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Criteria for dental implant selection in Palestine

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Dedication

I dedicate my message to my loving parents, sisters and brothers for their prayers and inspiration. I also dedicate this work to those who were extremely supportive, encouraging, and patient during this project.

First, last, and always, thank God. God deserves all the praise for the grandeur of His face.

I dedicate this effort and express my gratitude to my close friends and colleagues who trust in my abilities, especially my colleague Abdulkarim Dahdolan.

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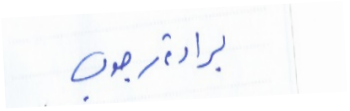
Baraa Rjoub

Declaration

I hereby declare that the work presented in this thesis, titled "Criteria for dental implant selection in Palestine “was done by me under the supervision of Dr. Mohammad Hjouj in partial fulfillment of the requirements for the award of the degree of Master in Medical Imaging Technology from Al-Quds University.

This thesis' content has not been submitted to any other university or institution for the award of any other degree.

Signed 

Baraa Abd Alhakeem Jobran Rjoub

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Praise be to God, Lord of the worlds, he has perfection alone.

May blessings and peace be upon our Master Muhammad, his faithful Prophet and Messenger, and upon all other prophets and messengers. Praise be to God Almighty who granted me the completion of this research. I extend my sincere thanks and gratitude to all my esteemed teachers who have helped me take this path.

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Abstract

Dental implants are alloplastic materials that are placed in order to assist repair or replace damaged orofacial components. The outcome is dependent on how well the implant's substance integrates with the surrounding tissue. However, this integration is influenced by several factors, such as implant material, bone quantity and quality, and implant loading status. Accurately detecting anatomical features in relation to implant size increases the success rate of implant surgery and reduces the risk of surgical damage. This can only be accomplished by a comprehensive and suitable radiological examination. In order to help the dentist, determine the best kind of implant for the patient, the study focuses at the characteristics of the implant and the medical imaging modalities Cone Beam Computed Tomography (CBCT) and panoramic that the dentist performs. A cross-sectional descriptive study about the functions of medical imaging in dental implants and the factors that influence selecting the type of implant among Palestine's dentists who perform dental implant. An online survey including inquiries about preferred dental implants, the status of patient's economy, and other important factors that influenced their choice of implant type. The statistical analysis conducted using IBM SPSS v27 to investigate the relationships and differences between various variables, Cronbach's alpha, chi-square test, Spearman's rank correlation, Kruskal Wallis and Mann-Whitney U test were used to examine relationship between the study's variables. Throughout the analysis, we consider statistically significant of a P-value of less than 0.05, indicating that observed effects were unlikely to be due to chance. 94.6% of participants stated that CBCT is their primary medical imaging modality. Additionally, the study's findings indicate that the following factors influenced the dentist's decision regarding the type of implant: (a) the time required for the procedure, which was 69.8% P-Value <0.001; (b) the patient's age, which was 60.4% P-Value <0.001; (c) the implant's cost, which was 62.8% P-Value <0.001; and (d) the patient's required number of implants, which was 59.7% P-Value ‹0.001. Surgical implants were selected primarily in comparison to basal and compressive implants based on characteristics such as implant stability, success and continuity, surrounding bone growth, and the expected medical benefit overall. The majority of Palestinian dentists use CBCT to identify the type of implant. Additionally, the outcomes demonstrated that while basal implants produce equivalent results more quickly, dentists did not initially favor them. When choosing an implant type, dentists considered the patient's age, the duration of the surgery, and the implant's cost into account.

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Chapter 1: Introduction

1.1. Background and Significance

Dental implants are unaltered, alloplastic substances that are inserted into the maxilla and/or mandible to help restore damaged orofacial components due to congenital malformations, neoplasm and trauma. The most prevalent kind of dental implants are endosseous ones, which consist of a single, separate implant unit (usually cylinder- or screw-shaped) inserted into a drilled hole in the dentoalveolar or basal bone. Dental implants typically contain titanium alloy or titanium that has been commercially pure. On the other hand, substitute materials consist of ceramics like aluminum oxide and other alloys like nickel-chrome-vanadium and gold. (Pye, et al., 2009), (Mupparapu & Beideman, 2000).

Over the past 50 years, dental implants often referred to as oral or endosseous implants, have been utilized to replace lost teeth. The degree of implant material integration with surrounding tissue determines the final result (Warreth, et al., 2017). However, a number of variables, including implant material, quantity and quality of bone, and implant loading state, affect this integration (Baig & Rajan, 2007), (Zupnik, et al., 2011).

There is a broad range of dental implant systems on the international marketplace; however, the American Dental Association (ADA) has only certified a small number of companies. The implant systems manufactured by Nobel Biocare, Straumann, AstraTech, Bicon, BioHorizon, BIOMET 3i, Intralock, and Zimmer are the most often used ones. While the fundamental ideas behind each are the same, the patented materials and technologies used in each vary (Warreth, et al., 2017).

In dental implant surgery, tooth roots replaced with metal roots that resemble screws, and damaged or missing teeth replaced with artificial teeth that closely resemble natural teeth in appearance and function (Durrani, et al., 2019). The mechanism of traditional (surgical) implantation depend on osseointegration: "the formation of a direct interface between an implant and bone, without intervening soft tissue" (Ali, et al., 2019), and delayed loading 3∼6 months.

Dental implants can generally be categorized as one- or two-piece implants. With the one-piece design, the abutment and the implant are molded together into a single, solid piece. Since there are no risky fractures, screw loosening, or micro-motions between the implant and abutment, the absence of a screw-joint is seen as an advantage. The one-stage implant insertion method is the only technique available to install these sorts of implants. The one-piece Y-TZP Ceramic Implant® (Nobel Biocare) and 3.0 Dental Implant® (BioHorizons) are two examples of one-piece implants (Warreth, et al., 2017).

On the other hand, a two-piece implant type comprises of an implant that is attached, typically with a screw, to an abutment or restoration. Compared to the one-piece implant kind, it is implemented more often. Both the one-stage and the two-stage implant surgical protocols can be used with this type of implant. (Warreth, et al., 2017).

The main differences between endosseous implants in their entirety are their macro-topography and general shape (e.g., cylindrical versus tapered). The survival rates of endosseous implants are influenced by various design criteria, such as body shape, size, chemical surface composition, and topographical aspects (Gaviria, et al., 2014).

Dental implants are complex dental appliances that need to be positioned precisely to reduce issues or implant failure. Selecting a dental implant specialist with the appropriate training, education, and expertise in implant dentistry is crucial for the best outcomes (AAID, 2023).

Implant dentistry has come a long way since Per-Ingvar Branemark, the "father" of modern dental implantology, first proved the osseointegration of dental implants. Branemark first detected "osseointegration" in 1969 when he noticed that a titanium fragment inserted in rabbit bone became securely lodged and challenging to remove. (Turkyilmaz, 2018), (Worthington, 2003).

The fundamental goals of dental implants are to attain mechanical strength and, via osseointegration, to foster a robust relationship between the implant and the bone throughout time (Javed, et al., 2013), (Meltzer, 2009). Three main macro-aspects with regard to endosseous implants are as follows: 1) pores on screws; 2) solid body press-fit designs (conical, cylindrical); and/or 3) designs with porous coatings (Stanford, 2008), (Stegenga, et al., 2003). The implant's success or failure is mostly determined by the long-term biomechanical characteristics at the bone-implant contact, which are impacted by each design.

The advantages of therapy became clear as the course of treatment became more consistent over time. Since then, the market has grown quickly due to the enormous demand for dental implants. The field of dentistry is growing and changing quickly, both in terms of surgical methods and accessible restoration kinds (Turkyilmaz, 2018), (Cushen & Turkyilmaz, 2013).

Dental implant therapy is a time-consuming, precise, and invasive process. Because the majority of implant businesses have a proprietary library of implant designs, sizes, and platforms, every component used in this process is distinct to the original implant, right down to the manufacturer, kind, and size. From initial planning to full restoration, the average patient's implant surgery might take up to a year, and the cost can reach $4000 per implant (AAID S. , 2020).

The following factors have mostly contributed to the remarkable growth of implant therapy seen in private practice; (1) significantly greater patient and physician acceptance for implant treatment. (2) The expanded range of indications for people with incomplete dentition who may benefit from implant treatments. (3) The streamlining of implant therapy, particularly in straightforward situations, such as employing implants with microrough surfaces to have shorter healing times. (4) The amazing advancements in bone enhancement techniques, which allow implants to be placed in locations where there is a local deficiency of bone (Buser, et al., 1998), (Belser, et al., 1998).

Several of patient-related and procedure-dependent factors are necessary for any implant surgery to be successful (Beer, et al., 2003). The two parameters that influence the nature of surgical operation and implant type are the volume and quality of the bone. Both elements are necessary for dental implant surgery to be successful (Ekfeldt, et al., 2001).

Peri-implantitis, peri-mucositis, osseous integration failure, placement error, anatomic anomalies, chronic pain, and breaking from force applied during function are the most prevalent reasons why dental implants fail (Vissink, et al., 2018), (Chrcanovic, et al., 2014), (Chrcanovic, et al., 2017), (Kullar & Miller, 2019).

Expert opinion states that receiving a dental implant is not entirely prohibited in any situation or health concern. Medical conditions that could make an implant contraindicated include bleeding disorders, severe immunosuppression, active cancer chemotherapy, receiving intravenous antiresorptive medication, oropharyngeal malignancies, recent cerebrovascular accidents and myocardial infarction, uncontrolled or poorly controlled epilepsy, diabetes mellitus or psychiatric illness, risk of osteoradionecrosis, and conditions that could endanger the patient's life or lifespan (Kullar & Miller, 2019), (Sugerman & Barber, 2002).

Dental implants typically inserted under local anesthesia in clinics that provide primary care, such as general dental practices. Osseointegration starts the moment endosseous implant components are surgically implanted into bone. "A clear, structural, and functional link between an organized living bone and the outer layer of a titanium implant, able to sustaining the functional load" is what is meant to be understood by osseointegration (Pye, et al., 2009).

One crucial factor for evaluating implant effectiveness and identifying possible peri-implantitis is the identification of peri-implant bone loss (Fienitz, et al., 2012), (Pelekos, et al., 2019). Because of its numerous advantages, including a low price, instant availability, good patient tolerance, ease of use and capability to produce high-resolution images for precise measurements in implant sites, intraoral radiology has been applied extensively to evaluate changes surrounding implants (Dos Santos Corpas, et al., 2011). Nevertheless, this technique's low sensitivity in detecting early bone

loss is caused by limitations such geometric distortions, anatomical overlap, and the inability to reflect oral bone levels (Pinheiro L. , et al., 2017), (Ritter, et al., 2014), (Schwindling, et al., 2019). These limitations may be troublesome in certain situations since the buccolingual region of an implant typically experiences the first bone loss because of the area's comparatively low bone thickness (Vadiati Saberi, et al., 2019).

Abundant bone, of a suitable quality, is necessary for the upper and lower jawbone to support dental implants and orthodontic mini-implants (Almasoud, et al., 2016). For dental implants as well as mini-implants, primary stability is still determined by the quality of the bone. As a result, it influences the treatment strategy as a whole (Molly, 2006), (Wilmes, et al., 2008). A treatment plan may need to be adjusted during surgery or while choosing the kind, size, and surface texture of an implant and mini-implant (Martinez, et al., 2001), (Wilmes, et al., 2011).

The expression "bone quality" refers to a number of variables that affect bone strength. Nonetheless, physicians use bone mineral density (BMD) as an objective measure to distinguish between the various types of bone (Friedman, 2006) (Almasoud, et al., 2016). A T-score, or the number of standard deviations (SD) above or below the mean BMD for healthy young people, is used to report a patient's BMD. Patients with osteopenia have been reported to have a T score between -1 and -2.5 SD and osteoporosis levels less than -2.5 (Lewiecki & Watts, 2009).

Doctors are able to observe structural changes in the dental and maxillofacial structures through imaging, which helps them make an appropriate diagnosis and develop a strategy for treatment that can be started right away or gradually applied as needed. Advancements in three-dimensional digital radiography imaging have opened up a new way of looking at things, enabling examination of the soft and hard tissues in three different spatial planes. By offering an actual image of the anatomy and doing away with super-impositions, three dimensions (3D) imaging overcomes this significant drawback in comparison to the conventional projection (plain film) radiograph, which is a two-dimensional shadow of a three-dimensional object (Cohenca & Silberman, 2017).

Imaging is crucial to the processes related to dental implants. Imaging modalities range from the common projections used in dentistry clinics to more advanced radiographic methods found exclusively in radiology centers. An accurate and trustworthy diagnostic of the patient's anatomy at the intended implant site is provided by implant imaging. Both intra-oral (periapical, occlusal) and extra-oral (panoramic, lateral cephalometric) radiographs are considered standard projections. Computed tomography (CT), cone beam computed tomography (CBCT) and dental magnetic resonance imaging (MRI) are examples of more sophisticated imaging methods.

The expense, availability, dose of radiation, and anatomical features of the patient all play a role in the decision on which radiography procedures to use in a given situation. In order to reduce the

patient's risk of any issues, the dentist attempts to achieve a balance between these aspects (Jayadevappa, et al., 2010).

Preoperative measurements for dental implants include the following: the location of the nasal and maxillary sinus floors, the mandibular canal site, the mental foramen, the submandibular gland fossa, the vertical height and width of the buccolingual bone in which the implant will be placed, and any potential lesions in the maxilla and mandible. The success rate of implant surgery is increased and surgical harm is prevented by precisely locating anatomical features in relation to the size of the implant. Only a thorough and appropriate radiological examination will be able to do this (Kim, et al., 2011); (Schropp, et al., 2009); (Mehra & Pai, 2012); (Rockenbach, et al., 2003); (Haghnegahdar & Bronoosh, 2013).

Up to this point, pre-surgical implant planning has been done using radiographic techniques such as (CBCT), (CT), panoramic, periapical, and occlusal radiographs (Apaydin, et al., 2018); (Jaju & Jaju, 2014).

Conventional radiography imaging, such as panoramic and periapical films, have historically been utilized to help clinicians plan implant treatment. As long as a parallel approach is employed, periapical radiography provides accurate images regarding the size of the object studied. When examining the maxillofacial region, which includes several important structures like the temporomandibular joints, inferior alveolar nerve (IAN), maxillary sinus, and alveolar bones, a panoramic radiograph is a very useful tool (Chan, et al., 2010).

When it comes to providing a wealth of information on the dentition and jaws with a minimal radiation exposure, panoramic radiography is an especially effective type of imaging technology (Lecomber, et al., 2014). Since panoramic radiography offers the benefits of being affordable, easily accessible, and producing high-resolution images, it has been employed extensively (Ahlqwist, et al., 1986).

Dental panoramic radiographs, sometimes known as "panorex" or orthopantomograms (OPG). In basic terms, it is a two-dimensional (2D) dental X-ray scan of the upper and lower jaws that displays a view of a half circle from ear to ear. This modality's main drawback is that it depends heavily on patient position as well as technological or processing problems, , it is necessary to take appropriate diagnosis and treatment plans into account (Ladeira, et al., 2012); (Laster, et al., 2005); (Devlin & Yuan, 2013); (Keerthna & Jain, 2018); (Coppenrath, et al., 2008); (Thonissen, et al., 2015); (Mansour & Dudhia, 2008).

Other drawbacks of panoramic radiography include the existence of ghost pictures, superimposition of the cervical spine, geometric variations such as inequitable magnification and elongation, and inferior quality of the image as compared to intraoral radiographs (Tang, et al., 2017).

Parallel periapical radiography (PPA) radiography, is the most common 2D technique. The image receiver is positioned parallel to the object in order to obtain these radiographs, and the center beam is projected perpendicular to the object and the image receptor (Saberi, et al., 2019). While oblique projected periapical (OPA) radiography is a kind of periapical radiography where the source of the beam is directed at an acute horizontal angle between the object and the image receptor, as opposed to PPA radiography (Mikolajczak & Wilk, 2008).

Drawbacks of a periapical that it can only show around three teeth. Bending the radiography film to reduce patient discomfort is another restriction that could result in inaccuracies (Chan, et al., 2010); (Gher & Richardson, 1995).

Periapical radiographs in conjunction with a clinical examination continue to be the gold standard of care, despite their limitations, and they ought to be taken into account at the time of the patient's initial evaluation. Although the combination of many 2D views might not accurately depict the actual anatomy, it will serve as a basis for deciding whether 3D imaging is required (Cohenca & Silberman, 2017).

In addition, radiographic exams that are just two dimensions (2D) cannot show the precise correlations between adjacent anatomical structures and the available bone width. Furthermore, on panoramic radiography, structures outside the focus area show as shadows and artifacts due to their blurriness (Jacobs & Quirynen, 2014); (Oznur, et al., 2018).

MRI, CT, and CBCT are just a few of the many methods used in three-dimensional imaging. The established benefits of CT and MRI in major maxillofacial injuries, pathology, and reconstructive surgery are well-established. On the other hand, CBCT has gained recommendation as a diagnostic tool for traumatic dental injuries (TDIs) because of its low radiation dose, excellent resolution, flexible field of view (FOV), and affordable equipment (Cohenca & Silberman, 2017).

Multislice Computerized Tomography (MSCT) scans, which create higher-quality, more detailed images faster than traditional spiral CT scans, revolutionized the field when they were introduced in 1998. Treatment planning benefits and diagnostic information for oral malformations have risen with the adoption of 3D technology in dentistry. Since their inception, medical CT scans have been utilized for craniofacial imaging; nevertheless, their widespread adoption did not occur until the development of high-resolution scanners with 2 mm slice thickness in the 1980s. The scanning

time is decreased because they enable the capture of multiple cross-sectional slices at once (Keerthna & Jain, 2018).

For the purpose of diagnosis and oral implant placement planning, MSCT offers data in a 3D format that includes information on craniofacial anatomy. The clinical benefits of MSCT scanning have been shown in a number of studies, particularly when paired with 3D implant planning software (van Steenberghe, et al., 2002).

Unluckily, compared to linear tomography or panoramic radiography, the use of MSCT results in noticeably greater absorbed radiation doses (Hamada, et al., 2005). Using MSCT, a fan-beam x-ray is sent from the source to a detector that is one dimension, and both are mounted to a rotating gantry. To get an image, the gantry must rotate around the patient several times (Tsiklakis, et al., 2004), (Pawelzik, et al., 2002).

Cone-beam computerized tomography derives its name from the way the x-ray is shaped like a cone. From the source, a cone-beam x-ray is transmitted to a two-dimensional detector that is placed on a revolving gantry and turned 360 degrees (i.e., just one rotation is needed) (Loubele, et al., 2007).

With the advent of CBCT in the late 1990s, oral and maxillofacial surgery practices have embraced 3D technology, which requires less radiation exposure. The utilization of CBCT scans presents various benefits in comparison to 2D images and CT scans. These advantages include the ability to obtain real-size data, the possibility of producing an extensive set of 2D images, the capacity to perform vertical scanning while the patient is seated naturally, isotropic voxel size, reduced interference from metal artifacts, and compatibility with Digital Imaging and Communications in Medicine (DICOM) (Amarnath, et al., 2015); (Oznur, et al., 2018).

CBCT produces high-resolution images in many orthogonal planes for precise measurements and acquires a lot of data in a comparatively short amount of time under X-ray radiation. As a result, CBCT is more cost-effective, radiation-dose-smaller, and energy-efficient than CT. Furthermore, it is appropriate for real-time intraoperative assessments in addition to preoperative diagnostics (Amarnath, et al., 2015); (Klatt, et al., 2013).

When it comes to implantology, CBCT has primarily been used to assess surgical sites prior to implant insertion or to identify postsurgical complications. This has made it possible to accurately and promptly identify the morphology of peri-implant bone loss, which helps patients with compromised implants receive the best possible care and have a better overall prognosis (Pelekos, et al., 2018), (Pinheiro L. , et al., 2017), (Pinheiro L. R., et al., 2015).

The benefits of CBCT in dental and maxillofacial trauma are undeniable, but while utilizing CBCT or any other imaging modality, practitioners should be aware of and follow the guidelines of ALARA for recommended radiologic exposures. Clinicians should think about using CBCT only in situations when lower dosage conventional dental radiography or other imaging modalities are unable to provide sufficient information, in order to reduce radiation exposure while optimizing diagnostic information.

Also, clinicians should constantly think about employing the shortest FOV required to scan the injured tissues if 3D imaging is indicated. At lower radiation doses, smaller field of view yields greater resolution images. This is especially crucial for children, since they are more vulnerable to radiation exposure than adults are due to their inherent radio sensitivity and longer life expectancy, which increases the chance of developing radiation-induced cancer (Cohenca & Silberman, 2017), (Scarfe, 2011).

MRI shows the fat in the trabecular bone and distinguishes the neurovascular bundle and inferior alveolar canal from the nearby trabecular bone. Radiation risks related to CT are avoided with MRI (Gray, et al., 1996).

In MRI images may be affected by ferromagnetic (high magnetic susceptibility) metallic substances, which are capable of distorting the magnetic field. Large image distortions are produced by non-precious ferromagnetic alloys (cobalt-chromium) but non-ferromagnetic alloys do not. Devge et al. discovered that Branemark system implants have no effect on MRI pictures (Devge, et al., 1997).

Since MRI is a non-invasive and non-ionizing technique, it offers excellent contrast for soft tissues and is the gold standard for many diagnostic imaging uses. However, there are still specific locations that cannot be imaged with MRI, such as solids as teeth or bones (Hovener, et al., 2012); (Pasteris, et al., 2008). The main causes of this are (a) certain solids having very few protons (1) and (b) the fact that the MR signal from solids decays far more quickly than the signal from liquids (short T_2 and $^{T*}_2$) (Schreiner, et al., 1991); (Funduk, et al., 1984). This rapidly decreasing signal is nearly challenging to capture using standard spin-echo or single-pulse MR sequences (Hovener, et al., 2012).

Imaging of solids can now be accomplished in minutes rather than hours because to newly developed MRI techniques that decrease the time between signal excitation and acquisition. These approaches have remarkable potential for dental MRI (Hovener, et al., 2012); (Appel & Baumann, 2002).

The industry's expansion has been driven by the need for implant-based therapy. Implants are becoming a common treatment recommended by doctors for both partial and total edentulous. The processes are no longer reserved for professionals (Cushen & Turkyilmaz, 2013). As more doctors who require specialized education and experience, perform dental implants and replacements, implant-related issues have been on an increase (Cushen & Turkyilmaz, 2013), (Reyes, et al., 2015).

Tragically, because most practitioners tend to promote their high success rates, there is a lack of quantitative data addressing implant problems (Turkyilmaz, 2018).

Ultimately, it is crucial to prioritize the patient in all treatment planning and to consider any unique requests or expectations that the patient may have. Not every patient need a permanent repair. For many patients, a straightforward over denture might have various benefits, including as easier maintenance, less challenging implant placement, and reduced expenses (Quirynen, et al., 2014).

The development of implants has significantly changed the ability to provide patients with successful fixed prostheses, although there are still certain functional, anatomical, physiological, and financial difficulties. Even though the field of dental implantology has advanced rapidly in recent years, clinicians still face significant challenges in selecting implant sites, sizes, and angulations. These challenges are particularly difficult to overcome in the absence of appropriate dental radiographs of the implant site, taken both before and after the implants are placed (Reddy & Wang, 1999).

Thus, the purpose of this research is to identify the characteristics of dental implants and the medical imaging technology employed by Palestinian dentists (mainly panoramic and CBCT), since these factors may affect their choice of dental implant.

1.1. Problem Statement:

Dental implant placement is an optional treatment that takes the patient's preferences, oral anatomy, potential trauma, and ability to recuperate into account. Therefore, the most important parts of the diagnostic evaluation are the indications, precautions, and contraindications. Health issues and medical conditions should be taken into consideration during the planning stage. Care should be taken to make sure the benefits of an operation or treatment exceed the dangers before proceeding (Kullar & Miller, 2019).

The popularity of dental implants has recently increased, and different types of dental implants are now widely available among dentists. This has led some dental professionals to seriously consider

the advantages of various implant types over one another, the criteria used by dentists to select a particular type of implant, and the relationship between the type of medical imaging (CBCT or panoramic imaging) and implant type selection.

Due to the lack of insurance that decreases the financial burden of implantation costs, it is likely in our societies that the patient's financial situation and patient age plays a significant part in the decision to get an operation.

Does the dentist give importance to bone density or bone volume when performing dental implants ?, because based on the answer to the previous question , a specific type of medical image is requested and not another.

Radiography is the most important tool for diagnosis and treatment planning in dentistry. Image data allows optimal placement of the implant and also improves short- and long-term results for all other stages of the process.

Chapter 2: Literature review

Over 2,000 years ago, the earliest civilizations began using dental implants. Their history spans several centuries. These cultures used carved stone, shells, bones, and gold to replace lost teeth, according to archeological discoveries (DiGiallorenzo, 2014), (Gaviria, et al., 2014).

Allografts and xenografts were used in dental implantation procedures during the middle Ages. However, because it was found to be the cause of infectious diseases and even fatalities, this technique never really took off (Sullivan, 2001) (Gaviria, et al., 2014).

During his time serving in the army during World War II, Dr. Norman Goldberg had an idea for a dental repair that would use metals that were used to replace missing bodily parts. This idea became the basis for modern dental implants (AAID, 2014). Together with Dr. Aaron Gershkoff, they later created the first successful sub-periosteal implant in 1948. This achievement laid the groundwork for implant dentistry, where they were global leaders in the development of instructional methods in dental societies and schools (Sullivan, 2001), (AAID, 2014).

Dental implants have their origins in ancient Egypt, when people replaced lost teeth with cut seashells and/or stones inserted into their jawbones. Other identified cases of early implantation are those made of precious metals and designed to resemble natural roots (Jae-Hoon, et al., 2005).

Dental implants are now a common treatment option for replacing a single lost tooth or a whole dentition. People with lower incomes or levels of education tend to have fewer remaining teeth, according to the American College of Prosthodontists (ACP, 2023).

Pey et al, 2009, reported that implant component collapse, which is characterized as "the insufficiency of the surrounding tissue to create or sustain osseointegration," could happen even with high success rates. Numerous variables could be to blame for this failure: mechanical overloading (such as traumatic occlusion, poor oral hygiene), implant failure (such as premature loading or previous failure), Patient "systematic factors" (such as drunkenness, systemic sickness), Patient "local factors" (such as gingivitis, nearby infection), and surgical technique/environment (such as surgical trauma, perioperative bacterial) (Pye, et al., 2009).

Evidence pertaining to dental implants and decision-making indicates that between 90% and 95% of dental implants are successfully maintained for a decade (Spiekermann, et al., 1995), and between 51.97% and 75.8% survive for sixteen to twenty years (Simonis, et al., 2010).

Dental implants have a high success and survival rate, yet there are occasional failures. Prior research has indicated that a number of factors, including patient health, age, gender, status, smoking, bone quality, oral hygiene, and implant maintenance practices, as well as implant-related factors like implant dimensions, characteristics, loading protocol, and other factors like clinicians' experience, can predict an implant's success. (Levin, et al., 2006), (Steven & Peter, 1998), (Lekholm, et al., 1999), (Lazzara, et al.).

According to research by Bornstein et al. (2008) and Buser et al. (1997), there are four primary categories of indications for implant therapy: (1) Single tooth gap. (2) Distally extended edentulous space (Kennedly Class I and II). (3) Extended edentulous space that is not contraindicated for conventional fixed partial denture therapy. (4) Complete edentulism (Bornstein, et al., 2008), (Buser, et al., 1997).

Clinical research has shown that dental implants placed in the mandible have a greater rate of long-term survival (Tinsley, et al., 2001). However, studies in the literature have noted a decreased survival probability for implants inserted in the maxilla, especially in the posterior region (Jemt & Lekholm, 1995), (Kaptein, et al., 1999). Furthermore, compared to mandibular implants, a poorer survival probability for maxillary implants loaded immediately or shortly after implantation has been noted. (Grunder, 2001).

Both the quantity and the quality of bone that is accessible for implant placement are thought to have an impact on the successful treatment of dental implants. The success of dental implants is significantly influenced by the quality of the bone (Hao, et al., 2014). Based on the ratio of cortical to spongy bone, Lekholm and Zarb categorized bone quality into four categories: Q1- Q4 (Lekholm & Zarb, 1985). Misch categorized bone into D1–D4 categories based on variations in resistance encountered during drilling operations. Furthermore, Misch proposed the aim of assessment of direct density values of bone, stated in hounsfield units (HU), using CT (Misch, 1993). HU are the corresponding densities of the human tissues on a gray-level range that has been measured (Hao, et al., 2014).

It appears that bone density has a significant role in both the predictability of the oral implant outcome and the stability of the main implant (Molly, 2006).

Current treatments for periodontal disease and oral surgery in general depend on accurate diagnostic imaging. It goes without saying that both the patient and the practitioner benefit from consistently acceptable quality radiographs. Planning oral implants in anatomical regions where bone width is constrained is particularly crucial. Having an accurate assessment can mean the difference between being able to install implants right away and having to wait till after bone augmentation. Many implant types can be inserted into a jawbone with a width of at least 4 mm,

but not one with a width of only 3 mm. Therefore, millimeter accuracy is essential (Loubele, et al., 2007).

X-rays are widely utilized to observe structures in the body such as the alveolar bone (Mengel, et al., 2006). Interproximal alveolar bone levels are visible on conventional intraoral radiographs, 2D radiographs block and summarize information in the direction of the x-rays (Donald & Sonali, 2008), (Pia-Merete, et al., 2010), (Andre, 2004). Due to geometric distortion and anatomical superposition, conventional intraoral radiographs is inherently 2D, which limits the ability to see of things as intra-osseous abnormalities and how they evolve over time (Tyndall & Brooks, 2000).

CBCT scanners are appropriate for craniofacial imaging were created in the late 1990s and have been progressively growing over the last few years (Hao, et al., 2014). The following indications have been available for this imaging technique: evaluation of the implant site, examination of the tempro-mandibular joint (TMJ), visualization of the periodontal osseous condition, and identification of the periodontal ligament spaces (Pia-Merete, et al., 2010), (Neugebauer, et al., 2006), (Small, 2007), (Mengel, et al., 2006).

In general, CBCT exposes patients to less radiation than CT does. This method involves use of isotopic voxels as small as 0.08 mm. Furthermore, CBCT exhibits fewer severe metallic artifacts than CT (Andre, 2004), (Mozzo, et al., 1998). Compared to CT, CBCT is more advantageous in terms of expense, time, image quality, and radiation exposure (Loubele, et al., 2007), (Loubele, et al., 2006), (Kobayashi, et al., 2004).

One of the most common reasons to utilize oral implants is partial edentulism. Therefore, compared to a CT scan, which is costlier and exposes unwonted tissue to radiation, CBCT may be the better option in this situation because the tissue involved is limited in volume (Loubele, et al., 2006).

According to study conducted in Dubai that aimed for the selection factors used by prosthodontics professionals when selecting dental implants and restorations. The study questionnaire was based on a 16-item survey that had been validated. The general implant characteristics, literature support, and ease of use of the restorative kit were the most crucial factors to consider when choosing an implant system, while cost, provider educational support, training background, and cost were the least crucial factors (Al-Saleh, et al., 2021).

The most important criteria when selecting an implant system were the general implant features, literature support and simplicity of restorative kit while the least important criteria were training background, educational support from provider and cost (Al-Saleh, et al., 2021).

Ten patients who had their teeth pulled and replaced with basal implants participated in a study in 2020 in Egypt to evaluate immediate implants on thirteen implants in both jaws, and follow-up of cases using clinical evaluation, CBCT, and the use of periotest. The study's findings show that basal implants are the best option for replacing lost teeth since they are stable according to the periotest (range of stability: -7.9 to +6.2 immediately; -8.0 to +3.7 after 6 months) (Warda, et al., 2020).

A study in 2012 showed that, for implant diagnosis and treatment planning, the doctors strongly favored cross-sectional imaging over traditional radiographic imaging. In terms of cross-sectional imaging, CBCT, Interactive computer guided implantology (ICGI), and Spiral CT scans were preferred over traditional CT scans. In comparison to traditional radiographic imaging modalities, the patient responded and tolerated the cross-sectional imaging technique very well. However, the only drawbacks to cross-sectional imaging were cost and accessibility (Sudhakar, et al., 2012).

2.1 Objectives

2.1.1 Main Objective:

The study attempts to determine the features of the implant and the medical imaging modality (Panoramic, CBCT) used by the dentist, which influence the selection of the appropriate type of implant for the patient.

2.1.2 Hypothesizes:

Research assumes that the CBCT is the pre-approved modality before dental implants because it is the best medical imaging modality for determining bone density.

Since basal implant delivers the same results in a shorter period, we assume that it is favored among implant's types.

The patient's age and financial situation are presumably factors in the dentist's decision regarding the type of implant**.**

Chapter 3: Materials and Methods

3.1 Study Design and Population

An institutional based cross-sectional descriptive study design, about the criteria for choosing the implant's type and the role of medical imaging in tooth implants. The study targeted dentists in specialized clinics who perform dental implants in Palestine.

The survey was distributed to 500 dentist.

Ethical approval obtained from Deanship of research at Al-Quds University, its included preserving the rights of the patent and dentist and privacy of their information, this study will not publish the participant's information. (Appendix 2)

3.2 Selection of Sample

Based on randomization, our sample was composed of dentists in Palestine who perform dental implants in their clinics, the sample was 500 dentist, only 129 responded.

3.2.1 Inclusion Criteria:

Dentist who perform dental implants in Palestine were included.

3.2.2 Exclusion Criteria:

We exclude dentist who does not perform dental implants.

3.3 Sources of data:

Data of this study was collected from dental clinics that perform dental implant in Palestine.

3.4 Collection of data:

A questionnaire consisting of 17 questions was conducted, which includes questions about preferred dental implants, the state of the economy, and other critical criteria that affected the decision on the type of dental implant. (Appendix 1)

Questionnaires were distributed to dentist who perform dental implants in dental clinics in Palestine , a sample obtained from Jerusalem (16),Hebron(37), Bethlehem(10), Ramallah(20), Tulkarm(11),jenin(17) ,and Nablus(18). We used a google forms questionnaire to guarantee a maximum response, 129 responses from 500 dentist were receive it.

3.5 Data Analysis:

The statistical analysis in this thesis was conducted using IBM SPSS v27 to investigate the relationships and differences between various variables. Cronbach's alpha was used to evaluate the internal consistency of the measures in order to guarantee precise measurement constructs. A chi-square test was employed to assess the association between categorical variables. For analyzing non-parametric data, a Kruskal wallis and Mann-Whitney U test explored potential differences between independent groups, while a Spearman's rank correlation examined the strength and direction of relationships between ordinal variables.

Throughout the analysis, a p-value of less than 0.05 was considered statistically significant, indicating that observed effects were unlikely to be due to chance. The conclusions drawn from these statistical tests, along with descriptive statistics and visual representations, were then used to address the research objectives and interpret the findings of the study.

Chapter 4: Results

It was mentioned that dentists' experience might have an impact on the sort of implants they choose. Was his experience a factor in his decision for a certain implant type? The study found no relationship between a doctor's experience and the implants they choose. This raises concerns about the dentist's personality and dependences. If the experience is unrelated to this, how do the dentist decide on the implant?

From more than five hundred surveys distributed, only 129 (25.8%) was filled, of those there was 8.2% does not practice dental implant.

The median differences for % preference are significantly higher for dentists who depend on compressive implants compared to those who depend on surgical implants, with p-values of 0.039 for basal, 0.002 for surgical, and 0.002 for compressive factors.

Table 1: differences for percentage preference

	% Preference or Choice of [Basal] Plants based on several Factors		% Preference or Choice of [Surgical] Plants based on several Factors		% Preference or Choice of [Compressive] Plants based on several Factors	
	Mean	Median	Mean	Median	Mean	Median
Compressive	44.29	40.00	67.14	66.67	72.38	76.67
Surgical	30.35	33.33	81.87	80.00	49.47	46.67
P- Value		0.039		0.002		0.002

The Mann-Whitney U test found no statistically significant relationship between dentist experience and the type of implant they use.

The analysis of the relationship between the type of dental implants used by dentists and their years of experience in the field reveals that dentists who primarily use compressive implants have, on average, more years of experience (mean = 9.7 years, median = 8.5 years) compared to those who use surgical implants (mean = 6.6 years, median = 5 years). The difference in experience, however, is not statistically significant (p-value = 0.124), indicating that while there is a trend towards more experienced dentists favoring compressive implants, this difference could be due to

chance. Overall, the data suggest that experience may influence the choice of implant type to some extent, but the evidence is not strong enough to confirm a significant relationship.

Table 2: relationship between years of experience and type of implant selection.

	Years of experience in this field		
	Mean	Median	P-value
Compressive (n=14)	9.7	8.5	0.124
Surgical (n=114)	6.6	5	
Total	6.9	5	

For the purpose of evaluating teeth and determining the ideal kind of implant, 94.6% of participants stated that they primarily rely on CBCT as their preferred medical imaging modality.

92.3% (22.5% mostly and 69.8%) of participants relay on x-ray to assess patient's teeth and select the best kind of implant, of those there was 94.6% depend on CBCT mainly.

Table 3: dentists responses regarding the type of imaging used and the type of implant preferred.

TOTAL Number of Cases		129	100.0%
		Count	Column N %
Medical imaging modalities does the doctor rely on the most to assess the teeth and determine the best type of implant	CBCT	122	94.6%
	Panoramic	7	5.4%
Type of implants will the dentist depend on	Compressive	14	10.9%
	Surgical	114	88.4%
	Basal	1	0.8%

Most of participants (76.0 %) believed that dentist need to attain a successful completion of specialist program in dental implants (P-Value <0.001).

There was a significant difference (P-Value <0.001) between participants related to their response about bone thickness and density, 81.4% of them showed that they always evaluate the thickness and density of the bone in order to select the best type of implant. Additionally, 85.3% (49.6% mostly and 35.7% always) of respondents indicated that the type of implant influences how soon the surrounding bone develops around the implant. This makes sense in relation to their response.

The study's findings also indicated that the following variables had an impact on the type of implant chosen:

a) The time required for the procedure, which was 69.8% (38% mostly and 31.8 always) P-Value <0.001;
b) The patient's age, which was 60.4% (36.4% mostly and 24% always) P-Value <0.001;
c) The cost of the implant, which was 62.8% (38% mostly and 24.8% always) P-Value <0.001; and
d) The required number of implants, which was 59.7% (39.7% mostly and 20.2% always) P-Value <0.001.

Regarding explaining to the patient why each implant option chooses if there were many options, just 55.8 % of participants indicated they do so always, 24.8% mostly do so, P-Value <0.001

For the usage of implants, preferences vary significantly across the implant types. Surgical implants show the highest median preference across all categories, with significant differences noted ($p = 0.006$). Basal and compressive implants do not exhibit significant differences ($p = 0.318$ and $p = 0.100$, respectively). When considering whether patients are given the option to select implants, surgical implants again show significant preference differences ($p = 0.014$), while basal and compressive implants do not ($p = 0.16$ and $p = 0.132$, respectively). This suggests a stronger preference and flexibility associated with surgical implants compared to the other types.

Table 4 :impact on dentist choice of the type of implant with type of implant that dentist perform or patient choose

		% Preference or Choice of [Basal] Plants based on several Factors	% Preference or Choice of [Surgical] Plants based on several Factors	% Preference or Choice of [Compressive] Plants based on several Factors
		Median	Median	Median
The dentist uses one of the aforementioned implant types.	Never	20.00	56.67	50.00
	Rarely	46.67	60.00	56.67
	Sometimes	26.67	73.33	60.00
	Mostly	40.00	80.00	60.00
	Always	26.67	86.67	40.00
	P- Value	0.318	**0.006**	0.100
Giving the patient the option to select the kind of implants he wants, even if it's not what's planned.	Never	26.67	93.33	43.33
	Rarely	26.67	80.00	66.67
	Sometimes	40.00	80.00	53.33
	Mostly	43.33	90.00	50.00
	Always	26.67	80.00	60.00
	P- Value	0.16	**0.014**	0.132

The results of the Spearman correlation analysis reveal several significant relationships among variables related to dental implant procedures. Notably, there is a significant positive correlation between providing patients with explanations for each implant option and the belief that dental implant surgeons have completed specialist training ($r = .225$, $p = .010$). The evaluation of bone thickness and density by the doctor when selecting the best implant type also shows significant positive correlations with the belief in the necessity of specialized training ($r = .192$, $p = .029$) and explaining implant options to patients ($r = .290$, $p = .001$). Additionally, the doctor considering the patient's age in implant selection is significantly correlated with implant cost considerations ($r = .385$, $p < .001$) and the number of required implants ($r = .357$, $p < .001$). The influence of financial cost on implant type selection is significantly correlated with both the patient's age ($r = .317$, $p < .001$) and the number of implants needed ($r = .278$, $p = .001$). Furthermore, the patient's number of implants required significantly influences the type of implant chosen ($r = .401$, $p < .001$) and the speed of bone improvement surrounding the implant ($r = .259$, $p = .003$). These findings

suggest that financial and patient-specific factors play a critical role in decision-making processes for dental implant procedures.

The results of the Spearman correlation analysis show significant relationships between preferences for various types of implants and their perceived success, stability, and anticipated medical benefit. The preference for compressive implants in terms of success and continuity is significantly correlated with the preference for basal implants ($r = .416$, $p < .001$). When considering the stability of implants and bone growth, basal implants are significantly correlated with compressive implants ($r = .290$, $p = .001$) and negatively with surgical implants ($r = -.191$, $p = .030$). Additionally, compressive implants show strong correlations with both basal ($r = .306$, $p < .001$) and surgical implants ($r = .788$, $p < .001$). Regarding anticipated medical benefits, basal implants have a significant positive correlation with compressive implants ($r = .263$, $p = .003$) and a strong correlation with surgical implants ($r = .728$, $p < .001$), which also shows a significant relationship with compressive implants ($r = .713$, $p < .001$). The analysis indicates that compressive and basal implants are consistently associated with positive perceptions of success, stability, and medical benefit, while surgical implants show varied relationships, often negatively correlated with other types in terms of stability and benefit. This highlights a preference among dentists for compressive and basal implants across multiple evaluative criteria.

Table 5: Spearman correlation analysis reveal several significant relationships among variables related to dental implant procedures.

	Dental implant surgeons have attained such specialization?	The dentist uses the x-ray image to determine the best type of implant.	The dentist uses one of the aforementioned implant types.	Give he atient ption to elect the ind of mplants	Giving the patient an explanation	The doctor evaluates at the thickness and density of the bone.	The doctor considers the time required for the procedure.	Time required for the procedure.	The doctor considers the patient's age	Financial cost.	# Of implants.
Explaining to patient	Correlation Coefficient	0.014	0.125	0.163	.225*						
	Sig. (2-tailed)	0.874	0.157	0.064	0.010						
Evaluating the thick and density of bone	Correlation Coefficient	-0.001	.192*	-0.127	-0.006	.290**					
	Sig. (2-tailed)	0.994	0.029	0.151	0.948	0.001					
Time	Correlation Coefficient	0.104	-0.007	-0.125	0.129	0.163	.211*				
	Sig. (2-tailed)	0.242	0.938	0.159	0.146	0.065	0.016				
Age	Correlation Coefficient	0.029	-0.021	-.188*	.276**	0.140	0.146	.385**			
	Sig. (2-tailed)	0.741	0.811	0.033	0.002	0.113	0.098	0.000			
Cost	Correlation Coefficient	0.009	-0.083	0.054	.285**	0.058	0.096	.317**	.278**		
	Sig. (2-tailed)	0.918	0.349	0.541	0.001	0.516	0.277	0.000	0.001		
# of implants	Correlation Coefficient	.176*	0.044	-0.123	.188*	0.081	0.165	.357**	.401**	.352**	
	Sig. (2-tailed)	0.046	0.622	0.166	0.032	0.361	0.062	0.000	0.000	0.000	
Type of implants affects how bone improves.	Correlation Coefficient	0.166	0.014	0.035	0.079	0.093	.177*	.192*	.220*	.213*	.259**
	Sig. (2-tailed)	0.061	0.878	0.697	0.373	0.297	0.045		0.012	0.015	0.003

Table 6: Spearman correlation analysis show significant relationships between preferences for various types of implants and their perceived success, stability, and anticipated medical benefit.

		in terms of success and continuity			in terms of the stability of the implant and the growth of bone surrounding it			in terms of the anticipated medical benefit generally		
		Basal	**Surgical**	**Compressive**	**Basal**	**Surgical**	**Compressive**	**Basal**	**Surgical**	**Compressive**
Success and continuity [Surgical]	Correlation Coefficient	-0.143								
	P-Value	0.107								
Success and continuity [Compressive]	Correlation Coefficient	.416**	0.136							
	P-Value	0.000	0.124							
Stability and growth of bone surrounding it .[Basal]	Correlation Coefficient	.711**	-.191*	.290**						
	P-Value	0.000	0.030	0.001						
Stability and growth of bone surrounding it [Surgical]	Correlation Coefficient	-0.051	.778**	0.025	-.176*					
	P-Value	0.568	0.000	0.775	0.045					
Stability and growth of bone surrounding it .[Compressive]	Correlation Coefficient	.306**	0.144	.788**	.194*	0.132				
	P-Value	0.000	0.103	0.000	0.027	0.135				
Anticipated medical benefit generally [Basal]	Correlation Coefficient	.728**	-.209*	.263**	.687**	-.204*	.174*			
	P-Value	0.000	0.018	0.003	0.000	0.020	0.048			
Anticipated medical benefit generally [Surgical]	Correlation Coefficient	-0.131	.725**	0.014	-.193*	.782**	0.135	-.222*		
	P-Value	0.138	0.000	0.875	0.028	0.000	0.128	0.011		
Anticipated medical benefit generally. [Compressive]	Correlation Coefficient	.313**	0.066	.713**	.185*	0.009	.825**	.269**	0.055	
	P-Value	0.000	0.456	0.000	0.036	0.918	0.000	0.002	0.536	

From all participants there was 33.3% reported that they 100% preferred surgical implants in terms of success and continuity, comparing to 0.8% and 3.9% of them preferred basal and compressive implants respectively (as shown in figure 3.1).

31% of participants stated they 100% preferred surgical implants in terms of implant stability and surrounding bone growth, compared to 2.3% who preferred basal implants and 8.5% who preferred compressive implants (Figure 3.2).

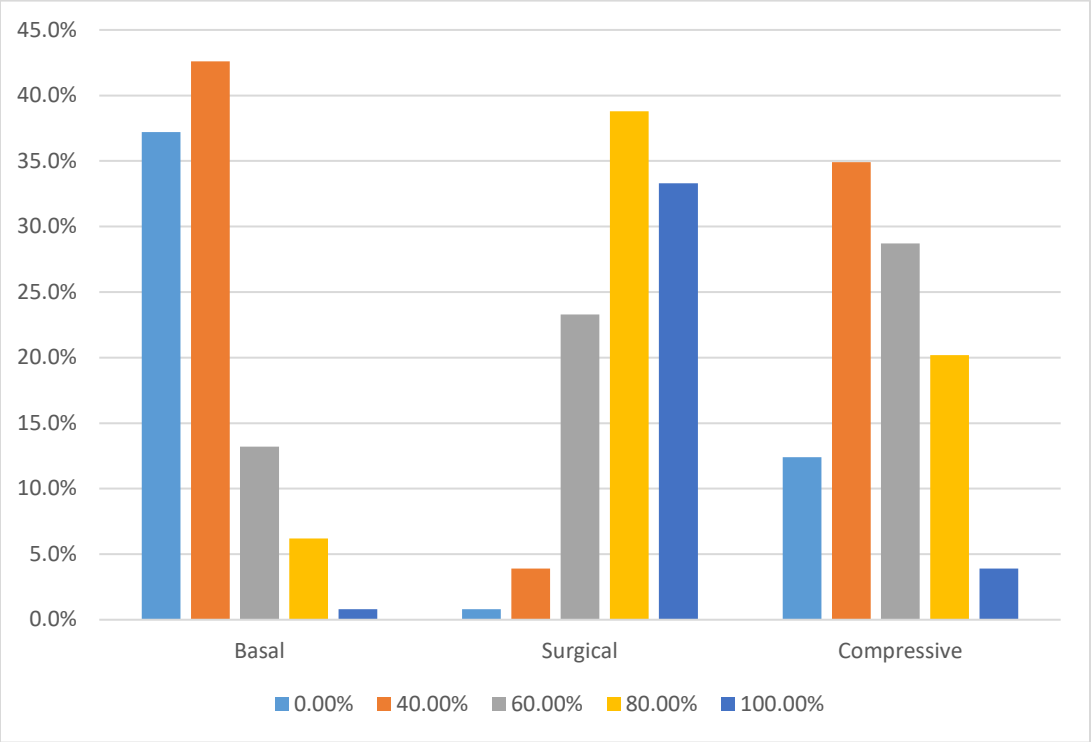

Figure 3.1 Dentist's preference for using each type of various implants in terms of success and continuity (x: dentist preferences type of implant, y: percentage of responding dentist).

In terms of the anticipated medical benefit generally, 37.2 % of participants indicated that they totally (100%) choose surgical implants compared to 3.1% and 7.8% of them choose basal and compressive, respectively (Figure 3.3).

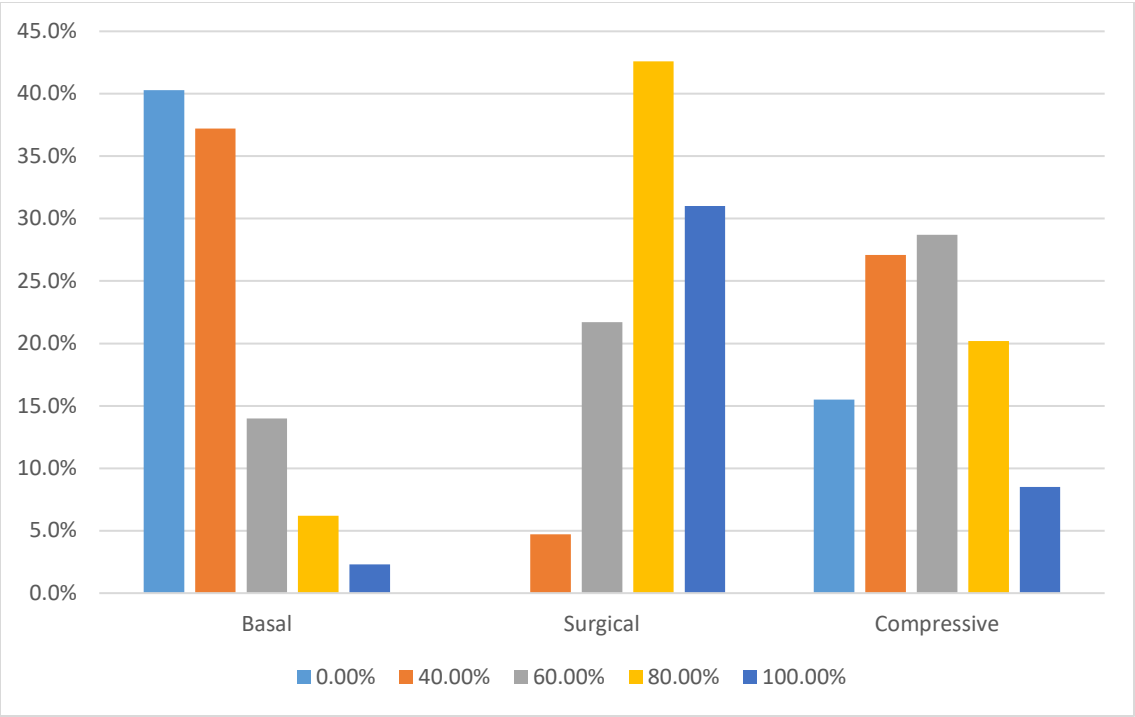

Figure 3.2 Dentist choice for using each type of implant in terms of the stability of the implant and the growth of bone surrounding it (x: dentist preferences type of implant, y: percentage of responding dentist).

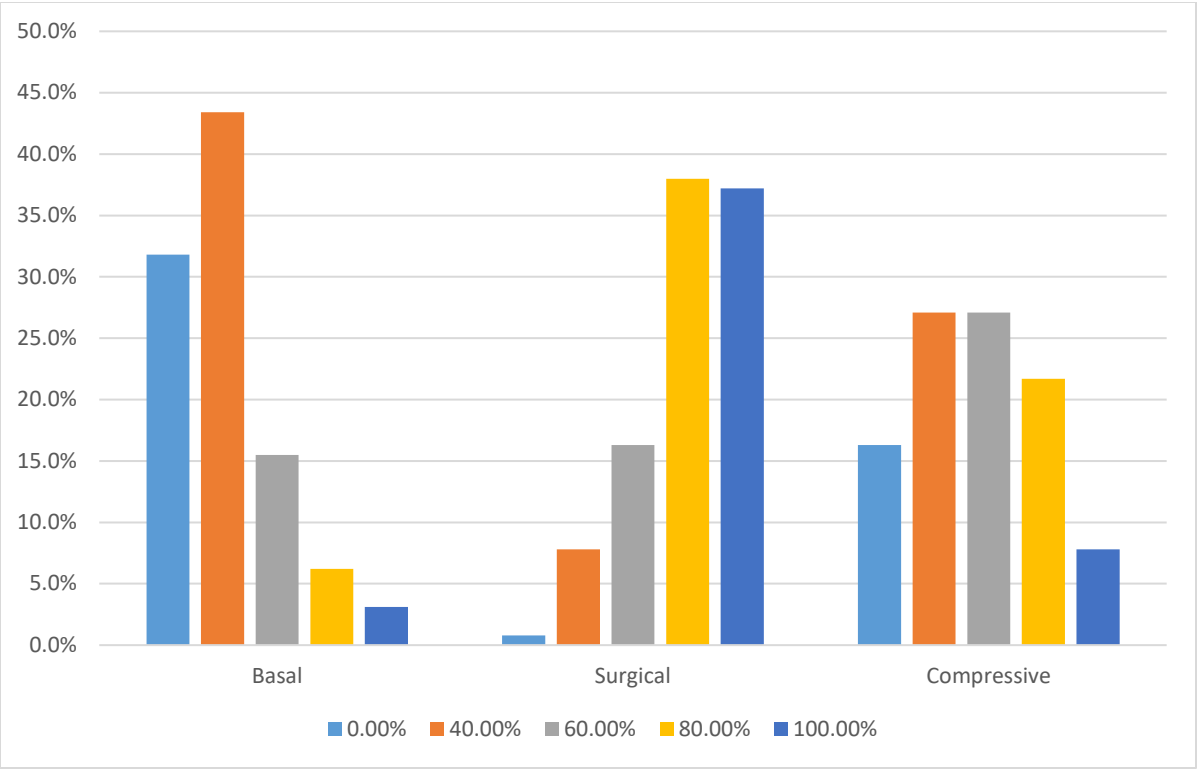

Figure 3.3 Dentist's choice for employing each type of implant in terms of the anticipated medical benefit generally (x: dentist preferences type of implant, y: percentage of responding dentist).

Of the three types of implants under study, (surgical, compressive, and basal) 88.4% of the dentists who specifically targeted stated that they rely on surgical implants, 10.9% on compressive implants, and 0.8% on basal implants.

Chapter 5: Discussion

The two primary causative reasons of peri-implant bone defects are improper biomechanical characteristics and inflammation brought on by plaque. If ignored, these abnormalities might eventually result in progressive peri-implant bone loss and implant loss. For the implants and the surrounding bone structure to be preserved, early detection of bone flaws is crucial, necessitating radiographic evaluations (Salvi, et al., 2016); (Khoshkam, et al., 2013); (Silveira-Neto, et al., 2017).

Peres et al., 2019, in their study revealed that the majority of dental disorders are chronic, and treating them puts an enormous financial strain on families as well as the medical sector (Peres, et al., 2019).

In oral and maxillofacial radiology, there are currently many different types of imaging modalities readily available. In dental implantology, intraoral radiographs, panoramic radiography, CT, and CBCT are the most often used methods. Intraoral radiographs are inexpensive and easily accessible, which makes them an appropriate option.

For preoperative planning and implant placement, a detailed radiographic evaluation of the jaws is essential. In dental implantology, CT and panoramic radiography are the most commonly utilized imaging modalities (Oznur, et al., 2018).

94.6% of participants in our study used CBCT as a pre-implant imaging modality. In contrast, a 2017 study conducted in Palestine examined the trends in radiographic prescriptions for dental implants and found that most dentists (59%) prescribe panoramic radiographs for dental implant assessment based on availability, and 41% prescribe both panoramic and CBCT. (Rabi, Qirresh, & Rabi, 2017)

In their study, Rabi et al. list the following factors as justifications for suggesting a specific radiologic evaluation: measurement precision, cost & measurement, availability, cost & radiation dose, and measurement accuracy. The observed outcome was that, of dentists who prescribed radiology examinations, 42.99% did so based on availability and only 25.44% based on measurement (Rabi, et al., 2017).

In their study, which was conducted at Sri Sai College of Dental Surgery in India, Athota et al. tried to compare modern CT techniques in implant imaging with traditional radiography because implantologist have differing preferences when it comes to imaging technologies. According to Athota et al.'s research, obtaining this particular data was made easier and more economical using panoramic radiography. Increased image magnification is a drawback of panorama images (Athota, et al., 2017).

Some studies concluded that the use of panoramic radiography for bone height determination was a safe and reliable technique. However, others claimed that the use of this method for presurgical planning could lead to an incorrect designation of implant length, which could eventually result in complications such as nerve injury and sinus perforations (Amarnath, et al., 2015); (Kyung-seok, et al., 2012); (Correa, et al., 2014).

According to Laster et al., overlapping and distortion may render horizontal readings on panoramic radiography incorrect (Laster, et al, 2005).

The interaction of implants with essential structures can have a significant effect on the surgical treatment's success. Therefore, limiting the preoperative diagnostic assessment to techniques based on 2D imaging could lead to implant malfunction (Greenstein, et al., 2008). Therefore, when implant surgery included the possibility of causing harm to important structures, Tang et al. suggested 3D imaging (Tang, et al., 2017). Parallel to this, Dreiseidler et al. found that CT and CBCT provided better images than panoramic radiography, but they also had drawbacks, including limited availability in many local hospitals due to costly expenses and technical constraints (Dreiseidler, et al., 2010).

Numerous studies have examined the utility of various imaging modalities for pre-implant assessment. When evaluating the intraoral bone height available for dental implant placement, Kopecka et al. examined the use of panoramic radiography and CBCT. They found that while panoramic radiography was adequate in the incisor region, it was insufficient in the canine region (Kopecka, et al., 2014).

Regarding practical experience, a Texas research revealed that the operator's degree of expertise affects the accuracy of implant placement, with more experienced operators properly inserting a greater number of implants (Cushen & Turkyilmaz, 2013). Based on the responses provided by our research participants, it appears that the dentist does not need to pursue a specialist in implantology. However, based on what we can gather, they also appear to concur that practice and real-world experience are key components of the process. A study carried out in Palestine on a group of dentists who perform dental implant work in their clinics provides additional support to this; the study's participants were primarily general dentist and implant practitioners (97.5%) rather than implant experts (Assaf, 2022).

Consistent with this study's findings, Assaf's research also revealed no statistically significant distinction between the number of years of experience and dental implant practice (Assaf, 2022).

In a study conducted at Istanbul University to evaluate the clinical and demographic data pertaining to dental implants in a group of Turkish patients. Bural et al. concluded that the most common indication for implants - particularly in the population over 40- appears to be complete edentulism, while the indication of a single tooth gap is more common in younger patients, indicating that age has an impact on implant procedure (Bural, et al., 2013). Consistent with this, our research revealed that two thirds of participants consider the age of the patient.

Furthermore, an analysis conducted retrospectively on 3755 patients at Seoul Veterans Hospital revealed that age is one of the variables influencing implant replacement (Jang, et al., 2011).

A systematic review study done in Suleyman Demirel University, Turkey, including 526 publications, 17 of them were about cost-effectiveness of dental implants and prosthesis, reported that dental care costs are considerably great (Tekpinar, et al., 2021). Not far of this, our study showed that 70.2% of dentists consider financial issue.

Conclusion and Recommendations

The present study concludes that the majority of Palestinians dentist who perform dental implants in their clinics depend mostly on CBCT to determine the type of implant. In addition, the results showed that even the basal implants deliver the same results in a shorter time but it was not the first choice for dentists.

This study also showed that dentists considered the procedure’s time, patient’s age and the cost of the implant when they decide the implant type.

We recommend performing prospective study on a large number of cases with follow-up measurements using multi imaging modalities mainly panoramic and CBCT.

Limitations

A study's constraints were the absence of official data regarding the number of dentists and the proportion of those who do dental implants, the uncooperative aspect of questionnaire completion, and the questionnaire's structure, which needed to be more precise.

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Appendix 1 Questionnaire and Consent Form

استبيان بخصوص زراعات الاسنان المستخدمة في فلسطين

الزميلات والزملاء أطباء الاسنان الأعزاء،

تحية طيبة وبعد:-

تقوم الباحثة براءة الرجوب بإجراء دراسة بعنوان " Criteria for dental implant selection in Palestine " بالتعاون مع كلية طب الاسنان وكلية المهن الصحية\ جامعة القدس

استنادا الى شح الدراسات العلمية في هذا المجال في فلسطين ونتيجة لوجود اراء طبية مختلفة فيما يخص أنواع زراعات الاسنان المختلفة، تهدف الدراسة الى تسليط الضوء على معايير اختيار نوع زراعات الاسنان المختلفة للوصول الى معايير علمية مناسبة للجميع بما يخدم مصلحة المرضى.

الاستبيان المرفق يستغرق دقائق قليلة ، نرجو منكم تعبئته بشكل حيادي وذلك بوضع √ في المكان المخصص

في سبيل البحث العلمي وإثراء المعرفة ومحاولة استكشاف الواقع الحقيقي في هذا المجال.

ونؤكد لكافة الزملاء والزميلات على التزامنا بالسرية وأن هذا الاستبيان سيتم استعماله لأغراض البحث العلمي فقط.

وتقبلوا فائق الاحترام والتقدير

الباحثة: براءة عبد الحكيم جبران رجوب

رقم الهاتف :0595404700

البريد الالكتروني:barарj35@gmail.com

Do you have any experience dealing with dental implants? Do you have a specialization in this field? ☐ YES ☐ NO

Number of years of experience in this field ☐

After completing the study of dentistry, dental implants are dependent on the successful completion of a specialist program in this field. Do you believe that dental implant surgeons have attained such specialization?

☐ Always ☐ Mostly ☐ Sometimes ☐ Rarely ☐ Not at All

Which of the following medical imaging modalities does the doctor rely on the most to assess the teeth and determine the best type of implant?

☐ CBCT ☐ Panoramic

The dentist uses the x-ray image to assess the teeth and determine the best type of implant.

☐ Always ☐ Mostly ☐ Sometimes ☐ Rarely ☐ Not at All

What type of implants will the dentist depend on?

☐ Compressive ☐ Surgical ☐ Basal

The dentist uses one of the aforementioned implant types.

☐ Always ☐ Mostly ☐ Sometimes ☐ Rarely ☐ Not at All

Do you give the patient the option to select the kind of implants he wants, even if it's not what's planned?

☐ Always ☐ Mostly ☐ Sometimes ☐ Rarely ☐ Not at All

Do you give the patient an explanation of the reason of each implant option if there are several to choose from?

☐ Always ☐ Mostly ☐ Sometimes ☐ Rarely ☐ Not at All

In order to select the best type of implant, the doctor evaluates at the thickness and density of the bone.

☐ Always ☐ Mostly ☐ Sometimes ☐ Rarely ☐ Not at All

When choosing the type of implant, the doctor considers the time required for the procedure.

☐ Always ☐ Mostly ☐ Sometimes ☐ Rarely ☐ Not at All

The doctor considers the patient's age in choosing the type of implant

☐ Always ☐ Mostly ☐ Sometimes ☐ Rarely ☐ Not at All

The type of implant used is influenced by the implant's financial cost.

☐ Always ☐ Mostly ☐ Sometimes ☐ Rarely ☐ Not at All

The doctor's choice of implant type is significantly influenced by the patient's required number of implants.

☐ Always ☐ Mostly ☐ Sometimes ☐ Rarely ☐ Not at All

The type of implants affects how quickly the implant's surrounding bone improves.

☐ Always ☐ Mostly ☐ Sometimes ☐ Rarely ☐ Not at All

Please indicate your preference for using each type of various implants in terms of success and continuity, from your perspective as a qualified dentist

	0%	40%	60%	80%	100%
Basal	○	○	○	○	○
Surgical	○	○	○	○	○
Compressive	○	○	○	○	○

Please indicate your choice for using each type of implant in terms of the stability of the implant and the growth of bone surrounding it from your perspective as a qualified dentist

	0%	40%	60%	80%	100%
Basal	○	○	○	○	○
Surgical	○	○	○	○	○
Compressive	○	○	○	○	○

Please indicate your choice for employing each type of implant in terms of the anticipated medical benefit generally, from your perspective as a qualified dentist

	0%	40%	60%	80%	100%
Basal	○	○	○	○	○
Surgical	○	○	○	○	○
Compressive	○	○	○	○	○

Appendix 2 Ethical approval

Al-Quds University
Research Ethics committee (REC)
Application Form

REC OFFICE USE		
HUMAN RESEARCH ETHICS COMMITTEE No		
Date Received		
Institute/Centre/Faculty		
Campus		
	Master's project	
	Grants Awarded	
	Small Grants Awarded	
	General	
	Clinical Trials	

1. Project Title (in full)

Criteria for dental implant selection in Palestine

RESEARCH PERSONNEL

Principal Investigator

Name	Mohammad Hjouj
Title	Dr
Qualifications	PhD
University Position Held: employee, affiliate (indicate type; eg. honorary associate, clinical academic), visiting	Associate professor of Medical Imaging
Full mailing address	Salah Eddin ST, P.O. Box 20295 – Jerusalem
Telephone	0545505360
Fax	-
E-mail	mhjouj@hotmail.com, mhjouj@staff.alquds.edu

Associate Investigator(s)

Name	Baraa Rjoub
Title	Mr
Qualifications	Master Medical Imaging Technology
University Position Held: employee, affiliate (indicate type; eg. honorary associate, clinical academic), visiting	Al-Quds University, Graduate Studies, Medical Imaging Technology
Full mailing address	
Telephone	0595404700
Fax	
E-mail	Bararj35@gmail.com

PROJECT AND SITE DETAILS

2. Please provide details of the research setting (Research laboratory, Hospital, ..etc)

This project will be held in private radiology institution

3. Provide information to demonstrate that the researchers involved in the project have the necessary training, expertise and experience to carry out their role in the research.

Baraa Rjoub is a qualified Medical Imaging specialist with experience in this field. Dr Mohammad Hjouj is an a academic and researcher in Medical Imaging technology

4. Please outline (or attach) the proposed procedure for dealing with any health emergencies that may arise during the conduct of the research. If the Principal Investigator at the proposed University site is not a health practitioner, please provide details of the medical practitioner who will be responsible for dealing with medical emergencies.

This is cross-sectional despective study

5. Risk assessment (please indicate that the following are accurate):

   √ The site has adequate data protection and security systems to ensure protection of participant's privacy

   √ The site has adequate, secure systems for storage of investigational products

   √ Participants are able to report adverse events and study outcomes reliably

6. Is this research at the University site commercially sponsored?

   √ NO

   ☐ YES – please provide a copy of the certificates

DECLARATION BY INVESTIGATORS

I confirm that I have read and understand the attached Code of Good Practise and Helsinki declaration in Research Conduct in Human Research.

I confirm that I have read and understand the Code of Good Practise and Helsinki declaration in Research Conduct in Human (Provided and declared by the Ethics Research Committee, Al-Quds University)

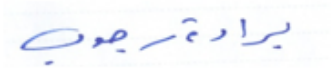
I confirm that the above information is accurate, and that the project will continue in accordance with the Human Research Ethics Committee approved protocol.

Principal Investigator

Mohammad Hjouj		
Name	*Signature*	*Date*

Associate Investigator(s)

Baraa Rjoub

		
Name	*Signature*	*Date*

SECTION 1: ADMINISTRATION

1.1

(a) Provide a brief summary of the project in non technical language (approximately 100 words)

(b) Outline the academic/scientific merits of this study (including potential contributions to the body of knowledge and methodological rigor) (approximately 100 words)

If the effectiveness of the project is proven, the surgery will be replaced with immediate implants because it takes the same time and the same result

ed

1.2 (a) Has this project already been submitted to any other HREC(s)? ☑ **N** ☐ **Y**

(b) Will this project be submitted to any other HREC(s)? ☑ **N** ☐ **Y**

If you answered YES to (a) or (b), give the name of the HREC(s)

1.3 (a) Indicate the proposed date of commencement of the project.

Projects should not commence without the prior written approval of the REC.

After ethical approval we need a monthis to start work

(b) Indicate the proposed completion date of the project.

1.4 (a) Has this protocol received research funding/contracting or is this submission being made as part of an application for research funding/contracting? ☑ **N** ☐ **Y**

If you answered YES, list the funding/contracting bodies to which you have submitted, or intend to submit, this project. Attach a copy of the grant application(s), contract(s) or similar agreement(s).

Funding/Contracting body 1:

Funding/Contracting body 2:

Funding/Contracting body 3:

SECTION 2: NATURE OF RESEARCH

2.1 The nature of this project is most appropriately described as research involving:- (more than one may apply):

–	behavioural observation	☐ Y
–	self-report questionnaire(s)	☑ Y
–	interview(s)	☐ Y
–	qualitative methodologies (e.g. focus groups)	☐ Y
–	psychological experiments	☐ Y
–	epidemiological studies	☐ Y
–	data linkage studies	☐ Y
–	psychiatric or clinical psychology studies	☐ Y
–	human physiological investigation(s)	☐ Y
–	biomechanical device(s)	☐ Y
–	human tissue	☐ Y
–	human genetic analysis	☐ Y
–	a clinical trial of drug(s) or device(s)	☐ Y
–	Other (please specify in the box below)	☑ Y

Proceed to Section 3.

SECTION 3: PARTICIPANTS AND RECRUITMENT

3.1 (a) What is the age range of all participants involved in this study?

60 volanteer in defferant ages but children .

(b) Are the participants include children (defined by statute for this purpose as anyone under 18) ☐ Y ☑ N

If you answered NO, give reasons why not.

Children usually not do implants .

3.2 Are the participants:- (more than one may apply)

- in a teacher–student relationship with the researchers or their associates? ☐ Y
- in an employer–employee relationship with the researchers or their associates? ☐ Y
- in any other dependent relationship with the researchers or their associates? ☐ Y
- prisoners? ☐ Y
- refugees? ☐ Y
- members of the security services? ☐ Y
- mentally ill? ☐ Y
- intellectually impaired? ☐ Y
- unconscious or critically ill patients? ☐ Y
- in a doctor–patient relationship or a health giver–receiver relationship with the researchers or their associates? ☐ Y

If you answered YES to any of the above, provide details.

3.3 (a) What is the sample size for the study? Comment on how this sample size will allow the aims of the study to be achieved.

3.4 Will participants receive any reimbursement ☑ N ☐ Y

If you answered YES, what is the amount or nature of the reward and the justification for this?

Proceed to section 4

SECTION 4: PRIVACY

4.1 Is there a requirement for the researchers to identify, collect, use, or disclose information of a personal nature *(either identifiable or potentially identifiable)* about individuals without their consent?

☑ N ☐ Y

If you answered YES, state what information will be sought and how many records will be accessed.

IF YOU ANSWERED NO, YOU DO NOT NEED TO COMPLETE ANY MORE OF SECTION 4. GO TO SECTION 5

Please provide details

Proceed to Section 5.

SECTION 5: COLLECTION OF DATA

5.1 Will any part of the study involve recordings using audio tape, film/video, or other electronic medium ? N: [√] Y: [ ]

If you answered YES, what is the medium and how it will be used?

5.2 Does your research involve the secretive use of photographs, tape-recordings, or any other form of record-taking? N: [√] Y: [ ]

If you answered YES, provide details and a justification for the secrecy.

5.3 (a) How will the results of the study be disseminated (e.g. via publication in journals and presentations in scientific meetings)?

Will be published in peer review journals in addition to use this results in scientific conferences

5.4 How will the confidentiality of the data, including the identity of participants, be ensured during collection and dissemination?

- We will not collect any private data from participants

5.5 (a) what is the proposed storage location of, and access to, materials collected during the study (including files, audiotapes, questionnaires, videotapes, photographs)?

Please cross (X) the appropriate box:

☐	**Principal investigator's Office**	**Room No.**		**Building**	Home
☐	**Faculty / Departmental Office**	**Room No.**		**Building**	
√	**Other** (Please provide details below)				

(b) On completion of the study, where will the materials that were collected during the study (including files, audiotapes, questionnaires, videotapes, photographs) be stored?

Please cross (X) the appropriate box:

X	**Principal Investigator's Office**	**Room No.**		**Building**	Home
X	**Faculty / Departmental Office**	**Room No.**	204	**Building**	HC
☐	**Other** (Please provide details below)				

Researcher laptop

SECTION 6: ASSESSMENT OF RISKS

6.1 Indicate if the participants might experience any of the following:

Risk of physical harm (e.g., falling, muscle pain)

Y ☐

Physical discomfort (e.g., tiredness, weakness, nausea)

Y ☐

Risk of psychological or emotional harm (e.g., trauma)

Y ☐

Psychological or emotional discomfort (e.g., anxiety, stress, loss of confidence, regret for disclosing personal information)

Y ☐

Legal repercussions for participating in the study (e.g., possibility of being sued, charged with criminal activity)

Y ☐

6.2 POTENTIAL RISK TO PARTICIPANTS AND RISK MANAGEMENT PROCEDURES

Identify, as far as possible, all potential risks to participants (e.g. physical, psychological, social, legal or economic), associated with the proposed research. Please explain what risk management procedures will be put in place.

No risk for any part of this study

6.3 ARE THERE ANY SPECIFIC RISKS TO RESEARCHERS THAT ARE GREATER THAN THOSE ENCOUNTERED IN NORMAL DAY TO DAY LIFE?

☐ YES √ NO *(If YES, please describe.)*

End of the application

Al Quds University
Faculty of Health Professions
Jerusalem –Abu Dis

جامعة القدس
كلية المهن الصحية
القدس – أبو ديس

Research Ethics Subcommittee of Faculty of Health Professions
Letter of approval

Jul 21, 2024
Ref. No.: RESC/2024-47

Dear Applicants, (**Dr. Mohammad Hjouj, Ms. Baraa Rjoub**)

Program: **MSc Medical Imaging Department**

The Research Ethics subcommittee of the Faculty of Health Professions has recently reviewed your proposal entitled (**Criteria for dental implant selection in Palestine**) submitted by (**Dr. Mohammad Hjouj**). Your proposal is deemed to meet the requirements of research ethics at Al-Quds University, but further assessment is required by the Central Research Ethics Committee of Al-Quds University. We wish you all best for the conduct of the project.

Hussein ALMasri, PhD
Associate Professor of Medical Imaging
Research Ethics Subcommittee Chair
Faculty of Health Professions

Hussein ALMasri

CC: File
CC: Committee members

Tel. Fax: 02 2791243 Email: dean@hpro.alquds.edu تلفاكس: 02 2791243

معايير اختيار زراعة الأسنان في فلسطين

إعداد: براء عبد الحكيم جبران الرجوب

رقم التسجيل: 21911821

المشرف: د. محمد حجوج

ملخص الدراسة

مقدمة: تهدف عملية زراعة الأسنان للمساعدة في إصلاح أو استبدال الأسنان والأضراس التالفة أو المفقودة. ويعتمد نجاح عملية الزراعة على مدى التكامل والترابط بين مادة الزرعة والأنسجة المحيطة بها. حيث أن هذا التكامل يتأثر بعدة عوامل مثل: مادة الزرعة وجودة العظم وكثافته (كميته). ويعتبر الكشف الدقيق عن السمات التشريحية لمنطقة الزرعة بشكل مسبق الى رفع نسبة نجاح عملية الزراعة وتقليل الخطر الجراحي. ومن أجل تحقيق ذلك لا بد من الاعتماد على التصوير الطبي الشامل والمناسب. **أهداف الدراسة:** يهدف هذا البحث الى دراسة خصائص الزراعات المستخدمة في فلسطين وطرق التصوير الطبي التي يعتمدها أطباء الأسنان وخصوصا التصوير الطبي المقطعي المخروطي (CBCT) وكذلك التصوير البانورامي للوجه والفكين (Panoramic). **طريقة الدراسة وأدواتها:** هذه دراسة وصفية مقطعية لوظائف التصوير الطبي في عملية زراعة الأسنان وكذلك العوامل المؤثرة في اختيار نوع الزرعة. حيث استهدفت هذا الدراسة بشكل عشوائي كافة أطباء الأسنان في فلسطين اللذين يقومون بزراعة الأسنان من خلال استبيان تضمن استفسارات حول نوع الزراعة المفضل، وتأثير بعض العوامل على عملية الزراعة ونوعها مثل: عمر المريض، الحالة الاقتصادية للمريض، عدد الزراعات، كثافة العظم وغيرها. ثم باستخدام برنامج IBM SPSS v27 تم دراسة العلاقات والاختلافات بين المتغيرات المختلفة، واعتماد القيمة الاحتمالية ($P\text{-Value} < 0.005$) أنها ذات دلالة إحصائية. **النتائج:** خلال التحليل، اعتبرنا أن القيمة P أقل من 0.05 ذات دلالة إحصائية، مما يشير إلى أن التأثيرات المرصودة من غير المرجح أن تكون نتيجة للصدفة. ذكر 94.6% من المشاركين أن CBCT هو وسيلة التصوير الطبي الأساسية لديهم. بالإضافة إلى ذلك، تشير نتائج الدراسة إلى أن العوامل التالية أثرت على قرار طبيب الأسنان فيما يتعلق بنوع الزرعة: (أ) الوقت اللازم لإجراء العملية، والذي كان 69.8% $P\text{-Value} < 0.001$؛ (ب) عمر المريض الذي كان 60.4٪ قيمة $P < 0.001$؛ (ج) تكلفة عملية الزرع، والتي كانت 62.8% قيمة $P < 0.001$؛ و (د) العدد المطلوب من الغرسات للمريض، والذي

كان 59.7% قيمة 0.001، P. تم اختيار الغرسات الجراحية في المقام الأول بالمقارنة مع الغرسات القاعدية والضغطية بناءً على خصائص مثل ثبات الزرعة، ونجاحها واستمراريتها، ونمو العظام المحيطة، والفائدة الطبية المتوقعة بشكل عام. يستخدم غالبية أطباء الأسنان الفلسطينيين تقنية CBCT لتحديد نوع الزرعة. بالإضافة إلى ذلك، أظهرت النتائج أنه في حين أن زراعة الأسنان القاعدية تنتج نتائج مماثلة بسرعة أكبر، إلا أن أطباء الأسنان لم يفضلوها في البداية. عند اختيار نوع الزرع، يأخذ أطباء الأسنان بعين الاعتبار عمر المريض ومدة الجراحة وتكلفة الزرع.