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# PROSTHETIC REHABILITATION

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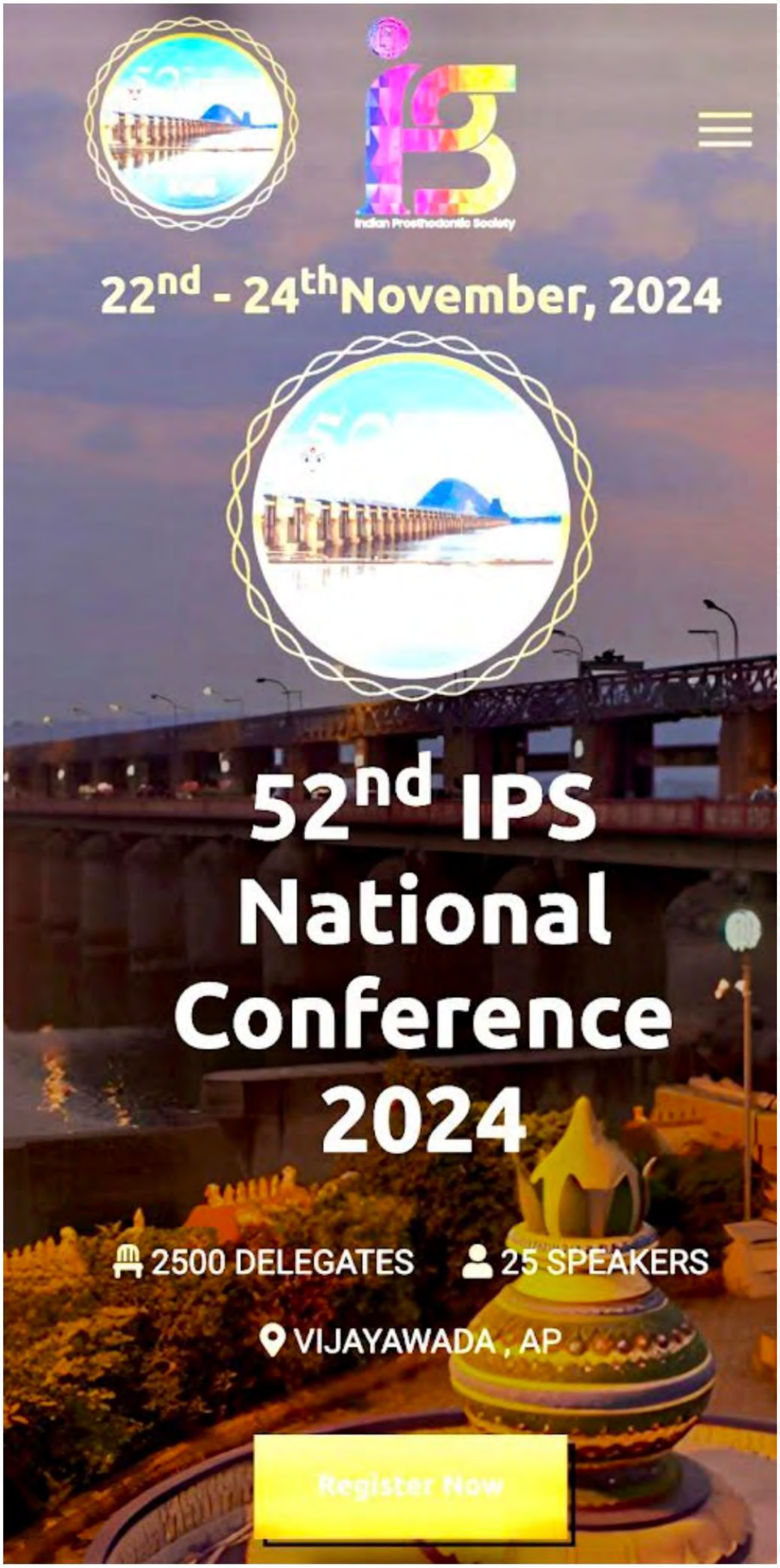
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# PEER REVIEWERS

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# FROM THE EDITOR'S DESK

**DR. NEELAM PANDE**

*"Courage doesn't always roar. Sometimes courage is the quiet voice at the end of the day saying 'I will try again tomorrow'."– Mary Anne Radmacher*

It's my honour to be the editor of 'The Journal of Prosthetic Rehabilitation', IPS Nagpur Branch. In this issue we have included articles not only from central India but also from Chhattisgarh, Ahmadabad & Jamnagar districts, showing more collaborative involvement from fellow colleagues.

In 2023, IPS Head office organized & hosted 51st IPS National conference at Goa between 7th – 10th December and 26th IPS Post-graduate Convention at Chennai between 5th -7th April 2024. Maximum IPS Nagpur Branch members including post-graduate students, participated in scientific paper, poster & table clinics and won best in session as well as best in overall presentations in various categories.

Last year there was sad demise of senior Prosthodontist, Dr Atul Alsi. In his fond memory, the executive committee members of the branch, decided to give two best scientific paper prizes to the authors among original research, review article & case report category.

I hope this issue inspires all the members and post graduate students to share their research and clinical work for exchange of knowledge.

I would like to take this opportunity to sincerely thank my fellow colleagues Dr. Aparna Barabde, President IPS Nagpur Branch for her invariable support and also to Dr. Rajlakshmi Banerjee, Secretary for her valuable suggestions. I would like to extend my sincere thanks to all the advisors, Co-editor, Guest editors, Section editors, Peer Reviewers, EC members and entire Branch members for their help.

Jai Hind! Jai IPS!!

**Dr. Neelam Pande**
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# Advancements in TMJ Ailments Treatment in Prosthodontics

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Temporomandibular Joint (TMJ) disorders represent a significant concern in the realm of dental and maxillofacial health. As prosthodontists, our understanding of TMJ ailments and our approaches to treatment have evolved significantly over the past decade. This editorial aims to shed light on the current trends and advancements in the treatment of TMJ disorders, highlighting how these innovations are shaping our practice and improving patient outcomes.

**Multidisciplinary Approaches:** One of the most noteworthy trends in TMJ treatment is the shift towards a multidisciplinary approach. TMJ disorders are complex and often involve a combination of dental, orthopedic, neurological, and psychological factors. Collaborative efforts among prosthodontists, oral surgeons, physical therapists, and psychologists are proving to be more effective than isolated treatments. This integrated approach ensures comprehensive care, addressing the multifaceted nature of TMJ disorders.

**Splint Therapy: Innovations and Efficacy:** Splint therapy, traditionally a cornerstone in managing TMJ disorders, has seen substantial advancements backed by robust clinical research. Modern splints are not only designed for occlusal adjustment but also for diagnostic and therapeutic purposes, tailored to the specific needs of the patient.

1. **Customized Digital Splints:** The integration of digital dentistry has revolutionized splint design and fabrication. Using digital impressions and CAD/CAM technology, splints can now be precisely customized to fit the patient's dentition and occlusal scheme. This precision enhances the efficacy of splints in reducing TMJ symptoms and improving jaw function. Studies have shown that digitally fabricated splints offer superior comfort and effectiveness compared to conventional splints.

2. **Biomechanical Considerations:** Recent research highlights the importance of biomechanical considerations in splint design. Dynamic bite force distribution and the alignment of the mandibular condyle are critical factors. Advanced splints incorporate features that optimize these parameters, reducing the stress on the TMJ and associated muscles. Evidence suggests that such biomechanically optimized splints significantly reduce pain and improve mandibular range of motion.

**3. Therapeutic Monitoring and Adjustments:** The use of wear-time sensors and telemetric devices embedded in splints allows for real-time monitoring of patient compliance and splint effectiveness. This data can be remotely accessed by clinicians, enabling timely adjustments and personalized treatment plans. Early studies indicate that this approach enhances treatment outcomes and patient adherence to splint therapy.

**4. Orthotic Devices: Advanced Applications:** Orthotic devices, like splints, play a crucial role in managing TMJ disorders, especially in cases involving severe malocclusion or structural abnormalities. Recent advancements have improved their design, functionality, and therapeutic outcomes.

**5. 3D-Printed Orthotics:** The advent of 3D printing technology has facilitated the production of highly precise and customizable orthotic devices. These devices can be tailored to correct specific jaw misalignments, providing a more targeted treatment approach. Research indicates that 3D-printed orthotics offer superior fit and patient comfort, leading to better clinical outcomes in TMJ disorder management .

**6. Bioresorbable Materials:** Innovations in materials science have introduced bioresorbable materials for orthotic devices. These materials gradually dissolve in the body, eliminating the need for device removal and reducing the risk of long-term complications. Clinical trials have demonstrated the effectiveness of bioresorbable orthotics in promoting natural joint healing and reducing inflammation in TMJ disorders.

**7. Neurophysiological Feedback:** Some advanced orthotic devices now incorporate neurophysiological feedback mechanisms. These devices monitor muscle activity and provide real-time feedback to patients, helping them adjust their jaw position and muscle use. Studies show that this biofeedback can significantly improve muscle coordination and reduce TMJ pain over time.

**8. Minimally Invasive Techniques:** Minimally invasive treatments are gaining traction due to their efficacy and reduced recovery times. Arthrocentesis, a procedure involving the irrigation of the TMJ with a saline solution to remove inflammatory byproducts, has shown promising results in relieving pain and improving joint function. Similarly, arthroscopy, which allows for direct visualization and treatment of the joint, is being favoured for its precision and minimal post-operative discomfort.

**9. Regenerative Medicine and Biomaterials:** The advent of regenerative medicine has introduced new possibilities in TMJ treatment. Stem cell therapy and platelet-rich plasma (PRP) injections are being explored for their potential to regenerate damaged cartilage and alleviate symptoms. Additionally, advancements in biomaterials are enhancing the success rates of TMJ prostheses. Customized alloplastic TMJ implants, made from biocompatible materials, are providing long-term solutions for patients with severe joint degeneration.

**10. Pain Management and Neuromodulation:** Effective pain management is a cornerstone of TMJ treatment. Recent advancements in neuromodulation techniques, such as transcutaneous electrical nerve stimulation (TENS) and botulinum toxin (Botox) injections, are offering new avenues for pain relief. These modalities target the neural pathways associated with TMJ pain, providing relief for patients who do not respond to traditional therapies.

**11. Telehealth and Remote Monitoring:** The COVID-19 pandemic has accelerated the adoption of telehealth in dentistry. Remote consultations and monitoring have become invaluable tools in managing TMJ disorders, particularly for follow-up care and minor adjustments. Telehealth allows for continuous patient engagement and monitoring, ensuring timely interventions and enhancing patient compliance with treatment protocols.

**Conclusion:** The field of prosthodontics is experiencing significant advancements in the treatment of TMJ disorders through the use of splints and orthotic devices. Digital customization, biomechanical optimization, and innovative materials are enhancing the efficacy and comfort of these treatments. Moreover, the integration of monitoring technologies and neurophysiological feedback mechanisms is paving the way for more personalized and effective patient care.

As we continue to embrace these evidence-based innovations, it is essential to remain committed to ongoing research and clinical trials to further refine these therapies. The future of TMJ disorder management looks promising, with these advanced splints and orthotics leading the way in improving patient outcomes and quality of life.

ORIGINAL ARTICLE

# Comparison of the effect of surface sealant on the color stability of different resin composite used to seal access holes of implant supported prostheses- an in vitro study.

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**Abstract:** An access hole in implant supported prosthesis is an opening in crown of screw-retained dental implant. The advantages of Screw retained implant prosthesis over cement retained are its retrievability and no cement interface between restoration & implant abutment. These access holes are sealed with resin composites but often the composites get discolored. Surface sealants have been developed to reduce discoloration capacity of composites.

**Method:** 30 disc shaped (diameter =14mm; height = 2mm) samples were fabricated of composites 1 (nanohybrid) and 2 (microhybrid). They were divided into 3 subgroups according to application of surface sealants i.e. sealant 1, sealant 2 and 1 control group. Baseline measurements were made using spectrophotometer before and after coffee discoloration for 144 hours at 37˚ C in an incubator. Intragroup comparison among three sub-groups in each composite type was done using One-way Anova 'F' test followed by Tukey's post hoc test for pairwise intergroup comparison between each sub-groups.

**Results:** The mean ΔE (9.07) of control subgroup of microhybrid was less than mean ΔE (16.68) of control subgroup of nanohybrid. Nanohybrid sealant 1 and sealant 2 had ΔE mean (10.29) and (14.46) respectively. Microhybrid sealant 1 and sealant 2 had ΔE mean (12.14) and (14.47) respectively. The control group of microhybrid resin composite without sealant showed better color stability than sealed composites. Nanohybrid composite had more discoloration than micro hybrid.

**Conclusion:** The surface sealants had a relative positive effect on nanohybrid composite whereas a negative effect on microhybrid composite. These color changes were above the clinically acceptable and perceptibility range.

**Keywords:** Screw retained prosthesis, access holes, resin composites, surface sealants, color stability.

**Introduction:** Recently, dental implants have been constantly evolving through various development and research in order to improve the quality of patient care, which allows dentists to practice a comprehensive and global restorative dentistry.(1) Increasing esthetic expectations of patients have increased the importance of the color match and long term color stability of the restoration material.(2)

One such shade matching concern is seen in screw retained implant supported restorations. These prostheses have an access opening for the abutment screw. An access hole in implant supported prosthesis is an opening in the crown of a screw-retained dental implant.

The advantages of Screw retained prosthesis are its retrievability and there is no cement interface between the restoration & implant abutment. Whereas the cement retained prosthesis has disadvantages which is difficult retrievability and peri implant complications.[1] These access holes are sealed with resin composites but often after a period of time the composites get discolored resulting in shade difference in the prosthesis and the composite.

The resin composites have been widely used for the direct restorations of both anterior and posterior teeth, due to their aesthetics, improved physical properties, better bonding systems. Resin composites have been classified according to various characteristics, such as filler type, filler distribution, average particle size of filler, and physical and mechanical properties of the materials. Most widely used are microfilled, microhybrid, and nanocomposite. Nanohybrid is a hybrid resin composite with nanofiller in a prepolymerised filler (PPF) form.[3] Whereas microhybrid composites are based on the particles averaging about 0.4–1.0 µm in size.

Discoloration of tooth colored resin composites may be caused by either intrinsic or extrinsic factors. The intrinsic factors depend on the composition of the matrix (percentage of Bis- GMA, UDMA), the type of bonding between the fillers and matrix, etc. Extrinsic factors such as adsorption or absorption of extrinsic stains pose a major problem for esthetic restorations.[4,7]

Porosities within RBC restorations are one of the main factors that may lead to staining, since they increase surface roughness and favor the penetration of pigments in the bulk of the restorations.[5,8] Intra-oral exposure to food dye, black cola, coffee, tea, chlorhexidine and even artificial saliva has a profound effect on staining susceptibility and physical properties in resin materials due to water sorption.[6]

A smooth restoration surface reduces plaque accumulation, thus minimizing the possibility of periodontal diseases and caries process. For this, surface covering agents (surface sealants) have been developed to reduce the discoloration capacity of the Resin Based Composites.

These surface sealants are low-viscosity, resin-based materials covering the surface of the composite restorations by penetrating through micro-structural defects. These agents aim to reduce the water absorption of the material, thereby minimizing the discoloration of the resin composite by wrapping the surface of the restoration in a thin film layer.[2,4,6]

The effect of two sealants was assessed on two types of resin composites to check the color stability after staining for a specific period of time.

**Materials and methodology:**

**Materials:** The two resin composites included in this study were Nanohybrid (Ivoclar, US), Microhybrid composite (3M Filtek, US). The sealants used in this study were G Coat Plus (GC Corp), Coat-IT surface sealant (Shofu). For discoloration, coffee solution was used (Nestle, India).

The spectrophotometer was used for checking color stability and incubator was used to maintain the temperature of test samples during coffee staining.

**Methodology:** Total 30 disc shaped (diameter =14mm; height = 2mm) samples were fabricated of composites 1 and 2 (15 each composite) (Figure 1). These were prepared using a metal jig. The samples were light cured for 40 secs. The distance from light source to the composite was 4 mm. Both the sample groups were further divided into 3 subgroups according to the application of surface sealants i.e. sealant 1, sealant 2 and 1 control group (no application of surface sealant). The sealants were applied to the respective subgroups and cured according to the manufacturer's recommendation. The 2 Sample groups divided into 3 subgroups (n=5) i.e. control group (no application of surface sealant), sealant 1, sealant 2. After application of surface sealants the initial (baseline) measurements with the spectrophotometer were be made of all the samples. Next all the samples were kept in coffee solution (Nescafe coffee) in an incubator at temperature 37˚C for 144 hours which simulates 6 months of coffee consumption.[2] After discoloration in coffee solution (Figure 2) the final color measurements were made using the spectrophotometer for all the samples.

The color measurements were done at baseline (0 hours) and after 144 hours. The L, a, b values were measured at 0 and 144 hours for each specimen. Following which the mean values of ΔL, Δa, Δb were calculated. The color difference ΔE was calculated from the mean ΔL, Δa, Δb values for each specimen using the following formula.[2,3,4]

ΔE (L a b) = [ (ΔL)2 + (Δa)2 + (Δb)2]1/2

Where, ΔL, Δa, Δb are the differences in L, a, b values before (0 hours) and after staining (144 hours). Statistical analysis was performed using Statistical Product and Service Solution (SPSS) version 21 for Windows. Overall intragroup comparison among three sub-groups in each composite type was done using One-way Anova 'F' test followed by Tukey's post hoc test for pairwise intergroup comparison between each sub-groups. Intergroup comparison between both composite groups in relation to each sub-group was done using unpaired t test.

**Results:** Table 1 showing the mean ΔE value of control group of nanohybrid composites was 16.68 (0.608), while the microhybrid composite ΔE value was 9.07 (2.86). The ΔE values for nanohybrid and microhybrid with sealant 1 were 10.29 (1.49) and 12.14 (0.28) respectively. While the ΔE values for sealants with nanohybrid and microhybrid were 14.46 (0.5) and 14.47 (0.59) respectively.

The control groups between both the groups showed significant difference. The composites with sealant 1 also showed significant difference. While both the composites with sealant 2 showed no significant difference.

**Discussion:** As there is an increasing esthetic demands from patients, there is an increased and widespread use of resin composites. The mechanical, physical, aesthetic properties and also their clinical behavior depends upon its structure. These composites have the organic matrix, the inorganic filler or dispersed phase and an organo-silane or coupling agent to bond the filler to the organic resin. The color stability of a resin composite is related to the resin matrix, the dimensions of the filler particles, depth of polymerization and coloring agents. Microcracks and micro voids located at the interface between the filler and the matrix are the most likely penetration pathways for stain. The roughness of the surface caused by wear and chemical degradation may also affect gloss and consequently increase the extrinsic staining.[3]

In this study, the samples were prepared using a metal jig, over which a glass slab was placed while curing the composite which made the surface polished to provide standardization and to increase the effectiveness of the surface sealants. This provided more accurate color determinations by minimizing the micro-gap formations on the surfaces of the composites.

Further in order to mimic the daily routine in vitro, coffee was used as one of the efficient and effective staining agent. The discoloration mechanism of coffee was explained by adsorbtion and absorption of the yellow colorants through the organic phase of the resin based composites. Hot coffee solution was determined as a more active agent for discoloration previously.[8] According to some studies 15 min as the average time for consumption of a cup of coffee and 3.2 cups as the average consumption per day was considered.[9] Also, 72 hours of simulated coffee consumption was considered as correspondence to 3 months of daily consumption.[8,10] The degree of discoloration was proportional to the increase of the temperature for composite samples which surface sealant was applied on.[6] So, in order to simulate the oral conditions 37°C temperature and constant exposure to staining solution was done. The samples were kept in coffee solution at constant 37°C in an incubator for 144 hours, which was corresponding to a person's coffee consumption of 6 months. The solution was renewed daily.

The color was evaluated using a spectrophotometer. The CIE L*a*b* color system used in this study is a recommended method for dental purposes[3] and it characterizes color based on human perception. It designates color according to 3 spatial coordinates, L*, a*, b*, where L* represents the brightness (value) of a shade, a* represents the amount of red-green color and b* represents the amount of yellow-blue color. L* coordinates are located along a vertical axis that ranges from a value of 0 (dark) to 100 (light). The a* and b* coordinates revolve on axes around L*. As a* becomes more positive in value, the color is more red and as a* becomes more negative in value, the color becomes more green. As b* becomes more positive in value, the color becomes more yellow and as b* becomes more negative in value, the color becomes more blue. Absolute measurements are made in L*a*b* coordinate and color change calculated as ΔE. In principle if a material is completely color stable, no color difference will be detected after its exposure to the testing environment ($\Delta E = 0$).[2,3]

As resin matrix and filler compositions are different for different composites, they might interact differently with certain stains and this may be related to the chemical compositions of the staining substance itself. Here, in this study the nanohybrid composite samples showed more discoloration than the microhybrid resin composite. This result was similar to the results of Korkut et al[2], Nasim et al[4], Hui et al[6], who reported more discoloration in nanohybrid composite resin. This could be attributed to the nature of the resin matrix and the possible porosities in aggregated filler particles as well as the porosities of the glass fillers.

Also, water absorption affects the mechanical properties of composites by hydrolytic degradation of the filler. Studies have shown that the composites with lowest filler contents had poor color stability.

The surface sealants have also influenced the color stability of the resin composite materials in this study. This effect was positive as well as negative to some extent and the level of the effect was sealant and composite type dependent. Both the sealants had negative effect with microhybrid resin composite as compared to nanohybrid composite. These results were similar to Korkut et al[2], Hui et al[6]. This may be due to the hydrophilicity and higher affinity to get discolored in hot coffee solutions within the micro-pits and porosities present in the sealant material. Also, they may have had debonding problems, as they were applied on less retentive, well polished composite surfaces.

The assessment of the control group of the microhybrid resin composite without sealant showed better color stability than the groups with the sealants. This similar result was seen in a study by Korkut et al[2]. Therefore, it might be interpretated that, the use of surface sealants might not be advantageous every time. This microhybrid composite had the ΔE values above perceptibility and acceptability thresholds.

Though there was positive effect with nanohybrid as the effect of sealant had showed less discoloration than their non-sealed samples but this effect was above the perceptibility and acceptability thresholds.

The perceptibility threshold (PT) refers to the smallest color difference that can be detected by an observer. The difference in color that is acceptable for observers corresponds to acceptability threshold (AT). O'Brien et al. determined that values of 2 or less were clinically acceptable.(11) Vichi et al.(12) and Tuncer et al.(13) reported value of 3.3 as perceptible, whereas Celik et al.(14) determined 3.7. Johnston and Kao(15) reported ΔE* threshold values of 3.7 and 6.8, and Douglas et al.(16) 2.6 and 5.5 for perceptibility and acceptability, respectively. The most recent review was that ΔE >1.2 for PT and ≤ 2.7 for AT was considered.(2,17)

**Conclusion:** Within the limitations of this study, it can be concluded that

1. Surface sealants affected the color stability of tested resin composites with hot coffee discoloration.
2. The color changes were above the clinically acceptable and perceptibility range.
3. The surface sealants had a relative positive effect on nanohybrid composite whereas a negative effect on microhybrid composite.
4. The microhybrid composite was more color stable than nanohybrid composite without the sealant application.

**Table 1:** Mean ±SD of color differences (ΔE) for test groups.

| Groups | Resin Composite 1 (Nanohybrid) Mean (SD) | Resin Composite 2 (Microhybrid) ean (SD) |
|---|---|---|
| Control | 16.68 (0.608)aA | 9.07 (2.86)bA |
| G coat plus | 10.29 (1.49)aB | 12.14 (0.28)bB |
| Coat it | 14.46 (0.5)aC | 14.47 (0.59)aB |
| Different lowercase letters indicate statistically difference in the rows. Different uppercase letters indicate statistically difference in the columns | | |

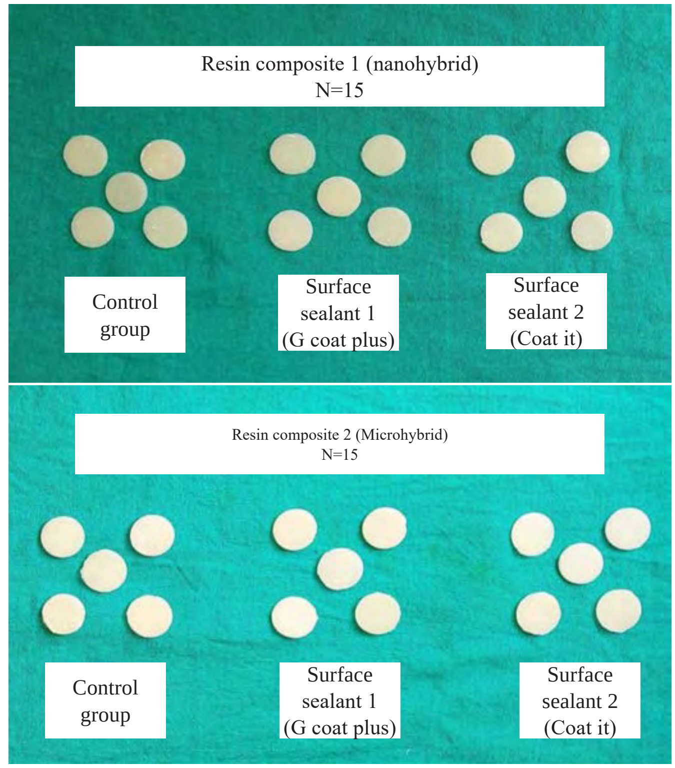


Figure 1:- Fabricated samples of Resin Composites


Figure 2:- Samples after coffee discoloration

**References:**


1 Misch CE. Dental Implant Prosthetics. St. Louis, MO: Mosby; 2015.

2 Korkut B, Bud M, Kukey P, Sancakli HS. Effect of surface sealants on color stability of different resin composites. Med Pharm Rep. 2022;95(1):71-9.

3 Gönülol N, Yılmaz F. The effects of finishing and polishing techniques on surface roughness and color stability of nanocomposites. J Dent. 2012;40:e64-70.

4 Nasim I, Neelakantan P, Sujeer R, Subbarao CV. Color stability of microfilled, microhybrid and nanocomposite resins—an in vitro study. J Dent. 2010;38:e137-42.

5 Cortopassi LS, Shimokawa CA, Willers AE, Sobral MA. Surface roughness and color stability of surface sealants and adhesive systems applied over a resin-based composite. J Esthet Restor Dent. 2020;32(1):64-72.

6 Hui R, Choi IH, Hussein I, Hockey J, Hetrelizides D, Wong RH. The effect of drinks and temperature on the staining of resin composites coated with surface sealants. J Dent Biomater. 2014;1(1):16-22.

7 Reddy PS, Tejaswi KS, Shetty S, Annapoorna BM, Pujari SC, Thippeswamy HM. Effects of commonly consumed beverages on surface roughness and color stability of the nano, microhybrid and hybrid composite resins: an in vitro study. J Contemp Dent Prac. 2013;14(4):718-23.

8 Rajkumar K, Kumar S, Mahalaxmi S, Ragavi P, Mageshwaran TA. Colour stability of resin composites after emersing in coffee of different temperature-an in vitro study. SRM Univ J Dent Sci. 2011;2(2):91-5.

9 Hepdeniz OK, Temel UB, Ugurlu M, Koskan O. The effect of surface sealants with different filler content on microleakage of Class V resin composite restorations. Eur J Dent. 2016;10(02):163-9.

10 Guler AU, Yilmaz F, Kulunk T, Guler E, Kurt S. Effects of different drinks on stainability of resin composite provisional restorative materials. J Prosthet Dent. 2005;94(2):118-24.

11 Poggio C, Ceci M, Beltrami R, Mirando M, Wassim J, Colombo M. Color stability of esthetic restorative materials: a spectrophotometric analysis. Acta Biomater Odontol Scand. 2016;2(1):95-101.

12 Vichi A, Ferrari M, Davidson CL. Color and opacity variations in three different resin-based composite products after water aging. Dent Mater J. 2004;20(6):530-4.

13 Tuncer S, Demirci M, Tiryaki M, Ünlü N, Uysal Ö. The effect of a modeling resin and thermocycling on the surface hardness, roughness, and color of different resin composites. J Esthet Restor Dent. 2013;25(6):404-19.

14 Çelik EU, Aladağ A, Türkün LŞ, Yilmaz G. Color changes of dental resin composites before and after polymerization and storage in water. J Esthet Restor Dent. 2011;23(3):179-88.

15 Johnston WM, Kao E. Assessment of appearance match by visual observation and clinical colorimetry. J Dent Res. 1989;68(5):819-22.

16 Douglas RD, Steinhauer TJ, Wee AG. Intraoral determination of the tolerance of dentists for perceptibility and acceptability of shade mismatch. J Prosthet Dent. 2007;97(4):200-8.

17 Paravina RD, Pérez MM, Ghinea R. Acceptability and perceptibility thresholds in dentistry: A comprehensive review of clinical and research applications. J Esthet Restor Dent. 2019;31(2):103-12.

# Radiographic Evaluation of Marginal Bone Levels of Implant – A Cross Sectional Study

Dr Sanjay B. Lagdive[1], Dr Sushma Lagdive[2], Dr. Dhara Rana[3], Dr Dhara Bajania[4], Dr Milap Karia[5], Dr Sanjay Umarania[6]

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**Abstract: Background:** Bone loss is normally seen after the dental implant placement that extends to the first thread of the implant body or till the first contact of the bone with the roughness of implant surface. Such type of bone loss is dependent on the site of the crest of implant in association with the alveolar crest, the formation of the interface between the implant parts and bone. The present study was conducted to determine the prevalence of marginal bone loss amongst two different implant groups.

**Materials and methods:** The cross sectional study was conducted at our center. Patients with implant supported prosthesis functioning for more than 2 year were called for follow up visit.  Clinical examination pertaining to implant and prosthesis was done. Intraoral periapical radiographs of all subjects were obtained with paralleling technique using Rinn XCP (extension cone paralleling) device (Dentsply sironaltd). Radiographic evaluation of marginal bone loss was done with help of Adobe Photoshop software (CS3 version9).

**Results:** The mean marginal bone loss on mesial side of group 1 was 0.22 while for group 2 was 0.5. mean marginal bone loss on distal side was 0.16 for group1 and 0.42 for group 2.

P value shows statistically significant difference between mesial and distal marginal bone loss of both groups indicating less amount of bone loss in group 1.

**Conclusion:** The study showed better maintenance of bone levels in group 1 implants after 2 year follow up period compared to bone loss observed in group 2 implants. Further studies are still required to support the inference of our study results also other factors like patient factors, implant related factors must be considered for future analysis.

**Keywords:** implant, marginal bone, Osstem, Dentium, radiographs, bone loss.

**Introduction:** Bone loss is normally seen after the dental implant placement that extends to the first thread of the implant body or till the first contact of the bone with the roughness of implant surface.[1] Marginal bone loss is assessed radiographically and is normally no more than 1.5 mm in the first year.[2] A retrospective cross-sectional study by Cecchinato showed that the vast majority (70%) of the subjects included in study exhibited no bone loss during a follow-up period of close to 5 years. Further, in the same interval, the majority of the implant sites (>80%) remained without signs of marginal bone loss. Only 8% of subjects and 4% of implant sites presented with marginal bone loss >2 mm. In the "diseased"subjects that returned for a clinical examination,the prevalence of sites with advanced bone and deep pockets was small.[3] The timing of radiographic assessment is crucial. In some researches the first X-ray was obtained on placing the prosthesis, while in other researches it is taken on placement of the implant.[4] Longitudinal researches with initial radiographs obtained at implant positioning showed significant bone loss before placement of the definitive restoration.[5] Such type of bone loss is dependent on the site of the upper part of the implant in association with the alveolar crest, the formation of the interface between the implant parts, and the type of neck and platform of implant. The present study was conducted to determine the prevalence of marginal bone loss levels amongst two different implant groups which were placed at our center.

**Materials and methods:** The Cross sectional study was conducted at Government Dental Hospital, Ahmedabad. Sample of 80 patients with implant supported prosthesis in function for more than 2 year were called for follow up visit. Total of 110 implants in 80 patients, placed in maxillary and mandibular posterior region were considered for evaluation based on selection criteria. From the 110 implants two groups were made, group 1 included 53 implants of Osstemand group 2 included 57 implants of Dentium.

**Inclusion criteria:** Absence of any local or systemic disease. Implants that had been placed at least 3 months after healing of extraction socket. 1–3 missing teeth in posterior region of the maxilla or mandible. Implantplaced according to delayed loading protocol.

Exclusion criteria:- General health conditions that counter indicated implant surgery. Patients having parafunctional habits. Subjects that required bone augmentation and unconventional procedure during implant procedures.Habit of smoking, metabolic disorders and poor oral hygiene.

All the subjects were informed about the study and a written consent was obtained from them.

Clinical examination pertaining to implant and prosthesis was done.Intraoral periapical radiographs of all subjects were obtained with paralleling technique with Rinn XCP (extension cone paralleling) device (Dentsply Sirona ltd). Radiographic assessment of marginal bone loss was done with help of Adobe photoshop software(CS 3 version9). Implant shoulder was taken as reference for assessing the bone levels and evaluating amount of bone loss(figure1). All the radiographs were taken by experienced oral radiologist. Allthe data thus obtained was arranged in a tabulated form and analysed using Microsoft excel.

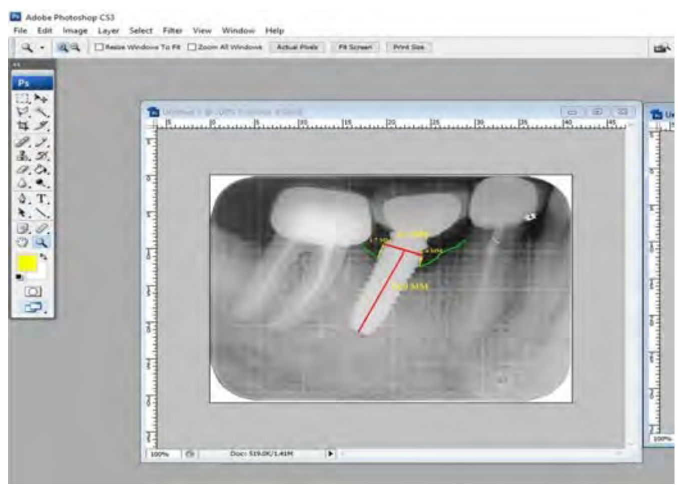



Figure 1: Evaluation of marginal bone loss in adobe photoshop software.

**Results:** Statistical analysis include descriptive analysis (mean±SD) and unpaired ‘T’ test. As the number of subjects included in the clinical examination was small, no attempts were made to analyse the effect of risk indicators such as oral hygiene levels, smoking, history of periodontitis and diabetes, presence and severity of bone loss and peri-implantitis.

Total of 78 patients with 110 implants (53 implant in group 1and 57 implant in group 2) were assessed radiographically to evaluate the amount of bone loss. The mean age of the 78 subjects included in the study was 45 ± 10 years. Table 1 shows mean value of the bone loss on mesial and distal side, their standard deviation and P-value.

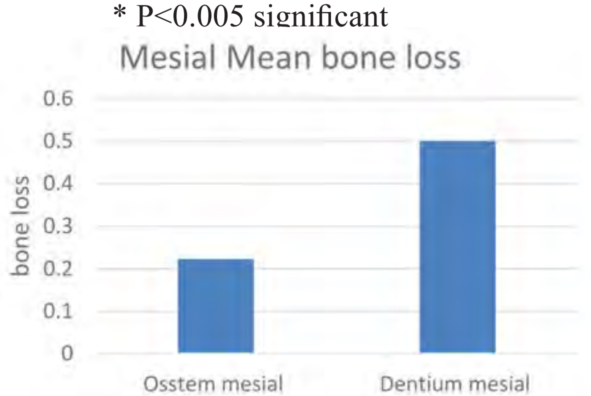
Results show that difference in mean marginal bone loss on mesial is statistically between group 1 and group 2 with a P-value of 0.0018.

Also difference in mean marginal bone loss of distal side is statistically significant with a P-value of 0.0047.

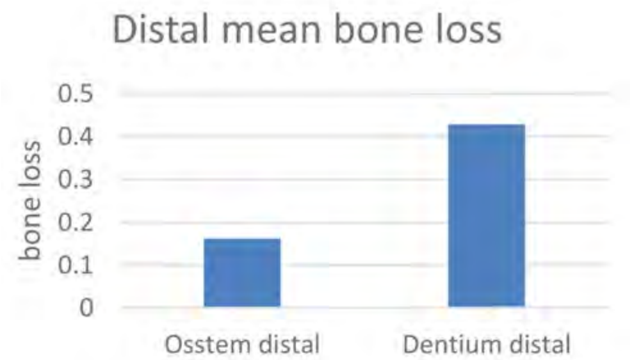
**Table 1:** Descriptive statistics showing mean, standard deviation and P value.

| Group | Site | Mean | Standard deviation | P value |
|---|---|---|---|---|
| 1 (Osstem) | Mesial marginal bone loss | 0.22 | 0.28 | 0.0018 * |
| 2 (Dentium) | Mesial marginal bone loss | 0.5 | 0.57 | |
| 1 (Osstem) | Distal marginal bone loss | 0.16 | 0.22 | 0.0047 * |
| 2 (Dentium) | Distal marginal bone loss | 0.42 | 0.63 | |

* P<0.005 significant




Graph 1:- Mean marginal bone loss of mesial side of group 1 and group 2




Graph 2:- Mean marginal bone loss of distal side of group 1 and group 2

Its signifies that group 1 implants shows better bone level maintenance and less amount of bone loss after 2 year of functioning, however this statistical difference may be attributable to patient related factors, implant related factors and demographic conditions.

**Discussion:** In the present study, subjects from only one center were included for the study. The patients were recalled for regular follow up visit upto1 year. The overall mean amount of radiographic marginal bone loss that had occurred after the 2 year interval, starting from post-loading was analysed during the study. It shows that group 1 implants shows less marginal bone loss in comparison to group 2 implants but due to certain factors not selected in our study demands more research in this area to support results of our study. Other factors related to implant and surrounding environment, host factors, bio mechanical aspects must be taken in to consideration in future studies to minimize the bias in study. Many implants systems in research field are evolving everyday. Every implant manufacturing company established till now claims their implant system to be (superior) in the competing field of implant dentistry. The general/overall design of root form implant remains the same, however there are minor modifications in implant design, material and surface treatment of each system are done. For long term success and survival of implant, good osseointegration of implant with the host bone and maintenance of marginal bone levels is the prime requisite. Implant success criteria, regarding marginal bone loss and other parameters, were first suggested in 1986 and today are still frequently referred to as the gold standard for implant success. However, according to the recent abundance of data on marginal bone loss and a better understanding of bone and soft tissue behaviour around the implant neck and body, these criteria are inaccurate for the wide variety of implant systems. Implant systems differ in neck configurations and lengths and micro configurations of the implant body. Moreover, implants can be classified into one- and two-piece. The recovery duration for implants is same to physiology of bone tissue healing. The researches of titanium implants have illustrated that the technique of healing can be classified in three stages: osteophilic, osteoconductive and osteoadaptive.[6] The accomplishment of therapy is primarily surgical, esthetic and functionally acceptable only if there is adequate type of bone and gums. The total amount of bone loss during the year may alter the depth sulcus and environment for the prolonged existence of the dental implant.[7]

**Conclusion:** Within the limitations of this study, it can be concluded that implants of the group 1 shows better maintenance of bone levels while bone loss in group 2 is comparatively more. To analyze the prevalence of bone loss in future studies, consistent case selections should be applied to large randomly selected population samples with adequate size and function time and generalize the implant related factors.

**References:**


1 Astrand P, Engquist B, Dahlgren S, Gröndahl K, Engquist E, Feldmann H. Astra Tech and Brånemark system implants: a 5-year prospective study of marginal bone reactions. Clin Oral Implants Res. 2004;15:413-20.

2 Weber HP, Buser D, Fiorellini JP, Williams RC. Radiographic evaluation of crestal bone levels adjacent to nonsubmerged titanium implants. Clin Oral Implants Res. 1992;3:181-8.

3 Cecchinato D, Parpaiola A, Lindhe J. A cross-sectional study on the prevalence of marginal bone loss among implant patients. Clinical oral implants research. 2013 Jan;24(1):87-90.

4 Albrektsson T, Zarb G, Worthington P, Eriksson AR. The long-term efficacy of currently used dental implants: A review and proposed criteria of success. Int J Oral Maxillofac Implants 1986;1:11-25.

5 Hermann JS, Cochran DL, Nummikoski PV, Buser D. Crestal bone changes around titanium implants. A radiographic evaluation of unloaded nonsubmerged and submerged implants in the canine mandible. J Periodontol1997;68:1117-30.

6 Brägger U, Gerber C, Joss A, Haenni S, Meier A, Hashorva E, et al. Patterns of tissue remodeling after placement of ITI Dental Implants using an osteotome technique: A longitudinal radiographic case cohort study. Clin Oral Implants Res 2004;15:158-66.

7 Misch CE. Dental implant prosthetich; Library of CongresCataloging in-Publicatioin Data. St Louis: Mosby; 2005.

8 Nickenig HJ, Wichmann M, Schlegel KA, Nkenke E, Eitner S. Radiographic evaluation of marginal bone levels adjacent to parallel-screw cylinder machined-neck implants and rough-surfaced microthreaded implants using digitized panoramic radiographs. Clin Oral Implants Res. 2009. Jun;20(6):550–4.

9 Lee SY, Piao CM, Koak JY, Kim SK, Kim YS, Ku Y, et al. A 3-year prospective radiographic evaluation of marginal bone level around different implant systems. J Oral Rehabil. 2010. Jul;37(7):538–44. 10.1111/j.1365-2842.2010.

10 Shin YK, Han CH, Heo SJ, Kim S, Chun HJ. Radiographic evaluation of marginal bone level around implants with different neck

designs after 1 year. Int J Oral Maxillofac Implants. Int J Oral Maxillofac Implants. 2006. Sep-Oct;21(5):789–94.

11 Canullo L, Fedele GR, Iannello G, Jepsen S. Platform switching and marginal bone-level alterations: the results of a randomized-controlled trial. Clin Oral Implants Res. 2010. Jan;21(1):115–21. 10.1111/j.1600-0501.2009.01867.x

12 Fickl S, Zuhr O, Stein JM, Hürzeler MB. Peri-implant bone level around implants with platform-switched abutments. Int J Oral Maxillofac Implants. 2010. May-Jun;25(3):577–81.

13 Prosper L, Redaelli S, Pasi M, Zarone F, Radaelli G, Gherlone EF. A randomized prospective multicenter trial evaluating the platform-switching technique for the prevention of postrestorative crestal bone loss. Int J Oral Maxillofac Implants. 2009. Mar-Apr;24(2):299–308.

14 Annibali S, Bignozzi I, Cristalli MP, Graziani F, La Monaca G, Polimeni A. Peri-implant marginal bone level: a systematic review and meta-analysis of studies comparing platform switching versus conventionally restored implants. J Clin Periodontol. 2012. Nov;39(11):1097–113.

15 Kahnberg KE. Implant Surgery in the Posterior Region of the Jaws. Acta Stomatol Croat. 2005;39(3):245.

# Comparison of effect of mechanical loading on reverse torque value of straight and angulated prosthetic abutment in regular platform dental implant: an in-vitro study.

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**Abstract: Background and objective:** Loosening and breaking of the screws that secure the prosthesis to the implant is a frequent issue with the use of dental implants for prostheses. Our objective was to assess the effect of mechanical loading on the reverse torque value of prosthetic abutments in regular-platform dental implants, namely, those that were angulated or straight.

**Methodology:** The sample size of 12 was divided into two groups: a) implant analog with an angulated prosthetic abutment (Group A) and b) implant analog with a straight prosthetic abutment (Group B), with six abutments in each group, resulting in 12 implant-abutment assemblies mounted onto an acrylic resin block (15 mm diameter ×15 mm height). 1,00,000 cycles of mechanical loading were applied, then the reverse torque value (RTV) ratio was calculated before and after loading, tabulated, and analyzed. Intergroup comparisons between groups for the study parameters were performed using an unpaired t-test.A paired t-test was used for intragroup comparisons within each group from the pre-to post-study findings.

**Results:** The results of this study showed that the initial screw loosening process occurred in both angulated and straight prosthetic abutments, but screwing loosening post-load occurred more frequently in group A. This could be because the loading on angled abutments is mostly off-axis. The initial and post-load RTV in Group A highly significant ($p<0.001$)whereas for Group B, the initial and post-load RTV were non-significant ($p=0.039$). The percentage difference between the initial and post-load RTV for Group A and Group B was highly significant ($p<0.001$).

**Conclusion:** It has been noted that screw loosening increased with increasing abutment angulations, and Higher RTVs were observed after loading straight prosthetic abutments after exposure to 1,00,000 cycles of the chewing simulator.

**Keywords:** Cyclic loading, removal torque value, screw loosening, Dental abutments.

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Introduction:- The turn of the century marked the advent of a new era in prosthodontics, characterized by the explosive advancement of oral implant technology. The introduction of implant technology has significantly enhanced the quality of life of patients by drastically improving the cosmetic and functional outcomes of definitive restorations compared with traditional methods. This advancement has expanded the number of options available to both clinicians and patients. Despite its numerous benefits, implant technology is not without flaws. The clinical practice of implant-supported restorations faces challenges, such as surgical trauma, high costs and prolonged treatment duration. Additionally, biological and mechanical complications, including peri-mucositis, peri-implantitis, loosening or fracturing of the abutment screw, fracturing of the abutment or superstructure, crown loosening, and porcelain cracking, pose significant concerns.[1]

In two-piece implant systems, there are two primary types of implant-abutment connections: external and internal. An external connection is characterized by a hexagonal or octagon structure, 1-2 mm in height protruding from the top of the implant to connect with the abutment. Conversely, an internal connection involves an abutment that extends 4-6 mm into the implant.[2]

A prevalent issue in the use of dental implants for prosthetics is the loosening and fracturing of the screws that secure the prosthesis to the implant.[3] Factors contributing to screw loosening include the settling effect, excessive bending, vibrating micro movement, fatigue, and insufficient tightening torque,[4] Various elements related to screw design and fabrication can influence the loosening of abutment or prosthetic screws in metal-to-metal screw systems. These factors primarily include the preload, components and screw material, manufacturer's quality control, screw joint design, surface roughness, and inappropriate tightening torque. Among these, inadequate tightening torque has been reported to be the main factor leading to screw loosening. Retightening of the implant abutment screw is highly recommended to mitigate the risk of screw loosening. Retightening the screws ten minutes after the initial tightening was the most effective strategy. Retightening also reduces the settling effect with a minimal impact on the preload, with the effect being more pronounced at high coefficients of friction.[5]

This in vitro study was conducted to compare the effect of mechanical loading on the reverse torque value (RTV) of angulated and straight prosthetic abutments in regular-platform dental implants. The null hypothesis tested was that there would be no significant differences between the initial and post-load reverse torque values before and after mechanical loading between angulated and straight prosthetic abutments.

**Materials and Methods:** This study used 12 implant fixtures (Genesis, India) equipped with either angulated or straight prosthetic abutments. These fixtures were divided into two groups, each containing six implants (n=6): Group A angulated prosthetic abutments and Group B with straight prosthetic abutments (Figure 1). The implants were embedded into acrylic resin within a cylindrical silicon mold measuring 15 mm in height and 15 mm in diameter. De Carvalho et al. stated that acrylic resin is suitable for cyclic loading tests owing to its adequate flexural strength. Its modulus of elasticity ($3.4 \times 10^5$ lb/in$^2$) closely resembles that of cancellous bone ($3.6 \times 10^5$ lb/in$^2$).

In this study, a torque of 25 Ncm was applied to both angulated and straight prosthetic abutments, according to the manufacturer's recommendations. After the initial tightening, the specimens were re-tightened after 10 min. The initial removal torque value (RTV) was measured using a high-resolution Lutron Digital Torque Meter (Figures 2 and 3) before subjecting the specimens to cyclic loading. Subsequently, the specimens in both Group A and Group B were re-tightened to the manufacturer's recommended torque of 25 Ncm after a 10-minute interval. The retightened specimens were then mounted on an S-D Mechatronik chewing simulator (Figure 4) for cyclic loading. After cyclic loading, the post-load removal torque (RTV) was measured. A vertical load was applied to the center of the abutment using a chewing simulator, with 100,000 cycles of mechanical loading corresponding to one month of the masticatory cycle (Figure 5).

Calculation of removal torque loss (RTL) ratio of abutment screw before and after dynamic cyclic loading (DCL)[2]

Loss ratio of removal torque before loading (%) = Tightening torque – initial removal torque value × 100 Tightening torque

Loss ratio of removal torque after loading (%) = Tightening torque – post load removal torque value × 100 Tightening torque

Loss ratio of removal torque between before and after loading (%) = initial removal torque value – post load removal torque value × 100 Initial removal torque value

**Data analysis:** Statistical analysis was performed using Statistical Package for Social Science (SPSS) version 21 for Windows (SPSS Inc, Chicago, IL). Intergroup comparisons between groups for the study parameters were performed using an unpaired t-test. A paired t-test was used for intragroup comparisons within each group from the pre-to post-study findings. Statistical significance was set at $p < 0.05$.

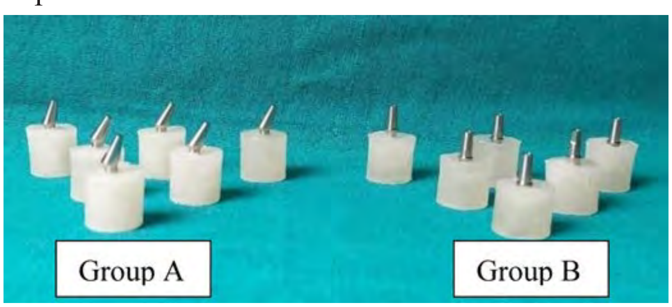


Figure 1: Grouping of specimens From left Group A Angulated prosthetic abutments to right Group B Straight prosthetic abutment.

Figure 2: Digital torque meter (Lutron Electronic Enterprises Co. Ltd. Taiwan)

Figure 3: Applying a 25Ncm torque on angulated and straight prosthetic abutment.

Figure:4 Chewing simulator

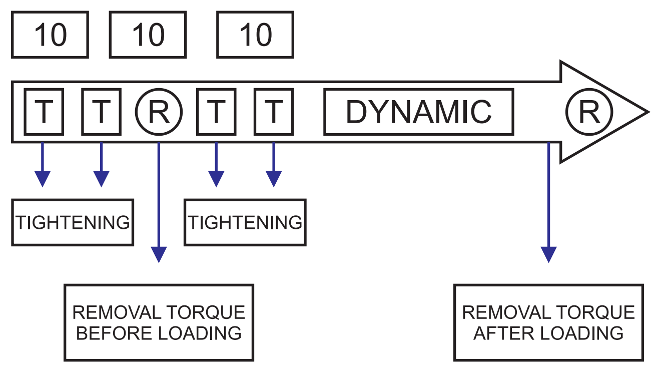


Figure:5 Diagrammatic arrow represents the procedure

**Results:** The initial removal torque values (RTV) for Group A and Group B were 20.55 ± 0.85 Ncm and 21.73 ± 1.82 Ncm, respectively (Table 1). The initial RTV percentages for Groups A and B were 17.8 ± 3.4% and 13.06 ± 7.3%, respectively.

Post-load RTV measurements revealed that Group A had a mean RTV of 16.63 ± 1.2 Ncm, while Group B had a mean RTV of 26.35 ± 4.39 Ncm (Table 2). The post-load RTV percentages were 33.46 ± 4.8% in Group A and -10.06 ± 19.68% in Group B. The mean percentage difference between the initial and post-load RTV was 18.96 ± 5.58% for Group A and -29.75 ± 22.8% for Group B (Figure 6). This difference was statistically significant ($p < 0.001$).

No significant difference was observed in the initial RTV between Group A and Group B ($p = 0.181$). Additionally, there was no significant difference between the initial and post-load RTV for Group B ($p = 0.039$). However, a highly significant difference was noted in the post-load RTV between Group A and Group B, as well as in the initial and post-load RTV for Group B ($p < 0.001$).

Table: 1 Comparison between initial and post-load removal torque values for Group A and Group B

| Groups | Initial RTV | Post load RTV | Difference between initial and post-load torque loss | Paired t test | P value, Significance |
|---|---|---|---|---|---|
| Group A (Angulated) | 20.55±0.85 | 16.63±1.2 | 3.91±0.6 | t= 6.507 | P<0.001** |
| Group B (Straight) | 21.73±1.82 | 26.35±4.39 | -4.61±1.94 | t= -2.378 | p = 0.039* |

p>0.05 – no significant difference
*P< 0.05 – significant
**p<0.001-highly significant

Table: 2 Comparison of initial and post-load removal torque loss for Group A and Group B

| Removal torque loss | Group A (Angulated) | Groups B (Straight) | Mean difference between initial and post-load torque loss | Unpaired t- test | P value, Significance |
|---|---|---|---|---|---|
| Initial | 17.8 ±3.4 | 13.06 ±7.3 | 4.73 ±3.29 | t= 1.438 | p= 0.181 |
| Post load | 33.46 ±4.81 | -10.06 ±19.68 | 43.53 ±8.27 | t= 5.261 | p < 0.001** |
| Percentage difference between initial and post load | 18.96±5.58 | -29.75±22.8 | 48.71± 9.58 | t = 5.083 | p< 0.001** |

p>0.05 – no significant difference
*P< 0.05 – significant
**p<0.001-highly significant

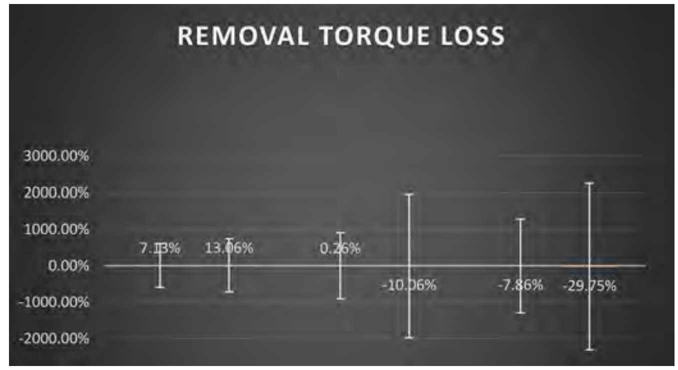


Figure 6: Intergroup comparison of before and after loading also difference ratio before and after removal torque

**Discussion:** Efforts to mitigate common challenges associated with treatment and enhance the survival rates of implants, abutment screws, implant-abutment connections, and superstructures persist in the dental implant field. Consequently, clinicians must be aware of the forces exerted on the screw joint to minimize or forestall screw loosening and related complications.[5,6]

A torque was applied to tighten the abutment screw, generating a preload that represents the force induced in the screw by the applied torque.[7] This preload corresponds to the tension exerted when tightening an abutment screw, directly influencing the clamping force. As the screw is tightened, tension is engendered in both the abutment screw and the implant surface, leading to elongation of the screw. Subsequently, the elastic recovery of the screw draws the two components together, akin to the clamping force generated by a rubber band.[7] Concurrently, joint separating forces, which strive to disengage components, are operative.[5]

Conversely, compressive stresses arise at the implant abutment interface and are governed by three key factors: machining tolerance, settling effect, and wedge effect. Machining tolerance encompasses surface roughness and dimensional variation, intrinsic to machined implant components. The settling effect occurs between two rough surfaces, where adhesive wear causes flattening of rough patches under pressure, resulting in closer proximity of the surfaces. Internal (INT) and external (EXT) connections are susceptible to this phenomenon. Notably, the wedge effect, which is more pronounced in the INT connection, involves the abutment acting as a wedge, concentrating the axial compressive forces in the direction of abutment insertion. This amplifies the frictional resistance and contact pressure, with the wedge effect escalating alongside the tightening torque.[8]

Thus, the primary factors implicated in maintaining the tightness of implant screws entail maximizing the clamping force while minimizing the joint separating forces. Notably, it is posited that 2–10% of the original preload may be forfeited due to the settling effect, constituting one of the principal mechanisms of screw loosening in implant-supported restorations, along with excessive bending of the screw joint in the direction of the applied load.[9]

The optimal torque value for screw tightening is recommended as 75% of the torque necessary to induce screw failure.[10,11] Bickford delineated the process of screw loosening into two distinct stages. During the initial tensile deformation phase, external forces primarily impacted the screw, leading to a reduction in the clamping force. Consequently, external forces act in opposition to the original tightness of the screw, causing slight stretching and subsequent diminishment of the clamping force.[12]

Subsequently, in the second stage, as the clamping force further decreases upon application of force, micromotion at the implant-abutment interface intensifies, fostering instability at the connection and subjecting the screw surface to stress, thereby precipitating screw loosening. The loss of preload due to the application of external force results in abutment screw loosening.[1]

Angled abutments facilitate the rehabilitation of implants positioned in buccolingual or mesiodistal misalignments, with prefabricated abutments angled by 25°, facilitating parallelism between adjacent abutments. Moreover, correction of implant trajectory using a 25° angled abutment may displace the restoration by two–three millimeters at the occlusal aspect. However, angulated abutments, employed in scenarios where axial or conventional positions are untenable owing to anatomical or biological factors, are susceptible to non-axial forces that transfer adverse forces to the implant and bone, potentially compromising treatment prognosis.[13,14]

In this study, abutment screws were tightened to 25 cm using a digital torque gauge according to the manufacturer's instructions. Following the initial torque application, a ten-minute interval elapsed. Subsequently, using the same digital torque gauge, all screws were retightened to an identical tightening torque (25 Ncm) to compensate for the preload loss attributable to the screw's settling effect. This approach ensured the attainment of an optimal preload, whereby only 10% of the initial torque was converted into preload, with the remaining 90% utilized to surmount friction between surface irregularities.[2]

A vertical load simulating masticatory forces was applied at the central point of the abutment by using a chewing simulator. Each chewing cycle entailed downward vertical movement lasting 1 s, amounting to 60 cycles per minute (1 Hz), with a masticatory load of 50 N. Notably, the average daily number of mastications is approximately 2,700, and 100,000 cycles correspond to approximately one month.[15,16]

The study findings revealed the occurrence of screw loosening in both Group A and Group B, attributed to distinct angulations of the prosthetic abutments. Initial mean RTV following tightening torque application of 25 Ncm for Group A and Group B amounted to 20.55 ± 0.85 Ncm and 21.73 ± 1.82 Ncm, respectively, with percentage losses of 17.8 ± 3.4% and 13.06 ± 7.3% for Group A and Group

B. Subsequent post-load RTV for Group A recorded 16.63 ± 1.2 Ncm with a percentage loss of 33.46 ± 4.81%, while for Group B, it measured 26.35 ± 4.39 Ncm with a percentage gain of -10.06 ± 19.68%.

The post-load RTV for Group A, characterized by a percentage loss of 33.46 ± 4.81%, underscores the exacerbation of off-axis forces with increasing angulation, imposing additional stress and strain on the implant components, particularly the screw. Off-axis loading engenders a threefold or greater amplification in the stress magnitude on the implant, correlating with the rise in abutment angulation and a statistically significant increase in strain and stress. This underscores the importance of mitigating excessive off-axial and occlusal stress in implant-supported restorations.

The clinical loading of implants restored with angled abutments may precipitate augmented lateral occlusal stresses, potentially inducing torsional forces and consequent screw loosening. Any load vector diverging from the implant's long axis accentuates crestal stresses on the abutment screws of the restoration and the implant-bone interface.(2)

Similarly, Group B exhibited a post-load RTV percentage gain of -10.06 ± 19.68%. Conversely, the straight prosthetic abutment demonstrated a positive effect owing to its broader diameter, increased surface area, and augmented material thickness, thereby mitigating the stress concentration at the implant-abutment junction. Notably, a significant percentage gain in the reverse torque value following cyclic loading was observed in Group B. This phenomenon has been attributed to the settling effect, also known as "embedment relaxation," which transpires when rough contact points flatten under load. The study's findings and data advocate for the utilization of angulated prosthetic abutments in scenarios characterized by misalignment or suboptimal implant positioning, whereas straight prosthetic abutments are recommended when forces are maximal.(15)

**Conclusions:** Within the scope and limitations of this study, the following conclusions were drawn:

1 The initial process of screw loosening transpired in both Group A (Angulated prosthetic abutment) and Group B (Straight prosthetic abutment).

2 Group B (straight prosthetic abutment) exhibited higher reverse torque values (RTVs), indicating a greater percentage gain after exposure to 100,000 chewing simulator cycles.

3 The percentage difference between the initial and post-load RTVs manifested as a percentage loss in Group A (angulated prosthetic abutment), indicating a higher propensity for screw loosening. Conversely, Group B (straight prosthetic abutment) showed a percentage gain, indicative of a diminished incidence of screw loosening.

**References:**

1 Huang Y, Wang J. Mechanism of and factors associated with the loosening of the implant abutment screw: A review. J Esthet Restor Dent. 2019;31(4):338–45.

2 El-Sheikh MAY, Mostafa TMN, El-Sheikh MM. Effect of different angulations and collar lengths of conical hybrid implant abutment on screw loosening after dynamic cyclic loading. Int J Implant Dent. 2018;4(1):39.

3 Sammour SR, Maamoun El-Sheikh M, Aly El-Gendy A. Effect of implant abutment connection designs, and implant diameters on screw loosening before and after cyclic loading: In-vitro study. Dent Mater. 2019;35(11):265–71.

4 Kim ES, Shin SY. Influence of the implant abutment types and the dynamic loading on initial screw loosening. J Adv Prosthodont. 2013;5(1):21–8.

5 Attiah EMN, AlGendy AA and Mostafa TMN. Effect of dynamic cyclic loading on screw loosening of retightened versus new abutment screw in both narrow and standard implants an in-vitro study. Int J Implant Dent. 2020;6(1):30-42.

6 Keating K. Connecting Abutments to Dental Implants - An Engineer's Perspective [Internet]. [place unknown]: Bicon; 2001 [date unknown]. Available from: https://www.bicon.com/news/n_publications_keating html Irish Dent. 2001:43-6.

7 Shetty M, Prasad K, Shetty NHG, Jaiman R. Implant abutment connection: Biomechanical perspectives. J Health and Allied Sci. 2014;04(2):47–53.

8 Lee JH, Kim DG, Park CJ, Cho LR. Axial displacements in external and internal implant-abutment connection. Clin Oral Implants Res. 2014;25(2):83-9.

9 Siamos G, Winkler S, Boberick KG. The relationship between implant preload and screw loosening on implant-supported prostheses. J Oral Implantol. 2002;28(2):67–73.

10 McGlumphy EA, Mendel DA, Holloway JA. Implant screw mechanics. Dent Clin North Am. 1998;42(1):71–89.

11 Winkler S, Ring K, Ring JD, Boberick KG. Implant screw mechanics and the settling effect: overview. J Oral Implantol. 2003;29(5):242–5.

12 Link RE. An introduction to the design and behavior of bolted joints. J Test Eval [Internet]. 1991;19(5):417–8.

13 Cavallaro J Jr, Greenstein G. Angled implant abutments: a practical application of available knowledge. J Am Dent Assoc. 2011;142(2):150–8.

14 Ahmed SE, Krishnan CS, Mohan J, Kalaignan P. Effect of cyclic loading on abutment screw loosening in angled implant AbutmentsAn in-vitro study. J Clin Diagn Res. 2019; 13(2):1-6.

15 Binon PP, McHugh MJ. The effect of eliminating implant/abutment rotational misfit on screw joint stability. Int J Prosthodont. 1996;9(6):511–9.

16 Cho WR, Huh YH, Park CJ, Cho LR. Effect of cyclic loading and retightening on reverse torque value in external and internal implants. J Adv Prosthodont. 2015;7(4):288–93.

# Advances in Lab Procedures for Implant Dentistry: A Comprehensive Review

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**Abstract:** Implant dentistry has significantly transformed the landscape of prosthodontics, offering patients a dependable and aesthetically pleasing alternative for tooth replacement. The efficacy of dental implants is intricately tied to the meticulousness and precision of laboratory procedures. This in-depth review delves into the most recent breakthroughs in lab methodologies for implant dentistry, encompassing advancements in digital technologies, materials and techniques. Emphasizing the pivotal role of evidence-based practice, the review underscores the critical need for a comprehensive understanding of the latest developments in order to ensure optimal outcomes for patients undergoing implant procedures.

**Key Words:** Advances, Prosthodontics, Implants, Laboratory, CAD-CAM.

**Introduction:** Implant dentistry has become the standard of care for replacing missing teeth due to its remarkable success rates and improved patient outcomes. The pivotal role of the dental laboratory in fabricating precise and esthetic restorations cannot be overstated. This review delves into the evolving landscape of lab procedures in implant dentistry.

**Discussion: 1. Digital Impressions and Scanning:** The advent of digital impressions and intraoral scanning systems has transformed the way implant cases are planned and executed. The benefits of digital impressions include increased accuracy, reduced patient discomfort, and streamlined communication between clinicians and technicians. Key systems such as the iTero, 3Shape TRIOS, and Planmeca Emerald have revolutionized this aspect of lab procedures.[1]

**2. Virtual Implant Planning:** Advanced software like 3D implant planning and guided surgery programs have enhanced the precision of implant placement. Utilizing cone-beam computed tomography (CBCT) scans, virtual planning. At present, the scientific literature does not consider direct intraoral scanning a sufficiently reliable method to capture impressions for the fabrication of long-span implant-supported prosthetic restorations, particularly in the case of FAs. Our present retrospective clinical study presents the clinical results obtained with a novel intraoral scanning technique, named “Continuous Scan Strategy” (CSS), based on the connection of the scan abutments through thermoplastic resin, to eliminate the “jump” between the different SBs and therefore reduce the intrinsic scan error. Allows for the precise assessment of bone quality and quantity. These systems provide a roadmap for implant placement, reducing surgical time and minimizing complications.[2]

**3. CAD/CAM Technology:** Computer-aided design and computer-aided manufacturing (CAD/CAM) technology have become integral in producing custom implant abutments, crowns, and bridges. Materials such as zirconia and titanium are milled with exceptional precision to create restorations that mimic natural dentition.[3]

**4. Material Advances:** The evolution of dental materials has had a profound impact on implant dentistry. Recent developments in ceramic materials like zirconia and lithium disilicate have led to highly esthetic and durable implant restorations. Additionally, advancements in nanotechnology have improved the surface properties of titanium implants, enhancing osseointegration.[4]

**5. 3D Printing:** The use of 3D printing technology has grown in implant dentistry, allowing for the rapid prototyping of surgical guides, provisional prostheses, and even permanent restorations. This technology offers cost-effective and time-efficient solutions for both the laboratory and the clinical setting.[5]

**6. Tissue Engineering:** This is an emerging field that holds promise for improving the esthetic and functional outcomes of implant dentistry. Scaffold-based approaches and growth factor applications are being explored to enhance soft and hard tissue regeneration around implants.[6]

**7. Prosthetic Workflow:** The prosthetic workflow in implant dentistry has seen significant advancements. Digital communication and collaboration between clinicians and technicians are facilitated by dedicated software platforms. This seamless exchange of information expedites case planning and ensures that the final restoration meets both functional and esthetic requirements.

**8. Implant-Abutment Connection:** The design of the implant-abutment connection plays a crucial role in the long-term success of implant restorations. Recent developments in this area include Morse taper connections, internal hex, and conical connections, all of which aim to provide better stability and minimize micro-movement at the implant-abutment interface.[7]

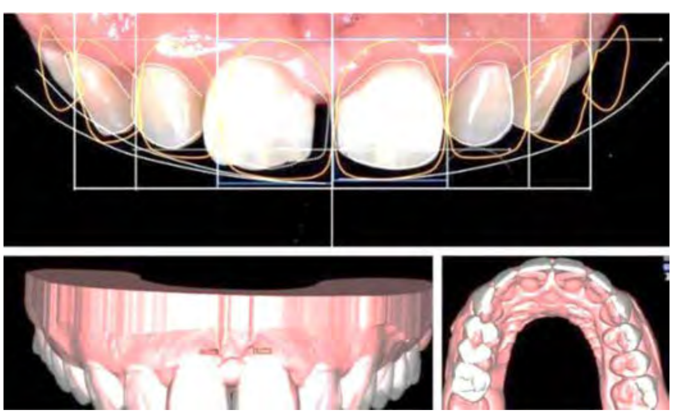
**9. Emerging Biomaterials:** Researchers are continuously exploring new biomaterials for use in implant dentistry. Biodegradable and bioactive materials are being investigated for their potential to enhance osseointegration and reduce the risk of peri-implantitis. Additionally, the use of antimicrobial coatings on implant surfaces is gaining attention as a strategy to prevent infections around implants.[8]

**10. Augmented Reality and Virtual Reality:** Augmented reality (AR) and virtual reality (VR) technologies are making their way into implant dentistry. They can assist both clinicians and patients in visualizing the final outcome of implant treatment. These technologies offer a more immersive experience for treatment planning and patient education.[9]

**11. Biomechanical Studies Biomechanical studies:** Studies have contributed significantly to the understanding of implant behaviour under various loading conditions. Finite element analysis and in vitro experiments are shedding light on the optimal design of implant-supported prostheses, leading to improved longevity and reduced complications.[10]

**12. Artificial Intelligence (AI) and Machine Learning:** AI and machine learning algorithms are being applied to various aspects of implant dentistry, including treatment planning, image analysis, and prosthesis design. These technologies can assist clinicians and technicians in making more accurate decisions and predicting treatment outcomes based on large data sets.

**13. Digital Smile Design (DSD):** Digital Smile Design is a patient-centric approach that combines digital imaging, CAD/CAM technology, and 3D printing to create highly personalized treatment plans. DSD allows for precise communication between the clinician, technician, and patient to achieve the desired esthetic outcome.



**14. Intraoral Scanning Integration:** Intraoral scanners are becoming more integrated with CAD/CAM systems, allowing for seamless digital workflows. This integration streamlines the capture of intraoral data and its transfer to the laboratory for prosthesis fabrication, reducing turnaround times and potential errors .

**15. Immediate Load Protocols:** Advancements in implant design and surface treatments have led to the development of immediate load protocols, allowing for implant placement and restoration in a single visit. This minimizes treatment time and enhances patient satisfaction.

**16. Augmented Reality Surgical Navigation:** Augmented reality (AR) surgical navigation systems are being used to assist clinicians during implant placement procedures. AR overlays digital implant planning onto the surgical field in real-time, improving accuracy and reducing complications.

**17. Patient-Specific Implants:** Customized implants designed based on patient-specific anatomy are gaining popularity. Utilizing 3D printing and CAD/CAM technologies, these implants provide an excellent fit and can optimize osseointegration.

**18. Laser Technology:** The use of lasers in implant dentistry is growing. Laser systems can be employed for soft tissue management, disinfection, and even abutment and crown preparation, offering precise and minimally invasive procedures.

**19. Minimal Intervention Techniques:** A trend toward minimal intervention and conservative approaches in implant dentistry is emerging. Preservation of natural tissues, such as the use of narrow-diameter implants or short implants, is being explored to reduce invasiveness and improve patient comfort.

**20. Patient Education Apps:** Mobile applications and software tools are being developed to educate patients about implant procedures and postoperative care. These apps enhance patient engagement and understanding, leading to better compliance and treatment outcomes.

**21. Sustainability in Dental Labs:** Dental laboratories are increasingly adopting sustainable practices, such as recycling, reducing waste, and using eco-friendly materials. Sustainable dentistry aligns with global environmental initiatives and contributes to responsible healthcare practices.

**Conclusion:** The ever-evolving landscape of lab procedures in implant dentistry is marked by a relentless pursuit of precision, esthetics, and patient satisfaction. Digital technologies, materials, and novel techniques have expanded the horizons of what is achievable. Clinicians and dental technicians must stay abreast of these advances and embrace evidence-based practices to ensure the best possible outcomes for their patients.

lab procedures in implant dentistry are undergoing a transformative evolution, driven by digital technologies, novel materials, and innovative techniques. Staying current with these advancements and implementing evidence-based practices is crucial for achieving optimal outcomes in implant treatment. Collaboration between clinicians and dental technicians, combined with ongoing education and research, will continue to drive progress in this field.

Incorporating these recent advancements into lab procedures can lead to improved precision, efficiency, and patient satisfaction in implant dentistry. Staying informed about emerging technologies and practices is essential for dental professionals to provide the best possible care to their patients.

**References:**


1. Sousa, R. D. S., Silva, F. S., & Gouveia, S. L. (2020). Accuracy of digital impressions and conventional impressions for implant-supported dental prostheses: A systematic review and meta-analysis. Clinical Oral Implants Research, 31(11), 1260-1271.
2. Tallarico, M., Kim, Y. J., Cocchi, F., Martinolli, M., & Canullo, L. (2017). Implant-buccal plate distance as diagnostic parameter: a prospective cohort study on the implant buccal plate distance stability and dimensional changes after 2 years of loading. Clinical Oral Implants Research, 28(10), 1205-1213.
3. Pjetursson, B. E., Tan, W. C., Tan, K., Brägger, U., & Zwahlen, M. (2015). A systematic review of the survival and complication rates of fixed partial dentures (FPDs) after an observation period of at least 5 years. Clinical Oral Implants Research, 26(Suppl 11), 28-45.
4. Dohan Ehrenfest, D. M., Coelho, P. G., Kang, B. S., Sul, Y. T., Albrektsson, T., & Classification Committee, W. (2010). Classification of osseointegrated implant surfaces: materials, chemistry and topography. Trends in Biotechnology, 28(4), 198-206.
5. Mangano, F. G., Hauschild, U., Admakin, O., Fullin, G., Sethi, A., & Nart, J. (2019). Trueness and precision of 5 intraoral scanners in the impressions of single and multiple implants: a comparative in vitro study. BMC Oral Health, 19(1), 101.
6. Tavelli, L., Asa'ad, F., Acunzo, R., Bielemann, A. M., Pagni, G., & Giannì, A. B. (2020). Tissue Engineering for Soft Tissue Regeneration in Periodontology and Implant Dentistry. Materials, 13(19), 4340.
7. Assenza, B., Scarano, A., Perrotti, V., & Iezzi, G. (2020). Influence of the Implant-Abutment Connection on the Peri-Implant Bone Levels: A Systematic Review. Journal of Oral Implantology, 46(6), 492-500.
8. Lazăr, A. B., Bădărău, A. S., Bădărău, I. A., & Râcă, I. E. (2021). Antimicrobial Strategies in the Dental Implant System: A Review of Current Literature. International Journal of Environmental Research and Public Health, 18(8), 4057.
9. Arutyunov, N. A., Kurgansky, A. V., Arutyunov, A. N., & Valenca, A. M. G. (2021). Augmented Reality and Virtual Reality in Dentistry: A Review. Healthcare, 9(7), 836.
10. Gupta, A., Chugh, A., & Pandey, R. K. (2021). Biomechanical Aspects of Dental Implants: A Review. Journal of Indian Prosthodontic Society, 21(4), 305-312.

# Pink esthetics: a milestone in enhancing smile: a review

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Abstract:- A successful prosthetic rehabilitation just not means replacement of the missing teeth but also creation of proper soft tissue contour along with the replacement. Maintaining proper shape and contour of associated soft tissues is essential for gingival and periodontal health and also for function and esthetics which ultimately leads to the long-term success of the prosthesis1. Failing to maintain it will lead to loss of papilla, open embrasures (black triangle disease), deficient ridges, ridge collapse and esthetic defects around teeth and implants2. Open embrasure also leads to inability of maintaining oral hygiene and food impaction3. Reconstruction of lost soft tissues including interdental papilla pose a challenge to Prosthodontist4. "Pink esthetics" refers to the soft tissue including interdental papilla and gingiva surrounding the teeth, implant and fixed restorations, which have significant esthetic and functional impact6. Creation of proper gingival emergence profile is really very crucial for the natural appearance of the prosthesis

Consideration of various factors is important during reconstruction of gingival emergence profile in prosthetic restorations5. Various different techniques of maintaining the soft tissue contour is discussed in the review.

Keywords:- pink esthetics, soft tissue, black triangle disease, reconstruction.

**Introduction:** In the realm of modern dentistry, achieving optimal esthetics goes beyond the mere restoration of damaged or missing teeth. It extends to the intricate balance between form and function[4], where the soft tissues surrounding dental restorations play a pivotal role. Among these soft tissues, the gingiva and mucosa—colloquially referred to as "pink esthetics"—hold particular significance in both fixed prosthodontics and implant dentistry.[6]

The term "pink esthetics" encapsulates the aesthetic considerations pertaining to the gums and mucosal tissues, alongside the teeth, in dental rehabilitation.[6] While traditional emphasis has often been placed on the appearance of the teeth themselves, the importance of harmonizing the surrounding soft tissues cannot be overstated.[5] Whether in the context of fixed prostheses or dental implants, achieving natural-looking pink esthetics is paramount for the overall success and patient satisfaction of these treatments.

The significance of pink esthetics in fixed prosthodontics and implant dentistry is multifaceted and profound as it very important for Aesthetic Integration, Enhanced Smile Design, Psychological Well-being, Functional Stability and Natural-Looking Results.[11]

Pink esthetics represent a crucial dimension of modern restorative dentistry, where the delicate balance between form, function, and aesthetics is meticulously crafted.[12,19] By recognizing the importance of soft tissue management and aesthetic integration, dental professionals can achieve outcomes that not only restore oral function but also enhance the beauty and confidence of their patients' smiles.[13]

**Concepts of crown contour:** The term "emergence profile" was first used in 1977 by Stein and Kuwata to describe tooth and crown contours as they traversed soft tissue and rose toward the contact area inter proximally and height of contour facially and lingually.

In 1989, Croll B M it was explained as the portion of axial tooth contour extending from the base of the gingival sulcus past the free gingival margin into the oral environment.

According to GPT10, emergence profile defined as, the contour of a tooth or restoration, such as the crown on a natural tooth, dental implant, or dental implant abutment, as it relates to the emergence from circumscribed soft tissues.

**Creation of emergence profile in FPDs:** Creating an emergence profile in a fixed partial denture (FPD) involves shaping the abutment teeth and the prosthetic components to mimic the natural emergence of teeth from the gingiva.[14,15] This ensures that the restoration blends seamlessly with the surrounding soft tissues, contributing to both aesthetics and function. Here are some methods commonly employed to achieve an optimal emergence profile:

1 **Preparation Design:** The preparation of abutment teeth plays a critical role in establishing the emergence profile. The margins of the preparations should be placed subgingivally to allow for proper contouring of the crown and emergence of the restoration from the gingiva.[7] Feather-edge or deep chamfer margins are often utilized to achieve this goal.

2 **Soft Tissue Management:** Prior to impression making, the soft tissues around the prepared teeth may require management to achieve the desired emergence profile. This can involve techniques such as gingival recontouring, crown lengthening[8], or minor gingival surgery[17] to ensure that the margins of the restoration are adequately supported by healthy gingiva.

3 **Customized Abutment Preparation:** In cases where natural teeth serve as abutments for the FPD, the abutment teeth can be prepared to facilitate the emergence profile. This may involve modifying the axial inclination of the preparations or creating a subgingival finish line that allows for the proper contouring of the final restoration.

4 **Provisionalization:** Fabricating and placing provisional restorations can aid in shaping the emergence profile during the interim period between tooth preparation and final restoration delivery.[1] Provisional restorations can be adjusted chairside to optimize the contour and emergence of the definitive restoration.(Fig. 1)


Fig 1. Creation of the emergence profile in FDP using modification in pontic design of temporary bridge1

5 **Customized Abutment Selection:** In implant-supported FPDs, selecting customized abutments with appropriate emergence profiles is crucial for achieving optimal aesthetics and function. These abutments can be designed to replicate the natural emergence of teeth, thereby facilitating the fabrication of a lifelike restoration.

6 **Layered Crown Build-Up:** During the fabrication of the final restoration, layering techniques can be employed to build up the emergence profile in the cervical region of the crown. By carefully layering porcelain or composite materials, dental technicians can create lifelike contours that blend seamlessly with the surrounding soft tissues.

7 **Gingival Shaping:** In some cases, gingival

shaping materials or techniques may be utilized to modify the contours of the gingiva around the restoration. This can help to further refine the emergence profile and ensure a harmonious transition between the restoration and the soft tissues.

By employing these methods in combination, dental professionals can effectively create an emergence profile in fixed partial dentures that enhances both the aesthetic and functional outcomes of the restoration. Close collaboration between the dentist and dental laboratory technician is often necessary to achieve optimal results.

Creating an emergence profile in implant dentistry is crucial for achieving natural-looking aesthetics and functional stability.[16] The emergence profile refers to the contour and positioning of the restoration as it emerges from the soft tissue surrounding the dental implant. Here are several methods used to create an optimal emergence profile:-

1 **Implant Placement:** Proper implant placement is fundamental to establishing an ideal emergence profile. The implant should be positioned within the alveolar ridge to ensure adequate bone support and soft tissue contours. Additionally, angulation and depth of implant placement should be carefully considered to facilitate the emergence of the restoration.[13]

2 **Custom Abutment Design:** Custom abutments are often fabricated to match the desired emergence profile. These abutments can be designed with specific contours to mimic the natural emergence of teeth from the gingiva. Digital or conventional impressions of the implant site are used to create precise custom abutments tailored to the patient's anatomy.

3 **Subgingival Margin Placement:** Placing the margin of the restoration subgingivally helps to conceal the transition between the restoration and the soft tissue, creating a more natural appearance. Subgingival margins also promote better soft tissue health and stability around the implant restoration.[7,13]

4 **Provisionalization:** Provisional restorations can be used to shape the emergence profile during the healing phase after implant placement. These temporary restorations allow for adjustments to be made to the contour and position of the emerging restoration, optimizing the final aesthetic outcome1.

Various methods of provisionalization are as follow(Fig. 2):

**Various techniques of Provisionalization:**

4.1 Provisionalization by modification of the impression post by adding composite resin intaorally[1]:-

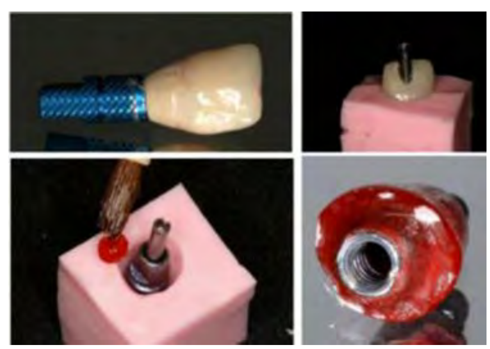

Fig 4.2 Provisionalization by modification of the impression post by adding resin extraorally[1]:-

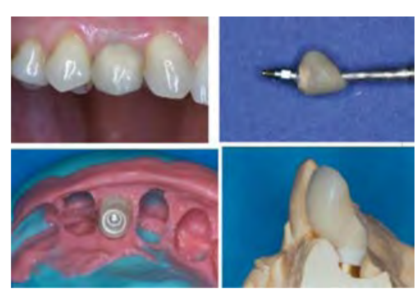

Fig 4.3 Fabrication of a Working Cast Mimicking the Soft Tissue Contour[1]:-

5 **Soft Tissue Management:** Proper soft tissue management is essential for creating an optimal emergence profile18, 20, 21. Techniques such as soft tissue grafting or gingival sculpting may be employed to enhance the contours of the soft tissue around the implant, ensuring a seamless transition between the restoration and the gingiva(Fig. 3).

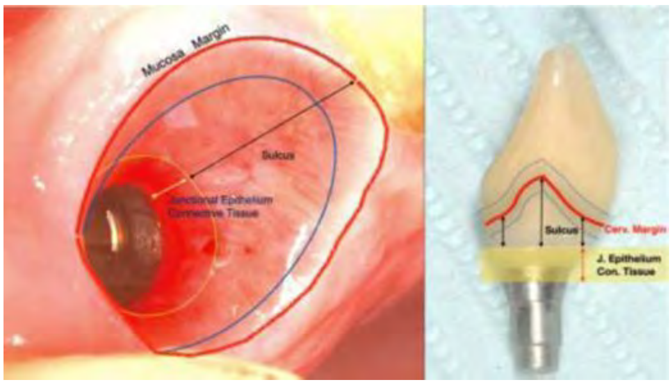


Fig. 3- Tissues of the Emergence Profile in a typical Implant:

**Fig. 3- Tissues of the Emergence Profile in a typical Implant:** Abutment-Prosthesis complex in the aesthetic zone. Subcrestal placement of this bone level implant has allowed for maintaining the desired scalloping of the soft tissues. The implant position and the design of the Emergence Profile allows for the Cervical Margin to coincide with the most coronal part of the sulcus, as in natural teeth.[21]

6 **Layered Crown Build-Up:** In cases where a cement-retained crown is used, layered crown build-up techniques can be employed to create lifelike contours that blend seamlessly with the surrounding soft tissues.[19] Layering porcelain or composite materials allows for customization of the restoration to match the natural dentition.

7 **The injectable gingival mask material:** This can transfer the emergence profile of implant abutments and the pontic site to the definitive cast both accurately and precisely. It is a straightforward technique that saves chairside time and does not require an additional impression. This technique can be used in different clinical situations, including different implant angulations.[22]

8 **Digital Design and CAD/CAM Technology:** Advanced digital design software and computer-aided manufacturing (CAD/CAM) technology enable precise fabrication of implant restorations with customized emergence profiles. Digital workflows allow for virtual planning of the restoration's emergence profile, ensuring optimal aesthetics and functional outcomes.

By employing these methods in combination, dental professionals can achieve excellent emergence profiles in implant dentistry, resulting in aesthetically pleasing and functionally stable implant restorations. Close collaboration between the dentist, dental technician, and other members of the treatment team is often necessary to achieve optimal results.

**Recent advances in creation of emergence profile:** The copy–paste full digital workflow in FDP and Implant- With the help of CAD software, we can align the different files and proper design of definitive prosthesis is generated and exact emergence profile is transferred(Fig. 4).

Fig. 4- Copy–paste full digital workflow in FDP and Implant

**Registration of intraoral and extra oral scans:**

1. Scan of the arch with the temporary prosthesis in place.
2. Scan of the arch without the temporary prosthesis.
3. Scan of the opposing arch
4. Bite scan in maximum intercuspation .
5. Scan of the temporary restoration connected to an analogue chair-side.
6. Scan of the scan body in high definition

Aligning the different scanned files will recreate the restoration in virtual environment (the CAD software) that includes the soft tissue profile, the shape of the temporary restoration and the morphology of the abutments.

The definitive restoration is designed as an exact copy of the temporary prosthesis and it will contain all the information that have been tested clinically in terms of tissue support, esthetics, phonetics, and function.

**Conclusion:** In conclusion, achieving an optimal emergence profile is a critical aspect of both implant dentistry and fixed dental prosthodontics, contributing significantly to the aesthetics, function, and long-term success of restorative treatments. Throughout this discussion, we have explored various methods employed to create this essential contouring of the restoration as it emerges from the surrounding soft tissues.

**References:**


1 Papadopoulos I, Pozidi G, Goussias H, Kourtis S. Transferring the emergence profile from the provisional to the final restoration. Journal of esthetic and restorative dentistry. 2014 May;26(3):154-61.

2 Bereznicki T, Dawood A. The creation of an emergence profile, Part I. Using an interim restoration as an aid to implant positioning. Dentistry Today. 2012 Apr 1;31(4):126-8.

3 Gingival Esthetics: JPD 1990, 64, 1-12

4 Rubinstein S. Parameters for Integrating Esthetics with Function.

5 Guttenberg SA, editor. Cosmesis of the mouth, face and jaws. John Wiley & Sons; 2012 Feb 17.

6 Belser UC. grütter L, Vailati F, Bornstein MM, Weber hP, Buser D. Outcome evaluation of early placed maxillary anterior single-tooth implants using objective esthetic criteria: a cross-sectional, retrospective study in 45 patients with a 2-to 4-year follow-up using pink and white esthetic scores. J Periodontol. 2009;80(1):140-51.

7 Subgingival preparation limit – Step by step, Dan Lazar, Dec 2017

8 Hadyaoui D, Daouahi N, Nouira Z, Cherif M. Gingival harmony in anterior aesthetic restorations. Dentistry Journal. 2014 Dec 5;2(4):155-62.

9 Goldstein RE, Chu SJ, Lee EA, Stappert CF, editors. Ronald E. Goldstein's Esthetics in Dentistry. John Wiley & Sons; 2018 Aug 7.

10 Forna N, Agop-Forna D. Esthetic aspects in implant-prosthetic rehabilitation. Medicine and Pharmacy reports. 2019 Dec;92(Suppl No 3):S6.

11 Agnini A, Romeo D, Giulia B, Tommaso W, Christian C, Agnini A. Copy–paste concept: Full digital approach in the management of gingival emergence profiles. Journal of Esthetic and Restorative Dentistry. 2023 Jan;35(1):222-9.

12 Sonick M, Hwang D. Periodontal plastic surgery II: Esthetic crown lengthening. Microsurgery. 2008 Nov;2(5).

13 Gomez-Meda R, Esquivel J, Blatz MB. The esthetic biological contour concept for implant restoration emergence profile design. Journal of Esthetic and Restorative Dentistry. 2021 Jan;33(1):173-84.

14 Le B, Schoenbaum TR, Hayashi N. PERI-IMPLANT SOFT TISSUE IN THE ESTHETIC ZONE: Tips, Techniques, and Strategies for Success. Journal of Cosmetic Dentistry. 2022 Sep 1;38(3).

15 Leopardi A, Cullum DR. The Provisional Restoration: A Diagnostic, Functional, and Esthetic Template. Minimally Invasive Dental Implant Surgery. 2015 Dec 4:66.

16 Tsai BY. A method for obtaining peri-implant soft-tissue contours by using screw-retained provisional restorations as impression copings: a clinical report. Journal of Oral Implantology. 2011 Oct 1;37(5):605-9.

17 Zucchelli GD, De Sanctis M. Treatment of multiple recession-type defects in patients with esthetic demands. Journal of periodontology. 2000 Sep;71(9):1506-14.

18 da Gama Ramos G, Ciotti DL, Ferreira SR, Margarido MR, Dantas RA, Guerreiro MN. The Use of a Hybrid Pillar and Its Importance for Aesthetic Rehabilitation and Tissue Stability: A Clinical Report. Case Reports in Dentistry. 2018;2018.

19 Fürhauser R, Florescu D, Benesch T, Haas R, Mailath G, Watzek G. Evaluation of soft tissue around single-tooth implant crowns: the pink esthetic score. Clinical oral implants research. 2005 Dec;16(6):639-44.

20 Tarnow D, Cho SC, Wallace SS. The effect of inter-implant distance on the height of inter-implant bone crest. Journal of periodontology. 2000 Apr;71(4):546-9.

21 Mattheos N, Vergoullis I, Janda M, Miseli A. The implant supracrestal complex and its significance for long-term successful clinical outcomes. The International journal of prosthodontics. 2021 Jan 1;34(1):88-100.

22 Tse RT, Marchack BW. Injectable silicone-based gingival mask technique: Transferring the emergence profile of multiple implant restorations. Journal of Prosthetic Dentistry. 2019 Jul 1;122(1):88-91.

# Nanotechnology Applications in Prosthodontics: A Comprehensive Review

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**Abstract:** Prosthodontics, a specialized branch of dentistry, has seen remarkable advancements in recent years with the integration of nanotechnology. Nanotechnology offers precise control over materials and structures at the nanoscale, enabling the development of innovative dental prosthetic materials and treatment modalities. This comprehensive review explores the various applications of nanotechnology in prosthodontics, including nanomaterials for restorative and prosthetic components, nanoscale surface modifications, and nanosensors for diagnostics and monitoring. We also discuss the potential benefits, challenges, and future prospects of nanotechnology in enhancing the quality of dental prosthetic care.

**Key words:** Prosthodontics, Nano sensors, Nano composites, Nano ceramics, Nano metals

**Introduction:** A dentistry specialty known as prosthodontics is focused on improving oral function and appearance by repairing and replacing teeth and other oral tissues that are missing or damaged. Metals, ceramics, and polymers are common materials used in traditional prosthodontics. However, the introduction of materials and methods that offer improved mechanical qualities, biocompatibility, and accuracy as a result of the integration of nanotechnology has completely changed the area.[1-3]

**Nanomaterials in Prosthodontics:** It can be divided into various categories like Nano powder, Nano fibre, Nano membrane, Nano blocks etc.[4-5] Out of which development of nano powder is longest and its technology is most mature. Nano materials have small size, large surface area, high surface energy and a large proportion of atoms.[5]

It has four unique effects:

1 Quantum size effect
2 Quantum tunnelling effect
3 Surface effect
4 Small size effect

Research in nano technology of dental materials is mainly focused on two ways :

- Preparation of new inorganic nano particles
- Modifying the surface with inorganic nano fillers.

These materials are widely used in ceramics, metals, resins and composites providing huge space for the improvement and innovation of dental material. Studies of nano metal shows that it has better antibacterial property.[11-14]

**Nanocomposites (Fig.1):** Nanocomposites combine nanoparticles with traditional dental materials to create novel prosthetic materials.[9]

Nanoparticles such as nano-sized fillers and reinforcements improve the mechanical properties of dental composites, making them more durable and resistant to wear. Additionally, nanocomposites can closely mimic the optical properties of natural teeth, providing aesthetically pleasing results.[9,15]

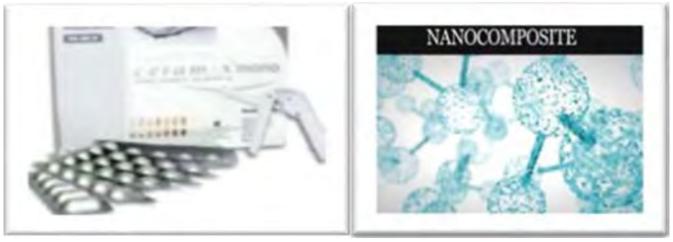


Fig 1

**Nanoceramics (fig. 2):** Nanoceramics, with their high strength and excellent esthetics, have gained popularity in prosthodontics. Nano-sized ceramic particles can be incorporated into crowns, bridges, and denture bases, resulting in restorations that closely resemble natural teeth in terms of appearance and function.[11-12]

Fig 2

Nanometals (fig.3): Nanotechnology has allowed for the development of stronger and more biocompatible metal alloys for dental prosthetics.8 Nanostructured metals exhibit improved mechanical properties and reduced corrosion rates, making them ideal for use in partial denture frameworks and implant-supported restorations.[17]


Fig3

**Nano technology in implants:** The application of nano technology in dental implants can be made by coating of nano particles over the dental implants. It has been demonstrated that different cell types respond positively to nano topography.[11-12] The surface of the implant plays a critical role in determining biocompatibility and bio integration because it is in the direct contact with the tissues. Implant surface composition, surface energy, surface roughness and surface topography are the four material factors which can influence events at bone implant interfaces.[3] Various surface textures have been created and used to successfully influence cell and tissue responses. The surface textures are of three types macro, micro and nano. The nano structured materials can exhibit enhanced mechanical, electrical, magnetic and optical properties compared with their conventional micro scale or macro scale counterparts. Nano structured materials contain a large volume fraction of defects such as grain boundaries, inter phase boundaries and dislocations and this strongly influences their chemical and physical properties.[15-19]

***Biomimetic implant*** may be the next development in the field. Coating implants with nano textured titanium, hydroxyl apatite and pharmacological agents such as bisphosphonates may induce cell differentiation and proliferation, and promote greater vascularity in cortical bone thereby improving conditions for early and long-term bone remodelling.[18,19]

**Nanoscale Surface Modifications:** Surface properties play a crucial role in the success of dental prosthetics. Nanotechnology enables precise surface modifications at the nanoscale to enhance biocompatibility and osseointegration of dental implants. Techniques such as nano structuring, surface coatings, and functionalization improve the interaction between the implant and surrounding tissues, leading to better clinical outcomes.[18]

It is a powerful way of altering protein interactions with the surface. There is an increase vitronectin adsorption on nano structured surfaces when compared to conventional surfaces. This led to increased osteoblast adhesion when compared to other cell types such as fibroblast on the nano surfaces. Variety of techniques are used to create nano features on dental implant surfaces. These can be divided into physical and chemical process.[16-19]

| Methods | Characteristics |
|---|---|
| Self-assembly of mono layers | Exposed functional end group could be a molecule with different functions such as osteoinductive or cell adhesion molecule |
| **Physical approaches:** | |
| 1. Compaction of nano particles<br><br>2.Ion beam composition | Conserves the chemistry of the surface among different topographies<br>Impact nano features to the surface<br>based on the material used |
| **Chemical methods:** | |
| 1.Acid etching<br>2.Peroxidation<br>3.Anodization<br>4.Alkali treatment | Imparts nano surface and remove contaminants<br>Produces titanium gel layer<br>Create new oxide layer<br>Produces a sodium titanite gel layer allowing hydroxyapatite deposition |
| **Nano particle deposition:** | |
| 1.Discrete crystalline deposition<br>2. Sol-gel (colloidal particle adsorption)<br>3. Lithography | Superimposes a nano scale surface topographical complexity on the surface<br>Creates a thin film of controlled chemical characteristics<br>Many different shapes and materials can be applied over the surface. |

Nano particle coated implant surface

**Nanosensors for Diagnostics and Monitoring:** Nanotechnology-based sensors have the potential to revolutionize the field of prosthodontics by enabling real-time monitoring of oral health and prosthetic performance.[14] Nanosensors can detect pH changes, bacterial infections, and mechanical stresses, providing valuable data for early intervention and personalized treatment planning.[9]

**Advantages of nano particles:**

1 Surface area to volume ratio
2 All properties can be controlled
3 Try to virtually imitate nature by constructing objects from basic components
4 High degree of precision & control over final product.
5 Better penetration to cells.

**Challenges and Future Prospects:** Despite the encouraging advancements, there are still a number of obstacles that need to be overcome in order to fully integrate nanotechnology into prosthodontics. Long-term clinical research, financial concerns, and regulatory permissions are a few of them. Further investigation is being done on the possibilities of 3D printing using nanomaterials to provide specialized prosthodontic solutions.[12,15,20]

**Conclusion:** A new age in prosthodontics has begun with the introduction of superior materials and methods that increase the caliber and durability of dental prosthesis restorations. For improving patient care in the field of prosthodontics, the combination of nanomaterials, nanoscale surface changes, and nanosensors offers significant potential. In order to fully realize the promise of nanotechnology in prosthodontic practice, more study and clinical trials are required.

This review highlights the significant role of nanotechnology in shaping the future of prosthodontics, providing clinicians and researchers with valuable insights into the current state of the field and its potential for continued growth and innovation.

References:


1. Bhadra, D., & Bhadra, S. (2015). Recent advances in nanodentistry. International Journal of Nanomedicine, 10, 6371-6394.
2. Subramani, K., & Ahmed, W. (2016). Advances in nanotechnology in contemporary dental practice: A review. Journal of Clinical and Diagnostic Research, 10(10), ZE05-ZE08.
3. Bhowmik, S., & Murali, R. V. (2018). Nanotechnology in prosthodontics: A comprehensive review. Journal of Indian Prosthodontic Society, 18(1), 1-9.
4. Naik, A., & Pai, R. C. (2017). Nanodentistry: Exploring the beauty of miniature. Journal of Interdisciplinary Dentistry, 7(3), 137-140.
5. Baniasadi, H., & Arami, S. (2019). Nanotechnology in prosthodontics: A review of the current literature. Journal of Dentistry (Tehran, Iran), 16(4), 249-255.
6. Kumar, P., & Jain, V. (2018). Nanotechnology in prosthodontics: A review. World Journal of Dentistry, 9(1), 69-73.
7. Vashisht, D., & Indira, R. (2016). Nanotechnology in prosthodontics: An overview. Journal of Oral Research and Review, 8(1), 33-36.
8. Prabhu, R., & Prabhu, G. (2016). Nanodentistry: Exploring the benefits of nanotechnology in dentistry. Journal of Clinical and Diagnostic Research, 10(5), ZE05-ZE08.
9. Hegde, C., & Rajesh, S. (2015). Nanotechnology: A revolution in dentistry. Journal of Interdisciplinary Dentistry, 5(1), 39-42.
10. Madhan Kumar, S., & Srinivasan, N. (2014). Nanotechnology in prosthodontics: A review. Journal of Pharmacy and Bioallied Sciences, 6(Suppl 1), S20-S22.
11. Singh, V., & Mehta, D. (2017). Nanotechnology in prosthodontics: A systematic review. Journal of Advanced Medical and Dental Sciences Research, 5(5), 131-134.
12. Gupta, S., & Jain, A. (2015). Nanotechnology in prosthodontics: A comprehensive review. International Journal of Dental Clinics, 7(2), 35-38.
13. Garg, S., & Mital, P. (2019). Nanotechnology in prosthodontics: A promising future. Journal of Contemporary Dentistry, 9(2), 97-100.
14. Chakkarayan, J., & Siddharthan, A. (2018). Nanotechnology in prosthodontics: An overview. Journal of Dental and Orofacial Research, 14(2), 47-50.
15. Kulkarni, R., & Kulkarni, M. (2016). Nanotechnology in prosthodontics: A review. Journal of Dental Sciences & Oral Rehabilitation, 7(1), 27-30.
16. Reddy, V. K., & Satyanarayana, D. (2017). Nanotechnology in prosthodontics: An overview. International Journal of Dentistry and Oral Health, 3(7), 41-46.
17. Kaur, G., & Basavaraj, P. (2018). Nanotechnology in prosthodontics: A paradigm shift. Journal of Indian Prosthodontic Society, 18(1), 10-16.
18. Subramaniam, R. (2015). Nanotechnology in prosthodontics: A comprehensive review. Journal of Indian Prosthodontic Society, 15(3), 204-207.
19. Patel, R., & Pabbati, R. (2019). Nanotechnology in prosthodontics: A systematic review. International Journal of Contemporary Medical Research, 6(7), 36-40.
20. Bhavani, A., & Padmavathi, B. (2017). Nanotechnology in prosthodontics: A critical review. Annals of Dental Specialty, 5(2), 108-111.

# Management and treatment modalities of sleep bruxism: An overview

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**Abstract:** Sleep bruxism is a sleep-related movement disorder characterized by clenching or grinding of the teeth. For approximately 50 years, bruxism has been advanced as a predominant factor in the onset or continuance of myofascial or muscle-pain-predominant temporomandibular disorders (TMDs). The etiology and pathophysiology of sleep Bruxism is uncertain, and the ultimate treatment for sleep bruxism is still a controversial topic, even if oral occlusal appliances, occlusal treatment with occlusal adjustment, emotional stress therapy, physiotherapy, and pharmacologic therapy are used to diminish sleep bruxism and improve sleep. This review article gives an overview of the background, etiology, diagnosis, clinical manifestations, and various treatment modalities of sleep bruxism.

**Keywords:** sleep bruxism (SB), polysomnography, electromyography (EMG), oral appliances, temporomandibular disorder (TMD).

**Introduction:** Bruxism is characterized by the grinding or clenching of the teeth. For approximately 50 years, bruxism has been advanced as a predominant factor in the onset or continuance of myofascial or muscle-pain-predominant temporomandibular disorders (TMDs).[1,2] SB may lead to excessive occlusal forces higher than the maximum clenching force under consciousness. Excessive mechanical stress is a critical risk factor for tooth fracture, periodontal disease, and masticatory muscle/temporomandibular joint disorders (TMD).[3] Therefore, it is important to relieve this excessive mechanical stress to maintain the morphological and physiological functions of the teeth, periodontal tissue, and masticatory muscle/temporomandibular joint (TMJ).

In a population, most people have a habit of grinding or clenching teeth either during the day or night, which may be due to lifestyle and high-stress activities.[4] It becomes a pathological state when the patient complains of severe tooth damage or sleep disturbances.[5] The pathophysiology of sleep bruxism is dubious. Sleep bruxism has a close association with tooth wear and orofacial pain. It leads to abstraction, attrition, and gingival recession, which can cause temporal headaches and temporomandibular disorders.

SB is difficult to diagnose in nonlaboratory settings. As detailed in a comprehensive critical review of research studies published from 1998 through 2008, SB can be detected unequivocally only by means of polysomnographic (PSG) recordings.[6] Sleep quality can be evaluated with objective assessment tests like the Pittsburgh Sleep Quality Index (PSQI), multiple sleep latency test (MSTL)and Maintenance of wakefulness test (MWT).[7]

The ultimate treatment of sleep bruxism is controversial. Thus, the review was conducted to evaluate and compare the management and treatment modalities of sleep bruxism.

**The etiology of sleep bruxism:** Sleep bruxism is a disease of sleep that has multiple facets. It has to do with tiny awakenings that interfere with sleep and cause bruxism during the night.[8] Obstructive sleep apnoea is a common complaint marked by repeated partial or total termination of air flow coupled with oxyhaemoglobin desaturation and a heightened attempt to breathe, which results in awakening from sleep. Mostly, obstructive sleep apnoea or hypopnea is found in patients with a restricted airway and facial deformities anomalies.

Pathophysiology of Sleep Bruxism (Kato et al., 2001b; Lavigne and Manzini, 2000).[8]

- Exogenous/Peripheral Factors
- Endogenous

| Sr. no. | Exogenous Factors |
|---|---|
| 1. | Stress-anxiety |
| 2. | Environmental influences (e.g., Familial jaw-clenching reactions, Tongue habits) |
| 3. | Occlusal interferences (Controversy) |
| 4. | Medication (e.g., L-dopa, Neuroleptics, Amphetamine, SSRI*) |
| 5. | Substance abuse (e.g., Cocaine, Alcohol) |

| Sr. no. | Endogenous Factors |
|---|---|
| 1. | Personality (e.g. Anxious) |
| 2. | Genetic (No proven transmission) |
| 3. | Neurochemicals (E.g., Dopamine, Noradrenaline, Serotonin). |
| 4. | Neurological disorders (e.g., Parkinson's, Meige syndrome/oral tardive dyskinesia, olivopontocerebellar atrophy, cerebellar haemorrhage) |
| 5. | Psychiatric-related disorders (e.g., Dementia, Mental retardation, Tics/ToureĨe's syndrome) |

Mental illnesses including stress, worry, and other strong emotions may also be linked to bruxism. People who are aggressive, competitive, or energetic have a higher risk of developing bruxism. Sometimes it has a connection to stress or worry that starts with biting behaviour's like lip, cheek, tooth tapping, and object biting/chewing.

**Clinical assessment of sleep bruxism:** Bruxism can cause dental problems, such as tooth wear which leads to frequent fractures of teeth, restorations, and pain in the Oro-facial region. Sleep bruxism is one of the main causes in the myofascial pain of the masticatory muscles, but the occurrence and features of pain in patients with sleep bruxism have not been evaluated. There are some methods to assess bruxism clinically by questionnaires, clinical examination, and sleep studies with polysomnography, split night studies, limited channel testing, and electromyography. The Questionnaire method is useful for the assessment of bruxism by both clinicians and investigators.

**Clinical indicators of bruxism:**

1. Report of tooth grinding or tapping sounds (usually reported by bed partner)
2. Presence of tooth wear seen within the normal range of jaw movements or at an eccentric position
3. Presence of masseter muscle hypertrophy on voluntary contraction
4. Complaint of masticatory muscle discomfort, fatigue, or stiffness in the morning (Occasionally, headache in temporal muscle region)
5. Tooth or teeth hypersensitive to cold air or liquid
6. Clicking or locking of temporomandibular joint
7. Tongue or cheek indentation

**Diagnosis of sleep bruxism:** Sleep studies include polysomnography, split night studies, limited channel testing, and electromyography for analysing sleep apnoea and bruxism. Electromyography is the soundtrack of the electrical activity of muscle tissue, or its illustration is a visual demonstration or audible signal, with electrodes attached to the skin or inserted into the muscle which helps to analyse the condition of the masticatory muscles in bruxers.

**Indices for classification of tooth wear:** A number of indices for the classification and measurement of incisal and occlusal dental wear will help to compare the relationship between sleep bruxism and occlusal wear. Individual (personal)Tooth-Wear Index ranks persons with reference to incisal and occlusal wear and also examines the prevalence and severity of tooth wear. First, the extent of incisal or occlusal wear for a single tooth is evaluated by the following four-point scale:

0: No wear or negligible wear of enamel;

1: Obvious wear of enamel or wear through the enamel to the dentine in single spots;

2: Wear of the dentine up to one-third of the crown height;

3: Wear of the dentine up to more than one-third of the crown height; excessive wear of tooth restorative material or dental material in the crown and bridgework, more than one-third of the crown height.

Smith and Knight Tooth wear index - produces the tooth wear index (TWI), a comprehensive system whereby all four visible surfaces (buccal, cervical, lingual and occlusal/incisal) of all teeth present are scored for wear, irrespective of its occurrence.

| Score | Surface | Criteria |
|---|---|---|
| 0 | B/L/O/I | No loss of enamel surface characteristics. |
| | C | No loss of contour. |
| 1 | B/L/O/I | Loss of enamel surface characteristics. |
| | C | Minimal loss of contour |
| 2 | B/L/O | Loss of enamel exposing dentine for less than one third of surface |
| | I | Loss of enamel just exposing dentine |
| | C | Defect less than 1mm deep. |
| 3 | B/L/O | Loss of enamel exposing dentine for more than one third of surface. |
| | I | Loss of enamel and substantial loss of dentine. |
| | C | Defect less than 1-2mm deep. |
| 4 | B/L/O | Complete enamel loss-Pulp exposure-Secondary dentine exposure. |
| | I | Pulp exposure or exposure of secondary dentine. |
| | C | Defect more than 2mm deep-Pulp exposure-Secondary dentine exposure. |

**Treatment modalities for sleep bruxism:**

1 **Muscle deprograming and occlusal appliances:-** It is the most common treatment of bruxism. It reduces the patient's tendency to clench and grind their teeth for the construction of a hard acrylic bruxing guard / interocclusal splint. They are horseshoe-shaped plastic devices that cover the teeth and have smooth surfaces so the lower teeth can slide over the plastic without resistance. It prevents teeth from biting together and relieves the forces. Even though the patients are using splints some of them clench against the guard and lead to tensional headache due to heavy stress on the temporalis muscle.

There are different types of splints - Stabilization splints, Repositioning splints, Pivot splints, soft splints, bite plate splints, mandibular orthopedic repositioning appliances.

2 **Stabilization splints:** Stabilization splints are commonly used for treating masticatory dysfunctional symptoms and signs such as muscular pain, temporomandibular joint pain, clicking, crepitus, limitation of motion, and incoordination of movement. This splint is formed with posterior occlusal contact in centric relation and posterior disocclusion on protrusive movement. It can cover maxillary or mandibular dentition.

3 **Maxillary occlusal splints:** It is the most popular form of treatment for bruxism. It is a detachable artificial occlusal surface called a maxillary occlusal splint (MOS). Occlusal splints keep the teeth apart at night to prevent

damage. By restoring the muscular equilibrium, it also reduces the activity of the masseteric and temporalis muscles at night.[9] [Figure-1]

Figure 1:- Maxillary Occlusal Splint (MOS)

4 **Repositioning splints:** The joint position and tooth contact are both impacted by the repositioning splint. They position the condyle appropriately By changing the joint's stress or loading and the location of the condyle disc. The majority of TMJ clicking is brought on by a sudden change in the location of the disc or condyle during condylar translation. Splint repositioning will stop the clicking and restore the proper disc condyle orientation.

5 **Pivot splints:** A rigid splint with just one posterior contact on each side is called a pivot splint. The most posterior tooth normally receives the touch. The condyle is diverted from the fossa and the joint is unloaded if the mandible rotates forward around the fulcrum of the pivot.[10]

6 **Soft splints:** Soft splints that are prefabricated are available to treat bruxism. Due to durability of the material, they can be utilized to temporarily relieve discomfort. Permanent usage of this appliance can make it difficult to adjust the occlusal contact and may cause tooth movement that is not under control.[11]

7 **Bite plate splints:** Bite plate splints are rigid, maxillary, or mandibular splints that permit contact between one or more anterior teeth while excluding the posterior teeth. They are also known as the anterior deprogrammer, Hawley with bite plate, the Luca jig, and the anterior jig. It interferes with the feeling of the mandible's location, eliminates proprioceptive feedback from the back teeth, and decreases muscular activity.[12][Fig-2]

Figure 2:- Bite plane splint

8 **Mandibular orthopaedic repositioning appliances:** In order to relieve airway obstruction in newborns with micrognathia, Pierre Robin first proposed the idea of moving the mandible forward with a functional appliance called a Monoblock in 1934. It has trays that fit snugly over the mandibular and maxillary teeth. There are both adjustable and fixed mandibular advancement appliances. Because they can be adjusted in an anterior-posterior direction until an appropriate amount of symptom depreciation has occurred, adjustable oral appliances are preferred for controlling temporomandibular joint or tooth sensitivity. The early position of the mandible with either a fixed or an adjustable device is often between 70 and 75 percent of its maximum protrusion in comparison to its maximum 20 retrusion.

Figure 3:- Mandibular Advancement Device

In order to prevent the tongue from slipping back into the pharynx, mandibular advancement devices (MAD) pull the tongue forward and slightly depress the lower jaw. In order to prevent the tongue from folding back into the airways, MADs are a typical dental appliance for obstructive sleep apnoea. One of the most successful therapy options for bruxism patients, who have obstructive sleep apnea, is MADs. [Figure 3]

9. **Clasp Retained Mandibular Positioner:** The mandible is securely fastened into the appliance by a number of clasps, preventing it from retruding. Since it is a single-piece appliance, the vertical dimension can be changed by adjusting the appliance's height. In cases of insufficient teeth to support the device, periodontal issues causing tooth movement, active temporomandibular joint (TMJ) condition, and restricted maximum protrusive distance (6mm), mandibular advancement devices (MAD) should be prohibited.[13][Figure 4]

Figure 4:- Clasp Retained Mandibular positioner

10. **Occlusal treatment with occlusal adjustment:** For occlusal treatment using occlusal adjustment, the dentist needs to have an excellent theoretical grasp of occlusion.[14] 'True' occlusal therapies such occlusal adjustment, rehabilitation, and orthodontic alignment are not supported in the literature for the treatment of bruxism, according to Frumker, who claimed that appropriate occlusion reduces stress and tension in the masticatory system. According to a study of recent publications, the etiology of bruxism is primarily controlled centrally rather than peripherally, hence treating emotional stress psychologically will stop bruxism episodes.[15]

11. **Pharmacological management:** Pharmaceutical treatment for bruxism is still being developed. Drugs that relax the muscles are used to lessen bruxism episodes. Certain medications, such as botulinum, prevent the release of acetylcholine at the neuromuscular junction, which has paralyzing effects such as coma, brain damage, amphetamine abuse, Huntington's disease, and autism.[16] The effects of serotonergic and dopaminergic medications in the management of sleep bruxism have been the subject of numerous investigations. Despite two cases of antipsychotic-induced bruxism responding well to the non-selective adrenergic beta-blocker propranolol, Huynh found no effects of this medication on sleep bruxism.[17] Different antidepressant side effects on bruxism include: Selective serotonin reuptake inhibitors (SSRI) can worsen the disease or do nothing.[18] From the above literatures some pharmacological approach improve bruxism but further studies are required for safety assessments of different drugs.

12. **Stress management:** Because the majority of nocturnal bruxers come from diverse emotional backgrounds, a professional dentist should be pleasant with their patients and strive to teach them relaxation and stress-reduction techniques to help them experience fewer bruxism episodes. Sleep bruxism can be lessened with behavioural therapy including practicing appropriate jaw and mouth positions. Continual stress from work, family, and finances can be a major bruxism trigger. Occlusal splints and stress reduction are thus the two main therapeutic options for sleep bruxism.[19]

According to the systematic review conducted by Minakucchi et al on 'Management of sleep bruxism in adults: A Systematic Review.' He categorised treatment modalities into: Oral Appliance therapy, Cognitive Behavioural Therapy, Biofeedback therapy and Pharmacological therapy.

According to Minakucchi et al, the stabilizing splints are a generally safe and effective therapeutic strategy for lowering the frequency and intensity of EMG-based SB. It was determined with a considerable degree of certainty that after a brief period, the biofeedback modalities- especially (contingent electrical stimulation) CES- significantly decreased the SB-related EMG occurrences. As a result, Biofeedback therapy can also be regarded as an efficient management technique with additional studies proving its efficacy. The positive and negative effects as well as the features of pharmacological therapy need to be evaluated further for its practical application.[20]

**Conclusion:** The movement syndrome known as sleep bruxism (SB) is characterized by teeth grinding or clenching while a person is asleep. To diagnose nocturnal bruxism, a comprehensive clinical evaluation and accurate history-taking are required. There is no perfect cure for stopping sleep bruxism. With occlusal appliances, occlusal treatment with occlusal adjustment, mental stress therapy, physical therapy, and pharmaceutical therapy, the frequency and duration of the bruxism can be changed. Mandibular advancement devices and maxillary occlusal splints are the two primary sleep bruxism prevention techniques. The cornerstone of treatment is still maxillary occlusal splints despite the fact that mandibular advancement devices offer a greater degree of improvement in the bruxism indices. This is because patients tolerate them better.

**References:**


1. Laskin DM. Etiology of the pain-dysfunction syndrome. JADA. 1969;79(1):147–153. [PubMed] [Google Scholar]
2. Schwartz LL. A temporomandibular joint pain-dysfunction syndrome. J Chronic Dis. 1956;3(3):284–293. [PubMed] [Google Scholar]
3. van de Sande FH, Collares K, Correa MB, Cenci MS, Demarco FF, Opdam N. Restoration survival: revisiting patients' risk factors through a systematic literature review. Oper Dent 2016;41(S7):S7–26.
4. Lobbezoo F, Ahlberg J, Glaros AG, Kato T, Koyano K , Lavigne GJ, Leeuw RD, Manfredini D, Svensson P, Winocur E. B r u x i s m d e ė n e d a n d g r a d e d : an international consensus. Journal of oral rehabilitation. 2013 Jan 1;40(1):2-4.
5. Bader G, Lavigne G. Sleep bruxism; an overview of an oromandibular sleep movement disorder. Sleep medicine reviews. 2000;4(1):27-43.
6. Manfredini D, Lobbezoo F. Relationship between bruxism and temporomandibular disorders: a systematic review of literature from 1998 to 2008. Oral Surg Oral Med Oral Pathol Oral Radiol Endod. 2010;109(6):e26–e50. [PubMed] [Google Scholar]
7. LiĬner MR, Kushida C, Wise M, G. Davila D, Morgenthaler T, Lee-Chiong T, Hirshkowitz M, Loube DL, Bailey D, Berry RB, Kapen S. Practice parameters for clinical use of the multiple sleep latency test and the maintenance of wakefulness test. Sleep. 2005 ;28(1):113-21.
8. Kato T, Rompre P, Montplaisir JY, Sessle BJ, Lav igne G J. Sleep br u x ism: an oromotor activity secondary to microarousal. Journal of dental research. 2001 Oct;80(10):1940-4.
9. Clark GT, Adler RC. A critical evaluation of occlusal therapy: occlusal adjustment procedures.
10. Muhtarogullari M, Avci M, Yuzugullu B. Efficiency of pivot splints as jaw exercise a p p a r a t u s i n c omb i n a t i o n w it h stabilization splints in anterior disc displacement without reduction: a retrospective study. Head & face medicine. 2014 Dec;10(1):42.

11. Seifeldin SA, Elhayes . So versus hard occlusal splint therapy in the management of temporomandibular disorders (TMDs). e Saudi dental journal. 2015 Oct 1;27(4):208-14.
12. Zwemer T. Bite plates and stabilization splints in mandibular dysfunction A c l i n i c a l a n d e l e c tr omy o g r a p h i c comparison: Lars Dahlström and Torgny Haraldson Acta Odontol. Scand. 1985; 43: 1 0 9 – 1 1 4 . A m e r i c a n J o u r n a l o f O r t h o d o n t i c s a n d D e n t o f a c i a l Orthopedics. 1987 Oct 1;92(4):360.
13. Petit FX, Pépin JL, Beega G, Sadek H, R a p h a ë l B, L é v y P. Ma n d i b u l a r a d v a n c e m e n t d e v i c e s : r a t e o f contraindications in 100 consecutive obstructive sleep apnea patients. American Journal of Respiratory and Critical Care Medicine. 2002 Aug 1;166(3):274-8.
14. Singh A, Tandon R, Singh A, Gupta B. Bruxism: An ignored malady. Orthodontic Journal of Nepal. 2014 Oct 24;4(1):48-51.
15. Frumker SC. Occlusion and muscle tension. Basal facts. 1981;4(3):85-7.
16. Nash MC, Ferrell RB, Lombardo MA, Williams RB. Treatment of bruxism in Huntington's disease with botulinum toxin. e Journal of neuropsychiatry and clinical neurosciences. 2004 Aug;16(3):381-a.
17. Huynh N, Lavigne GJ, Lanfranchi PA, Montplaisir JY, de Champlain J. e effect o f 2 sympatholytic medications-propranolol and clonidine-on sleep bruxism : experimental randomized controlled studies. Sleep. 2006 Mar 1;29(3):307-16.
18. Amir I, Hermesh H, Gavish A. Bruxism secondary to antipsychotic drug exposure: a positive response to propranolol. Clinical neuropharmacology. 1997 Feb;20(1):86- 9
19. Bader G, Lavigne G. Sleep bruxism; an overview of an oromandibular sleep movement disorder. Sleep medicine reviews. 2000;4(1):27-43.
20. Minakuchi H, Fujisawa M, Abe Y, Iida T, Oki K, Okura K, Tanabe N, Nishiyama A. Managements of sleep bruxism in adult: A systematic review. Japanese Dental Science Review. 2022 Nov 1;58:124-36.

# Attachment Systems for Implant Overdenture : A Comprehensive Literature Review

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**Abstract:** This review examines the diverse attachment systems for implant overdentures, emphasizing their design, biomechanical impacts, retention, stability, and associated complications. Implant overdentures represent a significant advancement over conventional complete dentures, providing better stability and patient satisfaction. This article synthesizes findings from recent studies, highlighting the importance of appropriate attachment system selection based on clinical criteria. The review underscores the need for tailored treatment plans to optimize prosthetic outcomes for edentulous patients.

**Keywords:** Implant overdenture, Attachment systems, Retention, Stability, Biomechanics, Prosthetic design.

**Introduction:** Complete edentulism, prevalent among the elderly, significantly impacts quality of life by affecting oral function, aesthetics, and social interactions.[10] Traditionally, complete dentures were the only treatment option, often falling short in stability and functionality.[4] The advent of dental implants introduced fixed and removable prosthetic alternatives, including implant overdentures, which have become a preferred choice due to their enhanced retention and stability.[19]

Implant overdentures are supported by attachment systems that connect the prosthesis to dental implants, thereby improving the balance and functionality of the dentures.[3] This review explores various attachment systems, their biomechanical properties, and the criteria for their selection, aiming to provide a comprehensive understanding for clinical applications.[12]

**Materials and Methods: Search Strategy:** A narrative review was conducted, focusing on studies from the last decade that report on attachment systems for implant overdentures. The search included electronic databases such as PubMed, Google Scholar, and Web of Science, using keywords like "implant overdenture," "attachment systems," "retention," "stability," "biomechanics," and "prosthetic design".

**Study Criteria:** Inclusion criteria were studies that investigated various types of attachment systems for implant overdentures, their biomechanical impacts, and clinical outcomes. Exclusion criteria included studies that did not provide quantitative data or those with a high risk of bias.

**Inclusion and Exclusion Criteria:** Included studies focused on:

- Different attachment system designs (e.g., bar, ball, locator, magnet, telescope).
- Biomechanical consequences such as retention, stability, and the relationship with implants.
- Efficiency and complications of attachment systems.

Excluded studies:

- Lacked comprehensive data on clinical outcomes.
- Were not peer-reviewed.
- Had methodological flaws or high bias risk.

**Discussion:**- Types of Attachment Systems

**Bar Attachments:** Bar attachments provide robust retention and stability by linking multiple implants, creating a rigid support structure. These systems distribute occlusal forces evenly, reducing stress on individual implants. However, they require sufficient vertical restorative space and precise implant placement.[2,8]

**Ball Attachments:** Ball attachments, often considered user-friendly, allow for rotational movement, offering moderate retention. They are suitable for patients with limited dexterity but may exhibit wear over time, necessitating maintenance. [12,18]

**Locator Attachments:** Locator attachments are versatile and provide good retention and stability, accommodating varying implant angulations. Their low profile makes them suitable for cases with limited vertical space, though they can require periodic replacement due to wear.[7,11]

**Magnet Attachments:** Magnet attachments offer ease of use and comfort, exerting gentle forces on the implants. However, their retention strength is generally lower compared to other systems, making them less suitable for patients with high functional demands.[18]

**Biomechanical Impacts:** The biomechanical performance of attachment systems is crucial for the success of implant overdentures. Factors such as implant angulation, attachment system design, and patient-specific anatomical conditions influence the retention and stability of the prosthesis. Studies indicate that optimal retention reduces prosthesis movement, minimizing stress on implants and enhancing patient comfort.[12]

**Complications and Maintenance:** Complications associated with attachment systems include wear of components, loss of retention, and need for frequent adjustments. Bar attachments, while providing excellent support, are prone to technical complications like screw loosening or bar fractures. Ball and locator attachments may require replacement of worn components, while magnet attachments can suffer from corrosion or demagnetization.[18]

**Clinical Guidelines for Selection:** The selection of attachment systems should be based on comprehensive clinical evaluation, considering factors such as available vertical restorative space (AVRS), interforaminal distance (IFD), and patient-specific anatomical conditions. A classification system proposed by Bhargava et al. suggests using AVRS and IFD to guide the selection of implant number and attachment type, ensuring optimal prosthetic outcomes.[5]

**Conclusion:** The choice of attachment systems for implant overdentures significantly influences their clinical success. By understanding the biomechanical properties and potential complications of different attachment systems, clinicians can make informed decisions to optimize patient outcomes. Future research should focus on long-term clinical trials to further refine the guidelines for attachment system selection.

**References:**

1. Bhargava A, Sehgal M, Gupta S, Mehra P. Classification system on the selection of number of implants and superstructure design on the basis of available vertical restorative space and interforaminal distance for implant-supported mandibular overdenture. J Indian Prosthodont Soc 2016; 16:131-5.
2. Meghea DM, Preoteasa CT, Preoteasa E. Attachment systems for implant overdentures: Literature review. Romanian Journal of Oral Rehabilitation 2014;6(4):51-54.
3. Alsabeeha NHM, Payne AGT, De Silva RK, Swain MV. Mandibular single-implant overdentures: Patient satisfaction and prosthodontic outcomes. Int J Prosthodont 2010; 23:229-35.

4. Heckmann SM, Schrott A, Graef F, Wichmann MG, Weber HP. Mandibular two implant telescopic overdentures. Clin Oral Implants Res 2004;15:560 9.

5. Eitner S, SchlegelA, Emeka N, Holst S, Will J, Hamel J. Comparing bar and double crown attachments in implant retained prosthetic reconstruction: A follow up investigation. Clin Oral Implants Res 2008;19:530 7.

6. Mericske Stern RD, Taylor TD, Belser U. Management of the edentulous patient. Clin Oral Implants Res 2000;11 Suppl 1:108 25.

7. Chung KH, Chung CY, Cagna DR, Cronin RJ Jr. Retention characteristics of attachment systems for implant overdentures. J Prosthodont 2004;13:221 6.

8. Sadowsky SJ, CaputoAA. Effect of anchorage systems and extension base contact on load transfer with mandibular implant retained overdentures. J Prosthet Dent 2000;84:327 34. 9. Goodacre CJ, BernalG, Rungcharassaeng K, Kan JY. Clinical complications with implants and implant prostheses. J Prosthet Dent 2003;90:121 32. 10. Ahuja S, Cagna DR. Classification and management of restorative space in edentulous implant overdenture patients. J Prosthet Dent 2011;105:332 7

10. Meijer H.J.R.G., Van't Hof M.A., Visser A. A controlled clinical trial of implant-retained mandibular overdentures: 10 years' results of clinical aspects and aftercare of IMZ implants and Brånemark implants. Clin. Oral Implants Res. 2004;15:421–427.

11. Nguyen C.T.M.R., Driscoll C.F., Romberg E. The effect of denture cleansing solutions on the retention of pink Locator Attachments: an in vitro study. J. Prosthodont. 2010;19(3):226–230. 12. Ortegon S.M.T.G., Agar J.R., Taylor T.D., Perdikis D. Retention forces of spherical attachments as a function of implant and matrix angulation in mandibular overdentures: an in vitro study. J. Prosthet. Dent. 2009;101(4):231–238.

13. Preoteasa E, Imre M, Preoteasa CT. A 3-year follow-up study of overdentures retained by minidental implants. Int J Oral Maxillofac Implants. 2014 Sep-Oct;29(5):1170-6.

14. Preoteasa E, Marin M, Imre M, Lerner H, Preoteasa CT, Patients' satisfaction with conventional dentures and mini implant anchored overdentures, Rev Med Chir Soc Med Nat Iasi. 2012 JanMar;116(1):310-6.

15. Pigozzo M.N.M.M., Henriques G.E., Vaz L.G., The service life of implant-retanied overdenture attachment systems, J.P.D., (2009), 102 (2), pp. 74-80;

16. Rutkunas V., Mizutani H., Takahashi H. Influence of attachment wear on retention of mandibular overdenture. J. Oral Rehabil. 2007;34(1):41–51.

17. Sadowsky S.J. Mandibular implant-retained overdentures: a literature review. J. Prosthet. Dent. 2001;86:468–473.

18. Simon H.Y.R., Terminology of implant prostheses, I.J.Oral Maxillofac. Implants (2003), 18, pp 539-543.

19. Tokuhisa M.M.Y., Koyano K., in vitro study of a mandibular overdenture retained with ball, magned or bar attachments: comparison of load transfer and denture stability, I.J.P., (2003), 16 (2), pp. 128- 134;

20. Türk PE, Geckili O, Türk Y, Günay V, Bilgin T, In vitro comparison of the retentive properties of ball and locator attachments for implant overdentures, Int J Oral Maxillofac Implants. 2014 SepOct;29(5):1106-13.

21. Visser A.M.H., Raghoebar G.M., Vissink A. Implant-retained mandibular overdentures versus conventional dentures: 10 years of care and aftercare. Int. J. Prosthodont. 2006;19(3):271–278

# Understanding Maxillofacial Retentive Aids: Enhancing Quality of Life

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**Abstract:** In maxillofacial prosthodontics, large facial defects are difficult to restore prosthetically due to lack of anatomic undercuts, limited means of retention, mobility of soft tissues, and weight of prosthesis.[1] Increased retention improves comfort as well as the confidence in the patient.[1] Retentive methods for maxillofacial prostheses can be categorized into four groups: Anatomical, Chemical, Mechanical and Implants.[2] The prosthodontist should be familiar with all the available options, to opt for the appropriate retentive method, while planning for the prosthetic rehabilitation for the patient.[1]

Key words:- Maxillofacial defects, retentive aids, rehabilitation, types, undercuts, mechanical, implants.

**Introduction:** Maxillofacial retentive aids play a crucial role in the rehabilitation of individuals who have undergone facial trauma, surgery, or have congenital facial anomalies. These aids are custom-made devices designed to provide stability, support, and retention for various prosthetic replacements in the maxillofacial region.[1] In this article, we will explore the significance of these aids and their diverse applications.

**The Anatomy of Maxillofacial Region:** Before delving into retentive aids, it's essential to comprehend the complex anatomy of the maxillofacial region. This region encompasses the facial bones, including the maxilla, mandible, and associated soft tissues. Trauma, congenital conditions, or surgical interventions in this area can lead to the need for specialized prosthetic solutions.[3]

**Types of Maxillofacial Retentive Aids:**

1. **Implant-Retained Prostheses:** Implant-retained prostheses involve the surgical placement of dental implants into the jawbone. These implants serve as anchors for various prosthetic devices, such as dentures or facial prostheses.[4]

Fig.1 Implant retained nasal prosthesis

2. **Adhesive Retention:** Adhesive retention relies on skin-safe adhesives to secure prosthetic components in place. This method is commonly used for nasal, auricular, and orbital prostheses.[4]

Fig. 2 Prosthetic Adhesive

3. **Magnets and Attachments:** Magnets and attachments are used to connect prosthetic components, providing stability and retention. They are particularly useful for orbital and auricular prostheses.[4]

Fig.3 Magnet and Attachment

4. **Surgical Clips and Wires:** Surgical clips and wires are employed for immediate post-surgical retention, often after maxillofacial surgeries. They aid in stabilizing tissues during the healing process.[4]

Fig. 4 Surgical Clip and bar

**Applications of Maxillofacial Retentive Aids:**

1. **Craniofacial Prosthetics:** Individuals with congenital anomalies or acquired deformities in the craniofacial region benefit from custom-designed prostheses that restore both form and function.[5]
2. **Post-Surgical Rehabilitation:** Maxillofacial surgeries, whether for tumour removal, trauma reconstruction, or corrective procedures, may necessitate the use of retentive aids to support the healing process.[5]
3. **Rehabilitation after Radiation Therapy:** Patients who have undergone radiation therapy for head and neck cancers may experience tissue changes that require prosthetic solutions for facial restoration.[5]
4. **Aesthetic Enhancement:** Maxillofacial retentive aids are utilized for cosmetic purposes, helping individuals achieve a natural appearance after facial alterations.[5]

**Advancements in Material and Design:** With advancements in technology, the materials and designs of maxillofacial retentive aids have significantly evolved. Silicone elastomers, for example, are widely used due to their biocompatibility and lifelike appearance. Additionally, 3D printing technology has revolutionized the customization and precision of these aids.[6]

**Patient-Specific Implants:** Patient-specific implant (PSI) is a personalized approach to reconstructive and esthetic surgery.[6] It can be achieved with implants custom made to fit a particular need. Manufacturing of maxillofacial PSIs begins with image acquisition; either CT or MRI scans of the area of interest. Polymers commonly used for maxillofacial PSIs include silicone, polymethylmethacrylate (PMMA) and polyetheretherketone (PEEK).[6]

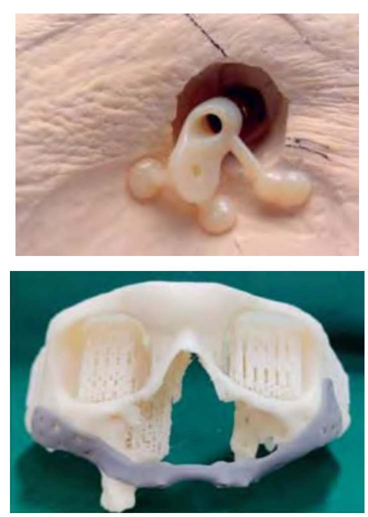


Fig. 5 Patient Specific Implants

The ideal implant material must be inexpensive, durable, radiolucent, lightweight and biocompatible. Maxillofacial PSIs are commonly manufactured from metals and polymers. Implants can be manufactured from pure titanium or an alloy. Maxillofacial PSIs are made from solid silicone and are used for soft tissue augmentation. Silicone implants can be easily modified intraoperatively as needed.[6]

For bony defects, PEEK and PMMA are the most popular polymers. PEEK is a biocompatible, robust semicrystalline polyaromatic polymer that has extensive industrial applications for manufacturing parts that are needed to withstand repeated stress. PEEK's initial medical application was in manufacturing of orthopaedic implants. PEEK is now one of the most commonly used polymers for the manufacture of maxillofacial implants.[7]

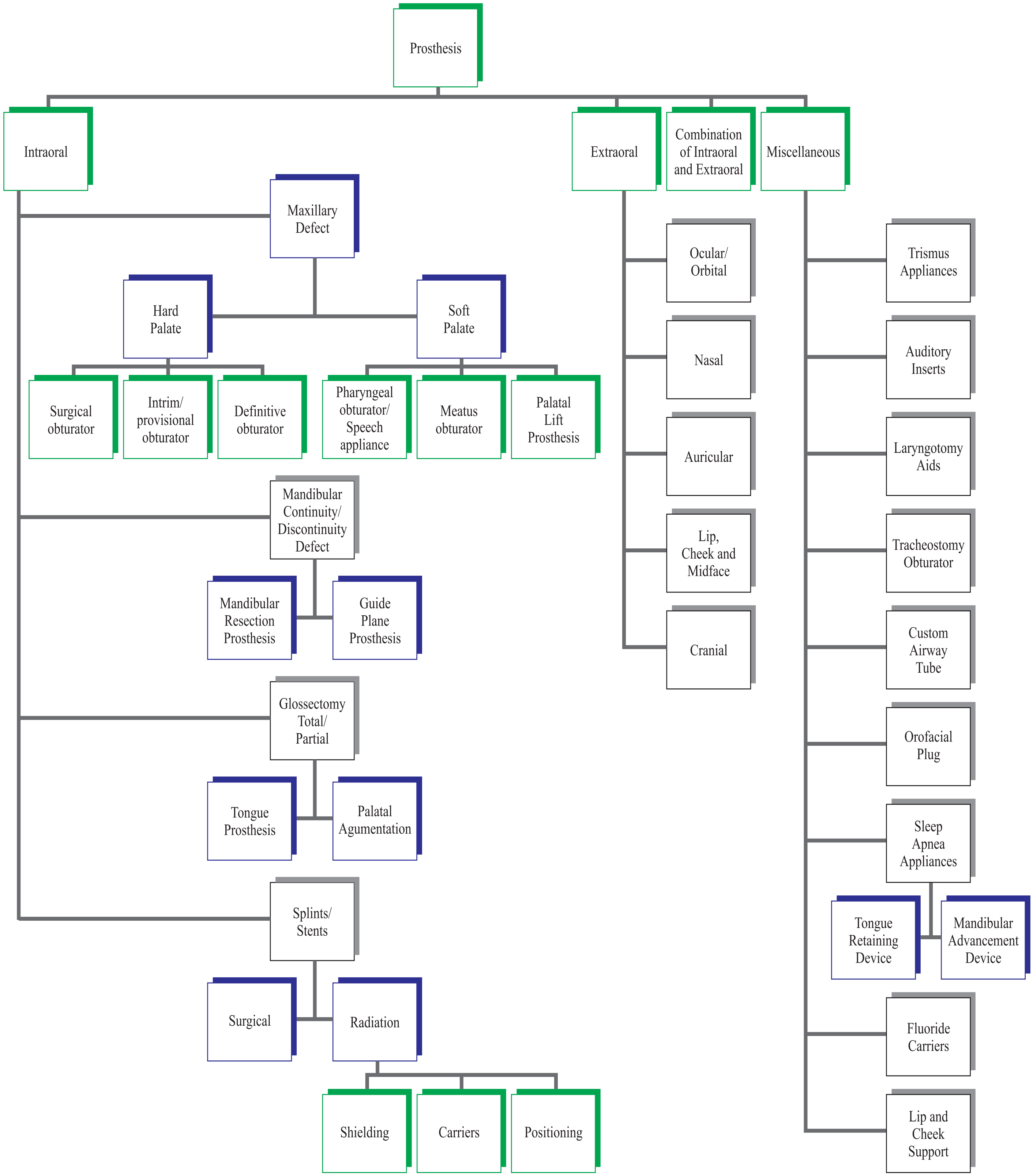
PMMA is a high molecular weight acrylic-based polymer that has been used for several decades in the manufacture of orthopaedic implants. PMMA is known for its strength and rigidity making it a suitable bone substitute. PMMA PSIs have been used for reconstructing cranial and maxillofacial defects Polyethar-ketone-ketone (PEKK) is a member of the polyaryletherketone family of polymers that also includes PEEK.[8] The use of PEKK for implant manufacturing is not as common as PEEK or PMMA but is gaining popularity. 3D-printed PEKK maxillofacial PSIs recently gained Food and Drug Administration clearance.[8]

**Future in Patient Specific Implants:** PSIs are currently produced by few manufacturers and it takes several days to weeks to fabricate a single PSI. The advent and rise in popularity of 3D printing is likely to decrease production time and cost of maxillofacial PSI production. Significant work is needed for the improvement of biomaterials used in PSI manufacturing. A biodegradable polymer will allow custom fabrication of implants that provides the correct amount of strength when needed and slowly degrades over time as it is replaced by tissue ingrowth.[9]

**Conclusion:** Maxillofacial retentive aids play a vital role in restoring the form, function, and aesthetics of the maxillofacial region for individuals who have experienced trauma, congenital anomalies, or surgical interventions. With ongoing advancements in materials and techniques, these aids continue to enhance the quality of life for many individuals worldwide.

OHRQoL in patients with maxillofacial tumours is a multidimensional element that needs to be addressed by researchers in health-care sectors. This could be attributed not only to the diagnosis of disease itself but also to significant functional and esthetic impairment as a result of therapeutic interventions. Hence, emotional functioning has a significant impact on OHRQoL.

## A flow chart of maxillofacial Prosthesis



**References:**


1 Nazar SA, Nair VV, Kumar H, Ravichandran R. Retention in maxillofacial prosthetics: A review. Int J Appl Dent Sci. 2021;7:568-73.

2 Nichlani G, Mittal DA, Joshi M, Ghadage M, Kadam N, Kamble SS, et al. Retention in Maxillofacial Prostheses: A Literature Review. Int J Health Sci. 2022;6(S2):2151–63. doi:10.53730/ijhs.v6nS2.5442.

3 Santhi B, Rao BL, Satyanarayana TSV, Padmini D, Bhargavi B, Kumar CS, et al. Retention In Maxillofacial Prosthetics: A Literature Review. Global J Res Anal. 2022;11(2):124–6.

4 Saini R, Nagpal A, Thakur K, Saini R, Shrivastav R. Retentive aids in maxillofacial prosthesis: A review. IP Ann Prosthodont Restor Dent. 2019;5(1):1–4. doi:10.18231/j.aprd.2019.001.

5 Kanathila H, Pangi A. The changing concepts in the retention of maxillofacial prosthesis from past to present- a review. J Evolution Med Dent Sci. 2017;6(84):5879–83.

6 Kotewar S, Dr N, Baig D, Jadhav DRV, Kasat. Method Of Retentive For Maxillofacial Prosthesis : A Review. Int J Creative Res Thoughts (IJCRT). 2020;8(6):2893–915.

7 Karthikeyan I, Khatree M, Gaddale R. A review on prosthetic rehabilitation of maxillofacial region. J Sci Dent. 2016;6(1):6–12.

8 Gurjar R, Kumar MVS, Rao H, Sharma A, Bhansali S. Retentive Aids in Maxillofacial Prosthodontics - A Review. IJCD. 2011;2(3):84–8.

9 Retenr S, Kumar S, Shankar R, Krishna H, Kumar S. Extra oral implants as retentive aids for maxillofacial prosthesis: A review. J Appl Dent Med Sci. 2016;2(2):135–42.

10 Mantri S, Khan Z. Prosthodontic rehabilitation of acquired maxillofacial defects. Head and neck cancer. Intech. 2012 Mar 14:315-6.

11 Türksayar AD, Saglam SA, Bulut AC. Retention systems used in maxillofacial prostheses: A review. Niger J Clin Pract. 2019;22(12):1629–34. doi:10.4103/njcp.njcp_92_19.

12 Visser A, Raghoebar GM, Van Oort RP, Vissink A. Fate of ImplantRetained Craniofacial Prostheses: Life Span and Aftercare. Int J Oral Maxillofac Implants. 2008;23(1):89–98.

# Revolutionizing Rehabilitation: A Literature Review on Digital Workflow in Maxillofacial Prosthodontics

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**Abstract:** In the realm of Maxillofacial Prosthodontics, digital workflow has emerged as a transformative force, revolutionizing the approach to patient care and prosthetic rehabilitation, offering significant improvements in precision, efficiency and patient outcomes. This review article explores the comprehensive digital workflow for the design and fabrication of maxillofacial prostheses, comparing it with conventional techniques, and highlighting the benefits, challenges and future directions of integrating digital solutions in clinical practice. Key components of the digital workflow, including 3D imaging, virtual planning, computer-aided design (CAD), and additive manufacturing techniques are discussed. The integration of these technologies has streamlined processes, reduced costs, and enhanced the accuracy of prosthetic devices, ultimately benefiting both practitioners and patients.

**Keywords:** Maxillofacial Prosthesis, Digital Workflow, 3D Printing, Computer-Aided Design, Additive Manufacturing, Data Acquisition

**Introduction:** Maxillofacial prosthodontics is a specialized field focusing on the rehabilitation of patients with defects or disabilities in the maxillofacial region. These defects can arise from congenital conditions, trauma, or oncological resections. Auricular prostheses for ear defects, facial prostheses for facial abnormalities, orbital prostheses for eye defects, and obturator prostheses for palatal defects have historically been among the most challenging prosthetic devices to produce. Maxillofacial prostheses utilize synthetic materials to replicate the appearance and function of lost tissues, helping to resolve patient's social and emotional concerns and significantly improving their quality of life.[1] These traditional methods for the fabrication of maxillofacial prostheses have been an artisanal process, reliant on manual techniques and the expertise of the clinician and technician, making them highly labour-intensive and time consuming. However, the advent of digital technology has introduced new methodologies that enhance precision, efficiency, and patient outcomes. Traditional impression, modelling, and processing techniques can likely be replaced by the introduction of digital workflow, which encompasses 3D scanners, 3D software, and rapid prototyping technology. Additionally, shade matching and adding surface characteristics to the prosthesis have become significantly easier and more predictable. The application of digital technology in maxillofacial prosthodontics has evolved considerably and continues to progress, offering substantial potential for enhancing both the process and the outcomes.[1,2] This article provides a detailed overview of the digital workflow in maxillofacial prosthodontics, comparing it to conventional methods, and highlighting the benefits and challenges associated with digital applications.

**Materials and Methods:** The transition from conventional to digital workflow in maxillofacial prosthodontics involves several key stages: data acquisition, digital design, and fabrication. This section outlines the materials and methods employed at each stage, including 3D imaging techniques, CAD software, and various additive manufacturing technologies.

1 **Data Acquisition:** Data acquisition is the first critical step in the digital workflow. It involves capturing detailed information about the defect site using various scanning technologies. Medical scans such as computed tomography (CT), cone-beam computed tomography (CBCT), and magnetic resonance imaging (MRI) provide comprehensive data, particularly useful for internal structures. Surface scanners, including structured light scanners, laser scanners, and intraoral scanners, are used for external surface details. Combining these technologies ensures accurate and complete data for prosthesis design. [1,2]

**Medical Scanning**

| | | |
|---|---|---|
| 1. | Computed Tomography (CT) | Specific to craniofacial imaging. |
| 2. | Cone Beam Computed Tomography (CBCT) | Useful for hard tissues, limited resolution for soft tissues, with radiation dose increasing with resolution. |
| 3. | Magnetic Resonance Imaging (MRI) | Excellent for detailed soft tissue imaging, suitable for auricular and orbital prostheses but not ideal for imaging multiple bony structures simultaneously. |

**Surface Scanning**

| | | |
|---|---|---|
| 1. | Laser Scanners | Use a laser line and a CCD to capture light pattern distortion, determining the surface's 3D coordinates through triangulation. |
| 2. | Structured Light Scanners | Project a light pattern onto the object and capture the image to determine 3D coordinates. |
| 3. | Facial and Intraoral Scanners | Capture detailed surface data. |
| 4. | Photogrammetry | Extracts 3D measurements from 2D images to create surface models. |
| 5. | Scanning Physical Casts | Plaster or alginate casts can be scanned if direct patient scanning isn't feasible. |

Table 1: shows Medical and Surface Scanning Techniques for Soft Tissue Reconstruction.

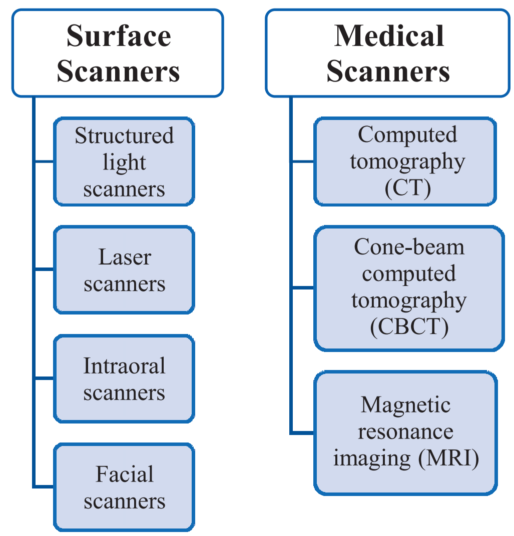


Figure 1: Types of 3D scanners

2 **Computer-Aided Design (CAD):** Once the data is acquired, it is processed using CAD software to design the prosthesis. Advanced CAD software allows for intricate designs, precise adjustments, and simulations to ensure the prosthesis meets the patient's specific needs.

3D design of soft tissue reconstructions can be achieved using several approaches:

a **Preoperative Scanning:** To capture the most natural form of the anatomy to be reconstructed, it is advisable to scan the healthy facial surface before surgery.

b **Mirroring Technique:** If a preoperative scan is unavailable, a mirror image of the healthy side can be used. This involves directly scanning the healthy side or using a model obtained from a conventional impression. The 3D image is then mirrored and superimposed on the affected area using CAD software to determine the correct position, resulting in the creation of an STL file.

c **Virtual Donor Approach:** A virtual "donor," such as a family member, can be used. The anatomical part to be reconstructed is scanned from the donor and combined with the patient's anatomical surface.

d **Digital Library Usage:** A digital library can be utilized to select a suitable size and shape for the reconstruction. The clinician can choose the appropriate design based on the patient's anatomy, which can then be visualized by the patient and the medical team before the reconstruction.[1]

**Popular software tools include:**

- **Meshmixer and Blender:** Freeware tools offering a range of functions for duplicating, cutting, and sculpting 3D models.
- **Zbrush:** High-cost software preferred by professionals for its advanced capabilities.
- **Plus ID Institute Software:** Developed specifically for facial prosthetic design, integrating advanced algorithms for colour and texture replication.[2,3]

3 **Rapid Prototyping and Additive Manufacturing:** Rapid Prototyping (RP), also known as Solid Freeform Manufacturing, is a relatively new technology used to create three-dimensional shapes from virtual designs. RP can be categorized into subtractive and additive manufacturing processes. Subtractive manufacturing involves the use of a CNC (Computer Numerical Control) router, which cuts the prosthesis from a solid block of polymer material, such as polyurethane. Recently, additive manufacturing, particularly 3D printing, has become the preferred method. This process constructs 3D physical models layer by layer from CAD files, offering greater flexibility and precision compared to traditional subtractive techniques.[5,9,10]

- Additive Manufacturing (3D Printing): Technologies such as Fused Deposition Modeling (FDM), Stereolithography (SLA), and Selective Laser Sintering (SLS) are commonly used.[9]
- Subtractive Manufacturing: CNC milling and laser cutting offer alternative methods for producing components with high precision. [13.15]

**Digital Applications in Maxillofacial Prosthodontics:** Digital applications in maxillofacial prosthodontics span across various stages from diagnosis to the final prosthesis. Advanced imaging technologies enable accurate diagnosis and treatment planning. Digital design tools facilitate the creation of customized prostheses that fit perfectly and look natural. Additionally, digital workflows allow for virtual try-ins and adjustments, significantly reducing the number of physical appointments needed.[10,12]

**3D Printing:** 3D printing allows for the precise fabrication of complex geometries that would be difficult or impossible to achieve with traditional methods. This includes:

i. Custom Implants and Prostheses: Tailored to the patient's anatomy, offering improved fit and function.

ii. Surgical Guides: Assisting in the accurate placement of implants during reconstructive surgery.[14]

**Additive Manufacturing:**

1 **Fused Deposition Modeling (FDM):** Involves extruding melted thermoplastic filament to build objects layer by layer. It is cost-effective but has limitations in resolution.

2 **Stereolithography (SLA):** Uses a UV laser to cure liquid resin into hardened plastic. It offers high resolution and smooth finishes.

3 **Selective Laser Sintering (SLS):** Uses a laser to sinter powdered material, creating strong and durable parts. It is suitable for complex geometries.

4 **Material Jetting:** Deposits droplets of material which are then cured, allowing for multi-material and multi-colour prints with high precision.

5 **Binder Jetting:** Powder printing, also known as binder jetting, uses injet technology in a 2D printer to combine layers of powdered material, such as gypsum or starch, with liquid resin. The advantage of this approach is the ability to use multiple printheads, each emitting a different color, allowing for his 3D printed parts in full color

6 **Silicone 3D Printing:** These printers create realistic, customized silicone prostheses directly from 3D models using platinum-catalyzed silicone.

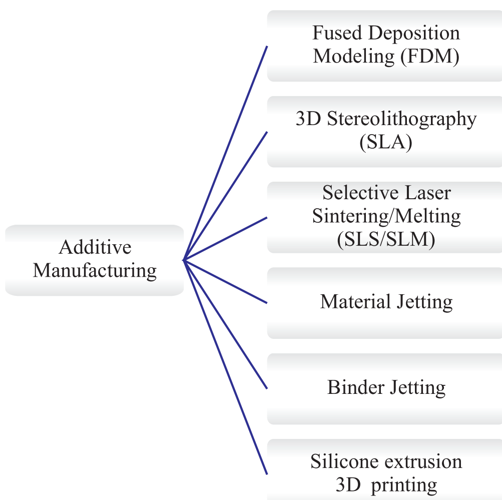


Figure 2: Additive manufacturing techniques

Figure 2 shows some additive manufacturing approaches that can be used to create complex objects from a variety of materials such as acrylic rigid polymers, wax, moulds, and even complete prosthesis.

**Software for CAD:**

1 Commercial Software: Includes Geomagic Studio, Zbrush, Rapidform, Rhinoceros, FreeForm, Magics, 3-Matic, Solidworks and Cinema 4D.

2 Open-Source Software: Includes Makerware, Meshmixer and Visual Toolkit (VTK).[2,3,11]

**Virtual Surgical Planning (VSP):** VSP enables surgeons to plan and simulate procedures using digital models. This improves surgical precision and reduces intraoperative time.

**Augmented Reality (AR) and Virtual Reality (VR):** AR and VR technologies are emerging tools for both surgical planning and patient education. These technologies provide immersive experiences that enhance understanding and collaboration among the surgical team. Technologies like Vuforia and Unity 3D have been utilized to develop apps facilitating complex computer capabilities, including image and object recognition, and real-world interactions. These apps employ augmented reality (AR) to overlay 3D models onto live video streams captured by the device's camera. For instance, an AR application was developed allowing prosthodontists to manipulate and resize photos to align with treatment plans, with visual buttons enabling control over various aspects like movement and size. The resulting scene is saved as a downloadable Android app for convenient access. [6]

**Digital Shade Matching:** Digital shade matching utilizes software tools to accurately match the colour of prostheses to the surrounding tissues of patient's faces. This technology ensures natural-looking aesthetics and patient satisfaction.[7,8]

**Discussion:**

**Conventional Workflow:** The conventional workflow for maxillofacial prostheses involves several manual steps: making physical impressions, creating plaster casts, sculpting wax patterns, and multiple try-ins before finalizing the prosthesis. This process is time-consuming, requires significant manual dexterity, and can be uncomfortable for patients.

The process of creating a maxillofacial prosthesis involves several steps. Initially, an accurate impression of the area needing the prosthesis is obtained using suitable impression materials like hydrocolloid alginates or elastic silicone polymers, chosen based on factors such as the type and size of the defect. Custom trays may be necessary, and some anatomical undercuts are blocked to facilitate easy removal of the impression without causing tissue damage. Once the impression is poured, a gypsum cast is obtained, and a wax model of the missing anatomical part is crafted. The wax is carefully carved to replicate natural morphological details. After a try-in to ensure proper fit and aesthetic appearance adjustments, moulds are produced using the final wax-up via the lost wax method. The final prosthesis is then fabricated using suitable materials, such as acrylic resins or silicones, depending on the complexity of the defect. For intraoral and complex defects involving a part or the complete dental arch, an impression of the opposite arch and mounting in a semi-adjustable articulator may also be necessary before the final fitting.[2,3]

**Digital Workflow:** In digital manufacturing of maxillofacial prostheses, the process involves several key steps. First, defect data acquisition is crucial, which can be achieved through medical scans like computed tomography (CT), cone beam computed tomography (CBCT), or magnetic resonance imaging (MRI), generating files in DICOM format. Surface scanners such as laser scanners and intraoral scanners are also utilized for defect data acquisition. Photogrammetry, which extracts three-dimensional measurements from two-dimensional images, is another method used to produce 3D surface models of patients' faces.

The design of the maxillofacial prosthesis, whether external or internal, is then achieved using various CAD programs and software suites, either open-source or commercially available. Rapid prototyping, particularly additive manufacturing, is employed to produce the final prosthesis. The prostheses can be manufactured indirectly by obtaining a model or mold of the prosthesis, followed by conventional workflow for anatomic part processing, or directly by 3D printing with suitable materials such as silicone-based elastomers and acrylic resins.

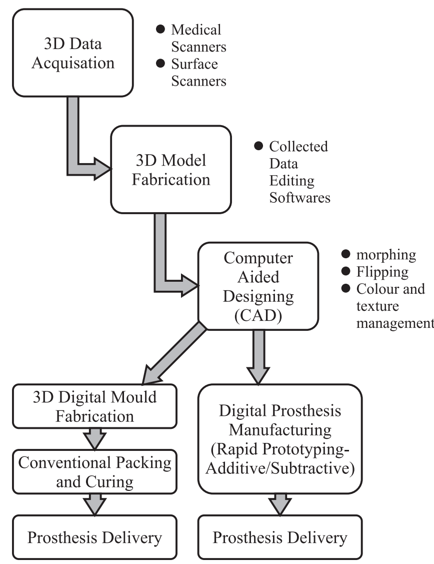


Figure 3: Digital Workflow for Fabrication of Maxillofacial Prosthesis

### Comparative Analysis:

**Efficiency:** Digital workflows are faster, reducing the total time from diagnosis to delivery of the prosthesis.

**Precision:** Digital tools offer higher accuracy and consistency, minimizing errors and rework.

**Patient Comfort:** Digital techniques are less invasive and more comfortable for patients, particularly during the data acquisition phase.

**Cost:** While the initial investment in digital equipment is high, the overall cost can be lower due to reduced labour and faster turn-around times.

The integration of digital technologies in maxillofacial prosthodontics represents a significant advancement in patient care. Digital workflows enhance precision, reduce patient discomfort, and improve the overall efficiency of the prosthesis fabrication process. However, the transition from conventional to digital methods poses challenges, including the need for training, high initial costs, and the adaptation of clinical practices.

**Advantages of Digitization in Maxillofacial Prosthodontics:**

1. **Improved Precision and Accuracy:** Digital techniques such as 3D scanning and computer-aided design (CAD) allow for highly precise and accurate prosthetic design and fabrication, leading to better-fitting prostheses.
2. **Enhanced Efficiency:** Digitization streamlines the workflow, reducing the time and labour required for prosthesis production compared to traditional methods, leading to increased productivity and cost-effectiveness.
3. **Customization:** Digital technologies enable the creation of highly customized prostheses tailored to the individual patient's anatomical features and aesthetic preferences, resulting in improved patient satisfaction and outcomes.
4. **Better Communication and Collaboration:** Digital platforms facilitate seamless communication and collaboration between clinicians, technicians, and patients, allowing for clearer visualization and understanding of treatment plans.

**Challenges and Limitations:-**

1. **Initial Investment and Costs:** The upfront costs associated with acquiring digital equipment and software can be substantial, limiting access to smaller clinics or facilities with limited budgets.
2. **Technical Expertise Requirement:** Effective utilization of digital tools requires specialized training and expertise, which may not be readily available to all dental professionals, leading to potential barriers to adoption.
3. **Material Limitations:** While digital technologies offer versatility, some materials used in 3D printing may lack the durability, biocompatibility, or aesthetic properties required for certain prosthetic applications.
4. **Workflow Integration Challenges:** Integrating digital workflows into existing clinical practices may pose challenges, requiring adjustments to traditional protocols, workflows, and infrastructure, which can disrupt established routines and processes.

**Future Prospects:** Research over the past two decades has highlighted the potential shift from a labour-intensive conventional workflow to a digitalized protocol for fabrication of maxillofacial prosthesis using CAD/CAM technology. However, current software and interfaces are often expensive and not optimized for this purpose, limiting access primarily to skilled dental professionals or CAD engineers.[4]

As demand for digital approaches in maxillofacial rehabilitation grows, there's a need for more user-friendly software modules, akin to those used in dental clinics and laboratories. Institutions can contribute by developing 3D libraries of morphological variations for easier design access.

Efforts are required to simplify data acquisition methods, improve software accessibility, enhance prosthetic esthetics and fit and provide biocompatible materials for direct printing of maxillofacial prostheses. Despite advancements, an indirect approach involving 3D-printed moulds for silicone injection, with manual colour individualization, remains necessary to achieve comparable esthetic outcomes to analogical methods in many cases.

**Conclusion:** The digital workflow in maxillofacial prosthodontics offers substantial benefits over traditional methods, including improved precision, efficiency, and patient comfort. As digital technologies continue to evolve, their integration into clinical practice is likely to become more widespread, ultimately enhancing patient outcomes and advancing the field of prosthodontics.

**References:**


1 Bakrolwala, H., Jurel, S. K., Chand, P., Singh, R. D., & Bhujbal, R. B. (2023). Digitalization in maxillofacial prosthodontics- A review. Journal of Dental Panacea, 5(2), 59-64.

2 Cristache, C.M.; Tudor, I.; Moraru, L.; Cristache, G.; Lanza, A.; Burlibasa, M. Digital Workflow in Maxillofacial Prosthodontics—An Update on Defect Data Acquisition, Editing and Design Using Open-Source and Commercial Available Software. Appl. Sci. 2021, 11, 973. https://doi.org/10.3390/ app11030973

3 Suresh N, Janakiram C, Nayar S, Krishnapriya VN, Mathew A. Effectiveness of digital data acquisition technologies in the fabrication of maxillofacial prostheses - A systematic review. J Oral Biol Craniofac Res. 2022 Jan-Feb;12(1):208-215. doi: 10.1016/j.jobcr.2021.12.004. Epub 2021 Dec 30. PMID: 35024329; PMCID: PMC8733177.

4 Salazar-Gamarra R, Binasco S, Seelaus R and Dib LL (2022) Present and future of extraoral maxillofacial prosthodontics: Cancer rehabilitation. Front. Oral. Health 3:1003430. doi: 10.3389/froh.2022.1003430

5 Bansod AV, Pisulkar SG, Dahihandekar C, Beri A. Rapid Prototyping in Maxillofacial Rehabilitation: A Review of Literature. Cureus. 2022 Sep 9;14(9):e28969. doi: 10.7759/cureus.28969. PMID: 36237787; PMCID: PMC9548214.

6 Zaidi, Syeda & Kumar, C & Sujesh, M & Rajanikanth, A & Sunitha, Kollu. (2022). Augmented reality application in prosthodontics. IP Annals of Prosthodontics and Restorative Dentistry. 8. 98-103. 10.18231/j.aprd.2022.019.

7 Pawar P, Borle A G, Patil R M, et al. (August 21, 2023) Digitization in Skin Shade Matching for Maxillofacial Prostheses: A Systematic Review. Cureus 15(8): e43886. DOI 10.7759/cureus.43886

8 Sharyu K Khatod, Sharayu V Nimonkar, Seema Sathe, Sweta Kale Pisulkar, Techniques of shade selection in maxillofacial prosthodontics, J Res Med Dent Sci, 2022, 10 (10): 255-259.

9 Jindal, P., Sharma, A., & Rajawat, I. (2021). Additive Manufacturing in Prosthodontics: A Review. Applied Sciences, 11(9), 973.

10 Sykes, L. M., Parrott, A. M., Owen, C. P., & Snaddon, D. R. (2004). Applications of rapid prototyping technology in maxillofacial prosthetics. International Journal of Prosthodontics, 17(4), 454-459.

11 Cenzi, R., Alfano, C., & Carinci, F. (2005). Computer-aided design/computer-aided manufacturing (CAD/CAM) technology in maxillofacial prosthetics: A pilot study on edentulous patients. The Journal of Craniofacial Surgery, 16(5), 835-841.

12 Ciocca, L., Fantini, M., & De Crescenzio, F. (2011). Digital prosthetic design in the maxillofacial area. Journal of Prosthetic Dentistry, 106(4), 201-205.

13 Eggbeer, D., Bibb, R., & Evans, P. (2005). Rapid prototyping technology in the treatment of patients with facial prostheses. British Journal of Oral and Maxillofacial Surgery, 43(5), 393-397.

14 Wu, G., Bi, Z., & Pan, Y. (2013). Application of digital technology in maxillofacial prosthodontics. Journal of Prosthodontics, 22(8), 641-644.

15 Bouyssie, J., Bouyssie, S., Sharrock, P., & Duret, F. (2007). Computer-assisted design and manufacturing of facial prostheses: Evaluation of usability and esthetics. The International Journal of Prosthodontics, 20(1), 71-76.

# Prosthetic Rehabilitation of Post-Mucormycosis Maxillofacial Defects Using Custom Patient-Specific Implants.

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**Abstract:** Due to substantial tissue and bone loss, rehabilitation of maxillofacial abnormalities during mucormycosis presents considerable obstacles. Conventional reconstruction techniques, such microsurgical flaps and grafting, are intrusive and have variable results. By matching the specific anatomy of each patient, personalized implants are created using CAD/CAM technology and advanced imaging techniques, improving surgical accuracy and efficacy. These patient-specific implants offer greater stability, decreased surgical morbidity, and increased patient satisfaction. When combined with soft tissue restoration and prompt prosthesis fitting, they greatly improve functional and aesthetic outcomes.

This case report describes the prosthetic rehabilitation of a male patient, age 51, who was classified as Class 2d after undergoing a maxillectomy and having a substantial maxillary defect. The patient had debridement of necrotic tissue, which resulted in a severe disruption in contact between the sinuses, nasal, and oral cavities. The patient had a history of COVID-19 infection followed by mucormycosis. An extraoral assessment indicated speech difficulty, nasal twang, poor facial aesthetics, and lack of upper lip support. A definitive prosthesis with an obturator to cover the intraoral defect was placed on custom patient-specific implants (DICUL AM Private Limited, Nagpur, Maharashtra). This demonstrated the transformative potential of personalized implants in restoring function and aesthetics, thereby improving the patient's quality of life.

**Key words:** Maxillofacial, Rehabilitation, mucormycosis, maxillectomy, obturator, patient specific implants.

**Introduction:** The rehabilitation of maxillofacial defects following mucormycosis[1] poses significant clinical challenges due to the extensive tissue and bone destruction caused by the infection. Surgical resection was associated with maxillofacial defect which had a huge impact on the patient's quality of life and caused mastication, swallowing, speech and esthetic problems. Various reconstruction options such as inlay grafting, onlay grafts, microsurgical revascularized flaps, have been employed previously but these options were considered invasive and had unpredictable outcomes.

By leveraging advanced imaging techniques and CAD/CAM technology, implants are meticulously designed to match each patient's unique anatomical structures, enhancing the precision and effectiveness of surgical interventions. The integration of these implants with soft tissue reconstruction and immediate prosthetic fitting significantly improves functional and aesthetic outcomes.[2]

Clinical results demonstrate that patient-specific implants provide superior stability, reduced surgical morbidity, and enhanced patient satisfaction compared to conventional methods.[4,5] This innovative approach highlights the potential of personalized implants to revolutionize maxillofacial rehabilitation, offering a promising solution for restoring the quality of life in patients affected by mucormycosis. This article describes prosthetic rehabilitation of one such patients with custom Patient specific implants.

**Case report:** A 51-year-old male patient was referred from the Department of Oral and Maxillofacial Surgery for the prosthetic rehabilitation of a large maxillary defect after maxillectomy. On intra-oral examination, the defect was classified as Class 2 d. [3] according to Brown et al and patient specific implant-supported prosthesis was planned for this patient. The patient gave a history of covid -19 infection followed by mucormycosis for which he underwent debridement of the necrotic tissue. The maxillary resection left a large maxillary defect and communication between the sinuses, nasal, and oral cavity.

Extra oral examination revealed loss of upper lip support, poor facial aesthetics, nasal twang, and speech impairment. Custom patient specific implants (DICUL AM Private Limited, Nagpur, Maharashtra) were placed. (Post operative intra-oral picture)

A splinted open tray impression with polyvinylsiloxane impression material al (GCFlexceed®, GC, India) was made and poured in Type IV gypsum (Kalabhai Kalstone, Kalabhai Karson, India). The Jig trial was done with pattern resin (GC pattern resin) for verification of passivity. Then the wax occlusal rims were fabricated on the acrylic record bases. The vertical dimension was established, the bite was recorded, teeth arrangement was done and try-in of the prosthesis was done to check esthetics, function and speech. Then according to the available interarch-space, a cement retained Porcelain fused metal (PFM) prosthesis was planned. Metal trial was done to verify the fit of the prosthesis and to check the passivity. Bisque trail was done and occlusal adjustments were done. Final glazed Porcelain fused metal (PFM) was cemented using type 1 GIC. The intra-oral defect was obturated using the custom heat processed acrylic plate.

**Discussion:** Patients with acquired maxillofacial abnormalities experience severe disruptions to their quality of life, making simple tasks like biting, swallowing, and speaking extremely difficult. The prosthodontic care that these patients receive depends on the kind and degree of bone loss in addition to the amount of soft and hard tissue that is still present. The need for extensive surgical debridement frequently results in the loss of vital supporting tissues, rendering the use of traditional implants futile. This case emphasizes the urgent need for cutting-edge solutions to help afflicted people regain their function and quality of life. Patient specific implants have proven to be a promising treatment option that enhances the retention, stability, and support of the prosthesis.

When a defect is present, using fixed prostheses becomes more challenging. A removable prosthesis offers a more practical solution, making it easier for patients to clean the affected area. The design of removable prostheses is user-friendly, and their attachments enhance retention, ensuring a secure fit. Additionally, the implants are splinted together to provide optimal load distribution across the remaining structures. This approach helps to distribute forces uniformly during activities like chewing, thereby increasing the overall stability and functionality of the prosthetic solution. Hence customized framework of patient specific implant offers a promising treatment option in this patients.

**Conclusion:** To summarize, the use of patient specific implants along with a removable obturator plate is a potential treatment option for patients with challenging maxillary defects. This case report demonstrates a unique technique that not only improves stability and support but also comfort and functionality, ultimately leading to a superior quality of life for patients seeking reliable prosthetic options.

References:

1 Kumar L, Verma A, Pal US, Mattoo K, Algarni YA, Bin Hassan SA, Baba SM, Jeri SY, Khateeb SU. Influence of Prosthodontic Rehabilitation Using Zygomatic Implants in Covid 19 Related Mucormycosis (Rhino-Orbital-Cerebral) Maxillectomy Patients Upon Post-Operative Stress, Anxiety and Functional Impairment: A Prospective Cohort Study. Clin Interv Aging. 2023;18:1201-1219

2 Gandhi N, Gandhi S, Talwar H, Dhawan K. Zygomatic implantsupported prosthetic rehabilitation of a patient with Brown et al. Class II c maxillary defect: A clinical report. J Indian Prosthodont Soc 2022;22:92-6

3 Brown JS, Rogers SN, McNally DN, Boyle M. A modified classification for the maxillectomy defect. Head & Neck: Journal for the Sciences and Specialties of the Head and Neck. 2000 Jan;22(1):17-26.

4 Kondaka S, Singh VD, Vadlamudi C, Bathala LR. Prosthetic rehabilitation of untailored defects using patient-specific implants. Dent Res J (Isfahan). 2022 Oct 20;19:83. PMID: 36426284; PMCID: PMC9680695.

5 Patel, N., Mel, A., Patel, P. et al. A Novel Method to Rehabilitate Post-mucormycosis Maxillectomy Defect by Using Patient-Specific Zygoma Implant. J. Maxillofac. Oral Surg. 22 (Suppl 1), 118–123 (2023). https://doi.org/10.1007/s12663-023-01847-1

Fig.1. Post Operative OPG

Fig.2. Intra oral photograph

Fig.3.Opent ray splinted impression

Fig. 4. Jig trail

Fig.5 Jaw relation made

Fig.6 Facebow record taken

Fig.7 Teeth arrangement on semi adjustable articulator

Fig. 8 Post operative intraoral & extra oral picture

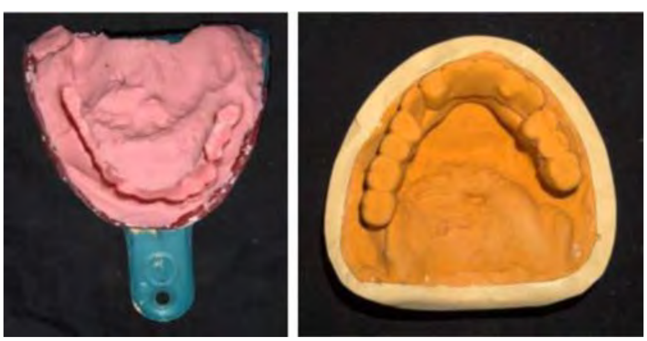

Fig. 9 Alginate impression & cast for obturator

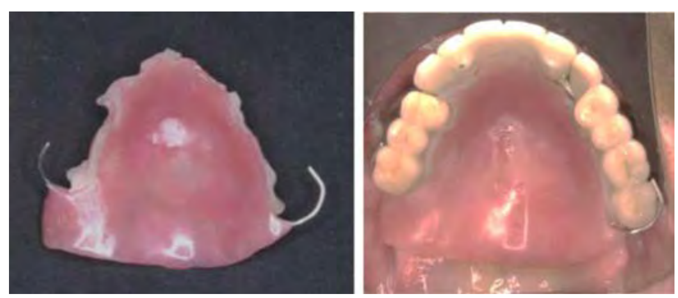

Fig. 10 Obturator plate, Intraoral picture of obturator covering the defect.

# Prosthodontic Rehabilitation of mandibular anterior ridge defect by using Andrew's bridge (Fixed Removable Prosthesis): A Case Report

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**Abstract:** Loss of teeth also results in the loss of soft tissue and hard tissue. In literature, it is given that treating anterior ridge defect cases are very difficult if patient is concern about their esthetics, because the esthetic outcome is not predictable in such cases. In such cases Andrew's bridge is far superior to the fixed prosthesis (Implant and tooth supported prosthesis). The purpose of this article is to describe the fabrication and indication of Andrew's bridge i.e. Fixed-removable prosthesis system in treating class III residual alveolar ridge defect. In this system two natural teeth use as an abutment and a cobalt chromium bar connects the two abutments. A metal sleeve over the bar helps in retention of removable partial denture. Andrew's system not only helps in retention of partial denture but also helps in improving esthetics and maintaining hygiene. Andrew's bar system provides alternative treatment option for dentist to treat anterior alveolar ridge defect cases.

**Keywords:** Andrew's bridge, Siebert Class III ridge defect, Metal sleeve, Cobalt-Chromium bar

**Introduction:** Loss of teeth also results in the loss of soft tissue and hard tissue. In literature, it is given that treating anterior ridge defect cases are very difficult if patient's is concern about their esthetics, because the esthetic outcome is not predictable in such cases. Prosthetic treatment of the anterior ridge defect requires replacement of lost teeth as well as restoration of alveolar defect. Such condition is challenging for the clinician from an esthetic point of view. The term localized alveolar ridge defect is intended to refer to a volumetric deficit of limited extent in bone and soft tissue within the alveolar process.[1] These ridge defect can be corrected by surgical or by non-surgical procedure.[2]

**Classification of the localized alveolar ridge defect:** This can be divided into qualitative and semiquantitative. Qualitative is based on three dimensional form and semi quantitave, on the basis of their severity and extent.[3,4]

| Criteria of classification | Siebert's nomenclature | Allen's nomenclature |
|---|---|---|
| Horizontal or buccal tissue loss with normal ridge height | Class I | Type B |
| Vertical or apico-coronal tissue loss with normal ridge Height | Class II | Type A |
| Combined horizontal and vertical bone loss | Class III | Type C |

Siebert's nomenclature is commonly used.

The degree of severity of a ridge defect has been determined semiquantitatively according to its size.[4] (Table 2)

| Criteria for classification in the Vertical and Horizontal dimension | | | |
|---|---|---|---|
| Defect size in relation to adjacent papilla tips | < 3 mm | 2 to 6 mm | > 6 mm |

| Criteria for classification in the Vertical and Horizontal dimension | | | |
|---|---|---|---|
| Designation | Mild vertical defect | Moderate vertical defect | Severe vertical defect |

The classification gives the idea of severity and extent of defect, which is helpful in diagnosis and treatment planning of such condition.[5] There are various treatment approaches for treating ridge defect.[6-9]

**Surgical approach:**

1 Soft tissue procedure- include

a) For class I defects- the Roll technique

b) For class II and III defects- the Interproximal graft technique

c) Onlay transplant technique and modifications

d) Subepithelial connective tissue transplant technique and modifications

2 Correction through guided bone regeneration therapy which include

a) As sole technique

b) In combination with bone material or bone substitute material

3 Combination of ridge augmentation using grafts followed by implant placement.

**Non-surgical methods:**

1 Fixed partial denture with gingival porcelain

2 Fixed partial denture with Long pontic

3 Removable flexible tooth mask made of pink silicone material

4 Fixed-removable partial denture (Andrew's bridge)

**What is Andrews bar?:** The purpose of Andrews bar is to splints multiple abutments on each side of an edentulous area. A precision-fitted metal sleeve inserts retentively on the bar, and removable prosthetic denture teeth are postured on the ridge, replacing pink acrylic processed to the sleeve. The machined bars and sleeves segment of one of four different-size perfect circles. Components of the same circle are interchangeable. The narrow width and great strength allow for restoration of all natural anatomic contours without creating unnatural bulk that encroaches tongue space.[10]

The bar and sleeve are manufactured from a unique stainless steel which has been thoroughly tested for biocompatibility and corrosion resistance which endures thousands of insertions and removals.

The restoration has proven to be durable, low maintenance, comfortable, and kind to the abutments and tissues under the ridge replacing acrylic. Theses remain completely healthy because the pontics are removed for through, unobstructed hygiene and are biologically fitted to the ridge.[11]

**Case report:** A 52 year old male patient reported to the department of Prosthodontics at V.S.P.M dental College and Research Centre with a chief complaint of poor esthetics due to missing teeth in the lower front region of the jaw since 7-8 months. Lower right and left incisors were missing (Figure.1). A patient had undergone for extraction of teeth due to mobility 7-8 months back. Patient had been wearing removable partial denture since 6 months, but was not satisfied. The radiographic findings showed that there was an angular bone loss in the chief complaint region. The defect is class III (Siebert's nomenclature) type C (Allen's Nomenclature).

**Treatment plan:** Treatment option was 1) Conventional fixed partial denture 2) Fixed removable partial denture 3) Implants. As patient is having a class III defects. In such condition, implant placement is contraindicated for long term success and there was a three sided defect so placing graft was not possible. For conventional fixed partial prosthesis, mock preparation and mockup was done. It was noticed that pontics height was increased due to ridge defect which gives the unaesthetic appearance and even in such cases it is difficult to maintain hygiene. In given case, final treatment was decided to give fixed removable prosthesis i.e. Andrew's Bridge.

**Procedure:** The abutment teeth 33 and 43 were prepared to receive porcelain fused to metal (PFM) crowns. Elastomeric impressions were made of lower arch using polyvinylsiloxane (aquasil) and master casts were poured in die stone (Type IV, ultrarock kalabhai). Pre-fabricated plastic bar attachment (CEKA) was attached to the wax pattern of copings according to ridge form (Figure.2). The bar along with the abutment copings was cast in cobalt chromium alloy. The complete framework was then checked in the patients for complete seating of copings and to check at least 3 mm of space between bar and alveolar ridge (Figue.3). Shade selection was done and ceramic build up- and firing was done accordingly (Figure.4). The bisque trial was taken. Then finishing, polishing and glazing was done and PFM crowns along with bar cemented with glass ionomer cement (GC Fuji) (Figure.5). After cementation, block-out was done undersurface of bar and alginate impressions were made and poured in stone (Type III, ultrarock kalabhai). Central and lateral incisors were arranged in the wax rim and the trial was done. After clinician and patient satisfaction as per phonetics and esthetics, acrylization was done.

There are two methods for attaching the sleeve in removable prosthesis are:

1) At the time of acrylisation,
2) After acrylisation.

In this case, sleeves were inserted after acrylization. The finished prosthesis was trimmed from the intaglio surface to make space for cold cure acrylic. The clip was placed directly on the bar. The polymer and monomer of auto polymerizing resin were mixed and when it comes to dough stage, these were placed in the intaglio surface which were trimmed before, and placed over the bar and clip. When initial setting was done, the prosthesis was removed along with sleeve. After complete setting of resin, prosthesis were finished and polished (Figure.6,7).

**Discussion:** Clinicians often come across clinical situations with localized alveolar ridge defects. It has been reported that only 9% of the patients with the anterior teeth missing between the two canines did not have ridge defects12. Class III (56% of cases) defects followed by horizontal defects i.e. class I (33% of the cases) are the most commonly seen in the clinics. 3-5% Vertical defects were reported to be found in the patients.[13] Such large bone defects pose a prosthodontics challenge as it is tough to restore function and esthetics. Such clinical situations are not productively treated by conventional fixed or removable prosthesis.

When clinicians planning for fixed in such large bony defects, unreplaced missing papillae invite food impaction and gives a black triangle appearance, which is esthetically unpleasant. Unlike Andrew's bridge all functional forces must be borne by the abutments. Missing papillae can be duplicated in acrylic without inviting food impaction trouble. Curved bars ensure all the lifting and depressed forces by the entire region and clip over the bar provides better retention.

**Conclusion:** After treatment, patient was recalled after 1, 3 and 6 months. Patient was satisfied with the function and esthetics of the prosthesis. Hygiene was maintained properly. No looseness was seen in the removable prosthesis with clip. There was no bone loss as compared to when the patient visited first time to the clinic. Hence, it is concluded that when there is severely resorbed ridges or periodontal compromised condition presenting in the anterior region, the Andrew's bar system is best modality for such cases. It serves all function like function, esthetics, phonetics and maintains the hygiene. Generally Andrew's bar system is used in esthetic region i.e. maxillary anterior[14] but in this case Andrew's bar was used in mandibular anterior region because of the age of the patient there was more display of lower anterior. So Andrews bar system can be indicated for lower anteriors.

**References:**

1. Studer S, Naef R, Scharer P. Adjustment of localized alveolar ridge defects by soft tissue transplantation to improve mucogingival esthetics: A proposal for clinical classification and evaluation of procedures. Quintessence Int 1997;28(12):785-805.
2. Seibert JS, Cohen DW. Periodontal Considerations in preparation for fixed and removable prosthodontics. Dent Clin North Am 1987;31(3):529-55.
3. Seibert JS. Reconstruction of deformed, partially edentulous ridges, using full thickness onlay grafts. Part I. Technique and wound healing. Compend Contin Educ Dent 1983;4(5):437-53.
4. Allen EP, Gainza CS, Farthing GG, Newbold DA. Improved technique for localized ridge augmentation. A report of 21 cases. J Periodontol 1985;56(4):195-9.
5. Seibert J, Lindhe J. Esthetics and periodontal Iherapy. In; Lindhe J (edl Textbook of Clinical Peri odontology, ed 2. Copenhagen; Munksgaard, I989;477-514.
6. Abrams L. Augmentation of the deformed residual edentulous ridge forfiMd prosthesis. Compend Contin Educ Denl 1980:1:205-213.
7. Langer B. Calagna L. The sub-epithelial connective tissue graft. J.Prosthet Dent l980.44;363-367.
8. Garher D, Rüsenberg E. The edentulous ridge in fixed prosthodontics, Compend Contin Educ Dent I9K l;3:212-224.
9. Seibert J. Ridge augmentation to enhance esthetics in fixed prosthetic treatment. Compenil Contm Educ Dent 1991; 12:548-560.
10. James A. Andrews, Walte F. Biggs. The Andrews bar and sleeve retained bridge: A Clinical Report. Dentistry Today 1999;8(4).
11. Mueninghoff L, Johnson M. Fixed removable partial denture. J Prosthodont Dent.1982;48:547-549.
12. Abrams H, Kopczyk RA, Kaplan AL. Incidence of anterior ridge deformities in partial edentulous patients. J Prosthet Dent 1987;57(2):191-4.
13. Garber DA, Rosenberg ES. The edentulous ridge in fixed prosthodontics. Compend Contin Edu 1981;2(4):212-23.
14. Ashish R. Jain. A prosthetic alternative treatment for severe anterior ridge defect using fixed removable partial denture Andrew's Bar system. World journal of dentistry, Oct-Nov 2013;4(4):282-285.


Fig. 1. Class III residual ridge defect

Fig. 2. Wax Pattern for Andrews's Bar and Metal copings

Fig. 3. Co-Cr Metal Copings and Framework trial in the Patient mouth. Proper clearence being checked between bar and soft tissue & bone.

Fig. 4. Shade selection for PFM crowns

Fig. 5. PFM crowns were cemented with Bar. sleeves attached to the bar

Fig. 6. Heat cure acrylic resin removable partial prosthesis with metal sleeves for bar attachment

Fig. 7. Definitive restoration with Andrew's Bar system


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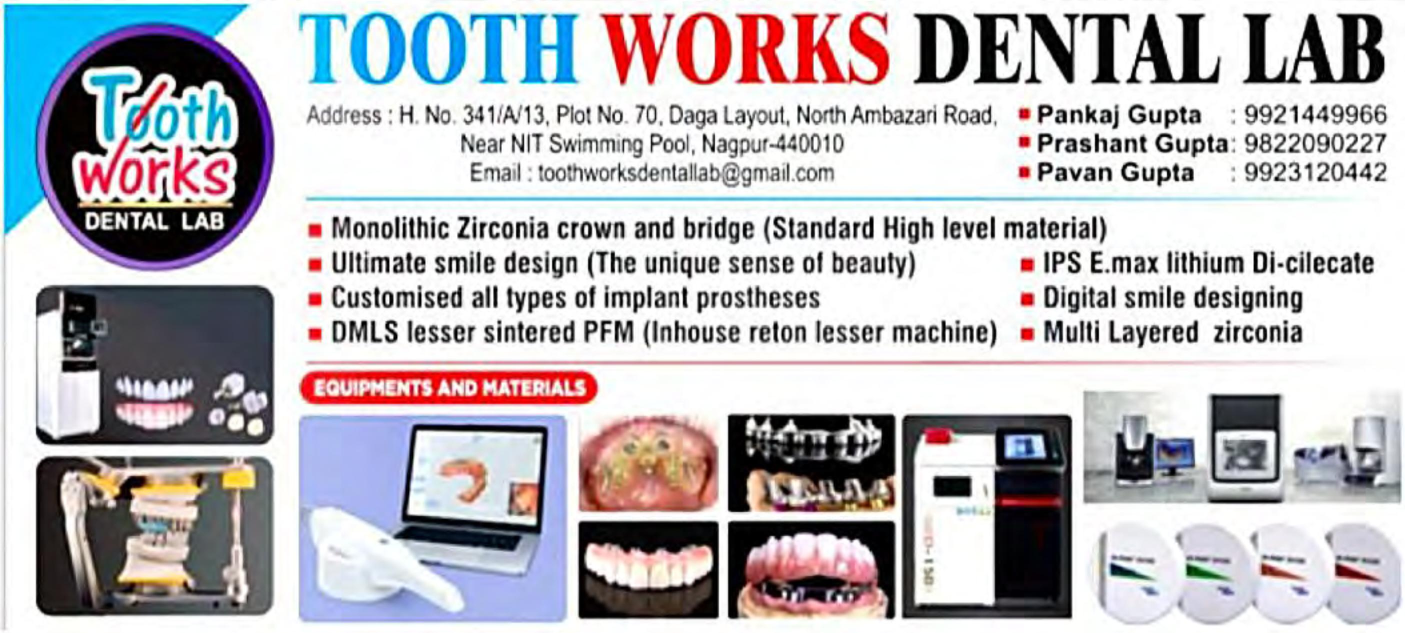

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