



DENTAL IMPLANT GUIDELINES

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1. Guideline Purpose and Brief

1.1. This document aims to establish Dental Implant Guidelines to enhance the quality and consistency of care. By aligning with the best international practices, these guidelines provide evidence-based support to practitioners and ensure practitioner competency and accountability through alignment with the dental implant privilege process.

1.2. This guideline applies to all Healthcare Facilities and Professionals licensed by DoH in the Emirate of Abu Dhabi to provide Dental Implants services. This guideline should be read in conjunction with DoH General Dentist and Specialist Dentist Scope of Practice.

2. Definitions and Abbreviations

No.	Term / Abbreviation	Definition
2.1	Access Flap Surgery	A surgical procedure to reduce pockets, allowing better cleaning and treatment of infected areas around implants.
2.2	Aesthetic Zone	The visible area of a patient's smile, where implants must be meticulously planned to prevent unsightly appearances.
2.3	Anterior Mandible	The front section of the lower jaw, which experiences less growth than the maxilla, but requires careful timing for implant placement due to compensatory dentition changes.
2.4	Anterior Maxilla	The front upper jaw, known for significant growth during adolescence, impacting the timing of implant placement.
2.5	Baseline Radiographs	Initial X-ray images taken at the time of prosthetic delivery to assess bone levels and support future comparisons.
2.6	Bleeding on Probing (BOP)	An indicator of inflammation; presence of blood upon probing can signal potential complications.
2.7	Bone Regeneration	A surgical technique to restore lost bones using grafting materials.
2.8	Bruxism	Involuntary, habitual grinding or clenching of the teeth, often cause complications with dental implants.
2.9	CBCT (Cone Beam Computed Tomography)	A specialized imaging technique providing three-dimensional views critical for assessing potential implant sites.
2.10	DCCT (Diabetes Control and Complications Trial)	a landmark study that established the link between blood glucose control and long-term complications in diabetes.
2.11	Chemotherapy	A cancer treatment using drugs that can affect bone health and delay implant procedures due to its impact on recovery.

2.12	Chlorhexidine	An antimicrobial mouth rinse is often used to reduce bacteria and prevent infection around dental implants.
2.13	Dentoalveolar Maturity	The developmental stage where the alveolar bone and dentition are fully formed, typically by age 21, ensuring stable conditions for dental implants.
2.14	Diagnostic Wax-Up	A detailed representation of the intended final prosthetic outcome used for visualization and planning before implant placement.
2.15	DICOM	Digital Imaging and Communications in Medicine, a standard for storing and transmitting information in medical imaging.
2.16	Early Failure	Occurs before the implant fully integrates with the bone, often due to surgical trauma or infection.
2.17	Full Arch Implant Rehabilitation	A comprehensive dental treatment involves the replacement of all teeth in an arch with implants and connected prostheses, significantly enhancing function and aesthetics.
2.18	GBR (Guided Bone Regeneration)	A surgical procedure that uses barrier membranes to direct the growth of new bone tissue around implants.
2.19	Gy	The gray (symbol: Gy) is the unit of ionizing radiation dose in the International System of Units (SI), defined as the absorption of one joule of radiation energy per kilogram of matter.
2.20	HbA1c	Hemoglobin A1c, a measure of blood sugar control over time, with implications for surgical outcomes like healing and infection rates in dental implant patients.
2.21	IDRA (Implant Disease Risk Assessment)	A tool or model used by clinicians to assess the risk factors related to implant disease and guide maintenance strategies.
2.22	Immediate Loading	A protocol in which dental implants receive prosthetic restoration within one week of placement, allowing immediate use.
2.23	Implant Stability	Refers to the solid, rigid state of a dental implant when placed in the jawbone, critical for successful osseointegration.
2.24	Implant Survival Rates	A metric used to measure the percentage of dental implants that remain functional over a specified time period.
2.25	Interarch Relationships	Refers to the functional and aesthetic interactions between the upper and lower teeth, impacting design and placement of dental implants.
2.26	ISQ (Implant Stability Quotient)	A numerical value representing the stability of a dental implant, aiding in the decision-making for loading protocols.

2.27	Late Failure	Occurs after the implant has osseointegrated, generally due to biological or mechanical issues like peri-implantitis or prosthetic overload.
2.28	Marginal Bone Loss	The reduction in bone height around the dental implant, which can affect the stability and prognosis of the implant.
2.29	Mechanical Debridement	The removal of plaque and calculus from implant surfaces, often utilizing specialized tools.
2.30	MRONJ	Medication-Related Osteonecrosis of the Jaw, a serious condition affecting patients using certain medications, presenting a contraindication for implants.
2.31	Orthopantomogram (OPG)	A panoramic X-ray of the mouth, providing a comprehensive view of the teeth and jaw structures.
2.32	Osseointegration	The biological process where a dental implant becomes firmly attached to the bone, acting like a naturally anchored root.
2.33	Osteoradionecrosis	Bone damage resulting from radiation therapy, leading to loss of bone tissue and a complication for implant placement.
2.34	Parallel vs. Tapered Implants	Refers to the cylindrical (parallel) versus conical (tapered) shapes of implants, impacting how they perform in different bone densities.
2.35	Periapical Radiograph	A type of dental X-ray that shows the entire tooth and surrounding bone structure, useful in monitoring implant placement.
2.36	Peri-implantitis	A chronic condition characterized by inflammation and bone loss around a dental implant, similar to periodontitis.
2.37	Peri-implant mucositis	Inflammation of the soft tissue surrounding a dental implant, which is reversible if treated early.
2.38	Posterior Mandible	The rear section of the lower jaw, which shows noticeable rotational growth, necessitating mature bone development before implant placement.
2.39	Posterior Maxilla	The back section of the upper jaw, which undergoes significant growth, particularly in terms of bone height and depth.
2.40	Preload	The force exerted on a screw joint in implants through tightening (torque), critical for maintaining implant stability.
2.41	Probing Depths	Measurement of the depth of the pocket between the gum and the implant, used to monitor health status.

2.42	Prosthetic Overload	Excessive force on an implant or its components, potentially leading to mechanical failure or bone loss.
2.43	Prosthetic Rehabilitation	The process of restoring oral function with dental prostheses, including single implant crowns, bridges, or full dentures.
2.44	STL	Standard Tessellation Language, a file format native to 3D modeling, used in the digital planning of dental prostheses.
2.45	Suppuration	The presence or formation of pus, indicating an infection around the implant.
2.46	Surgical Guide	A device used during implant placement to guide drilling and ensure accurate positioning based on pre-planned prosthetic considerations.
2.47	Veneer Fractures	Breakage or damage of the thin layer of porcelain or other material applied over a prosthetic core.
2.48	V-Shaped Threads	A type of implant threading design offering a mix of compressive and shear forces, adaptable in various clinical scenarios for better load distribution.

3. Practice Guidelines

Dental implant therapy shall be initiated only after a comprehensive clinical assessment encompassing the patient's systemic and oral health status. Adherence to established clinical safety thresholds, risk mitigation strategies, and ethical standards is mandatory to ensure responsible resource utilization, minimize procedural risks, and optimize long-term treatment outcomes.

3.1 Age and Dentoalveolar Maturity

3.1.1 Eligibility for dental implant therapy requires patients to be at least 21 years 0 days of age reflecting the attainment of full dentoalveolar and craniofacial maturity.

The integration of oral implants at a young age can be significantly complicated by the ongoing growth of the jaw, which may compromise the long-term success and aesthetics of the treatment. Despite this, there has been a rising trend in placing implants in adolescents, particularly following trauma to a maxillary incisor. This raises important considerations regarding the appropriate minimum age for a solitary implant placement.

The core principle underpinning the success of dental implants is their osseointegration, which essentially causes the implants to act like ankylosed entities. Consequently, they do not adapt to the continued development of jawbones and alveolar processes, potentially leading to unesthetic outcomes, especially in the anterior regions. Therefore, the establishment of a minimum age of 21 for dental implant placement is crucial, as growth is typically concluded by this age, thereby minimizing risks associated with jaw development.

3.1.2 Anterior Maxilla: This area poses the highest risk for early implant placement due to significant and unpredictable growth variations. Premature implantation in this region may require repeated adjustments to the transgingival or transmucosal part of the implant, leading to an unfavorable implant-prosthesis ratio and magnified load stresses. Delaying implantation until age 21 reduces these risks, ensuring a more predictable and stable outcome.

3.1.3 Posterior Maxilla: There are considerable variations in the sagittal and vertical growth in the posterior maxilla.

3.1.4 Anterior Mandible: While transverse and sagittal growth in the anterior mandible completes relatively early, early implant placement in conjunction with natural teeth is inadvisable. Significant compensatory changes can occur within the dentition during growth, potentially disrupting the synergy between implants and adjacent natural teeth. Implementing a cutoff age of 21 helps ensure the natural dentition has matured appropriately, reducing the likelihood of complications.

3.1.5 Posterior Mandible: The mandible undergoes rotational growth, with substantial alterations observed in both the alveolus and mandibular border. A minimum age threshold of 21 allows for these developmental changes to stabilize, providing a more reliable foundation for implant integration.

3.1.6 In accordance with these guidelines, an age cutoff of 21 years shall be observed for implant placement to ensure complete maturation of jaw development. This requirement is intended to mitigate risks associated with skeletal growth and to ensure that implants are placed within a stable anatomical environment, thereby optimizing both functional and aesthetic outcomes in compliance with established standards.

3.1.7 Although no universally accepted diagnostic tool exists to definitively confirm skeletal growth cessation, clinical consensus and evidence-based literature support the age threshold of 21 years 0 days as a safe proxy for completed facial development.

3.1.8 Exceptions to the age requirement must be justified by appropriate radiographic evidence, clinical indicators of growth cessation, and formal endorsement by a qualified specialist.

- **General Health and Surgical Fitness**
 - Candidates must demonstrate medical stability and surgical fitness sufficient to undergo implant procedures, which may extend over a period of up to 12 months.
 - The treating clinician holds full responsibility for assessing:
 - Surgical readiness, including the patient’s capacity for healing and tolerance of local or general anesthesia.
 - The patient’s ability to comprehend treatment complexity, provide informed consent, and commit to the required oral hygiene and follow-up care.
 - Patients must demonstrate capability and willingness to engage in the full continuum of care: pre-surgical evaluation, surgical intervention, prosthetic rehabilitation, and long-term maintenance.
 - The treating clinician must refer patients whose dental implant treatment requires interventions that are beyond their scope of practice, experience or training, and those cases that necessitate a different practice setting for better outcomes of care.

3.3 Medical Conditions and Contraindications

3.3.1 Implant therapy candidacy requires careful consideration of specific medical conditions. The table below outlines conditions necessitating documentation, specialist clearance, or absolute exclusion from treatment:

Table 1: Contraindications for Dental Implants

Medical Condition	Clinical Rationale and Policy Implication
History of Orofacial Radiation (>50 Gy)	Contraindicated due to elevated risk of osteoradionecrosis and impaired osseointegration. Radiation dose documentation mandatory.
Recent Chemotherapy (within 6 months)	Implant placement deferred until hematologic recovery; minimum six months post-treatment with physician confirmation required.
Recent Major Cardiovascular Events	Includes myocardial infarction, cerebrovascular accident, and prosthetic heart valve surgery. Treatment deferred ≥6 months with clearance.
Intravenous Bisphosphonate Use	Absolute contraindication due to risk of medication-related osteonecrosis of the jaw (MRONJ).
Heavy Smoking or Vaping (>10/day)	Smoking is strictly discouraged due to its association with an elevated risk of implant failure and peri-implantitis. Cessation of smoking is strongly recommended as a prerequisite for eligibility.
Rare Bone Disorders (e.g., Paget’s disease)	High risk of jaw infection or implant failure; specialist report and radiographs required.

Poorly Controlled Diabetes (HbA1c >55 mmol/mol), >7.2 up to ≤ 8% DCCT units. patient must obtain documented clearance from their treating endocrinologist prior to proceeding with dental implant therapy.	Dental implant is contraindicated for patient with HbA1C more than 8 %
Severe Systemic Conditions	Conditions such as advanced nephropathy, hepatic failure, leukemia, and immunosuppression contraindicate implant therapy.
Temporomandibular Disorders (TMD)	Requires case-by-case evaluation.
History of Facial Bone Fracture	Implant placement only after radiographic confirmation of complete healing and structural integrity.

3.4 Additional Contraindications

Additional contraindications from various international **Guidelines for Implant Dentistry**

3.4.1 Absolute Contraindications ^{8.3, 8.4, 8.5}

- Bleeding disorders
- Drug abuse
- Terminal illness
- Tumoricidal radiation at implant site
- Unrealistic patient expectations
- Inability to prosthodontically restore implants
- Collagen and bone diseases
- Hyperactive involuntary muscle movements
- Patients under 16 years of age

3.4.2 Relative Contraindications:

- Blood dyscrasia
- Pulmonary diseases
- Anticoagulant therapy
- Psychiatric illness (Patient must obtain documented clearance from their treating psychiatrist prior to proceeding with dental implant therapy).
- Mental retardation
- Chemotherapy
- Tobacco use
- Osteoporosis

- HIV infection
- Hypothyroidism
- Immunosuppression therapy
- Lupus
- Renal insufficiency
- Scleroderma
- Pregnancy
- Cervicofacial irradiation

3.5 Documentation and Requirements for Dental Implants

To proceed with dental implant planning and treatment, the following documentation must be documented and reviewed to ensure patient safety and treatment appropriateness:

3.5.1 Comprehensive Medical History and Informed Consent:

Detailed documentation of the patient's medical and dental history, alongside a signed informed consent form that confirms the patient's understanding of the treatment complexity, potential risks, benefits, and their commitment to follow-up care and maintenance.

3.5.2 Relevant Laboratory and Imaging Investigations:

Necessary diagnostic tests including, but not limited to, radiographs (e.g., orthopantomogram (OPG), CBCT scans), laboratory reports assessing systemic health (e.g., HbA1c levels, blood counts), and any other investigations confirming bone quality, craniofacial maturity, and overall medical status.

3.5.3 Specialist Clearance Letters:

Written endorsements from relevant specialists such as oncologists, cardiologists, endocrinologists, or other medical consultants, particularly when the patient presents with systemic conditions or prior treatments that impact implant eligibility or risk management.

3.5.4 Supporting Clinical Documentation:

Discharge summaries, treatment completion reports, radiation dose charts, or other official medical records relevant to the patient's prior therapies (e.g., chemotherapy, radiotherapy) must be included where applicable.

3.6 Treatment Planning and Interdisciplinary Collaboration

3.6.1 Comprehensive Diagnostic Assessment

3.6.1.1 All dental implant treatment plans shall be founded on a comprehensive diagnostic protocol that includes a full clinical examination, diagnostic-quality radiographs (including CBCT scans where indicated), study model analysis and clinical photographs.

3.6.1.2 The diagnostic evaluation should assess:

- Bone quantity and quality
- Vertical and horizontal space availability
- Anatomical limitations (e.g., proximity to sinus, mandibular canal)
- Occlusal dynamics and inter-arch relationships

3.6.1.3 Risk assessment shall identify:

- Systemic comorbidities (e.g., diabetes, immunosuppression)
- Local risk factors (e.g., bruxism, poor oral hygiene, smoking)
- History of periodontal disease or previous implant failure.

- Presence of oral health disease.

3.6.1.4 Inter-specialty consultations with periodontists, prosthodontists, Oral Maxillofacial Surgeons, radiologists, ENT specialists, or relevant medical consultants shall be mandated when anatomical, aesthetic, or systemic complexity exists.

3.6.1.5 Diagnostic wax-ups, radiographic and surgical guides, and digital planning tools (such as virtual implant placement and guided surgery) shall be utilized to simulate optimal outcomes and support prosthetically driven treatment planning.

3.6.2 Individualized Treatment Planning

3.6.2.1 Treatment plans shall be individualized based on the patients:

- Clinical condition and oral health status
- Functional and aesthetic needs
- Willingness and ability to maintain long-term follow-up
- Financial resources and coverage.

3.6.2.2 The proposed type of prosthetic rehabilitation must be clearly defined and documented, including:

- Implant-supported prostheses (single units, fixed partial dentures, hybrid full-arch prostheses)
- Implant-retained overdentures (retained by ball, locator, or bar attachments)

3.6.2.3 The loading protocol shall be pre-defined, supported by diagnostic evidence, and categorized as:

- Immediate Occlusal Loading: within 48 hours to 2 weeks post-placement
- Early Occlusal Loading: between 2 weeks and 3 months
- Non-functional Restoration: no occlusal contact, used for aesthetics or tissue contouring
- Delayed Occlusal Loading: 3 months or more, utilizing one- or two-stage protocols

3.6.3 multidisciplinary team (MDT) and Workflow Integration

3.6.3.1 Implant therapy shall be planned and executed within a coordinated interdisciplinary framework involving:

- Restorative dentists or prosthodontists
- Oral surgeons or periodontists
- Radiologists
- Dental hygienists
- Laboratory technicians (as required)
- Implant case committee.

3.6.3.2 Workflow integration shall be achieved through:

- Interdisciplinary case conferences
- Shared clinical planning platforms
- Digital data sharing formats (e.g., STL, DICOM, treatment simulations)

3.6.3.3 The collaborative team must ensure:

- Accurate three-dimensional implant positioning based on prosthetic requirements
- Adequate restorative space for the proposed prosthesis
- Biomechanical soundness, including appropriate crown-to-implant ratios and even occlusal force distribution
- Esthetic zone considerations such as gingival display and emergence profile

3.6.4 Patient Communication and Informed Consent

3.6.4.1 All patients shall receive a structured treatment presentation that includes:

- Clinical and radiographic findings
- Proposed treatment options, including risks and benefits
- Alternative therapies or the option of no treatment
- Timeframe for surgical and prosthetic phases
- Maintenance expectations and oral hygiene commitments
- Financial responsibilities.

3.6.4.2 A signed informed consent form must be obtained prior to treatment, accompanied by written pre-operative and post-operative instructions and prescriptions when clinically indicated.

3.6.5 Follow-Up and Continuity of Care

3.6.5.1 The treatment plan shall incorporate a structured follow-up schedule with defined intervals for:

- Peri-implant soft tissue assessments
- Radiographic evaluations of osseointegration and bone stability
- Periodontal charting and hygiene reinforcement

3.6.5.2 Follow-up care shall emphasize:

- Early detection and management of peri-implant mucositis or peri-implantitis
- Management of prosthetic wear, fractures, or screw loosening
- Occlusal adjustments to prevent implant overloading or traumatic contacts

3.6.5.3 Patients are strongly encouraged to follow the recommended maintenance protocol. Consistent adherence is important for ensuring optimal long-term implant outcomes.

3.7 Implant Planning Considerations

This section outlines key clinical considerations that influence decision-making for implant therapy, focusing on soft and hard tissue evaluation, prosthetic planning, and occlusal dynamics.

3.7.1 Aesthetic Evaluation

Lip coverage should be assessed during normal function and smiling, especially regarding visibility of anterior teeth and gingival tissues. Anterior restorations must provide adequate lip support. The anticipated final restoration appearance should be evaluated using diagnostic wax-ups or provisional restorations, which can also assist in fabricating surgical guides or interim prostheses. Patient evaluation should occur both with and without existing or provisional prostheses to assess effects on

facial profile, lip support, prosthesis visibility, and tooth positioning. For optimal pink aesthetics, consider hard and soft tissue grafting when indicated. Additional assessments include keratinized tissue presence, frenum position, ridge shape and volume, and comprehensive occlusal analysis.

3.7.2 Functional Considerations

Functional limitations are commonly reported in patients with missing molars. The concept of the shortened dental arch must be considered when planning implants. A detailed occlusal evaluation is necessary to ensure functional stability and guide prosthetic rehabilitation.

3.7.3 Treatment Planning Parameters

Visual inspection and palpation of the edentulous ridge are critical to evaluate ridge height, width, and contour. Attention should be given to labial concavities or irregularities, ridge angulation, and spatial relationships with opposing dentition. Clinical techniques such as ridge mapping, soft tissue thickness measurement (bone sounding), and inter-arch space dimensional evaluation are recommended. Ridge forms with labial proclination may require corresponding implant angulation, affecting aesthetics and mechanical loading. In cases of significant maxillomandibular discrepancies, such as pseudo-Class III relationships caused by maxillary resorption, fixed prostheses may not be feasible.

3.7.4 Soft Tissue Evaluation and Implant Feasibility

Soft tissue thickness and quality are critical for long-term peri-implant health and aesthetics. Presence of attached keratinized mucosa enhances soft tissue stability. Measure the mesiodistal length of the edentulous span to determine the number and optimal implant positioning, considering anatomical constraints like adjacent tooth root angulation, assessed clinically or radiographically.

3.7.5 Restorative and Endodontic Status

Evaluate adjacent teeth condition, restorations, and any endodontic treatments to anticipate challenges or contraindications.

3.7.6 Case Complexity Classification

3.7.6.1 To optimize patient outcomes and align treatment with clinician expertise, dental implant cases must be systematically classified by complexity. This guides treatment planning, risk assessment, resource allocation, and referral decisions.

3.7.6.2 Definitions and Purpose

- *Straightforward Cases* have predictable outcomes, minimal surgical or prosthetic challenges, and limited risk factors, suitable for routine protocols.
- *Complex Cases* involve heightened risk due to anatomical, medical, functional, or aesthetic factors, requiring multidisciplinary input, advanced techniques, or longer treatment.

3.7.6.3 Many cases may exhibit features of both categories; this classification helps stratify risk and plan accordingly.

Table 2 Case Complexity Decision Guide

Parameter	Straightforward Cases	Complex Cases
Perception of Case	Predictable outcomes; no significant aesthetic concerns; standard restorative requirements.	Outcome difficult to visualize; high aesthetic demands (anterior zone, smile line); requires customized planning.
Patient Age & Medical History	Individuals aged 21 years and older, Medically stable; fit for routine procedures; no special management required.	Elderly or significant comorbidities (diabetes, cardiovascular disease); needs medical clearance and perioperative management.

Tooth Position & Arch Form	Edentulous space aligns with arch; adjacent/opposing teeth stable; no orthodontic/pre-prosthetic needed.	Malpositioned teeth; orthodontic correction or extensive imaging needed; ridge resorption or irregularities.
Implant Surgery	Favorable anatomy; no significant augmentation; conventional drilling; no proximity to vital structures.	Challenging sites near nerves/sinuses; extensive grafting required; guided or advanced surgery; higher risks.
Occlusion	Stable scheme; no vertical dimension changes; no parafunctional habits.	Modifications to occlusion or vertical dimension needed; parafunctional habits requires protective measures.
Loading Protocol	Conventional delayed loading (8-12 weeks); no immediate provisionalization.	Immediate or early loading protocols; implant-supported provisionals; risk of micromotion if mismanaged.
Soft Tissue Management	Minor manipulation; adequate keratinized mucosa; no extensive grafting.	Significant soft tissue deficiency: grafting needed; thin biotype; scar tissue management.
Periodontal Status	Healthy or minor gingivitis manageable conservatively.	Active periodontitis; mobile/compromised adjacent teeth; risk factors (smoking, diabetes) affect prognosis.
Maintenance	Non-surgical management; minor mucositis or peri-implantitis treated conservatively.	Surgical intervention or implant removal due to advanced peri-implantitis.
Placement Timing	Delayed placement after healing.	Immediate placement following extraction or provisionalization.

Table 3 Aesthetic Zone and Smile Line Criteria

Parameter	Straightforward (No Advanced Aesthetic Zone)	Complex (Advanced Aesthetic Zone)
Aesthetic Zone Definition	Implant site outside aesthetic zone (premolars/posterior teeth).	Implant site within aesthetic zone (incisors, canines, first premolars).
Smile Line (Gingival Display)	< 1 mm gingival display (low smile line).	≥ 2 mm gingival display (high smile line).
Interdental Papilla Height	Papilla intact; no black triangles near implant site.	Black triangles ≥ 2 mm or papilla loss near implant site.
Lip Line Position	Lip line covers cervical third of implant tooth/site when smiling.	Lip line exposes entire crown and cervical areas of implant site teeth.

Soft Tissue Biotype	Thick biotype ≥ 2 mm.	Thin biotype < 2 mm requiring soft tissue augmentation.
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Table 4 Intervention Types

Type	Description	Examples
Orthodontic Intervention	Tooth movement or realignment to create suitable implant space or site.	Braces, clear aligners; space opening; malocclusion correction.
Major Pre-Prosthetic Intervention	Surgical/restorative procedures to correct hard/soft tissue deficiencies or ridge form.	Bone grafting, ridge splitting, soft tissue grafting, alveoloplasty, vestibuloplasty.

Table 5 Vertical Dimension (VD) Considerations

Parameter	Straightforward	Complex
No Change in VD	Implant placement/restoration fits current bite without change.	—
Change in VD Required	—	Requires increasing or decreasing bite height; correction of occlusal disharmony.

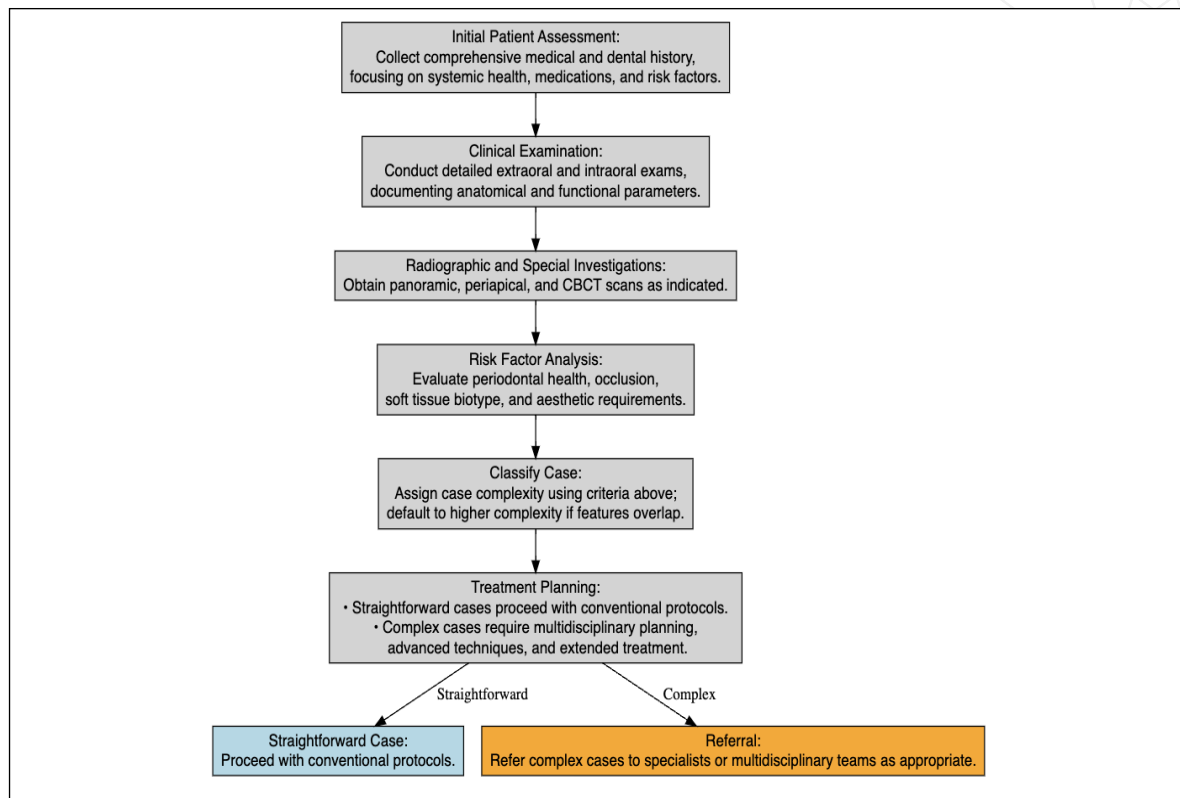


Figure 1 Clinical Workflow for Case Classification

4. Choosing the Appropriate Implant

4.1 Implant Geometry: Parallel vs. Tapered

4.1.1 Parallel-walled implants, characterized by a consistent cylindrical diameter, are generally straightforward to place and provide reliable stability in dense bone. However, in softer bone, they may offer reduced primary stability and are associated with a higher risk of micromovement.

4.1.2 Tapered implants, designed with a conical configuration, enhance primary stability in sites with soft or low-density bone. These implants are particularly suitable for immediate placement protocols. However, their use requires careful planning, as they may increase the risk of bone compression if not precisely positioned.

4.2 Thread Design and Biomechanical Considerations

Implant thread geometry plays a critical role in load distribution and bone-implant interface stability:

4.2.1 Square or Buttress Threads: These generate predominantly compressive forces that are conducive to bone maintenance and osseointegration while minimizing detrimental shear forces.

4.2.2 V-Shaped and Reverse Buttress Threads: These configurations create a combination of compressive, tensile, and shear forces. While offering adaptability across different clinical scenarios, they may not provide the same bone preservation benefits as square thread designs.

4.2.3 Parallel Implants: Due to their geometry, they tend to generate more shear forces, which may be suboptimal for bone remodeling, particularly in areas with low bone density.

4.2.4 Tapered Implants: These implants tend to produce compressive forces that support bone formation and implant stability, making them favorable in cases of soft bone.

4.2.5 Clinical Recommendations:

The selection of an appropriate implant system must be based on a comprehensive evaluation of the clinical site and patient-specific factors. Tissue-level implants are typically preferred for posterior regions due to their simplified maintenance and restorative workflows. In contrast, bone-level implants are more suitable for anterior regions, where aesthetic demands and precise soft tissue management are paramount. Furthermore, implant material, restorative connection type, implant geometry, and thread design should all be carefully considered, as each factor significantly influences long-term implant success and patient outcomes.

4.3 Spatial Requirements

4.3.1 Mesiodistal Dimension

To accommodate a single implant of 4 mm in diameter, a minimum mesiodistal space of 7 mm is required. This ensures at least 1.5 mm clearance between the implant and the adjacent teeth. For the placement of multiple implants, a greater separation is necessary—typically no less than 3 mm between adjacent fixtures—to preserve inter-implant bone and optimize soft tissue support.

Mesiodistal danger zones lie within 1.0–1.5 mm of adjacent tooth roots. Infringing upon this critical zone may result in bone resorption, diminished papilla height, and compromised restorative outcomes due to loss of interproximal bone and altered emergence profiles.

4.3.2 Orofacial Dimension

Implant positioning in the orofacial dimension should ensure that the implant shoulder is located within the “comfort zone”—approximately 1.5 to 2.0 mm from the intended point of prosthetic emergence.

Placing the implant too facially increases the risk of soft tissue recession and restoration complications, especially when the facial bone wall is thin. Conversely, placing the implant more than 2 mm palatal to the emergence profile may result in ridge-lap restorations, negatively affecting both function and aesthetics. An optimal facial bone thickness of at least 2 mm is recommended to support peri-implant soft tissue and mitigate the risk of resorption.

4.3.3 Coronoapical Dimension:

Precise coronoapical placement is critical for functional and aesthetic success. For tissue-level implants, the implant shoulder should be positioned approximately 1 mm apical to the cemento-enamel junction (CEJ) of adjacent teeth.

For bone-level implants, a vertical distance of 3–4 mm apical to the CEJ is generally advised to accommodate soft tissue and bone contours. Ideally, the implant shoulder should be placed around 2 mm apical to the mid-facial gingival margin of the final restoration. This positioning can be determined with the aid of a **surgical guide** that indicates the planned gingival contour.

Clinical assessment tools, such as a periodontal probe aligned with the CEJs of adjacent teeth, can assist in intraoperative verification. Tooth-specific anatomical variations in CEJ height should also be considered, for example, the CEJ of lateral incisors often lies more coronally than that of central incisors or canines.

Improper apical placement beyond 3 mm may lead to gingival recession and facial bone loss, while positioning the implant shoulder too coronally risks metal exposure and an unaesthetic emergence profile. To enhance soft tissue contours in such cases, a beveled healing cap can aid facial flap adaptation, and soft-tissue grafting may be indicated where bone grafting is not required.

4.4 Digital Planning for Implant Placement

Accurate digital planning is essential for ensuring predictable implant outcomes. The following digital resources are typically used during the planning phase:

- 4.4.1 Baseline Scan:** An intraoral scan or a physical model (converted to STL format) provides a reference for evaluating the current condition and initiating treatment planning.
- 4.4.2 Wax-Up:** A diagnostic wax-up—either physical or digital—illustrates the desired prosthetic outcome, serving as a reference for esthetics and function.
- 4.4.3 CBCT Imaging:** Cone Beam Computed Tomography (CBCT) offers a detailed, three-dimensional view of the maxillofacial anatomy. CBCT is critical for evaluating bone quantity, angulation, and anatomical landmarks necessary for implant placement.

4.5 Implant Number Guidelines

The determination of the number of implants required is contingent upon several factors, including the number of missing teeth, prosthetic design considerations, bone quality and quantity, and functional loading requirements:

4.5.1 Anterior Region:

- Single Tooth Loss: *A single implant is typically sufficient to replace one anterior tooth.*
- Two Missing Teeth: *Two implants are generally required, each placed in separate sites.*
- Three Missing Teeth: *Placement of two or three implants may be appropriate, depending on bone support and interdental spacing.*
- Four Missing Teeth: *Between two and four implants may be indicated, tailored according to anatomical constraints and prosthetic requirements.*

4.5.2 Posterior Region:

- One Molar: One implant is generally adequate; however, in cases involving high occlusal loads or compromised bone quality, two implants may be warranted.
- Two Molars: Typically, two to three implants are recommended to ensure optimal load distribution and prosthetic stability.

4.5.3 Full Arch Overdentures:

- Maxilla: A minimum of four implants is considered the standard of care for supporting a maxillary overdenture.
- Mandible: Generally, at least two implants suffice for mandibular overdentures, though clinical indications may necessitate additional implants.

4.6 Timing of Implant Placement Following Tooth Extraction

Implant placement timing post-extraction is categorized into four protocols (Type I to Type IV)^{8,2}

4.6.1 Immediate Implant Placement (Type I)

4.6.1.1 *Healing Period Prior to Implant Placement:* None

Selection Criteria:

- Intact facial bone wall with thickness greater than 1 mm
- Thick, soft tissue biotype
- Absence of acute infection
- Adequate apical bone volume to achieve primary implant stability

4.6.1.2 *Surgical Considerations:*

- A flapless surgical approach is recommended when feasible
- Internal augmentation may be necessary

4.6.1.3 Type I involves implant placement immediately following tooth extraction within the same surgical session. This method reduces the number of surgical interventions and shortens the overall treatment timeline. However, it is **technique-sensitive** due to challenges in implant positioning and soft tissue management. Despite immediate placement, post-extraction alveolar ridge remodeling cannot be fully prevented.

4.6.2 Early Implant Placement with Soft Tissue Healing (Type II)

4.6.2.1 *Healing Period Prior to Implant Placement:* 4–8 weeks

Selection Criteria:

- Thick or compromised facial bone wall
- Adequate bone volume for three-dimensional implant stability

4.6.2.2 *Surgical Considerations:*

- Open flap surgical approach
- Contour augmentation utilizing guided bone regeneration (GBR)

4.6.2.3 Type II placement occurs following soft tissue closure of the extraction socket, typically within 4 to 8 weeks post-extraction. This protocol enhances soft tissue quality and allows thorough assessment of residual infection. Although extending treatment duration, it offers improved soft tissue outcomes and is indicated when sufficient bone volume exists.

4.6.3 Early Implant Placement with Partial Bone Healing (Type III)

4.6.3.1 Healing Period Prior to Implant Placement: 12–16 weeks

Selection Criteria:

- Presence of extensive periapical bone lesions precluding Types I or II placement

4.6.3.2 Surgical Considerations:

- Open flap surgical approach
- GBR for contour augmentation

4.6.3.3 Type III involves implant placement after partial bone regeneration within the socket, generally between 12- and 16-weeks post-extraction. This approach supports enhanced primary stability and is indicated when large periapical lesions **exclude** immediate or early placement.

4.6.4 Late Implant Placement (Type IV)

4.6.4.1 With Prior Socket Grafting for Ridge Preservation

- *Healing Period:* ≥6 months
- *Selection Criteria:*
 - Adolescents (<20 years) not yet eligible for implant therapy
 - Significant apical or palatal bone defects
 - Ankylosed roots with insufficient apical bone volume
- *Surgical Considerations:*
 - Open flap approach with GBR for contour augmentation

4.6.4.2 Without Prior Socket Grafting

- *Healing Period:* ≥6 months
- *Selection Criteria:*
 - Delays in implant therapy due to patient or site-specific factors
- *Surgical Considerations:*
 - If adequate bone volume is present: open flap approach with GBR
 - If bone volume is insufficient: staged GBR followed by implant placement and possible secondary augmentation

4.6.4.3 Type IV denotes implant placement in fully healed extraction sites, typically 4–6 months or more after extraction. This protocol benefits from placement in mature ridges with established soft tissue architecture but entails longer treatment durations and a higher risk of ridge resorption. It is the preferred approach when immediate or early implant placement is contraindicated. Use of socket preservation techniques is recommended to mitigate post-extraction bone loss.

4.7 Timing of Loading in Dental Implantology:

- **Implant Loading Protocols^{8,2:}**

4.7.1.1 Classified by timing of prosthetic restoration after implant placement:

4.7.1.2 Immediate Loading: Within 1 week

- **Definition:** Prosthetic loading within 1 week of implant placement.
- **Advantages:**
 - Immediate restoration of function, speech, aesthetics
 - Shorter overall treatment time and fewer appointments
 - Less postoperative discomfort
 - Improved patient satisfaction and quality of life
 - Successful osseointegration under functional load possible
- **Clinical Requirements:**
 - Adequate bone quantity/quality
 - High primary stability (ISQ \geq 60 recommended)
 - Multi-unit cases require rigid splinting of implants

4.7.1.3 Early Loading: Between 1 week and 2 months

- **Definition:** Loading between 1 week and 2 months post-placement.
- **Considerations:**
 - Similar prerequisites as immediate loading (good bone, primary stability)
 - Balances accelerated treatment with biological healing

4.7.1.4 Conventional (Delayed) Loading: After \geq 2 months

- **Definition:** Loading after \geq 2 months healing.
- **Indications:**
 - Poor primary stability
 - Need for substantial bone augmentation
 - Use of narrow or short implants
 - Compromised host factors (e.g., bruxism)
- Most predictable and common protocol, especially with biological/mechanical risk factors.

4.7.2 Important Anatomical Considerations and Spatial Requirements

4.7.2.1 Inferior Alveolar Nerve & Maxillary Sinus:

Maintain 2.5–3 mm clearance to avoid nerve damage.

4.7.2.2 Mental Nerve & Anterior Loop:

Avoid implant placement immediately anterior to mental foramen; maintain \geq 4 mm safety margin.

4.7.2.3 Blood Vessels (Sublingual & Submental Arteries):

Avoid perforation of lingual cortical plates; reflect lingual flap carefully^{8,2}.

4.7.2.4 Floor of the Mouth:

Protect by managing lingual flap to prevent vascular injury.

4.7.2.5 Nasal Cavity & Maxillary Sinuses:

Ensure clearance to prevent complications.

4.7.2.6 Proximity to Adjacent Teeth:

Maintain \geq 1.5 mm distance to protect periodontal structures.

4.7.2.7 Distance Between Implants:

Maintain \geq 3 mm to preserve bone and ensure osseointegration.

4.7.2.8 Interocclusal Space:

Minimum 7 mm is required to fit prosthetic components and ensure function.

4.8 Surgical Protocols and Preoperative Planning for Dental Implant Placement

4.8.1 Surgical Complexity and Treatment Pathways:

4.8.1.1 Dental implant procedures vary in complexity and require tailored planning based on clinical indications and long-term objectives:

- Immediate loading may be appropriate in select cases, allowing implant placement and provisional restoration within the same visit.
- Staged approaches are preferred where osseointegration or soft tissue conditioning requires healing periods before prosthetic placement.
- Adjunctive procedures (e.g., bone grafting or soft tissue augmentation) should be considered when native anatomy is inadequate.

Treatment planning must align with patient-specific risk factors and functional and aesthetic goals.

4.8.2 Preoperative Care and Surgical Asepsis:

4.8.2.1 Standardized preoperative protocols help reduce surgical risks and promote implant success:

- Medication protocols should ensure timely administration of NSAIDs and antimicrobials.
- Antibiotic prophylaxis (e.g., 2g amoxicillin, orally, one hour prior to surgery) significantly lowers early implant failure rates^{8,2}.
- Strict surgical asepsis must be followed, including disinfection, instrument sterilization, sterile gowning, and defined operative zoning.

4.8.3 Anatomical Considerations and Surgical Safety:

4.8.3.1 Accurate anatomical understanding is essential to avoid complications:

- Maintain a minimum clearance of 1.5–2 mm from critical landmarks like the mental foramen.
- Evaluate high-risk structures (e.g., incisive canal, buccal/lingual concavities) to prevent neurovascular injury.
- Use intraoperative visualization for precise osteotomy placement.

4.8.4 Radiographic and Clinical Verification

Radiographic findings must be corroborated clinically for safe surgery:

- Cone-beam CT and orthopantomogram (OPG) radiographs assist in assessing anatomical constraints and pathology.
- Surgical flaps should provide adequate exposure to verify radiographic data and avoid injury to adjacent structures.

4.8.5 Flap Design in Dental Implant Surgery

Flap design should optimize visibility, access, and tissue preservation:

- Goals: minimize trauma, preserve vascular supply, promote healing, and maintain soft tissue aesthetics.

4.8.5.1 Flap Design Techniques and Principles

- Incision planning: Crestal incisions with or without vertical releases, maintaining a wide base for vascular supply.
- Tissue handling: Avoid overstretching, twisting, or excessive manipulation.

4.8.5.2 Limited Flap Design: Indications and Limitations

- Indications: Aesthetic areas; help preserve papillae and crestal bone.
- Limitations: Reduced visibility, difficult access for grafting, and increased risk of tension and dehiscence.

4.8.5.3 Preventive Measures and Risk Mitigation

- Necrosis prevention: Broad-based flaps with preserved axial blood supply.
- Dehiscence control: Tension-free closure; consider periosteal releasing incisions.
- Tearing avoidance: Adequately sized flaps with sufficient releasing incisions.

4.8.5.4 Flap Design Variations and Clinical Applications

- Crestal/horizontal incisions: May be adjusted (e.g., paramedian or palatal) in anterior zones for aesthetics.
- Two-/three-sided flaps: Provide better access, especially in reconstruction or bone grafting.

4.8.6 Implant Bed Preparation, Placement, and Wound Closure

4.8.6.1 Implant Bed Preparation

- Follow system-specific drilling protocols.
- Use sharp drills at speeds <800 rpm with saline irrigation to prevent thermal injury.
- Ensure atraumatic techniques to protect bone and soft tissue.

4.8.6.2 Implant Placement

- Administer local anesthesia before implant insertion.
- Position implants as pre-planned; use surgical guides in complex or aesthetic zones.
- Consider immediate provisionalization when appropriate; otherwise, place a healing abutment.

4.8.6.3 Assessment of Implant Stability

- Primary stability is essential for osseointegration.
- Use insertion torque and Implant Stability Quotient (ISQ) to assess stability.
- ISQ values between 55–85 is considered acceptable.

4.8.6.4 Wound Closure Protocols

- One-stage protocol: Implant and healing abutment placed together; no second surgery needed.
- Two-stage protocol: Implant is submerged and covered with mucosa; requires a second surgery for abutment placement.

4.8.7 Types of Bone Graft Materials for Dental Implant Surgery

Selection depends on biological properties, source, and clinical needs:

4.8.7.1 Autograft (Autogenous/Autologous)

- Source: Patient's own bone (mandible, chin, iliac crest).
- Pros: Osteogenic, no immune reaction, high biologic potential.
- Cons: Requires second surgical site, limited quantity, donor site morbidity.

4.8.7.2 Allograft

- Source: Human donors (processed).
- Pros: No donor site, widely available.
- Cons: Risk of disease transmission, immune reactions, ethical concerns.

4.8.7.3 Xenograft

- Source: Animal bone (commonly bovine).
- Pros: Stable volume, no donor site, abundant supply.
- Cons: Slower resorption, possible immune response, safety concerns.

4.8.7.4 Alloplast (Synthetic)

- Source: Synthetic (e.g., hydroxyapatite, TCP).
- Pros: No risk of disease, unlimited availability.
- Cons: Lacks osteoinductive/osteogenic potential; may resorb quickly.

4.8.8 Types of Bone Augmentation

Evidence suggests multiple techniques are reliable for ridge augmentation. Choice depends on augmentation extent, anatomical limitations, and complication risk.

4.8.8.1 Guided Bone Regeneration (GBR)

- Uses graft materials with resorbable or non-resorbable membranes to guide bone regeneration.
- Suitable for atrophic ridges; high implant survival (>90%)^{8,2}.

4.8.8.2 Sinus Lift (Sinus Augmentation)

- Lateral window technique: Accesses sinus through lateral wall; used for greater augmentation^{8,2}.
- Crestal lift: Less invasive; ideal for minor augmentation^{8,2}.

4.8.8.3 Ridge Expansion (Split Ridge Technique)

- Expands narrow ridges to accommodate implants.
- Involves segmental osteotomy and placement of bone grafts in the created space.

4.8.8.4 Distraction Osteogenesis (DO)

- Gradual separation of bone segments stimulates bone growth.
- Ideal for vertical ridge augmentation exceeding 4 mm.

4.8.8.5 Onlay Block Grafting

- Autologous block grafts are fixed onto recipient sites.
- Suitable for vertical and horizontal augmentation.
- Implant survival rates:
- Horizontal: 96.9–100%
- Vertical: 89.5–100%^{8,2}.
- Often combined with GBR for improved outcomes.

4.8.9 Soft Tissue Augmentation

Purpose:

Indicated when adequate bone volume is present but soft tissue is deficient. Goals include:

- Enhancing aesthetics around prosthetic restorations
- Achieving optimal soft tissue coverage
- Increasing the width of keratinized tissue adjacent to implants or natural teeth (when required)

Non-Surgical Alternative:

Patients may opt for pink-colored restorative materials to mask soft tissue deficits without undergoing grafting.

4.8.9.1 Soft Tissue Grafting Techniques

- **Pedicle Graft Procedure**

Indication: Localized, minor ridge defects (horizontal/vertical)

Technique: A connective tissue pedicle (e.g., from the palate) is rotated into a buccal subepithelial pouch (e.g., roll flap technique)

- **Free Graft Procedures**

Recommended for larger or extensive defects. Types include:

4.8.9.2 Pouch Grafts

Indication: Class I ridge defects

Technique: A connective tissue graft (from palate/tuberosity) is placed into a subepithelial pouch at the defect site.

- **Interpositional Grafts**

Indication: Class I and small/moderate Class II defects

Technique: A composite graft (epithelium + connective tissue) is inserted into a recipient envelope, leaving the epithelial portion exposed.

- **Onlay Grafts**

Indication: Class II and III defects needing ridge height increase

Technique: A free epithelialized graft from the palate is placed on a de-epithelialized recipient bed.

Contraindications: Avoid in cases with:

- o Narrow gingival width
- o High frenum attachment
- o Gingival scarring

- **Combined Onlay–Interpositional Grafts**

Indication: Class III defects requiring complex soft tissue reconstruction

5. Prosthetic Treatment in Implant Dentistry

The following are guidelines outlining the protocols for prosthetic treatment following implant placement. They serve to ensure long-term success in function, aesthetics, and patient satisfaction.

5.1 Full Arch Implant Rehabilitation

5.1.2 Bone Resorption and Classification

Bone Resorption Post-Extraction:

- **Maxilla predominantly experiences labial/buccal bone loss.**
- **Mandible shows labial loss anteriorly and lingual loss posteriorly.**

5.1.3 **Factors Influencing Resorption:** Extraction history, prosthesis fit, parafunctional habits, and systemic diseases such as diabetes and osteoporosis.

5.1.4 Classification of Edentulous Jaws:

Jaws classified into six classes based on bone shape and volume:^{8,2}

5.1.4.1 **Four bone quality types ranging from full cortical bone to thin cortical with sparse trabecular^{8,2}.**

5.1.5 Implant-Supported Overdentures:

- Significant improvements over conventional dentures in retention, stability, and quality of life.
- Minimum requirements: Mandibular overdentures require at least two implants in the canine region; maxillary overdentures typically require 4-6 implants.
- Attachments: Options vary between splinted and individual systems, each with maintenance and hygiene considerations.

5.1.6 Implant-Supported Precision Attachments

Attachment Types:

- 5.1.6.1 Ball: Simple, vertical space required, subject to wear.
- 5.1.6.2 Locator: Strong retention, minimal space requirement, component replacement needed.
- 5.1.6.3 Magnetic: Patient-friendly, corrosion/demagnetization risk.
- 5.1.6.4 Bar and Clip Systems: Excellent retention, but pose a hygiene challenge.
- 5.1.6.5 Milled Bars (CAD/CAM): High precision, costlier, with hygiene needs.

5.2 Full-arch fixed prostheses involve using existing dentures as guides, necessitating 4-6 implants per arch.

5.2.1 Mandibular:

- 5.2.1.1 For non-resorbed segments, implants should be angled above the inferior alveolar nerve.
- 5.2.1.2 Resorbed mandibles favor implants anterior to the mental foramen. Alternatives include short implants or vertical ridge augmentation.

○ Maxillary:

- 5.2.1.1 Implants should be angled distally along the mesial sinus wall, with alternatives like short implants, sinus augmentation, and zygomatic implants. The All-on-Four approach shows a 99.8% survival rate over 24 months.

5.4 Prosthetically-Driven Implant Treatment

Key Principles:

- Prospective prosthesis planning prior to implant placement ensures alignment with restorative goals:
- Improved hygiene and peri-implant tissue health.
- Optimal plaque control and reduced disease risks.
- Enhanced restoration longevity.
- Accurate Implant Impressions and Verification
- Utilize closed-tray and open-tray techniques ensuring passive, precise fit through:
- **Verification jigs and periapical radiographs confirm implant positions.**

Types of Implant-Retained Prostheses:

- Fixed Prostheses: Single crowns, bridges, and full-arch restorations.
- Removable Prostheses: Enhance stability compared to traditional dentures.

- Full-Arch Options: Screw-retained restorations favor maintenance; cement-retained offer superior aesthetics.
- Screw Retention: Preferred for large restorations to improve retrievability.

5.5 Materials and Design Considerations

Selection guided by biomechanical and aesthetic demands:

- Porcelain-fused-to-metal, gold alloys, acrylic, and zirconia are among options.
- Abutment Selection: Can be prefabricated or custom-designed based on clinical factors such as implant depth, position, and load direction.

5.6 Role of Prosthodontists in Complex Cases

Prosthodontists are essential in managing challenging implant cases, offering expertise in treatment planning, material selection, and complication management, thereby enhancing prosthetic outcomes and patient satisfaction.

5.7 Preload

Definition: Tensile force via torque application creates clamping force for stability.

Guidelines:

- Follow manufacturer specifications, use calibrated torque drivers, and maintain quality control.
- Occlusion and Considerations in Bruxism Patients
- Occlusal schemes must ensure axial loading and light contact.
- Bruxism poses risks such as implant failure and bone loss, managed through occlusal splints, material selection, and precise adjustments.

6. Maintenance, Complication Management, and Survival of Dental Implants

Effective long-term outcomes in implant dentistry rely not only on successful surgical placement but also on structured maintenance, timely complication management, and appropriate risk mitigation strategies. This section explores protocols and clinical considerations vital to maintaining implant health and prosthetic integrity.

6.1 Dental Implant Maintenance

Ongoing maintenance post-implant placement is essential for reducing the risk of peri-implant complications and supporting implant longevity. This process involves patient education, regular professional evaluations, and preventive strategies tailored to individual risk profiles.

6.1.1 Patient Education and Oral Hygiene

Patients must receive specific instructions on how to maintain optimal hygiene around implant-supported prostheses. Key recommendations include:

- Daily mechanical plaque removal using soft toothbrushes and interdental aids.
- Use of antimicrobial mouth rinses, particularly for patients with reduced dexterity or high susceptibility to biofilm accumulation.
- Avoiding trauma to peri-implant soft tissues.

Clear communication about warning signs, such as bleeding, swelling, or implant mobility, is crucial for early detection of complications.

6.1.2 Maintenance Protocols

A structured recall and maintenance protocol is fundamental for minimizing biological and mechanical risks. Key components include:

- Recall intervals: Typically, every 5–6 months, adjusted based on individual risk (e.g., smoking, diabetes, history of periodontitis).
- Professional cleaning using implant-safe instruments (e.g., plastic or titanium scalers, air polishers with glycine).
- Assessment of soft tissue health, probing depths, bleeding on probing, and mucosal condition.

Risk stratification tools such as the Implant Disease Risk Assessment (IDRA) enable clinicians to personalize maintenance strategies by evaluating:

- Medical status
- Implant design and location
- Prosthesis type
- Oral hygiene compliance

6.1.3 Radiographic Monitoring and Bone Level Assessment

Radiographs are integral to long-term monitoring. Guidelines include:

- Baseline radiographs after definitive restoration placement.
- Follow-up imaging at 6–12 months post-loading and then at intervals based on risk.

Expected marginal bone remodeling includes:

- 0.9–1.5 mm of bone loss during the first year.
- <0.1 mm annually thereafter, in the absence of pathology.

Clinicians must differentiate between physiological remodeling and **pathological bone loss**, which may signal peri-implantitis or other complications.

6.1.4 Risk Management and Prevention

Preventing implant failure requires a proactive approach to risk assessment and ongoing care. Key practices include:

- Identification of risk factors (e.g., systemic disease, bruxism).
- Regular assessment of plaque control and tissue health.
- Use of IDRA or equivalent tools to guide clinical decision-making.
- Early intervention in cases of inflammation or marginal bone changes.

7. Dental Implant Complication Management

Complications can occur at any stage of implant therapy and may significantly affect outcomes. Prompt recognition and management are essential to reduce morbidity and improve prognosis.

7.1 Classification of Implant Failures

Implant failures are typically classified as:

- **Early Failure:** Occurs **before osseointegration** and is commonly linked to:
 - Surgical trauma
 - Poor primary stability
 - Infection
 - Systemic conditions affecting bone healing

- **Late Failure:** Arises **after osseointegration** due to:
 - **Biological causes:** Peri-implantitis, mucositis
 - **Mechanical causes:** Prosthetic overload, component fracture

While early failures are often unpredictable, late failures are largely **preventable** through adequate prosthetic design, occlusal control, and maintenance.

7.2 Risk Factors for Peri-Implant Disease

Several factors increase susceptibility to peri-implant diseases:

- **Host factors:**
 - History of periodontitis
 - Smoking
 - Diabetes
 - Immunosuppressive therapies
 - Poor plaque control

- **Prosthetic design:**
 - Over contoured restorations hinder hygiene access.
 - Non-cleansable embrasures and connectors.

- **Implant surface characteristics:**
 - Rough surfaces may enhance bacterial colonization.

- **Soft tissue quality:**
 - Inadequate keratinized tissue may necessitate soft tissue augmentation.

- **Compliance:**

- Long-term success is highly dependent on patient adherence to hygiene protocols and follow-up visits.

7.3 Types of Implant-Related Complications

Complications can be classified into three categories:

7.3.1 Biological Complications

- Surgical: Nerve injury, excessive bleeding, sinus perforation
- Postoperative: Early implant loss due to infection or failed integration
- Soft tissue: Mucositis, fistulae, mucosal recession, dehiscence
- Peri-implantitis: Progressive bone loss and inflammation

7.3.2 Mechanical/Technical Complications

- Fracture of restorations from occlusal overload
- Screw loosening or fracture, often related to preload failure or component misfit
- Wear of opposing dentition or prosthetic material
- Abutment complications, including misfit, improper torque, or fracture

7.3.3 Risk factors:

- Excessive cantilever (>15 mm)
- Long-span bridges
- Bruxism or parafunction
- Lack of metal framework in overdentures

While these complications may affect prosthetic performance, **they do not always compromise implant survival.**

7.4 Aesthetic Complications

- Poor crown contour, alignment, or color mismatch
- Gingival recession or soft tissue collapse
- Metal visibility or “black triangles” due to papilla loss

Patients with high esthetic expectations or challenging soft tissue architecture require advanced planning and possibly surgical soft tissue augmentation.

7.5 Implant Survival and Success Metrics ^{8,2}.

7.5.1 Dental implants are highly successful, yet complications still occur, with reported complication rates reaching **up to 33.6%**. The most common complications include ^{8,2}:

- Veneer fractures: 13.5%
- Peri-implantitis and soft tissue complications: 8.5%
- Loss of access hole restoration: 5.4%
- Screw or abutment loosening: 5.3%
- Loss of retention in cemented restorations: 4.7%

7.5.2 While aesthetic complications have decreased due to advancements in design, biological and mechanical issues, **veneering fractures**, remain significant.

7.5.3 Long-term success depends on several factors:

- Buccal bone thickness and interproximal bone levels for soft tissue stability
- Selection of the correct implant type for a favourable emergence profile
- Precise surgical manipulation
- Design of the prosthesis

7.5.4 Implant Survival Rates

The long-term outlook for implants is favorable, with recent studies reporting:

- 5-year survival rate: ~97.1%, an increase from previous estimates of 93.5%.

7.5.5 Impact of Implant Placement Timing

- Immediate placement (fresh extraction sockets): ~4% failure rate.
- Delayed placement (healed sites): ~3.09% failure rate.
- Infected sites: Higher risk, mitigated with preoperative rinses, curettage, and thorough debridement.

7.5.6 Full-Arch Implant-Supported Protheses

- **Mandibular overdentures** show **93–100% survival rates**, regardless of attachment type.
- Common issues include:
 - Component replacements
 - Prosthetic fractures
 - Occlusal adjustments

7.6 Peri-Implant Health Considerations

7.6.1 Risk Factors for Implant Failure

- Poor plaque control
- History of periodontitis
- Smoking

7.6.2 Disease Progression

- **Peri-implant mucositis**: Reversible inflammation of soft tissues.
- **Peri-implantitis**: Bone loss and potential implant failure.

7.6.3 Peri-implant mucositis Clinical Implications

- Faster progression than periodontitis
- ~22% of implants in periodontitis patients develop peri-implantitis
- Ensure absence of active periodontitis before implant placement
- Emphasize meticulous hygiene and regular maintenance

7.7 Patient Education and Monitoring

7.7.1 Educate patients on:

- Daily oral hygiene practices
- Recognizing early warning signs
- Scheduling regular follow-ups

7.7.2 Warning Signs to Communicate

- Bleeding during brushing/flossing
- Redness or swelling
- Halitosis or bad taste
- Mobility of implant or prosthesis

7.7.3 Management Protocol

- Early detection = key to implant longevity
- Regular monitoring to address mucositis before it progresses

7.7.4 Peri-Implantitis: Diagnosis and Monitoring

Definition: A progressive inflammatory condition involving soft and hard tissues around osseointegrated implants, characterized by bone loss.

Prevalence: Estimated at ~15% of implants.

7.3.5 Diagnosis Criteria

Clinical Signs:

- Redness, swelling, suppuration
- Bleeding on probing (BOP)
- Deepened probing depths

Radiographic Signs:

- ≥ 2 mm bone loss from baseline
- Require baseline and follow-up imaging

Table 6 Differentiating Peri-Implant Conditions

Feature	Peri-Implant Mucositis	Peri-Implantitis
Tissue Involvement	Soft tissue only	Soft + bone
Bone Loss	None	≥ 2 mm
Bleeding on Probing	Present	Present, may include pus
Reversibility	Reversible	Progressive

7.3.6 Monitoring Tools

7.3.6.1 Probing:

- Assess BOP, depth, mucosal migration
- Establish baseline after prosthesis delivery

7.3.6.2 Radiographs:

- Detect marginal bone loss and early signs of peri-implantitis
- Schedule annually or based on symptoms

7.7.4.4 Treatment Options

Non-Surgical:

- Mechanical debridement
- Chlorhexidine and antibiotics
- Patient hygiene improvement
- Risk factor control (e.g., smoking, diabetes)

Surgical (for advanced cases):

- Access flap surgery
- Bone regeneration (grafting)
- Laser-assisted decontamination

8.Relevant References Documents

No.	Reference Date	Reference Name	Relation Explanation / Coding / Publication Links
8.1	-	ITI Publications	International Team for Implantology, is a global association of professionals in implant dentistry and tissue regeneration. https://www.iti.org/academy/publications
8.2	-	The Association of Dental Implantology guidelines	The Association of Dental Implantology (ADI), the UK's independent network for implant dentistry https://www.adi.org.uk/resources/before_surgery_risk_factors
8.3	-	Guidance on the Standards of Care for NHS-Funded Dental Implant Treatment	NHS https://www.rcseng.ac.uk/-/media/files/rcs/fds/publications/implant-guidelines.pdf
8.4	-	Training Standards in Implant Dentistry - NHS	College of General Dentistry, UK
8.5	2021	Guidelines for Implant Dentistry	Dubai Health Authority, Guidelines for Implant Dentistry https://www.dha.gov.ae/uploads/112021/f29883ce-cb88-46a4-969d-0a7fa725678f.pdf
8.6	2018	Decision making tree for maxillary anterior implants: A review	International Journal of Applied Dental Sciences 2018; 4(4): 218-222 https://www.academia.edu/85048606/Decision_making_tr
8.7	2022	A Decision Tree with Updated Views of Timing of Implant Placement for Single Maxillary Anterior Residual Root	Journal of Dentistry and Oral Biology https://www.remedypublications.com/open-access/a-decision-tree-with-updated-views-of-timing-of-implant-8398.pdf

9. Appendices

Appendix 1: JAWDA Guidelines for Dental Clinic and Centers

Type: Dental Care Quality Indicator Number:

DQ03

Failures following dental implant surgical procedure (late failure – Mechanical failure) between 3 months to 18 months.	
Domain	Patient safety
Sub-domain	Complication – treatment outcome
Definition:	Percentage of failures detected in the period between 3-18 months from the implant procedure date among adult aged 18 and older
Calculation:	<p>Numerator: : Reported number of failures reported in the period between 3-18 months. people aged 18 years and above.</p> <p>Inclusion complication Criteria:</p> <ul style="list-style-type: none"> o Nerve damage and altered sensation related to implant procedure. S04; R20; R43; Y83.1; Y83.8 o Unintentional cut, puncture, perforation or hemorrhage during surgical and medical care - K91.72 o Anesthesia of skin (nerve injury) - R20.0 o Paresthesia of ski (nerve injury) - R20.2 o Unspecified complication of internal prosthetic device, implant - and graft - T85.9XXA; T85.9XXD; T85.9XXS; o Osseointegration failure of dental implant - M27.61 o Post-osseointegration biological failure of dental implant - M27.62 o Post-osseointegration mechanical failure of dental implant - M27.63 o Other endosseous dental implant failure - M27.69 <p>CDT Dental codes for the Numerator:</p> <p>Dental failure implant due to occlusal trauma, poor prosthetic design - M27.62</p> <p>Dental implant Osseo-integration failure - M27.61</p> <p>Dental implant Osseo-integration biological failure - M27.61</p> <p>Dental implant Osseo-integration mechanical failure - M27.61</p> <p>Failure of dental implant due to infection - M27.62</p> <p>Failure of dental implant due to lack of attached gingiva - M27.62</p> <p>Failure of dental implant due to occlusal trauma - M27.62</p> <p>Failure of dental implant due to parafunctional habits - M27.62</p> <p>Failure of dental implant due to peri-implantitis - M27.62</p> <p>Failure of dental implant due to periodontal infection (peri-implantitis) - M27.62</p> <p>Failure of dental implant due to poor oral hygiene - M27.62</p> <p>Failure of dental implant due to unintentional loading - M27.69</p> <p>Failure of dental implant osseointegration due to premature loading - M27.61</p> <p>Failure of dental implant osseointegration due to unintentional prosthetic loading (M27.61)</p> <p>Failure of dental implant osseointegration due to intentional prosthetic loading (M27.61)</p> <p>Failure of dental prosthesis - M27.69</p> <p>Failure of osseointegration of dental implant - M27.61</p>

	<p>Mechanical failure of dental implant - M27.69</p> <p>Denominator: Total number of implant procedures performed among adult aged 18 and older during the reporting period. (see Appendix 2)</p>
Reporting Frequency:	<i>Quarterly</i>
Unit of Measure:	<i>Percentage</i>
International comparison if available	<i>Developed by DoH - Abu Dhabi</i>
Desired direction:	<i>Lower is better</i>
Notes for all facilities	
Data Source/ Report Name:	-Administrative and medical records -Claims