneration update. Int Dent J 1998, 48:386-98.
7. Lundgren D, Sennerby L, Taylor A, Gottlow J, and Nyman S. Bone augmentation at titanium implants using autoiogous bone grafts and abioresorabable barrier. An expermintal study in rabbit tibia. Clin Oral Implant Res 1997, [8]: 82-9.
8. Mohamed EI, Maiolo C, Linder R, Pöppl SJ, and De Lorenzo A. Artificial Neural Network Analysis: A Novel Application for Predicting Site-Specific Bone Mineral Density. Proceedings of The Sixth International Symposium "In Vivo Body Composition Studies" Acta Diabetol., 40 Suppl. 1: S19-22, 2003.
9. Mohamed EI, Tarantino U, Promenzio L, Maiolo C, and De Lorenzo A. Predicting Bone

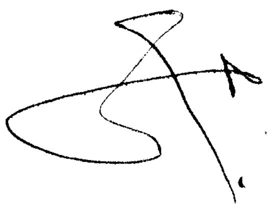
Mineral Density of Postmenopausal Healthy and Cirrhotic Italian Women Using Age and Body Mass Index. Proceedings of The Sixth International Symposium "In Vivo Body Composition Studies" Acta Diabetol., 40 Suppl. 1: S23-8, 2003.

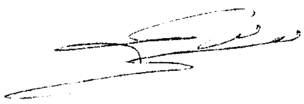
10. Casini A, Mohamed EI, Gandin C, Tarantino U, Di Daniele N, and De Lorenzo A. Predicting Bone Mineral Density of Postmenopausal Healthy and Cirrhotic Italian Women Using Anthropometric Variables. Digest. Liver Dis., 35: 881-7, 2003.

11. Tothill P. Review: Dual-energy X-ray absorptiometry for the measurement of bone and soft tissue composition. Clin. Nutr. 1995; 14: 263–8.

12. Roubenoff R, Kehayias JJ, Dawson-Hughes B, Heymsfield SB. Use of dual-energy X-ray absorptiometry in body composition studies: not yet a "gold standard." Am. J. Clin. Nutr. 1993; 58: 589–91.







ARABIC SUMMARY

الملخص العربى

الملخص العربى

أن وضع الغرسات السنيه فى عظام الفك يعتمد على موقع وشكل العظم وكذلك موقع الاعصاب والاوعيه الدمويه فى مكان وضع الغرسات-ونتيجه ان سمك وحجم النسيج الفمى يمكن ان يغطى شكل وحجم العظم المغطى له فلذلك يوجد الاحتياج لاستخدام الاشعه السينيه لتشخيص وتحديد خطط العلاج.

أن التقييم الاشعاعى هو وسيله فعاله لتقييم كثافه وكفاءه العظام الفكى وتحيد العلامات التشريحيه وتحديد اى امراض بثولوجيه تساعدك على تحديد خطه العلاج وتحديد حدود العظام بدقه-وهذه الاشعه تساعد على تحديد حجم وشكل ونوع السطح والزاويه والاسلوب الجراحى المستخدم فى وضع الغرسات.

يوجد العديد من الانواع المستخدمه من الاشعه السينيه وكذلك بعض الاساليب المعقده مثل الاشعه المقطعيه ولكن لا يوجد حاجه دائمه لاستخدامها بالرغم من طلب بعض المرضى استخدام هذه الاساليب للتاكد من نجاح الغرسات.

أن الاشعه البانوراميه وحول الجذور مثال للاشعه الاكثر استخداما فى تحديد خطه العلاج.تلك الاشعه توفر رؤيه ثنائيه الابعاد ويمكن عن طريقها الحكم على كثافه وارتفاع العظم.كذلك يقيم الروابط السنيه او العصب السنى-كذلك تستخدم لتحديد العلاقه بالجذور المجاوره والمواقع التشريحيه المجاورة .

أن استخدام هذا النوع من الاشعه يقلل التكاليف على المرضى سهولة توافرها فى عياده طب الاسنان.

أن الاشعه حول الجذور لها مميزات متعدده ووحيده فوق انواع الاشعه السينيه الاخرى حيث انها تستخدم لتحديد كميه العظام المتكونه حول الغرسات ويمكن استخدامها خلال وقت العمليه لتحديد عمق الحفر.

من عيوب الاشعه حول الجذور أنها تؤدى الى تكبير فى الحجم وكذلك صغر حجم الفلم يؤدى الى تقليص حجم الرؤيه ولكنها مفيده فى حاله الاستخدام لغرس أسنان فى سنه فرديه

أن الاشعه حول الجذور الرقميه تقلل كميه الاشعه بنسبه 90% مما يؤدى الى امكانيه استخدام العديد من الصور الاشعيه مع تقليل حجم الضرر من استخدام الاشعه السينيه

أن الاشعه البانوراميه تعتبر المقياس الرئيسى فى اى غرسه سينيه حيث انها تعطى صوره للنسيج الرخو والصلب والتركيبات التشريحيه فى الفك السفلى والعلوى فى فيلم واحد ولكنها تنقل فقط صوره ثنائيه الابعاد فلا تحتوى على عمق ولها نقاء اقل خصوصا فى المنطقه الاماميه من الفك وتحتوى على 22:15% نسبه تكبير فلا يمكن من خلالها تحديد ارتفاع او عرض العظام فى اى مكان من غير عمليه حسابيه لالغاء نسبه التكبير وبالرغم من هذا فأنها تعتبر الوسيله الاكثر انتشارا فى تحديد خطط العلاج للغرسات السنيه وذلك لانتشارها ورخص ثمنها.

من عيوب الاشعه البانوراميه تكوين الصور فوق الاخرى للتركيبات التشريحيه الهامه وتغير فى زاويه الاشعه السينيه مما يؤدى الى تدمير فى الصوره وكذلك صعوبه الوصول الى الاماكن الخلفيه.

من فوائد استخدام الاشعه المقطعيه السنيه انها تكون صوره ثلاثيه الابعاد وتفصل مابين الانسجه الرخوه والصلبه نتيجه استخدام العديد من الصور من زاويه واحده مما يؤدى الى تكوين صوره ثلاثيه الابعاد لتركيبات الفكين وتحدد الاماكن التشريحيه الحرجه.

أن الأشعة ثنائية المقطع DXA تستخدم لتحديد احتمالية وجود هشاشة عظام أو وجود مشكلة فى العظم نتيجة أنها تحدد كفاءة العظم فى جسد المريض مما يؤدى الى أخذ الحذر أثناء وضع الغرسات السنية.

أن الأشعة السينية (حول الجذور ، البانوراميـة) تستخدم فى تحديد كمية وشكل العظم بينما الأشعة ثنائية المقطع DXA تحدد كفاءة العظم مما يساعد على تحديد خطط العلاج المقترحة.

ينصح بأستخدام الأشعة ثنائية المقطع DXA عند توافرها لأكتشاف وجود هشاشة عظام أو أى مشكلة فى العظم .

المشرفون

أ. د. ميشيل موسى مسعد

أستاذ الفيزياء الحيوية الطبية

رئيس قسم الفيزياء الحيوية

معهد البحوث الطبية

جامعة الإسكندرية

....

أ. د. عباس السيد علام

أستاذ الاستعاضه الاصطناعية

قسم الاستعاضه

كلية طب الاسنان

جامعة الإسكندرية

....

أ. د. إيهاب إبراهيم عبده محمد

أستاذ م. الفيزياء الحيوية الطبية

قسم الفيزياء الحيوية

معهد البحوث الطبية

جامعة الإسكندرية

....

المشــــرفـــــون

أ. د. ميشيل موسى مسعد

أستاذ الفيزيــاء الحيويــة الطبيــة

رئيس قســم الفيزيـــاء الحيويـــة

معهــــــد البحــــوث الطبيـــة

جامعـــــــة الإسكنـــــــــدرية

أ. د. عباس السيد علام

أستاذ الاستعاضـــه الاصطناعـــية

قســـــــم الاستعـــاضــــــــه

كليـــــــة طـــــــب الاسنان

جامعـــــــة الإسكنـــــــــدرية

أ. د. إيهاب إبراهيم عبده محمد

أستاذ م. الفيزيـــاء الحيويـــة الطبية

قســــم الفيزيـــــاء الحيويـــــة

معهـــــد البحـــوث الطبيـــة

جامعـــــــة الإسكنـــــــــدرية

لجنة الحكم

أ. د. احمد محمد رشاد

أستاذ جراحة الفم

رئيس قســم جراحة الفم

كليـــــة طـــــب الاسنان

جامعـــــة الإسكنـــــدرية

أ. د. سهير محمود الخولي

أستاذ الفيزيــاء الحيويــة الطبية

قســـم الفيزيـــاء الحيويـــة

معهـــد البحـــوث الطبيـــة

جامعـــــة الإسكنـــــدرية

أ. د. عباس السيد علام

أستاذ الاستعاضـــه الاصطناعـية

قســـم الاستعـــاضــــه

كليـــــة طـــــب الاسنان

جامعـــــة الإسكنـــــدرية

أ. د. إيهاب إبراهيم عبده محمد

أستاذ م. الفيزيــاء الحيويــة الطبية

قســـم الفيزيـــاء الحيويـــة

معهـــد البحـــوث الطبيـــة

جامعـــــة الإسكنـــــدرية

تحليل مقارن لمقياس إمتصاص أشعة-إكس مزدوجة الطاقة و مصور أشعة-إكس البانورامى لدراسة صحة عظام الفك قبل الغرسات السنيه

خطة بحث مقدمة إلى

معهد البحوث الطبية

جامعة الإسكندرية

كإيفاءٍ جزئى للحصول على

درجة الماچيستير

فى

الطبيعة الحيوية الطبية

قسم الطبيعة الحيوية

من

طبيب أسنان/ حسن مصطفى حسن ابوشا ل

بكالوريوس طب وجراحة الفم و الاسنان

كلية طب الاسنان

جامعة الإسكندرية - ٢٠٠٢

معهد البحوث الطبية

جامعة الإسكندرية

٢٠٠٩