European Journal of Dental and Oral Health
Vol 6 | Issue 1 | February 2025
ISSN 2684-4443

REVIEW

The Guidelines for Patient Examination Before Dental Implant: Literature Review

Mohammed Majid Abdulmunem[1,*] and Mena Nabeel Ali[2]

ABSTRACT

Loss of teeth produces profound morbidity regarding the esthetic and functional demand of the patient. The decision for the type of treatment to replace missing teeth is made by multiple replacement therapies such as removable and fixed appliances. Nowadays, Dental implants represent the best solution for such cases, however, the possibility or not of the treatment and the decision for appropriate treatment plan depends on different factors; some of which are related to the patients such as general health, presence of systemic diseases, medications that interfere with the treatment and may affect short and long term success of the dental implant, in addition to the condition of the oral cavity such as: gingival tissue, oral hygiene, type of occlusion, caries index, in addition to the condition of the planned implant site that include: available bone height and width, bone density, etc. all these factors should be assessed carefully by the oral surgeon utilizing intra and extra-oral clinical examination and radio graphical examinations by two or three-dimensional methods to reach the correct treatment plan for each case separately according to the acquired information after completing these tests. And to decide the type of treatment, number, length, and width of the implant and whether other modifications are needed such as a sinus lifting procedure, ridge splitting, or adding a bone graft.

Keywords: Clinical assessment, dental implant, radiographic assessment, three-dimensional radiograph.

Submitted: January 01, 2025

Published: February 02, 2025

10.24018/ejdent.2025.6.1.362

[1] *B.D.S., M.Sc., Department of Oral Surgery and Periodontology, College of Dentistry, Mustansiriyah University, Iraq.*
[2] *B.D.S., Department of Oral Surgery and Periodontology, College of Dentistry, Mustansiriyah University, Iraq.*

* ***Corresponding Author:***
e-mail:
mohammed.m.abdulmunem@uomustansiriyah.edu.iq

1. Introduction

Nowadays, dental implants have become a treatment of choice to establish the esthetic and functional demand of patients who complain of losing their teeth, the decision about this type of treatment depends on whether dental implants are appropriate for this patient, this particular oral circumstance, within the context of a thorough reconstructive treatment strategy [1].

The implant survival rate is influenced by different independent factors such as periodontal diseases, bone resorption, smoking, unfavorable bone quality, type of loading, etc. All these factors collectively affect implant success and more negative parameters increase the possibility of failure [2].

Owing to the growing number of malpractice lawsuits, it is necessary to thoroughly evaluate the patient's medical history and be aware of the potential for treatment failure and complications. This is because the outcomes of implant therapy are less predictable than those of conventional therapies involving fixed or removable dental prostheses. Using a methodical patient evaluation in conjunction with a simple diagnostic planning process makes it easier to prescribe the best results and reduces the risk of errors and problems [1].

The aim of studying the methods of patient assessment for dental implants is to explain the examination methods to assess various factors such as general health, oral health, bone quality and quantity, and patient expectations to determine the suitability for dental implant therapy. This assessment helps ensure successful outcomes, reduce risks, and provide personalized treatment plans for each patient.

2. Factors Affect Implant Survival

2.1. Age

The age of the patient alone is not considered a factor affecting dental implant treatment, as it can be the treatment in hand that is preferred for every case to rehabilitate the missed teeth, especially in elderly individuals, to recover their oral function and to get the benefit of this

type of treatment back to its high survival rate the fewest complications [3]. The younger patients had more attitude toward dental implants to replace the missing teeth, while the old age (older than fifty years old) person became more tolerant of the absence of [4], [5]. Furthermore, the older age complained of a greater number of missing teeth, which in turn means that more extensive surgeries are needed to restore normal function [6].

As long as the patient can undergo the surgical phase and the self-maintenance that follows, there is no upper age limit. On the other hand, young people should postpone receiving implants until their growth is finished [7]. To avoid any connected post-operative complications linked to additional bone growth, patients should be at least 18 years old and have appropriate bone volume and maturity [8]. Clinicians need to be aware that complications may arise from facial growth that persists after the age of 18 years.

2.2. *Systemic Factors*

Osteoporosis, which primarily affects postmenopausal women, is more common in older individuals. It causes a gradual loss of bone mass, enhancing the possibility of bone fragility and fractures. A greater risk of implant failure could result from increased trabecular space. Osteoporosis is therefore regarded as a risk factor for dental implant treatment [9]. Although not all writers concur that osteoporosis can jeopardize dental implant rehabilitation treatments, it has been demonstrated in the literature that patients with grade 4 bone density are more likely to suffer from dental implant failure [10].

The most widely used medications for osteoporosis are bisphosphonates. These medications reduce the activity of osteoclasts, which decreases the process of bone resorption [11]. However, it has been demonstrated that these medications have adverse effects, the most common of which is osteonecrosis. Patients on bisphosphonates are more likely to develop osteonecrosis due to jaw bone infections or bone damage after dental implantation [12]. The American Association of Oral and Maxillofacial Surgeons notes that the likelihood of osteonecrosis in these patients is unknown [13].

When considering the osseointegration process, previous reviews did not find any statistically significant differences between individuals who were not treated and those who received antiresorptive medication. However, some other research concluded that oral bisphosphonates can worsen the osseointegration of dental implants, increasing the likelihood of failure [14].

The risk for peri-implant diseases was increased in diabetic patients, so the control of this metabolic disorder is an important factor for successful treatment [15]. Schwarz *et al*. stated at the World Workshop on Peri-implants 2017 that the literature's findings regarding diabetes's role as a risk factor for periimplantitis are debatable [16]. According to Tawil *et al*., individuals with a mean HbA1c level of 7% did not exhibit implants with peri-implantitis; nevertheless, among patients with high HbA1c levels (7% to 9%), the peri-implant disease was observed in 6 out of 141 implants [17]. However, Costa *et al*. failed to find a difference between those with diabetes and those in good health Concerning the occurrence of peri-implant disease [18]. Aghaloo *et al*. in their systematic review, found no effect of diabetes on the process of osseointegration however, they pointed out that there is a change in the proinflammatory infiltrate leading to a decrease in the coupling between osteoblasts and osteoclasts in early time after loading [19].

Smoking affects a person's general and oral health. Smoking reduces leukocyte activity, which in turn causes a decline in phagocytic activity, chemotactic migration rate, and wound healing and infection resistance. Additionally, smoking lowers the absorption of calcium [20].

Dental implants have a worse chance of survival among smokers. Smoking increases platelet aggregation and peripheral resistance, which slow down the osseointegration process, reducing blood flow. When paired with nicotine, the byproducts of tobacco, including cyanide and carbon monoxide, impede the healing of wounds. Tobacco usage directly inhibits osteoblast activity. According to Strietzel *et al*., smoking affects implant prognosis with or without augmentations. Smokers exhibit greater bone resorption at the marginal bone than nonsmokers do [20].

Radiation therapy is usually used in combination with surgical excision for the treatment of malignant tumors in the craniofacial region. Before implant therapy, hyperbaric oxygen therapy increases implant success rates in persons who have been exposed to radiation [21]. Patients who have had radiation therapy to their jaws should be given additional caution [22], [23]. observed a 1.9-fold higher risk of implant failure for irradiated patients. Furthermore, Ettl concluded that radiation with a dose of over 60 Gray negatively influenced implant success [24].

Neurologic disorders have a negative influence on the patient's oral hygiene status, and such patients usually complain of parafunctional habits such as bruxism and behavioral disabilities. These in turn affect the implant survival and success rate [19].

2.3. *Dental Factors*

The patients should have good dental health and healthy periodontal tissues. untreated periodontal disease, poor oral hygiene, and persistent dental caries may cause postoperative complications [25], [26]. The progressive outcome of the inflammatory process by peri-implantitis can lead to implant failure [27]. Precise and accurate diagnosis of alteration in hard and soft tissue has a positive impact on the long-term preservation of implants and their prosthetic parts as well as its effect on long-term maintenance of the peri-implant health [28].

Glauser found that implants placed in bruxism patients were lost at a higher rate (41% vs. 12%) than implants placed in individuals without parafunctional habits. Fibro osseointegration may be formed as a result of extreme functional loading translated over the implant which in turn decreases the success rate. early or immediate loading may not be harmful to osseointegration unless there are significant micromotions at the bone-implant interface throughout the healing phase [29].

There should be sufficient bone quality and volume in relation to anatomical structures and the intended restoration. The predicted restoration outcome should cover the aesthetic and functional demand. Furthermore, it should

be easy for the patient to sustain good hygiene measures [25], [26].

In complex cases or when anatomical issues are a concern, three-dimensional imaging in combination with computed technologies may be the proper choice [30], [31]. The possibility of collateral injury to critical tissues like the maxillary sinus and inferior alveolar nerve, which can cause serious, lifelong morbidities, may be decreased by such sophisticated imaging [32].

3. Steps of Clinical Examination

3.1. Extra Oral Examination

Most of the points that were examined extra orally have an importance on the aesthetic requirement and giving an overview of the outcome of the treatment [1], and it includes:

1. Facial proportions (dividing the face into thirds starting from the hairline and going up to the eyebrow, sub nasal point, and chin)
2. Soft tissue support: subjects with removable dentures should be assessed both with and without wearing the current denture
3. The classification of facial skeletons whether it is of normal anteroposterior correlation or prognathic or retrognathic
4. Intermaxillary relation: maxillomandibular distance at rest (normal, reduced and increased) and vertical dimension of occlusion. When the occlusal vertical dimension is reduced, it is crucial to assess if the interocclusal distance can be increased to the anticipated dimension, or if a muscular accommodation has taken place and the interocclusal space has decreased simultaneously, necessitating a gradual increase of the vertical dimension [1].
5. Relation between maxillary central incisal edge and the occlusal plane: proper placement is the centrals' incisal edge position about 1–2 mm below the occlusal plane. This relation should be assessed during rest in relation to the length of the upper lip, also when the patient smiles [33].
6. To provide a starting point assessment in the event of intraoperative nerve lesions, a neurologic test of the trigeminal nerve should be performed.
7. TMJ function, contraction, or hypertrophy of the facial musculature, wear, and abrasion of the occlusal surfaces are also considered a sign of parafunctional habits [1].

3.2. Intra-Oral Examination

This line of examination concentrated on the appropriate of the patient's mouth to be a good receiver for dental implants with long-term success [1], which include:

1. A dental examination of carious and restored teeth; an assessment of oral hygiene; a periodontal examination; and a pulp vitality test. determines the midline between the upper central incisors, which corresponds to the philtrum position; any malposition teeth (elongation, intrusion, ectopic tooth position).
2. Edentulous regions: ridge defects (horizontal, vertical, or a combination of them); crown-to-bone connection (distance between the clinical crowns optimal location and the supporting bone); feasibility of using soft and/or hard tissue for defect compensation; requirement for a prosthetic base.
3. The condition of the mucosa and the alveolar bone contour is assessed; pressure spots and pathologies are noted, and the extent of the alveolar ridge loss is checked. Through palpation, we can evaluate the quantity and quality of mucosa relative to the underlying bone. Thick keratinized mucosa is better than thin, flaky, non-keratinized mucosa. The adequate thickness of the mucosa aids in covering the abutment margin and promotes the proper emerging profile of the clinical crown.
4. current prosthesis: extent, shape, location, and color of prosthetic teeth. A choice is made regarding whether the current prosthesis is adequate and the tooth arrangement is appropriate for future treatment, whether this restoration can act as a temporary solution, or whether supplementary diagnostics and a provisional prosthesis are needed, depending on additional planning [1].
5. Occlusal status and functional examination: muscular tension, hypertrophy, dental attrition, abrasion and wear can be used to diagnose parafunctional behaviors (bruxism, clenching). While parafunction in and of itself does not exclude the placement of an implant, if left unchecked, it may lead to technical issues including overloading and fractures of the framework or screws. Thus, early treatment for temporomandibular problems is recommended before surgery to lessen the possibility of occlusal pressures later on and increase the likelihood of long-term success [34].

4. Study Casts

Study models are typically used to analyze the clinical situation. Study casts can be prepared with or without the prosthesis in position, and once utilized for additional diagnostics, they can be mounted if removable appliances are available. Predicted alterations in tooth alignment or midline correction are transported to the study casts to alert the lab technician to the impending modifications. This configuration can be adjusted as a surgical template, used for further radiological examination, and integrated into a temporary repair [33].

The optimal positioning of the suggested teeth concerning the current anatomical condition can be used to assess the volume of bone loss in the vertical and horizontal dimensions [33]. There will be minimal bone resorption if the optimal clinical crown rests on the soft tissue level. The edentulous ridge area may undergo moderate to severe resorption when a significant vertical void exists between

the artificial teeth in their ideal positions and the surrounding tissues. It is necessary to consider defect compensation using prosthetic flanges or bone augmentation procedures.

4.1. Radiologic Examination

Pre-operative radiographs are necessary to assess the amount of bone that currently exists and to identify nearby anatomical and topographic structures that must be conserved [35]. The radiograph should provide a clear assessment of the anatomical landmarks: The distance from the nasal floor, the size and localization of the incisal canal, the inferior alveolar nerve, the angulation and the condition of the roots of the adjacent teeth, and the anatomy and size of the maxillary sinus including its bony septa.

4.1.1. Conventional Two-Dimension Radiographic Methods

The main conventional method utilized for the preparation of dental implants is the Panoramic radiograph. In addition to offering a useful two-dimensional picture, panoramic radiographs also make it easier to identify diseases affecting the bone of the jaw evaluate the amount of bone in the mesiodistal and vertical dimensions, and determine vital structures. For this reason, panoramics are regarded as routine radiography examinations to plan implant treatment and make an initial diagnosis [35].

In specific cases, extra periapical radiographs taken using the parallel-cone approach help in determining the direction of the neighboring roots in solitary tooth spaces. The complexity of the anatomical situation, any planned augmentation treatments, and the difficulty of the anticipated restoration will all determine if additional cross-sectional imaging modalities are needed [35].

4.1.2. Advanced Three-Dimensional Radiographs

Computed tomography (CT scan) creates a third dimension in a second plane and makes it easier to assess the amount of bone in the bucco-oral dimension. It also provides improved orientation for identifying anatomic structures and determining the best location for implants [1]. High radiation dose making the shift from clinical CT to more specific radiograph, Cone beam computed tomography (CBCT), which enhances the appraisal of treatment planning based on information such as linear measurements of the available ridge height, width, and relative bone quality; examination of the topography of the 3D surface alveolar ridge; identifying incidental disease and characterizing significant anatomic landmarks pertinent to the implant location [36].

The key benefit of CBCT is its capacity to assess the morphology of the ridges and their closeness to significant anatomic structures in three dimensions, which helps to evaluate if additional grafting is required for precise implant placement. In comparison to the other two-dimensional imaging modalities, CBCT pictures are superior in this aspect [37], [38]. The nasal cavity floor, the walls of the maxillary sinuses, and other cortical bone thickness may all be precisely measured with CBCT.

CBCT imaging, similar to other imaging methods that use ionizing radiation, should only be employed when the patient's possible advantages outweigh the dangers. Dental professionals should only think about CBCT imaging if they anticipate that its diagnostic data will improve patient safety and care and eventually enable a more predictable, ideal course of treatment [39].

4.2. Available Bone for Implant Placement

In implantology, success depends on the dentist's expertise and available bone density [40]. Bone volume can decrease after tooth loss. The characteristics of residual ridge changes after dental extraction are:

- Bone loss is more significant in the 1st year after tooth extraction and decreases in subsequent years [41].
- The mandibular posterior edentulous ridge experiences bone resorption at a faster rate compared to the anterior mandible [42].
- Females tend to show faster bone loss and a larger overall reduction in the mandibular symphysis during the first two years [43].
- Extraction of multiple teeth can lead to dramatic changes in height and width of the edentulous anterior maxillary ridge [44].
- The remaining ridge shifts palatally in the maxilla and lingually in the mandible to tooth location [40].
- The maxilla continues to resorb toward the midline after initial bone loss, while the mandibular basal bone widens, resulting in facial progression of late mandible resorption [41].

4.3. Available Bone Height

The height of the available bone is determined by the distance between the opposing landmark and the crest of the edentulous ridge. The best technique for determining the available bone dimensions is cone beam computed tomography (CBCT) [45].

The available bone height in an edentulous site is a crucial consideration when selecting an implant because it affects both implant length and crown height. Crown height influences both aesthetics and force aspects. Furthermore, bone augmentation can be employed to establish a site that is perfect for restorative procedures and implant insertion needs even in cases when the width is insufficient due to bone augmentation, which is more predictable in width than height [45].

The mandibular inferior border and the maxillary nostrils limit the anterior regions for the anterior maxillary and mandibular area respectively, so the anterior regions of both jaws often have the highest height. the maxillary canine eminence region frequently provides the maximum height of bone [46].

However, the anterior area of the jaws represents the safer sites for implant placement but you should take in mind that the size of the mandibular incisive canal in the anterior mandible and the size, location, and shape of the nasopalatine (incisive) canal in the midline of the maxilla should be carefully diagnosed in the three-dimensional image to prevent future complications [47], [48].

In contrast, the maxillary sinus and inferior alveolar canal restrict height in the posterior areas, the maxillary first premolar in the posterior jaw region typically has more bone height than the second premolar, which has more height than the molar sites [45]. The mandibular first premolar region gives the posterior mandible's most vertical column of bone and is typically located anterior to the mental foramen. But occasionally, due to the location of the mental foramen or, if it exists, the anterior loop of the mandibular canal as it passes underneath the foramen and moves upward, distally, then exiting through the mental foramen, this premolar site may appear shorter than the anterior region [45].

4.4. Available Bone Width

The alveolar bone width between the lingual and facial plates is measured at the crest of the intended implant placement. The edentulous ridge's crest is typically supported by a broader base. The width of the alveolar bone is the second most important factor impacting the survival of endosteal implants, after sufficient height, although the triangle cross section in most cases, modifications can be done to increase the width of the bone while decreasing its height [45]. Typically, the implant needs at least 1.5 mm of buccal bone and 1 mm of lingual bone to provide sufficient bone for good blood supply which is important for its survival [45].

4.5. Available Bone Length

In an edentulous location, neighbouring teeth or implants frequently provide a limit on the mesiodistal distance of the alveolar bone. Generally, the implant needs to be at least 1.5 mm from a neighbouring tooth and 3 mm from another implant [49].

Therefore, the diameter of the implant decides the minimum length of accessible bone required for an endosteal implant in case of a single tooth replacement. For instance, a 4.5 mm implant diameter should have a minimum of 7.5 mm of mesiodistal length. For an implant with a diameter of 4 mm, a mesiodistal length of at least 7 mm is typically appropriate.

5. Conclusion

A careful and systematic examination is important in determining the correct treatment plan. Sequential steps accomplished in the examination started with listening to the patient complain and assessing the general health of the patient and proceeded with extra and intra-oral examination however the radio graphical examination especially that acquired from three-dimensional images represents the gold standard for selecting the appropriate implant dimension adding to decide whether the native site for implant placemat.

Conflict of Interest

Authors declare that they do not have any conflict of interest.

References

[1] Zitzmann NU, Margolin MD, Filippi A, Weiger R, Krastl G. Patient assessment and diagnosis in implant treatment. *Aust Dent J*. 2008;53(s1):S3–10. doi: 10.1111/j.1834-7819.2008.00036.x.

[2] Chatzopoulos GS, Wolff LF. Dental implant failure and factors associated with treatment outcome: a retrospective study. *J Stomatol, Oral Maxillofac Surg*. 2023 Apr 1;124(2):101314. doi: 10.1016/j.jormas.2022.10.013.

[3] Srinivasan M, Meyer S, Mombelli A, Müller F. Dental implants in the elderly population: a systematic review and meta-analysis. *Clin Oral Implants Res*. 2017 Aug;28(8):920–30. doi: 10.1111/clr.12898.

[4] Müller F, Wahl G, Fuhr K. Age-related satisfaction with complete dentures, desire for improvement and attitudes to implant treatment. *Gerodontology*. 1994;11(1):7–12. doi: 10.1111/j.1741-2358.1994.tb00096.x.

[5] Yakar N, Duruel O, Güncü GN, Karabulut E, Yamalık N. Factors affecting demand for dental implant treatment: a patient centered observational study. *J Int Acad Periodontol*. 1946 Jan 24;2022:52.

[6] Baracat LF, Teixeira AM, dos Santos MBF, da Cunha VPP, Marchini L. Patients' expectations before and evaluation after dental implant therapy. *Clin Implant Dent Relat Res*. 2011;13(2):141–5. doi: 10.1111/j.1708-8208.2009.00191.x.

[7] Westwood RM, Duncan JM. Implants in adolescents: a review and case reports. *Int J Oral Maxillofac Implants*. 1996;11:750–5.

[8] Hobkirk J, Watson RM, Albrektsson T. Patient assessment. In *Dentomaxillofacial Implantology*. London: Mosby Wolfe, 1995.

[9] Alghamdi HS, Jansen JA. Bone regeneration associated with non-therapeutic and therapeutic surface coatings for dental implants in osteoporosis. *Tissue Eng Part B Rev*. 2013;19(3):233–53. doi: 10.1089/ten.teb.2012.0400.

[10] Radi IA-W, Ibrahim W, Iskandar SMS, AbdelNabi N. Prognosis of dental implants in patients with low bone density: a systematic review and meta-analysis. *J Prosthet Dent*. 2018;120(5):668–77. doi: 10.1016/j.prosdent.2018.01.019.

[11] Ferreira Jr LH, Mendonça Jr KD, Chaves de Souza J, Soares dos Reis DC, do Carmo Faleiros Veloso Guedes C, de Souza Castro Filice L, *et al.* Bisphosphonate-associated osteonecrosis of the jaw. *Minerva Dent Oral Sci*. 2021;70(1):49–57. doi: 10.23736/S2724-6329.20.04306-X.

[12] Ruggiero SL, Dodson TB, Fantasia J, Goodday R, Aghaloo T, Mehrotra B, *et al.* American association of oral and maxillofacial surgeons american association of oral and maxillofacial surgeons position paper on medication-related osteonecrosis of the jaw—2014 update. *J Oral Maxillofac Surg*. 2014;72(10):1938–56. doi: 10.1016/j.joms.2014.04.031.

[13] Ruggiero SL, Dodson TB, Aghaloo T, Carlson ER, Ward BB, Kademani D. American association of oral and maxillofacial surgeons' position paper on medication-related osteonecrosis of the jaws—2022 update. *J Oral Maxillofac Surg*. 2022;80(5):920–43. doi: 10.1016/j.joms.2022.02.008.

[14] D'Ambrosio F, Amato A, Chiacchio A, Sisalli L, Giordano F. Do systemic diseases and medications influence dental implant osseointegration and dental implant health? An umbrella review. *Dent J*. 2023 Jun 5;11(6):146. doi: 10.3390/dj11060146.

[15] Ferreira SD, Silva GL, Cortelli JR, Costa JE, Costa FO. Prevalence and risk variables for peri-implant disease in Brazilian subjects. *J Clin Periodontol*. 2006;33(12):929–35. doi: 10.1111/j.1600-051X.2006.01001.x.

[16] Schwarz F, Derks J, Monje A, Wang H-L. Peri-implantitis. *J Clin Periodontol*. 2018;45(Suppl. S20):S246–66.

[17] Tawil G, Younan R, Azar P, Sleilati G. Conventional and advanced implant treatment in the type II diabetic patient: surgical protocol and long-term clinical results. *Int J Oral Maxillofac Implant*. 2008;23:744–52.

[18] Costa FO, Takenaka-Martinez S, Cota LOM, Ferreira SD, Silva GLM, Costa JE. Peri-implant disease in subjects with and without preventive maintenance: a 5-year follow-up. *J Clin Periodontol*. 2012;39(2):173–81. doi: 10.1111/j.1600-051X.2011.01819.x.

[19] Aghaloo T, Pi-Anfruns J, Moshaverinia A, Sim D, Grogan T, Hadaya D. The effects of systemic diseases and medications on implant osseointegration: a systematic review. *Int J Oral Maxillofac Implant*. 2019;34:s35–49. doi: 10.11607/jomi.19suppl.g3.

[20] Strietzel FP, Reichart PA, Kale A, Kulkarni M, Wegner B, Küchler I. Smoking interferes with the prognosis of dental implant treatment: a systematic review and meta-analysis. *J Clin Periodontol*. 2007;34(6):523–44. doi: 10.1111/j.1600-051X.2007.01083.x.

[21] Granström G, Tjellström A, Brånemark PI. Osseointegrated implants in irradiated bone: a case-controlled study using adjunctive hyperbaric oxygen therapy. *J Oral Maxillofac Surg*. 1999;57(5):493–9. doi: 10.1016/S0278-2391(99)90059-9.

[22] Ruggiero SL. Bisphosphonate-related osteonecrosis of the jaw: an overview. *Ann NY Acad Sci*. 2010;1218(1):38–46. doi: 10.1111/j.1749-6632.2010.05768.x.
[23] Doll C, Nack C, Raguse JD, Stricker A, Duttenhoefer F, Nelson K, *et al.* Survival analysis of dental implants and implant-retained prostheses in oral cancer patients up to 20 years. *Clin Oral Investig*. 2015 Jul;19(6):1347–52. doi: 10.1007/s00784-014-1359-2.
[24] Ettl T, Junold N, Zeman F, Hautmann M, Hahnel S, Kolbeck C, *et al.* Implant survival or implant success? Evaluation of implant-based prosthetic rehabilitation in head and neck cancer patients—a prospective observational study. *Clin Oral Investig*. 2020 Sep;24(9):3039–47. doi: 10.1007/s00784-019-03172-9.
[25] Perel ML. Parafunctional habits, nightguards, and root form implants. *Implant Dent*. 1994;3(4):261–3. doi: 10.1097/00008505-199412000-00011.
[26] Rangert B, Krogh PH, Langer B, Van Roekel N. Bending overload and implant fracture: a retrospective clinical analysis. *Int J Oral Maxillofac Implants*. 1995;10:326–34.
[27] Figueira KS. Revisão da literatura médica vigente sobre as dificuldades frente a implantoplastia. *Braz J Implantol Health Sci*. 2019;1(1):2–17.
[28] Sendyk CL, Sendyk WR, Gromatzky A. *Periodontia e Implantodontia: a atuação clínica baseada em evidências científicas*. Implantodontia; 2005.
[29] Glauser R, Rée A, Lundgren A, Gottlow J, Hämmerle CH, Schärer P. Immediate occlusal loading of brånemark implants applied in various jawbone regions: a prospective, 1-year clinical study. *Clin Implant Dent Relat Res*. 2001;3(4):204–13. doi: 10.1111/j.1708-8208.2001.tb00142.x.
[30] Harris D, Buser D, Dula K, Gröndahl K, Harris D, Jacobs R, *et al.* EAO guidelines for the use of diagnostic imaging in implant dentistry. A consensus workshop organized by the European association for osseointegration in trinity college. *Dublin Clin Oral Implants Res*. 2002;13(5):566–70. doi: 10.1034/j.1600-0501.2002.130518.x.
[31] Pendlebury ME, Horner K, Eaton KA. *Faculty of General Dental Practitioners: Selection Criteria for Dental Radiography*. 2nd ed. London: Royal College of Surgeons of England; 2004.
[32] Renton T, Dawood T, Aneesha S, Lloyd S, Yilmaz Z. Post implant neuropathy of the trigeminal nerve. A case series. *Clin Implant Dent Relat Res*. In press. 2012 Jun 8;212(11):E17. doi: 10.1038/sj.bdj.2012.497.
[33] Zitzmann NU, Marinello CP. Treatment plan for restoring the edentulous maxilla with implant-supported restorations: removable overdenture versus fixed partial denture design. *J Prosthet Dent*. 1999;82(2):188–96. doi: 10.1016/S0022-3913(99)70155-1.
[34] Henry PJ. A review of guidelines for implant rehabilitation of the edentulous maxilla. *J Prosthet Dent*. 2002;87(3):281–8. doi: 10.1067/mpr.2002.122775.
[35] Dula K, Mini R, van der Stelt PF, Buser D. The radiographic assessment of implant patients: decision-making criteria. *Int J Oral Maxillofac Implants*. 2001;16:80–9.
[36] Benavides E, Rios HF, Ganz SD, Chang HN, Randolph R, Gayle TR, *et al.* Use of cone beam computed tomography in implant dentistry: The international congress of oral implantologists consensus report. *Implant Dent*. 2012;21:78–86.
[37] Angelopoulos C, Thomas SL, Hechler S, Parissis N, Hlavacek M. Comparison between digital panoramic radiography and cone-beam computed tomography for the identification of the mandibular canal as part of presurgical dental implant assessment. *J Oral Maxillofac Surg*. 2008;66(10):2130–5. doi: 10.1016/j.joms.2008.06.021.
[38] Lofthag-Hansen S, Gröndahl K, Ekestubbe A. Cone-beam CT for preoperative implant planning in the posterior mandible: visibility of anatomic landmarks. *Clin Implant Dent Relat Res*. 2009;11(3):246–55. doi: 10.1111/j.1708-8208.2008.00114.x.
[39] Rios HF, Borgnakke WS, Benavides E. The use of cone-beam computed tomography in management of patients requiring dental implants: an American Academy of Periodontology best evidence review. *J Periodontol*. 2017 Oct;88(10):946–59. doi: 10.1902/jop.2017.160548.
[40] Wical KE, Swoope CC. Studies of residual ridge resorption. Part I: use of panoramic radiographs for evaluation and classification of mandibular resorption. *J Prosthet Dent*. 1974;32(1):7–12. doi: 10.1016/0022-3913(74)90093-6.
[41] Tallgren A. The continuing reduction of the residual alveolar ridges in complete denture wearers. A mixed longitudinal study covering 25 years. *J Prosthet Dent*. 1972;27(2):120–32. doi: 10.1016/0022-3913(72)90188-6.
[42] Atwood DA, Coy WA. Clinical, cephalometric and densitometric study of reduction of residual ridges. *J Prosthet Dent*. 1971;26(3):280–95. doi: 10.1016/0022-3913(71)90070-9.
[43] Karkazis HC, Lambadakis J, Tsichlakis K. Cephalometric evalua tion of the changes in mandibular symphysis after 7 years of denture wearing. *Gerodontology*. 1997;14:10–5.
[44] Lam RV. Contour changes of the alveolar process following extrac tion. *J Prosthet Dent*. 1960;10(1):25–32. doi: 10.1016/0022-3913(60)90083-4.
[45] Misch CE. *Contemporary Implant Dentistry*. St Louis: Mosby Elsevier; 2008. p. 1034–5.
[46] Razavi R, Zena RB, Khan Z, Gould AR. Anatomic site evaluation of edentulous maxillae for dental implant placement. *J Prosthet Dent*. 1995;4(2):90–4. doi: 10.1111/j.1532-849X.1995.tb00322.x.
[47] Todorovic VS, Beetge MM, Kleyn J, Hoffman J, van Zyl AW. Micro-XCT analysis of anatomical features and dimensions of the incisive canal: implications for dental implant treatment in the anterior maxilla. *BMC Oral Health*. 2024 Oct 18;24(1):1244. doi: 10.1186/s12903-024-05046-3.
[48] Kuc AE, Kotuła J, Nawrocki J, Szeląg E, Kawala B, Lis J, *et al.* Morphological evaluation of the incisive canal in the aspect of the diagnosis and planning of orthodontic treatment—CBCT study. *Appl Sci*. 2023 Nov 3;13(21):12010. doi: 10.3390/app132112010.
[49] Tarnow DP, Cho SC, Wallace SS. The effect of interimplant dis tance on the height of inter-implant bone crest. *Periodontology*. 2000;71(4):546–9. doi: 10.1902/jop.2000.71.4.546.