RECENT ADVANCES IN PROSTHODONTICS

Abstract

Dentistry has advanced well beyond tooth replacement to include the repair of lost alveolar components that support facial characteristics, aesthetic restoration, speech improvement, and a variety of other key breakthroughs. Most importantly, by combining artificial materials and cutting-edge technologies, dentistry can now provide a surprisingly lifelike appearance, demonstrating one of the pinnacles of human achievement. Prosthodontics progresses at a quick speed, not just in response to scientific developments, but also as a result of societal influences such as consumerism. In order to fulfil these desires, it is our duty to be updated with both knowledge and skills about new trends in prosthodontics, so that these aspirations can be met with. This chapter gives an insight about the various trends and concepts applied in the field of prosthodontics.

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I. INTRODUCTION

The allure of innovations captures human interest, particularly when these advancements yield tangible advantages. From the inception of human society, there has been an ongoing evolution marked by transformative milestones, ranging from the discovery of fundamental elements like wheels and fire, to the revolutionary emergence of supercomputers and gravity-defying aircraft.

Undoubtedly, our world has made remarkable progress along similar lines. In a parallel fashion, aspects of human well-being, such as oral and dental health, are undergoing significant shifts. The scientific and technological foundations of dentistry are rapidly expanding within a context where changes in healthcare management and financing, shifts in demographic trends, and heightened public expectations for an enhanced "quality of life" play substantial roles.

Dentistry has progressed far beyond mere tooth replacement, extending to the restoration of lost alveolar structures that support facial features, restoration of aesthetics, improvement of speech, and numerous other significant advancements. Most notably, through the integration of artificial materials and cutting-edge technologies, dentistry can now offer a remarkably natural appearance, showcasing one of the pinnacles of human achievement. Progress in the field of prosthodontics continues at a rapid pace, not solely in response to technological innovations but also as a result of societal forces like consumerism.

Central to prosthodontics is the restoration of depleted or damaged dentitions, a practice that encompasses a wide spectrum of approaches. However, the core principle remains the replacement of missing teeth and tooth structures. This principle is built upon the belief that reinstating the integrity of the dental arch holds therapeutic benefits for the patient, while selecting prosthodontic interventions with favorable mechanical characteristics is expected to positively influence treatment outcomes.

Unsurprisingly, definitions of prosthodontics as found in publications consistently exhibit a distinct technological viewpoint of the field. Arguably the most widely adopted definition of prosthodontics is as follows: "The branch of dentistry concerned with restoring and preserving oral function, comfort, appearance, and health through the utilization of artificial substitutes to replace missing teeth and adjacent tissues." Despite its widespread acceptance, there are individuals who find fault in the definition due to its lack of specificity concerning the desired levels of oral function, comfort, appearance, and health in various situations. For instance, it remains unclear whether the pursuit is for an ideal, maximum, or merely acceptable level of oral function.

Additionally, the definition lacks clarification regarding the extent to which missing teeth should be replaced, assuming it as an essential requirement. Simultaneously, both risks and benefits can be associated with prosthodontic procedures, as well as with abstaining from such interventions. A more comprehensive interpretation of the discipline was put forth in a recent article, defining prosthodontics as follows: "Prosthodontics encompasses the domain of dentistry that addresses the ramifications of congenital absence or acquired loss of oral tissues, while assessing whether the insertion of alloplastic devices yields a favorable balance of benefits over drawbacks." This definition stands out for its broader scope, focusing not only on the consequences of diminished oral tissues but also on the evaluation of outcomes resulting from the modification of these conditions, instead of solely emphasizing the technical facets of prosthodontics.

Furthermore, this comprehensive definition acknowledges the inclination of dentists to gauge their patients' treatment needs primarily through morphological considerations. Dentists often assess these requirements at a more intensive level compared to patients, underscoring the gap between what is deemed necessary and what is actually requested. This disparity is exacerbated by dentists' tendency to operate within the confines of specific technical sub-disciplines of prosthodontics, such as complete dentures, removable partial dentures, fixed partial dentures, and implant-supported prostheses. This can lead to a disproportionate focus on mechanical factors and possibilities, potentially hindering the crucial diagnostic phase of the treatment process.

Despite the absence of substantial scientific support for a direct link between mechanics and function, prosthodontics has, nevertheless, managed to leverage this approach to significantly enhance patients' quality of life. Conversely, the considerable expenses and various other barriers to treatment limit access to comprehensive care for most individuals, barring a fortunate minority. Furthermore, alongside challenges arising from factors like economic disparities, shifts in patterns of dental ailments and tooth loss contribute to a growing number of older adults retaining some of their natural teeth for longer periods. These retained teeth often necessitate extensive restorations, which can be intricate and demand considerable time and advanced skills to uphold.

The argument favoring the necessity for altering the way treatment is provided to accommodate this emerging reality is compelling. Solving such a challenge will demand a combined endeavor from the dental field and society, as the conventional prosthodontic methods for addressing this issue seem impractical and inadequate when considering the entire population. Given the current knowledge, this text endeavors to delineate the advancements in prosthodontics and its areas of treatment.

II. ADVANCEMENT IN COMPLETE DENTURES

1. **A CAD/CAM System for fabrication of Complete Dentures:** This study aims to explore the development of a Computer-Aided System designed for the creation and production of Complete Dentures. Historically, the utilization of CAD/CAM technology has primarily concentrated on fixed restorations such as inlays and crowns, primarily due to the challenges associated with accurately capturing soft tissue morphologies in edentulous areas and intricacies related to interocclusal relationships.

   Nevertheless, recent advancements in optoelectronic measuring units and CAD software have substantially improved the methods for capturing and quantifying three-dimensional shapes.

   Procedure

   - Involve three major steps:
   - Impression procedure.

- Denture designing.
- Denture fabrication.

Figure 1: Steps in Fabrication of CAD/CAM Denture.

2. **BPS Dentures:** The Biofunctional Prosthetic System (BPS) brand denture encompasses a comprehensive approach that covers various aspects including impression-taking, record-keeping, tooth placement, fabrication, and processing. The key advantage of this approach is its ability to provide patients with complete dentures that offer the highest levels of form, function, and aesthetic appeal. The foundation of this system lies in a collaborative effort and a systematic method for removable prosthetic treatment.

Figure 2: BPS Dentures.

3. **Advancement in injection molding techniques (Valplast):** Valplast stands as a flexible denture base resin (polyamide) uniquely suited for partial dentures. Formulated from a biocompatible nylon thermoplastic, this resin possesses exceptional physical and aesthetic characteristics. Notably, Valplast's distinctive trait is its capacity to allow the natural tissue tone of the patient to shine through the material, which comes available in three different shades. Furthermore, the product offers a lifetime guarantee against any breakage.

   They might also be available through your laboratory

Figure 3: Valplast.

4. **Advancement in Thermoplastic Resins (THERMOPRESS 400):** The THERMOPRESS 400 injection molding system enables the processing of highly biocompatible materials for the creation of quality restorations that are free from metal. Thermopress restorations are recognized for their enhanced aesthetics and natural appearance, often surpassing comparable metal restorations [9]. The THERMOPRESS 400 system stands out for its user-friendly operation, featuring fully programmed parameters and settings for each injection material. Additionally, it incorporates two simultaneously heated injection channels, promoting rapid and efficient workflows [9].
   Five advanced thermoplastic resins provide a wide range of indications:

   - Bre.Dentan:
   - Bio Dentaplast:
   - Bio XS:
   - Bre.flex:
   - Bre.Crystal:

Figure 4: Thermopress 400.

5. **Advancements in Artificial teeth:**

   - **SR Vivo TAC, SR Ortho TAC:** The ready-made SR Vivo TAC teeth empower dental technicians to incorporate both esthetic and functional factors while creating stents. These stents, in turn, play a crucial role in aiding dentists to establish implant positions accurately. Thus, these stents serve as invaluable communication tools between dentists and dental technicians.

These teeth, made from radio-opaque resin, streamline the process of planning implant-supported restorations. This efficiency allows dental professionals to precisely define the implant's ultimate location in a straightforward and time-efficient manner.

Figure 5: SR Vivo TAC, SR Ortho TAC.

- **SR Phonares tooth lines (Ivoclar):** Ivoclar Vivadent introduces its latest nano-hybrid composite (NHC) based sets of teeth. Featuring a straightforward selection process, the tooth molds are organized into readily identifiable groups. This innovative approach enables the easy selection of teeth that best correspond to the individual traits of each patient.

  SR PHONARESTyp NHC:
  SR PHONARESLingual NHC:

Figure 6: SR Phonares tooth lines (Ivoclar)

- **SR Trio DCL and SR Triolingual:**
  - **Triolingual DCL**. When opposing a Trio arrangement, choose the upper SR Ortholingual® DCL posterior denture teeth.
  - **SR Triotyp DCL** exhibits a semi-anatomic occlusal design, suitable for use in complete and partial dentures where applicable. For opposing a Trio setup, opt for the corresponding upper SR Orthotyp® DCL posterior denture teeth.

- **SR Ortholingual DCL (Double cross-linked):** The SR Ortholingual DCL presents a straightforward and functional setup approach, especially tailored for the lingualized setup theory in implant-supported dentures. This particular denture tooth line is not only user-friendly but also remarkably adaptable. The three-layer composition lends these teeth an authentically lifelike look, rendering them a perfect match for intricate cases in both clinical practice and laboratory settings.The occlusal surfaces of these teeth are meticulously designed to align with the lingualized occlusal scheme.

Delivery forms:
- 3 upper posterior moulds: LU3, LU5, LU6.
- 3 lower posterior moulds: LL3, LL5, LL6.

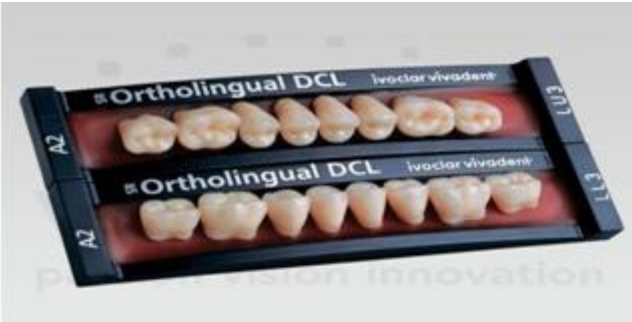


Figure 7: Ortholingual DCL

- **SR Orthoplane DCL:** The 0-degree SR Orthoplane DCL posterior teeth exhibit a straightforward occlusal design. These SR Orthoplane DCL teeth are notably suitable for geroprosthodontics. The SR Orthoplane DCL tooth series is created to cater to a broad spectrum of applications. These teeth are recognized for their uncomplicated occlusal structure. Crafted from double cross-linked material, SR Orthoplane DCL teeth have undergone toxicological assessments, affirming the advanced resin's biocompatibility.

Delivery forms:
- 3 upper posterior moulds: MU3, MU5, MU6.
- 3 lower posterior moulds: ML3, ML5, ML6.

Figure 8: Orthoplanes DCL.

6. **Laser Application in the Treatment of Denture - Induced Mucosal Lesion:** The utilization of low-energy lasers has garnered significant attention in recent times. These lasers are primarily applied to alleviate pain, diminish inflammation and swelling, and expedite the healing process. Investigations into the biological impacts of low-energy lasers have centered on their capacity to enhance blood circulation in regenerating tissues, boost collagen production by fibroblasts, and induce a suppressive influence on the immune system.

7. **Stafne's Bone Cavity and its utilization in Complete Denture Retention:** In 1942, Stafne described a series of asymptomatic radiolucent lesions situated near the mandibular angle. Subsequent findings have revealed that this condition corresponds to a distinct concavity in the cortical bone along the lingual surface of the mandible.

   Due to their location, these bone cavities have also been termed lingual/mandibular salivary gland depressions or lingual/cortical mandibular defects. Although presumed to be developmental, these defects do not seem to be present at birth. Occasionally, the defect may manifest bilaterally.

III. ADVANCEMENTS IN FIXED PARTIAL DENTURES

1. Dental Occlusal Analysis System T-Scan® III:

- For a significant period, analyzing dental occlusion was primarily a speculative endeavor for dental professionals.
- Dentists relied on tools like articulation paper, waxes, and pressure indicator paste to evaluate and equilibrate occlusal forces.
- Many of these methods lacked the sensitivity to detect simultaneous contacts, and none gauged both force and timing. Tekscan addressed this challenge by introducing the T-scan system.
- The success of T-Scan's grid-based sensor technology was so profound that Tekscan extended the same technology to numerous other applications, leading to the establishment of Tekscan's Medical and Industrial divisions.

Figure 9: T-Scan demonstration.

Figure 10: T- Scan III System.

2. Advancements in Shade Selection

- **Digital Shade Guide DSG 4 Plus:**
- **Shade Eye NCC by Shofu:**

Figure 11: Shade Eye NCC by Shofu.

- **ShadeScan™ by Cynovad:**

Figure 12: ShadeScan by cynovad.

- **VITA Easyshade by Vident:**

Figure 13: VITA Easyshade.

- **Shade Vision Systems by X-Rite T:**

Figure 14: Shade Vision Systems by X-Rite T.

3. Advancements in use of CAD/CAM:

Zirconia in crown and Bridge (CAD/CAM)
• CAD ZIRCONIA COPINGS (3M LAVA, PROCERA, CERCON, ETC) • CAD ZIRCONIA CROWNS (CEREC) • CAD ZIRCONIA POSTS

CAD Ceramics:

E-max CAD	Lithium Disilicate Glass-Ceramic. To be used with Cerec.
Empress CAD	IPS Empress® CAD is the esthetic leucite-reinforced glass-ceramic for the efficient fabrication of highly esthetic, fully anatomical crowns
Wide YZ Cubes	Yttrium Stabilized Zirconium
VITABLOCS® Guide 3D-Master	Nethaline Feldspar Ceramic

- In Ceram (Vita Zahnfabrik Germany).
- Procera (Nobel Biocare).
- Empress (Ivoclar Vivadent).

Figure 15: Digital Impression & fabrication of prosthesis.

- **Computer Aided Design/Computer Aided Machine (CAD-CAM)**: In 1985, the first chair side ceramic inlay produced via a CAD CAM unit, specifically Cerec by Siemens in Germany, was introduced. Since then, various subsequent developments have occurred, including the introduction of a second generation in 1994, followed by Cerec3 in 2000.

  Cerec 3 encompasses both an acquisition and a milling unit, allowing for simultaneous design and production of restorations. The software can be enhanced with the Cerec 3 crown module, featuring a tooth library and suitable for crafting posterior restorations and anterior crowns.

  Shoulder Porcelain:
  Opalescent Porcelain:
  Castable Ceramic:
  Ceromers:

Figure 16: CAD machine.

Figure 17: CAM machine.

4. **Non-Metal Post Systems:** The recent years, non-metal alternatives for post system have been introduced.

   - **Composite Post System.**

     Carbon fibre Post:
     - **Composipost:**
     - **Carbonite:**
     - **Mirafit Carbon:** Identical to Carbonite.

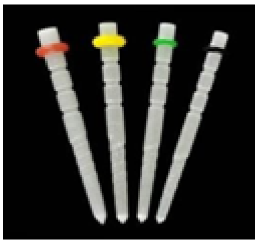


Figure 18: Carbon fiber posts.

Silica Fibre Post:
- **Aesthetipost:**
- **Aesthetiplus post:**
- **Snow post (l.mm, 1.2mm, 1.4mm):**
- **Light transmitting post:**

- **All Ceramic Post And Cores:** Using metal posts and cores along with all-ceramic restorations for endodontically treated teeth might result in compromised aesthetics due to the partial translucency of ceramics and the opaque metal substructure of the underlying post and core.

Dental ceramic materials used for all-ceramic post and core:
- Traditional dental ceramics
- High-toughness ceramics like glass-infiltrated alumina ceramic (In-Ceram)
- Dense-sintered alumina ceramic Procera
- Zirconium oxide ceramics

Techniques or construction of all-ceramic post- and core with high toughness ceramic materials:

- Slip-casting technique.
- Copy-milling technique.
- Two-piece technique.
- Heat-press technique.

Other Pre-fabricated All-ceramic post:

- BIOPOST (Incermed SA, Lausanna, Switzerland)
- TZP post (Maillefer SA, Ballaigues, Switzerland)
- Cera post (Komet)

Figure 19: All Ceramic Posts.

Ziroconia Ceramics

- Cosmopost™ (Ivoclar Vivadent):
- Cerapost (Komet, GEBR Brasseler GmbH):
- Ceracap (Komet):
- IPS Empress® Cosmo Ingot:

Figure 20: Zirconia posts.

5. **Advancements in Temporization:**

- **CAD Acrylic Temporaries (Telio CAD):**

Figure 21: Telio CAD.

- **REVOTER LC™Light Cured Composite Resin for Temporary Restorations:**
- **UNIFAST LC Light Cured Temporary Resin Material:**

Figure 22: UNIFAST LC.

- **Fermit / Fermit N:**
  Fermit – high elasticity:

Figure 23: Fermit

- **Systemp, c&b:**

Figure 24: Systemp. c&b II.

- **Protemp™ Crown Temporiastion Material:**

Figure 25: Protemp.

- **GC TEMP ADVANTAGE® Temporary Cement:**

Figure 26: GC TEMP Advantage.

- **Systemp. Link:** Systemp. Link represents a dual-curing luting composite designed for aesthetically pleasing temporary cementation of provisional crowns, bridges, inlays, onlays, and veneers.

6. **Advancements – Gingival Retraction Techniques**

- **Lasers for gingival retraction:**

Figure 27: Gingival retraction using Laser.

- **EXPASYL Gingival retraction paste:**

Figure 28: Gingival retraction using Expasyl.

Figure 29: Expasyl Kit.

- **Stayput:**

Figure 30: Stayput.

- **Magic Foamcord**

Figure 31: Magic Foamcord.

- **Comprecord**

Figure 32: Comprecord.

- **Matrix Impression Technique**

7. **Laser Use In Fixed Prosthesis**

- Precise management of the oral environment at the operative site is crucial.
- Often, situations arise where adjustments to gingival tissues are necessary due to inflammation in the area, previous subgingival restorations, or underlying subgingival decay.
- Placing the finishing line close to the epithelial attachment
- Persistent bleeding in the gingival sulcus can hinder the process of creating an impression.

8. **Chair Side Pre Fabricated Fibre Reinforced Resin Composite Fixed Partial Denture:** The introduction of pre-impregnated fiber-reinforced resin composite has presented the field of dentistry with an opportunity to craft and deliver tooth replacements that are adhesive, aesthetically pleasing, and devoid of metal.

The incorporation of pre-impregnated fiber-reinforced composite (FRC) has introduced an additional avenue for creating fixed partial dentures (FPDs) chairside.

9. Other Recent Advances
- The 3M ESPE Lava™ Chairside Oral Scanner C.O.S.
- LUMINEERS® BY CIRCINATE®

Figure 33: Lumineers.

IV. ADVANCEMENTS IN REMOVABLE PARTIAL DENTURES.

1. **Titanium Removable Partial Denture Clasp:** Despite some instances of casting defects, the flexibility and durable retentive capabilities of clasps indicate that titanium and its alloys are appropriate for Removable Partial Dentures, particularly in cases involving deep undercuts.

Figure 34: Ti-6AL-4V clasp.

2. **Optical Surveying of Cast for Removable Partial Denture:** Surveyors play a crucial role in establishing the path of insertion for Removable Partial Dentures (RPDs). Essentially, a surveyor comprises a movable platform upon which a cast is positioned and tilted in various directions relative to a vertical red marking.

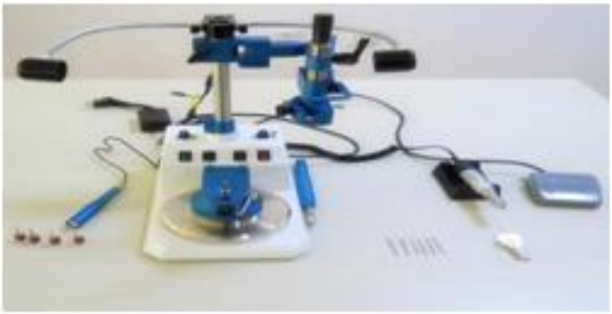


Figure 35: Optical Surveyor.

3. **Acetal Resin Clasp:** You can now offer your patients the perfect fusion of benefits. Acetal Resin Clasps, formulated from a high-strength thermoplastic techno polymer, boast a crystalline structure devoid of monomers.

Figure 36: Acetal Resin Clasps.

4. **Laser Sintered RPD (Lasermet RPD)**

Figure 37: Laser sintered Removable Partial Denture

5. **Computer-aided design and rapid prototyping fabrication of removable partial denture framework:** A patient's plaster cast underwent digital scanning using an optical scanner. The obtained surface data were imported into three-dimensional (3-D) software. Within this software, the data underwent preprocessing, enabling the design of each component of the RPD framework while referencing the digitally scanned model.

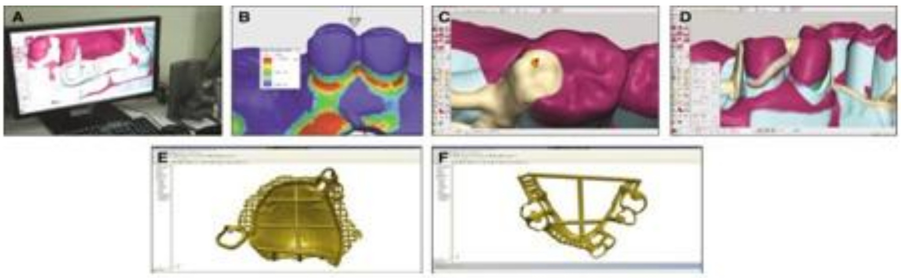


Figure 38: CAD/CAM fabrication of Removable partial denture framework.

V. ADVANCEMENTS IN MAXILLO-FACIAL PROSTHESIS

1. **CAD/CAM Technology In Maxillo-Facial Prosthodontics:** The adage 'a picture is worth a thousand words' has been reimagined by users of stereolithography to convey the idea that 'a single tangible prototype holds the value of a thousand images.'

Stereolithography is a rapid prototyping technique that generates tangible models by selectively solidifying a UV-sensitive liquid resin using a laser beam.

- **Stereolithography Process:** A software segment dissects a CAD model into thin layers, typically around five to ten layers per millimeter. The 3D printer employs a laser to "paint" a single layer by exposing and solidifying liquid plastic within a tank. This procedure commences with the solidification of the object's outer borders, followed by its internal components.

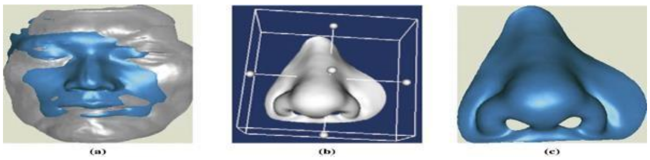


Figure 39: CAD aided fabrication of prosthesis.

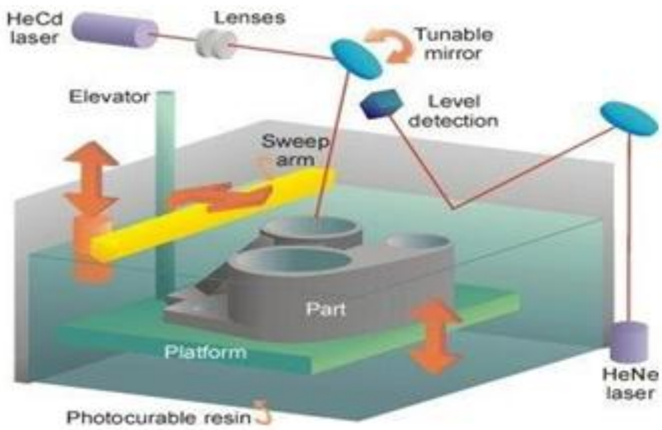
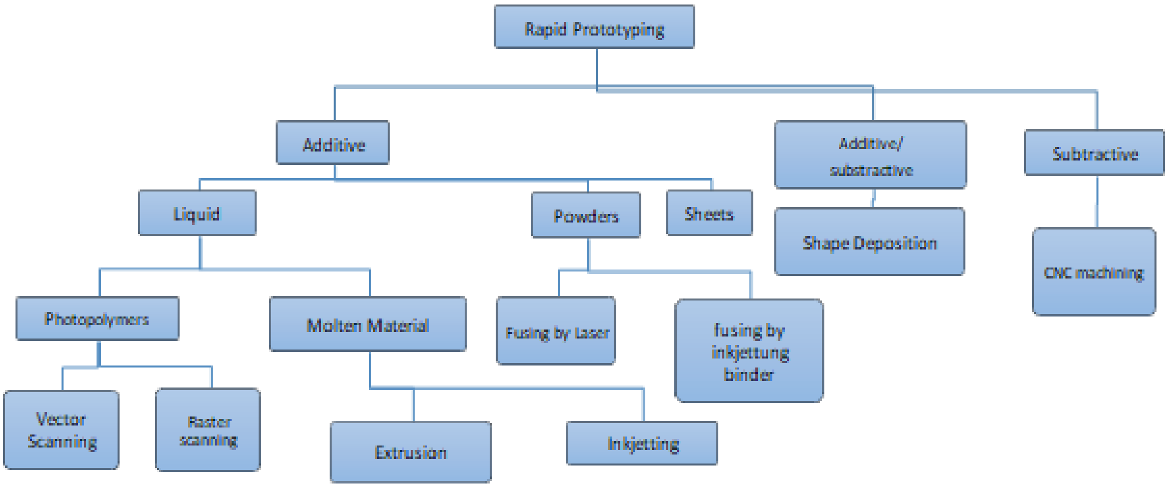


Figure 40: Mechanism of Stereolithography.



Additive Techniques Stereolithography	**Subtractive techniques**
Implant surgery.	CAD custom implants.
Maxillofacial Prosthodontics.	CAD implant abutments.
Laser sintered implants.	CAD custom implant.
Laser sintered copings.	CAD Zirconia crowns cerec.
Laser sintered R.P.D.	CAD Zirconia copings, lava, cercon, procera.
Complete Denture duplication	CAD Zirconia post and cores.
	CAD milled metal copings.
	CAD milled temporisation, telio.
	CAD milled acrylic copings, cad wax, IPS Acryl CAD.
	3MParadigm MZ100 block for CEREC (composite).

Figure 41: Stereolithography Machine.

2. **Laser Sintering:** The majority of CAD/CAM frameworks are commonly crafted from ceramic materials, often zirconia. In situations where cost is a primary consideration, Direct Metal Laser Sintering (DMLS) can serve as a substitute for the zirconia machining process, producing metal-based alternatives. This advanced technique, occasionally referred to as '3D printing,' constructs each framework by layering successive thin strata (each about 0.20mm thick).

3. **Materials In Maxillo-Facial Prosthodontics**

   - MPDS -- Silicone Block Copolymers
     (Methacryloxy propyl-terminated poly dimethyl siloxane):
   - SILPHENYLENES:
   - POLYPHOSPHAZENES:
   - MDX 4 – 4210:

Figure 42: MDX4-4210.

4. Advances In Ear Prosthesis

- **The Baha System:** Osseointegrated implants offer an additional advantage, particularly in relation to retaining bone-conducting hearing aids. An alternative hearing device called the Baha, produced and distributed by Cochlear Corporation, serves as an option for individuals who are unable to use conventional hearing instruments.

  This device is particularly suitable for patients facing medically untreatable conductive hearing losses, such as bilateral atresia or chronic middle ear issues. Additionally, the FDA has recently sanctioned the utilization of the Baha as an alternative to CROS hearing aids for patients with unilateral sensorineural hearing loss.

Figure 43: Baha System.

5. **Advances in Eye Prosthesis:** Scientists affiliated with the Boston Retinal Implant Project have been diligently crafting a bionic eye implant aimed at potentially restoring vision to individuals grappling with age-related blindness.

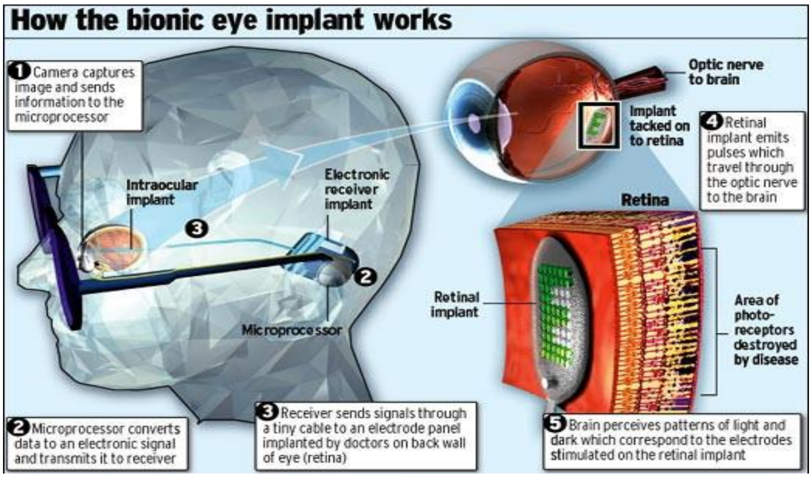


Figure 44: Bionic Eye.

6. **A Titanium and Visible Light Polymerized Resin Obturator**.

   Advantages:

- Decrease weight.
- Increase facilities in fabrication.
- Increase facilities in adjustment

VI. ADVANCEMENTS IN IMPLANT DENTISTRY

1. Implant Surface Treatments

- **Implant biomimetic agents – Biometric agents** – it is an agent / material able to replicate or imitate a body structure (anatomy) and/or function (physiology).
- **Implant biometric agents-requirements:**
  - ➢ Potential to stimulate the differentiation of specific cells, thereby promoting improved new bone growth.

- **Classification**
  - ➢ **Bioceramics :**
    Hydroxyapatite
    Calcium phosphate phase
  - ➢ **Bioactive proteins :**
    Bone morphogenic proteins
    Type 1 collagen
    Growth factors
    RGD peptide sequence
  - ➢ **Ions :**
    Fluoride
  - ➢ **Polymers :**
    Chitosan

Following are the manufacturers/Researchers and their advancements in Surface Treatment of Implants:

- Straumann:(SLA active New Hydrophilic Implant Surface Treatment)
- Straumann:(Biofunctional Imlpant Coating)
- Straumann:(Mussel-Based Implant Adhesive Coating)
- Universite de Montreal:(Intelligent Metal Surfaces direct Osteoblast Cell Activity)
- Bicon:(NanoTite – HA splutter coated titanium surface)
- Osteohealth:GEM 21S – Recombinant human platelet derived growth factor (rhPGDF-BB)
- Biomet/3i:(Nanotite Implant).
- Densply Friadent:(BioPore Sructuring)
- Nobel Biocare:(Ti-Unite to feature BMP-2 coating)
- .Canadian Researchers at the NRC Industrial Material Institute (NRS-IMI) in Boucherville, Quebec:(Titanium Foam-New Implant Surface)
- Thommen Medical:(New Implant Packaging APLIQUIQ)
- Independent Research:(NanoTitanium Ultrafine Grain Metal)

Research indicates that these novel metals facilitate bone integration up to 20 times quicker than traditional metals. As a result, patients are expected to have reduced healing periods following surgery, along with enhanced and dependable fusion of these fresh implants with their bodies.

- **SLA -**Sand blasted and acid etched.
- **RBM -** Resorbable blast media.
- **TPS -** Titanium plasma sprayed.

2. Advancements In Implant Design

- Prosthetically driven guided surgery (Noble Biocare)
- Platform Switching:
- LOCATOR® IMPLANT ATTACHMENT SYSTEMS
- Reverse abutments (MIS implants):
- All on four concept (Noble Biocare):
- Differentiated osseointegration:
- Custom made zirconia implants, Wolfgang Pirker, Alfred Kocher, Vienna, Austria:
- Bioimplant : Individualised Zirconium Implants
- Z-System's Zirconium Implants and Surgical Instruments
- Straumann's Roxolid TiZr Alloy Implant
- Nobel Biocare's Groovy Implant Surface
- Branemark System
- Bone level Implant Designs
- Straumann's new Bone level implant:
- Straumann's New Asymmetrical Implant:

- Anatomic® Implant system bu Innova:
- Injection Moulded Zirconia Abutments

3. Other Advancement in Implantology

- **Implant Location System:**
- ➢ MIS Crest Widener Kit:
- ➢ Drug Delivering Prosthetic Implant:
- **Implant Guidance System:**
- **Robotic Smart Drill:**
  The Baha System, an Osseointegration:
- **Implant simulator:**

4. Advancements in Surgical Methods:

Piezoelectric surgery	Thanks to the controlled three dimensional ultrasound vibrations, the original PEIZOSURGERY technique opens up new age for osteotomy and osteoplasty in Implantology, Periodontology, Endodontics and surgical Orthodontics. • Bony window osteotomy in sinus lift • Ridge expansion • Bone harvesting: chips • Bone harvesting: blocks • Osteoplasty. • Implant site preparation • Extraction for immediate implant positioning • Elevation of Schneider's membrane
Distraction Osteogenesis	Distraction osteogenesis, also known as callus distraction, callotasis, and osteodistraction, is a surgical technique employed to correct skeletal deformities and extend the length of long bones in the body. This method involves the utilization of a corticotomy to create a controlled bone fracture, dividing the bone into two segments. During the distraction phase, these bone ends are incrementally moved apart, creating a gap that prompts the formation of new bone. Following the achievement of the desired or feasible length, a consolidation phase ensues, allowing the bone to continue its healing process. The advantage of distraction osteogenesis lies in its simultaneous enhancement of bone length and the volume of adjacent soft tissues.

Balloon Sinus Lifter	An innovative balloon sinus lifter has been introduced, offering a less invasive hydraulic approach for sinus lifts (both internal and lateral methods). This advancement minimizes the potential for membrane tears. The micro-mini balloon, when filled with saline using a 5cc syringe, inflates to 1.9mm. Applying gentle pressure to the membrane, the sinus graft space is expanded in a controlled manner, eliminating the need for sharp instruments.

5. **Laser Use in Implant Dentistry:** The significance of establishing a conducive environment for soft tissues surrounding the perimucosal region of implants cannot be overstated. Every implant necessitates traversing the submucosa and the superimposed stratified squamous epithelium.

   Misch emphasized that this junction serves as a critical connection point between secure prosthetic attachment and the dependable bony support of the implant. The gingival epithelium or biological seal emerges as a pivotal element influencing implant longevity.

   When utilizing laser technology as opposed to traditional surgery, the creation of a biological seal right from the outset of implant uncovering gains prominence. This approach results in the attached gingiva healing directly around the implant, forming what can be termed an epithelial cuff.

   Protective exposure of implants can be executed using laser energy. In cases where soft tissues exceed a thickness of 3mm, laser reduction can be applied to attain an optimal pocket depth around the implant.

6. **Advancements in use of Zirconia**

Zirconia in Implantology:
• CAD CUSTOM MADE ZIRCONIA IMPLANTS. • ZIRCONIA IMPLANT DRILLS. • ZIRCONIA COLLARED IMPLANTS. • INJECTION MOLDED ZIRCONIA ABUTMENTS. • CAD IMPLANT ABUTMENTS.

7. **Advancements in Ceramics for use in Dental Implants:** The ceramic materials developed for coating the dental implant surface are basically of two types:
   - **Bioactive ceramics:** Ceramics – e.g.: a) Calcium phosphates such as fluorapatite, and tricalcium phosphate; Bioglasses.
   - **Inert Ceramics** – e.g: Aluminium oxide (Alumina); Zirconium oxide.

   Methods for applying ceramic materials as coatings for dental implants:
   - Plasma Spraying (40-60µm).
   - Vacuum Deposition techniques :
     - Ion-beam sputtering (1-2µm)

  - ➢ RF sputtering (1-3µm)
  - ➢ Pulsed laser deposition (1-5µm)
- Sol-gel & Dip coating methods (5-20µm)
- Hot - isostatic pressing (20-l00µm)
- Electrolytic Process :
  - ➢ Electrophoretic deposition (10-30µm)
  - ➢ Electro-deposition (20-40 µm)

Implant supported ceramic restorations:

- **Cera One Abutment (Nobel Biocare, Branemark System):** CeraOne abutment system provides:
  - ➢ Premanufactured, hexagonal, and system-compliant ceramic constructed from aluminum oxide.
  - ➢ Gold cylinder components intended for utilization alongside ceramic materials, like tailor-made Celay In-Ceram Crowns.

VII. ADVANCEMENTS IN LASERS

Commonly used Lasers in Dentistry:

- Argon
- Neodymium: YAG
- Erbium family
- Co_2

1. **Argon:**
2. **Neodymium: YAG:**
3. **Erbium family:**
4. **Co_2 :**

Figure 45: Portable Laser Machine.

VIII. ADVANCEMENTS IN MATERIALS

1. Advancements in Impression Materials

- ROMP(Ring-opening metathesis polymerisation)
- Light cured impression trays
- EXAFAST™ fast set VPS Impression Material
- EXA'lence™ Vinyl Poly
- Virtual CADbite Registration
- CEO HYDROPHILIC GEL™
- Vinyl Polysilozane Indicator Material FIT CHECKER™II
- TRAY ADHESIVE REMOVER For use with All Metal Trays
- QUAD-TRAY Xtreme METAL Dual arch Impression
- Tray:
- Triple tray impression technique:
- Improvements In Alginates:
- Impression Material Mixing Instrument (Pentamix 2):

2. Advancements in Waxes

- Light cured pattern waxes
  - Used to make patterns for R.P.D.
- Metacon Light-Cured Wax Patterns (F.P.D.)

3. Advancements in Investing materials:

- GC FUJIVEST SUPER
- GC FUJIVEST II
- GC Stellavest

4. Advancements in Bite Registration Material:

- GC EXABITE
- RAMITEC PENTA
- DIMENSION BITE(60 seconds)

5. Advancements in Flasking Stone

- GC ADVASTONE
- GC STONE GLAZE LIQUID
- Dissolving Agent for Dental Stone & Plaster

6. Advancements in Luting Cements

- GC FUJI PLUS
- GC FUJI PLUS EWT
- TWINLOOK

7. Advances in Dental Diamond Burs: Traditional diamond burs have several limitations, including inconsistent grain shape, challenges in automating fabrication, decreased cutting efficiency due to repeated sterilization, and the potential release of Ni+ ions from the metallic binder into bodily fluids.

A novel rotary diamond instrument has been developed using a continuous diamond film obtained through Chemical Vapor Deposition (CVD). Following cutting tests, SEM examination and Electron Microprobe Analysis (EMA) were conducted to identify any metallic residue on both the bur's surface and the substrate.

8. Advancements in Other Materials

- Denture Comfort with Steradent
- GC Fit Checker
- GC Fit Checker II
- GC METAL PRIMER II
- GC ACRON MC
- GC PATTERN RESIN LS
- Composite Restorative Material Unifil F

Other Miscellaneous Advancements

- Primosplint-light cured MMA
- Monoblock technique
- Osteo Odonto Kerato Prosthesis
- Device for Ultrasonic Imaging of Jaws
- BloMedavie's GumEast – Cryo-Anesthetic Dental Mouthpiece
- Dento-Munch – A Robotic Chewing System
- Applications of Nanorobotics to Dentistry
- Nanotechnology in Dentition Renaturalization Procedures
- Nanotechnology in Durability and Appearance
- Nanotechnology in Dental Hypersensitivity
- Various Nanotechnology Products:
  - Nanocream- Nano Aluminium Oxide Fibres
  - Nano Filtration:
  - Nanoporous Silica-Filled Composite:
  - Nanoadhesive – Poss

- NV 101-Local Anesthetic Reversal Agent
- Gold Nanoparticles Laser Sintered to Reduce Dentinal Hypersensitivit
- Banking Stem Cells from Human Exfoliated Deciduous Teeth (SHED)
- Titanium casting
- NTI-tss Device
- Air-Abrasion
- Dust free water blaster
- Versyo.com:Heraeus-Kulzer
- Ni-ti

IX. CONCLUSIONS & SUMMARY

The discipline of prosthodontics has undergone substantial changes over the past few decades, primarily due to advancements in new materials, techniques, preventative measures, and enhanced dental health. These changes are likely to persist and potentially introduce new initiatives. The evolution of dental implants and emerging technologies such as adhesive methods, high-strength ceramics, and CAD/CAM technologies are gradually becoming integral components of mainstream prosthodontics.

However, while these advancements have led to significant shifts in clinical practices, dental education seems to be lagging behind in various aspects. Nonetheless, the focus on pushing forward with advanced technologies in prosthodontics and related fields is expected to continue in numerous institutions. Despite this, conventional prosthodontic treatments, including removable dentures, will maintain their crucial role in everyday dentistry across most parts of the world. This scenario is often influenced by socio-political disparities.

Anticipating how the prosthodontic profession will respond to this broader perspective is challenging. Regardless, it is important to aspire to align these factors with the future evolution of prosthodontic education and research, even if existing data and ongoing trends may not yet definitively indicate such a trajectory.

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