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Review Article

Prosthetic Considerations in Implant Prostheses Treatment Planning- A Review

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Abstract: Implant prosthetic treatment planning has seen a shift from surgically driven implantology to prosthetically driven to decrease the ratio of implant failures due to prosthetic reasons. This approach of prosthetically driven implantology balances implant aesthetics and implant function by considering factors of prosthesis planning before surgical implantation. Thorough evaluation of the patient and treatment planning of the prosthesis decreases the chances of implant failures. This review article describes the factors to be considered during implant prosthesis treatment planning. Each of these factors plays an important role in determining the long-term success of the prosthesis.

Keywords: Dental Implant, Implant Considerations, Prosthetic Driven Implantology, Implant Biomechanics, Implant Occlusion, Occlusal Scheme.

INTRODUCTION

The stride in the field of science and technology has led to significant improvement in the quality of human life. When it comes to the restoration of the edentulous state, a wide number of options are available. However, maintaining a balance between functions and aesthetics becomes difficult [1].

The present era has shifted from a function-driven approach to an aesthetically driven approach, and with that, there is an increase in the use of implant prostheses. Planning of implant prosthesis requires the clinician to evaluate a variety of factors, patient and prosthesis related.

To balance between now increasing demand of aesthetics along with function, prosthetically driven implantology has come to play i.e. prosthetic part of the prosthesis is considered before the surgical part. The prosthetic considerations include the physical and medical status of the patient, bone evaluation, radiographic considerations, factors that implant selection will affect occlusal scheme considerations and maintenance by the patient, and follow-up by the clinician [1].

General considerations

1. Age: Implant placement needs to be done after the completion of the growth of the patient. If done before growth completion it may lead to complications such as submerging of implant and/or its relocation [2].

2. Medical history: Patients with cardiovascular disorders should be advised to get clearance for implant placement by the cardiologist or their physician. In patients with pulmonary disorders, alginate impressions should be avoided as it can lead to suffocation [2, 3].
3. Oral hygiene and habits: The patient's oral hygiene has a direct influence on the prognosis. Patients with poor oral hygiene or habits such as tobacco chewing and chain-smoking have a higher risk of implant failures. Patients with a history of smoking should cease smoking for a minimum of one week prior and at least 8 weeks after implant surgery.
4. Parafunctional activity: Activities such as bruxism and clenching have been identified as a major concern in implant treatment planning as they result in increased pressure on the implants and eventually metal fatigue and bone loss.

INTRAORAL EVALUATION

1. **Soft tissue considerations**: Gingival biotype plays a crucial role in the aesthetic success of the prosthesis.
   - Thick and fibrous biotype provides better aesthetic results while thin biotype does not mask the implant and abutment parts [4].
   - In Gingival papillae that are fine and long, aesthetic results are difficult to obtain. Whereas in thick and short papillae natural regeneration is facilitated [5].
2. Evaluation of alveolar bone: Alveolar bone should be evaluated for bone defects. In cases of the presence of difference in the bone level at the implant site and adjacent to that, there is an increased risk to both- periodontal and peri-implant tissue. Reconstruction f crest either by regeneration or bone grafting becomes important [6].
3. Inter-arch distance and space evaluation: Inter-arch distance for proper visibility and instrumentation should be evaluated [6].
   - Inter-arch space on the other hand is necessary to provide adequate function, aesthetics, and phonetics to the patient. Decreased space may lead to implant prosthesis with occlusal plane interferences.
   - A minimum of 8-10mm of inter-arch space is required in the anterior region and a minimum of 7mm space in the posterior region for fixed implant prosthesis. For a removable prosthesis, a minimum of 12mm of space is needed.
4. Crown- height space (CHS): CHS affects the appearance and amount of moment force on the implant and surrounding crestal bone. It is measured from the occlusal or incisal plane to the crest of the ridge [6].

Laboratory investigations

- Vitals of the patient: pulse, blood pressure, temperature, respiration
- Blood investigations including CBC, Haematocrit, Bleeding, and Clotting tests.
- Urine analysis and biochemical profiles (serum profile) for the patient becomes necessary.
- Patients with low haemoglobin need to be addressed before implant placement.
- The patient is advised to fast for 6-8 hours before testing for blood glucose levels.
- Serum analysis for calcium becomes important as calcium plays an important role in the remodelling of bone. If the patient is found to be hypo-calcaemic, this should be addressed before implant placement [6].

Radiographic considerations

Radiographic evaluation helps in the determination of factors such as bone availability, the density of bone, vital structures, pathologies, and evaluation of adjacent teeth. All of these factors play an important role in the determination of the prognosis of the entire treatment.

1. A minimum of 1.5-2mm of bone should be taken from an anatomical landmark, the most crucial in the mandible being the mandibular canal and mental foramen [6, 7]
2. A buffer of 1.5mm-2mm is taken from the adjacent tooth. This minimum amount of bone allows the implant to gain primary stability.
3. Height of the available bone: The minimum bone height suggested for implant placement is 12mm. Studies have shown height less than 9mm to have a higher rate of implant failure.
4. Bone width is measured from lingual plate to labial plate. This should be at least 2mm greater than the implant diameter.
5. Edentulous span: the length of the available bone should be such that a minimum of 1.5 mm of bone should be present from adjacent tooth and a minimum of 3mm bone from an adjacent implant [8, 9].

Biomechanical considerations [6, 7]

1. Bone density: Different densities of bone have different strengths and modulus of elasticity and hence there is a difference in stress-strain distribution.
   - In D1 bone (thick compact bone) highest stresses are observed near the crest of the implant.
   - In D2 bone, the intensity of stresses extends apically.

- Bone density is directly related to BIC and therefore influences the healing of the implant and its primary stability.
- D1 bone has about 85% BIC, D2 has 65%-76% BIC, D3 has about 40%-50% BIC and D4 has less than 30% BIC.

2. Bone-implant interface (BIC): Less the BIC more implant surface area is required to achieve more contact and increase primary stability. Therefore, in D3 and D4 bones, the stresses per unit area should be reduced. This is achieved by placing implants for individual tooth and decreasing the cantilever length. D4 bone may require a wider implant.
    - An increase in BIC can be obtained by using a threaded implant with more threads, it can also be obtained by using a coated implant.

Implant related considerations

1. Thread design: Thread design should be such that it maximizes BIC and therefore reduces stress. Smaller pitch i.e. the distance between two threads indicates more surface area for better stress distribution.
2. Thread depth: deep threads increase the surface area and contribute to the primary stability of the implant [2, 7].
3. Implant length and width: increase in implant length increases the primary stability but it doesn't decrease the stresses. For regions where maximum stresses are concentrated, an increase in the width of the implant is a better way to distribute the stresses.
4. Crest module: the crest module is always slightly larger than the outer thread diameter. A parallel or same-sized crest module increases the risk of bone loss after loading.

Implant selection considerations [6, 7]

1. Implant length: It is selected according to bone availability, anatomic vital structures.
2. For mandibular posterior areas, an osteotomy is prepared at least 2mm from the nerve.
3. Implant diameter: buccolingual and mesiodistal ridge dimensions usually determine the diameter of the implant to be used. A minimum of 1mm of bone should be presented buccal and lingual to the implant. A minimum of 3mm between the edges of two implant platforms is necessary and a minimum of 1.5mm bone from an adjacent tooth is required. All these criteria help to determine the diameter of the implant.
4. Implant surface: smooth implants have been used for years, but roughened surfaces are used because of the enhanced bone-implant interface. Roughened surface increases the initial fixation of the implant TPS (titanium-plasma sprayed) implants have increased load-bearing capacity by 25-30% [9, 10].
5. Implant position: Implant angulation for posterior segments should be such that the long axis emerges from the center of the occlusal surface. In the anterior tooth region, the long axis of the implant should emerge from the cingulum of the tooth. Implant position should not be compromised by the availability of bone. Bone grafting in such cases should be planned prior to implant placement [4].
6. Implant number: though one implant for one tooth is the best option, however, five implants are sufficient for 12 teeth in the mandible and 8-12 implants for the maxilla depending on bone and parafunctional habits.

Occlusal considerations [11, 12]

1. A number of factors influence the prognosis of implant prosthesis. One of the main factors being occlusal. A poor occlusal scheme leads to increased mechanical stresses causing crestal bone loss and resulting in implant failure.
2. Occlusal contacts: occlusal adjustments should be done using an articulating paper of less than 25 μm thickness, this relieves the initial contact leading to increased load on adjacent teeth. A greater thickness articulating paper is then used to check for equal contacts when heavier forces are applied.
3. Surface area: the occlusal table of the implant crown should be narrow. This reduces the magnitude of the force acting by decreasing the cantilever. Another method to decrease the magnitude of force acting is to use additional implants, ridge augmentation, reduction of crown height, and increasing the implant diameter.
4. Cusp angle: steeper cusps are seen to increase torquing forces.
5. Cantilever length: cantilevers act as class I lever, increasing the occlusal load on the implants. The force and length of the cantilever are directly proportional to the force acting on the implant.
6. Occlusal contact position: according to Peter K Thomas, there should be a tripod contact on each occluding cusp, marginal ridge, and central fossa [13].

Occlusal scheme selection: implant-supported fixed prosthesis

1. **Edentulous ridge opposing natural dentition**- Group function occlusion is preferred. In cases of shallow anterior guidance, mutually protected occlusion is given [14, 15].
    - Simultaneous contact bilaterally and anterio-posteriorly during maximum intercuspation and in centric relation.
    - Freedom in centric should be provided in centric and MIP (1-1.5mm). Infraocclusion by 100nm decreases the risk of fatigue and failure of the prosthesis [16].

2. **Completely edentulous arch opposing a complete denture**- Bilaterally balanced occlusion scheme is preferred [14, 15].

Occlusal scheme for implant-supported overdenture

1. Completely edentulous arch with normal/healthy ridges:- An optimal occlusal scheme in such cases is bilaterally balanced occlusion with lingualized occlusion. A minimum of 3 point contact during lateral and protrusive movements should be established [16, 17].
2. Completely edentulous arch with severely resorbed ridges: optimal occlusal scheme in such cases is monoplane occlusion as it reduces the forces acting on the ridge.

Occlusal scheme for fixed partial dentures

1. Class i or ii partially edentulous:- mutually protected occlusal scheme is preferred or group function when anterior teeth are periodontally compromised [18].
2. Class iii and class iv partially edentulous:- The optimal occlusal scheme is group function. Freedom in centric of 1-1.5mm to be given along with a narrow occlusal table.

Maintenance considerations for implant prosthesis success

- Maintenance of implant is important for long-term success.
- Regular recall visits at 1, 3, 6, and 12 months after implant prosthesis delivery should be carried out.
- Home care instructions should be given [1].
- The patient's role in the maintenance of the prosthesis is crucial. Plaque control by using floss, soft toothbrushes, antibacterial mouthwashes, and slim sonic brushes for cleansing of dentures.
- Brushes are dipped in chlorhexidine (0.12% solution), this has been found to kill 100% bacteria in a 30-sec rinse [19, 20].

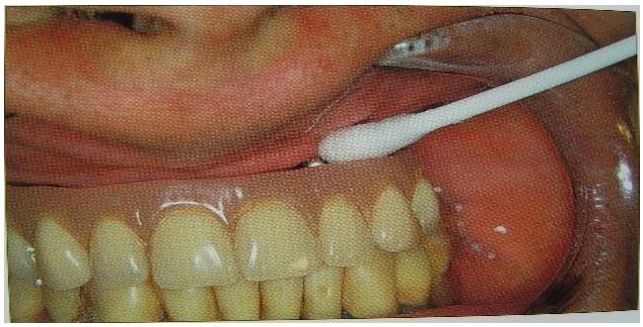

Fig-1

Fig-2

Clinician's role Includes [6, 7]

1. Review of medical and general health of the patient at each appointment
2. Assessment of the implant: including soft tissue assessment and signs of inflammation, presence or absence of mobility, and radiographic evaluation. Tenderness during function or percussion usually occurs during healing in the proximity of a nerve or when the stress on the bone is beyond physiologic limits [6]. Pain during function or percussion may also occur during soft tissue impingement between implant and abutment. In such cases, removal of abutment followed by excision of soft tissue and repositioning of the components should be done.
3. Diagnosing of peri-implant disease such as peri-implant mucositis, and peri-implantitis for early intervention.

4. Plaque control by plastic, graphite, or solid titanium instruments is recommended to avoid scratching the implant surface.
5. Reinforcement of home-care for the patient.

CONCLUSION

Success is achieved if the prosthesis is designed taking care of aesthetics, function, and hygiene. It falls into the hands of the dentist to identify possible complications at the right time to avoid implant failures.

Several risk factors associated with high failure rates have been identified. Poor bone quality, bone grafts, irradiation, immunosuppressive medication, and selected disease states are universally recognized as risk factors, furthermore, factors such as bruxism, alcoholism, tobacco smoking, and osteoporosis are relative contraindications whereby treatment results may be compromised.

All diagnostic procedures should be in a detailed manner to design the treatment plan accordingly. These included intraoral and extraoral evaluation, radiographic evaluation, implant design considerations, and biomechanical considerations.

REFERENCES

1. Swaminathan, Y., Rao, G. (2013). Implant Protected Occlusion. IOSR-JDMS, 11(3), 20-25.
2. Babbush, C.A., Hahn, J.A., Krauser, J.T., Rosenlicht, J.L. (2010). Dental Implants – E-Book: The Art and Science.2nd ed. Philadelphia- United States: Saunders.
3. Donos, N., Calciolari, E. (2014). Dental implants in patients affected by systemic diseases. Br Dent J, 217(8), 425-30.
4. Frank, R., Bo, R. (1999). Risk factors in implant dentistry; Quintessence publishing co 1999.
5. Zitzmann, N.U., Marinello, C.P. (1999). Treatment plans for restoring the edentulous maxilla with implant-supported restorations: removable overdenture versus fixed partial denture design. J Prosthet Den, 82,188-96.
6. Misch, C.E. (2014). Dental Implant Prosthetics. 2nd ed. Amsterdam, Netherlands: Elsevier Health Sciences.
7. Carl E Misch - Dental implant prosthodontics – Elsevier Mosby publishing co. 3rd Ed.
8. Razavi R, Zena RB, Khan Z, Gould AR.(1995). Anatomic site evaluation of edentulous maxillae for dental implant placement. J Prosthodont, 4(2),90-4.
9. Sharma MS, Pandey V, Vartak V, Bondekar V.(2016). Prosthetic Driven Implantology- A Review. Int J Res Health Allied Sci, 2(3),21-25.
10. Calcium phosphate coating for dental implants current status and future potential DCNA 1992, 36,1-18.
11. Kim, Y., Oh, T.J., Misch, C.E., Wang, H.L. (2005). Occlusal considerations in implant therapy: clinical guidelines with biomechanical rationale. Clin Oral Implants Res, 16(1), 26-35.
12. Curtis, D.A., Sharma, A., Finzen, F.C., Kao, R.T. (2000). Occlusal considerations for implant restorations in the partially edentulous patient. J Calif Dent Assoc, 28(10), 771-9.
13. Prashanti, E., Sumanth, K., Reddy, J. (2008). Components of implant protective occlusion- A Review, 7(2).
14. Kim, Y., Oh, T.J., Misch, C.E., Wang, .L. (2005). Occlusal considerations in implant therapy: clinical guidelines with biomechanical rationale. Clin Oral Implants Res. Feb, 16(1), 26-35.
15. Jambhekar, S. (2010). Occlusion and occlusal considerations in implantology. IJDA, 2(1), 125-130.
16. Parekh, R.B., Shetty, O., Tabassum, R. (2013). Occlusion in implant prosthodontics. J Dent Implant, 3,153-156.
17. Rilo, B., Silva J.L., Mora M.J. (2008). Guidelines for occlusion strategy in implant-borne prosthesis: A Review, 58, 139-145.
18. Wismeijer, D., Van, Waas, M.A., Kalk, W. (1995). Factors to consider in selecting an occlusal concept for patients with implants in the edentulous mandible. J Prosthet Den., Oct, 74(4), 380-4.
19. Rams, T.E., Robert, T.W., Tatum, H. (1984). The subgingival microbial flora associated with human dental implants. J Prosthet Dent., 52, 529-34.
20. Jalkovsky, D.L., Waki, M.Y., Newman, M.G. (1990). Clinical and microbiological effects of subgingival and gingival marginal irrigation with chlorhexidine gluconate. J Periodontol., 61, 663-69.

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