International Journal of Current Advanced Research
ISSN: O: 2319-6475, ISSN: P: 2319-6505, Impact Factor: 6.614
Available Online at www.journalijcar.org
Volume 9; Issue 02 (B); February 2020; Page No.21217-21222
DOI: http://dx.doi.org/10.24327/ijcar.2020.21222.4164

Research Article

ADVANCEMENTS IN COMPLETE DENTURE PROSTHESIS-A REVIEW

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A R T I C L E I N F O

Article History:
Received 12th November, 2019
Received in revised form 23rd December, 2019
Accepted 7th January, 2020
Published online 28th February, 2020

Key words:

Denture marking,Denture labelling, CAD/CAM, CEREC,Magnets, Bio functional prosthetic system.

A B S T R A C T

Complete dentures are prosthetic devices fabricated to replace all missing teeth and are supported by surrounding soft and hard tissues of the oral cavity. According to the condition and patient need different types of dentures are made. Complete denture uses to support facial muscle and decrease the oral bone loss and create self-confident among patients. This article throws light on technique of making different types of complete denture prosthesis.

INTRODUCTION

Complete Dentures Prosthodontics involves the replacement of the lost natural dentition to provide favorable support and stability for the dentures, with the preservation of alveolar bone[1].More dental care and new products are being developed in shorter time periods, as the patients become more active and demand to improve clinical efficiency by combining two or more steps into one[2].

For the patients facing the loss of all the natural teeth, there are three treatment options. One is for the patient to have all remaining teeth extracted and wait six to eight weeks for the extraction sites to cure. Following healing, leaving the patient without teeth not only during the curing phase but also during the time required for the manufacturing of complete denture. A second option is to change an existing removable partial denture into an interim complete denture. A third option is to make a conventional immediate complete denture[3].

Tray Byte (Dentsply Tray byte) combines the edentulous custom tray with a prepositioned occlusion rim that allows for impression-making and recording centric and vertical relationships during the same appointment. This technique can shorten clinical fabrication steps from five appointments to three. Other "three visit denture systems" may not use occlusal rims (the so-called "mush-bite") or they may skip the final wax try-in[2]. The dentogenic concept was proposed by John P. Frush and Roland D. Fisher to bring in a revolution into the esthetics in artificial dentures in 1955.

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Characterizations of these dentures add as a compliment to the esthetic factor in false denture. Complete dentures must be as aesthetic as its use. "Denture characterization is modification of the form and shade of the denture base and teeth to produce a more lifelike appearance" according to the GPT8 [4].

Review of literature

Denture Marking and Labelling

Identification is an essential need of any medicolegal investigation because a wrong identity may pose a problem in delivering justice. The Forensic Odontology in American Board guidelines show that most dental identifications are based on filling, dental caries, missing teeth and prosthetic devices. Prosthodontists play a very important role in forensic dentistry as they are concerned with manufacture of various prosthesis which can help as a main tool for identification. Bar coding technique is also used for denture marking. (FIG 1)

Fig 1

In post mortem during war, crimes, and civil unrest, natural and mass disasters are recognized with the help of dentures. Labeling of all dentures is suggested by most international dental associations and forensic odontologists. Recently Aadhaar card number as shown in FIG2A and name as shown in FIG 2B is also used in labelling the denture.

Fig 2 A Fig 2b

The American Dental Association [5,6] has described certain criteria for denture marking:
The identification should be specific.
The technique should be simple.
The mark should be fire and solvent resistant.
The denture should not be weakened.
The mark should be cosmetically acceptable.

Denture Marking

Surface marking methods[5,7]	Inclusion methods[5,7]
Engraving method	Lose inclusion method
Embossing method	Youngs method
Invisible ink method	Dippenars method
Fibre tip pen method	Reesons method
Heaths method	Clear acrylic T bar method
Stevensons method	Olivers method
Weckers electro pen method	Lenticular card method
Laser etching method	Bar coding method
Onion skin paper method	Radio frequency identification tag
Denture bar coding method	Lead foil method
	Metallic band according to Swedish guidelines
	Photograph inclusion method
	MinI Dent method
	Data matrix code
	Microlabelling
	Cast embossed identification plate
	Ceramic crown engraving method
	Memory card method.

Sites for Location of the Denture Marker

Usually polished surface of denture is preferred but if esthetics is concerned, internal surface or impression surface is used. If the denture label is placed on internal surface, they become invisible when relining is done. The most appropriate sites for the location of denture marker are[5]:

1. Posterior buccal surface of maxillary denture (FIG 3A)
2. Lingual flange of mandibular denture (FIG 3B)

Fig 3A

Fig 3B

These areas are chosen because: Visible to the reader, adequate thickness of resin to incorporate without any technical difficulties, aesthetics of the denture is not affected. Other sites are: Within the palate or buccal to tuberosity regions, in case of fixed prosthesis like crowns the initial or identification number is marked usually on lingual surface of anterior and posteriors. Occlusal surface of the posteriors is not preferred because of chance of loss of details during occlusal adjustments.

Denture Labelling and its importance in forensic dentistry

In the finding of the following, marking dentures has been well documented as a useful aid: Victims of fatal disasters, misplaced dentures in hospitals, nursing homes, and institutions, as well as patients who suffer from unconsciousness or psychiatric problems such as traumatic or senile loss of memory.[8]More often denture may be found close to the scene where body is found and chances of finding of edentulous person wearing denture are less difficult in comparison to those in a dentate patient. Hence denture labeling is very important.[9]

In the recent Highland Towers Condominium disaster at Ulu Kelang, Selangor there were five edentulous victims wearing dentures. The investigating forensic odontologist did not find any of their dentures having any form of identifying markings, thereby frustrating the dental victim identification team from making any conclusive identification.[10]The denture should be labeled and include the country code prefixed before the identity card number is proposed by the author in the study. The driving license number, social security number or the

income tax file number can be used in countries where no identity cards are issued to their citizens is the recommended identifying number to be employed.[11] It has been observed in numerous incinerated bodies the lower lingual posterior, and the upper palatal posterior portions of the dentures are usually spared. These sites become the option of areas for the marking.[10] Denture marking should also not be restricted to acrylic dentures only but also be extended to those made from cobalt-chromium. Cobalt-chromium appliances withstand melting even in some cases of incinerated remains. Identifying markings can also be incorporated in orthodontic appliances, maxillo-facial reconstructive prostheses, crowns, and bridges.[11]Denture labeling was evaluated in an Indian sample. In European studies the results are different wherein the most of patients agreed to denture marking, indicating patient background (E.g., Education level).[12]

Advantages	Disadvantages
❖ Patient identification in natural and mass accident. ❖ Appliance identification in old people institutions. ❖ Retrieval of dental records in cases of emergencies like accidents. ❖ Diagnostic and decision support in medico legal issues. ❖ Recording and storage of patient's details on an easily accessible system. ❖ Complete and assured documentation of patient's details since the marked dentures are fabricated by trained professionals.	❖ All the ADA specifications are not fulfilled by the denture marking systems. ❖ If the denture labelling systems are placed on the internalsurface, they become invisible when relining is done. ❖ After inclusion of the marker in the dentures changing the patients detail becomes a tedious job. ❖ Certain denture marking systems are expensive and require special equipment's to read the data. ❖ There is fading of certain identification marks like photograph, bar codes micro labels etc. over a period of time. ❖ Surface engraving methods leads to food lodgment and the details can be changed without the consent of the patient and the dentist.

CAD/CAM

"CAD-CAM acronym for COMPUTER AIDED DESIGN-COMPUTER AIDED MANUFACTURING (or Computer Assisted Machining): the Computer Numerical Control (CNC) subtractive fabrication of a 3D object; in dentistry, it is a CAD-CAM technology used to produce different type of prostheses, including crowns, veneers, inlay, onlay, fixed prostheses, removable dental prostheses, dental implant prostheses and orthodontic and other devices; comp, STEREOLITHOGRAPHY" GPT8[4]

Fig 4

Components: All CAD/CAM system consist of three **components:** Digitalization tool/scanner, Software,a production technology scanner.

There are two different scanning possibilities: 1) Optical scanners 2) Mechanical scanners

***Optical scanners*:** The basis of this type of scanner is the collection of three-dimensional structures in a 'triangulation procedure'. Here, the source of light (E.g. laser) and the receptor unit are in a definite angle in their relationship to one another. Computer can calculate a three-dimensional data set from the image on the receptor unit through this angle. Examples: LAVA Scan ST (3M ESPE, white light projections) and es1 (etkon, laser beam).

Mechanical scanner: The master cast is read mechanically line-by-line by means of a ruby ball and the three-dimensional structure is measured in this scanner variant. This type of scanner isdifferentiatedby a high scanning accuracy, whereby the diameter of the ruby ball is set to the smallest grinder in the milling system as shown in FIG 5, with the result that all data collected by the system can also be milled. Example: Procera Scanner.

Fig 5

Drawbacks:the complicated mechanics,the apparatus is very expensive,long processing times compared to optical systems

Different CAD-CAM systems

Cercon: It does not have a CAD component. In this system, a wax pattern (coping and pontic) with a minimum thickness of 0.4 mm is made. The system scans the wax pattern and mills a zirconia bridge coping from pre-sintered zirconia blanks. The coping is then sintered in the Cercon heat furnace (1,350C) for 6 to 8 hours.[13]

Everest: The Everest system consists of scan, engine, and therm components. A reflection free gypsum cast is fixed to the turntable and scanned by a CCD camera in a 1:1 ratio with an accuracy of measurement of 20 μm in the scanning unit. Its machining unit has 5-axis movement that is capable of developing detailed morphology and precise margins from a variety of materials. Examples: leucite reinforced glass ceramics, partially and fully sintered zirconia, and titanium.[14]

Lava: This system uses yttria stabilized tetragonal zirconia polycrystals (Y-TZP) which have greater fracture resistance than conventional ceramics. Lava system uses a laser optical system to digitalize the information. The Lava CAD software automatically finds the margin and suggests a pontic. The

framework is designed to be 20% larger to compensate for sintering shrinkage.[13,14]

Procera: This system has combined pantographic reproduction with electrical discharge machining. It uses an innovative concept for generating its alumina and zirconia copings. A scanning stylus require 3D images of the master dies that are sent to the processing center via modem. The processing center then generates enlarged dies designed to compensate for the shrinkage of the ceramic material. Copings are developed by dry pressing high-purity alumina powder (> 99.9%) against the enlarged dies. These densely packed copings are then milled to the desired thickness. The Procera restorations have excellent clinical longevity and strength.[14]

DCS Precident: It is comprised of a Preciscan laser scanner and Precimill CAM multitool milling center. It can scan 14 dies at the same time and mill up to 30 framework units in 1 fully automated operation.[10] Materials used: Porcelain, Glass Ceramic, In- Ceram, Dense Zirconia, metals, and Fiber-Reinforced Composites. This system is one of the few CAD/CAM systems that can mill titanium and fully dense sintered zirconia.[14]

CICERO System: The computer desegregated crown reconstruction was developed by CICERO Dental System B.V. (Hoorn, The Netherlands). The system makes use of optical scanning, near net-shaped metal, ceramic sintering and computer-aided fabrication techniques.[15]

CEREC System: The computer- aided design/computer-aided manufacture (CAD/CAM) CEREC (computer-assisted ceramic reconstruction) system is used for electronically designing and milling restorations.

Cerec 1: In this, the ceramic block could be turned on the block carrier with a spindle and feed against the grinding wheel, which grinds the ceramic block to a new contour with a different distance from the axis at each feed step. (FIG 6A)

Cerec 2: The introduction of an additional cylinder diamond enables the grinding of partial and full crowns. It introduced the design of the occlusion in three modes: extrapolation, correlation and function. However, the design still was displayed two-dimensionally.[16] (FIG 6B)

With CEREC 1 and CEREC 2, by using couple charged device camera an optical scan of the prepared tooth is made, and a 3-dimensional digital image is generated on the monitor. The restoration is then designed and milled.[14]

Cerec 3: This system skipped the wheel and introduced the two bur-system. The "step bur", reduced the diameter of the top onethird of the cylindrical bur to a small- diameter tip enabling high precision form grinding with reasonable bur life.[16] The most important factor for three-dimensional scanning with the Cerec 3 intraoral camera is that tooth preparations for crowns and inlays have a unique characteristic: all points of interest can be seen from a single viewing line, representing the preparation and insertion axes, respectively.[17] (FIG 6C)

CEREC in Lab: Is a laboratory system in which working dies are laser-scanned and a digital image of the virtual model is displayed on a screen. After designing the framework, the laboratory technician inserts the suitable VITA In-Ceram block into the CEREC in Lab machine for milling. The technician then verifies the fit of the milled coping or framework.[14]

Fig 6a CEREC 1

Fig 6b CEREC 2

Fig 6c CEREC 3

E4D Dentist System: Presently it is the only system besides CEREC that permits same day in-office restorations. This system includes a laser scanner (Intraoral digitizer), a design center and a milling unit. The scanner is placed near the target tooth, and has 2 rubber feet that hold it to specific distance from the area being scanned. The software gradually creates a 3D image as each picture is taken. The design system automatically detects the finish lines and marks them on the screen. As soon as the restoration is accepted, the data are transmitted to either the in-house milling machine or a dental laboratory. The office milling machine will then manufacture the restoration from the chosen blocks of ceramic or composite.[18]

Restorative materials for CAD-CAM processing: According to the fabrication method: Pre-sintered, densely sintered, Glass infiltrated

Stages in fabrication of prosthesis with CAD/CAM technology: Computer surface digitization, Computer-aided designing, Computer assisted manufacturing, Computer-aided esthetics, Computer-aided finishing.

Advantages [19,20]	Disadvantages [19,20]
❖ Applications of new materials –The new material for FPDs frame work are high strength ceramics that are expected have been difficult to process using conventional dental laboratory technologies. ❖ Time effectiveness. ❖ Reduced labor. ❖ Quality control. ❖ A digital impression also means that patients do not have to have impression material and trays used, saving them discomfort. ❖ Recent innovation in CAD/CAM system provide occlusion to be viewed and developed in dynamic state.	❖ Greater learning curve required. ❖ Capital costs of these systems is quite high and rapid large-scale production of good quality restoration is necessary to achieve financial viability. ❖ Some CAD/CAM system relies on margin capture for digitization, thus making subgingival margin capture challenging. ❖ CAD/CAM is ever advancing technology. Upgrades and updates are often required. ❖ Matching the patient's tooth shade to the blocks of materials used to fabricate the restorations can be a challenge to the dentist initially

Magnets in Complete Dentures

Magnets have been used for retaining complete denture in the mouth because they are small and are easy to incorporate into a denture.[21]The first attempt of using magnets to retain dentures involved implanting them within the jaw as shown in FIG 7, problems ensued because of the large size of the magnets and the inadequate forces that they provided.[22] Improvements in magnetic materials have allowed smaller and more powerful magnetic attachments. Implantation of magnets Two types: a) Magnet Repulsion and b) Magnet Attraction.

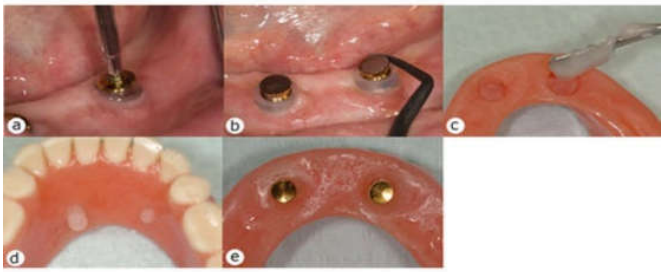

Fig 7

The first recorded use of magnets in prosthetic dentistry involved using the repulsion of like poles of magnets to maintain and improve the seating of complete dentures.[22] The magnetic material used was Alnico type that has been stopped to use because of large bulk necessary for magnet strength. The use of attractive force retention was reported in the early 1960s.[21] This first attempt was made with Al-Ni-Co V which was surgically implanted in the mandible of edentulous patients. Because of the distance between the two magnets, they provided inadequate force to aid in retention. After that the smaller and stronger Co-Pt magnets were implanted.[21] Several disadvantages were associated with Co-Pt magnets, including their high cost, limited availability, difficult fabrication. The implanted magnet migrated through the bone and tissues until it became exposed in the oral cavity.[23] As material technology improved, smaller magnets were made that could be incorporated into the retained roots.

Advantages	Disadvantages
❖ Small size within over denture. ❖ Increases the stability. ❖ Easily constructed without special technique. ❖ Insertion and removal of overdenture is easy. ❖ Reduces lateral forces on the abutment tooth. ❖ Teeth in poor condition such as residual root with caries and cyst, impacted teeth, loose teeth can be used as abutment due to minimal lateral pressure on the teeth.	❖ Low corrosion resistance ❖ Cytotoxic effects of the leachants ❖ High cost ❖ Short track record

Failures

The main problem in the use of magnets as retentive devices is corrosion. Both SmCo5 and Nd-Fe-B magnets are extremely susceptible to corrosion, especially in chloride containing environments. Before use in dental applications the magnetic materials must be securely separated from the oral fluids. Although some current magnet assemblies are encapsulated in stainless steel or titanium, some are failing approximately 18 months in clinical use because of corrosion and loss of the retention provided by the attachment.

Biofunctional Prosthetic System (BPS)

It is also called as bio functional or biogenic because of the ability to construct dentures which are really similar to the natural elements they substitute, fulfilling this way esthetics, functional and phonetics demands of the patient. BPS denture meets the esthetic demand of patients with its unique Ivoclar teeth, which replicate anatomy of the natural tooth Ivoclar teeth are made up of 3 layers of cross-linked acrylic resins that contribute to a life-like appearance and resistance to wearing. BPS system uses a controlled heat/pressure polymerization procedure during which time the exact amount of material flows into the flask to compensate for shrinkage, which ensures a perfect fit. This pressure also optimizes the physical properties of the denture. BPS also available in Partial dentures, Combination dentures, Hybrid dentures, Removable implant dentures, Complete dentures. (FIG 8)

Fig 8

Advantages

Reduced irritation to the gum, extremely dense material reduces the chance of breakage, non-porous surface greatly lessor odor causing plaque and bacteria, non-irritating and comfortable to wear, eat virtually any food, naturally looking so you can smile, laugh, speak with comfortable, will not distort stains and taste.

CONCLUSION

The review of the literature demonstrate that advancement of complete denture prosthesis is necessary. This study makes the knowledge of denture marking, denture labelling, CAD/CAM, magnets in complete denture, bio functional prosthesis system. Proper method for fabrication should be done to avoid any complications and to make tooth appear more natural. Every treatment should be done according to the particular patient's condition and work should be done in such a way that most portion of natural tooth is protected from damage. Hope this review will be helpful in providing some useful information related to complete denture prosthesis to dental students.

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How to cite this article:

Dr. M.A. Eswaran, Dr. Rathika Rai, T. Sangeetha and S.G.Devika (2020) 'Advancements in Complete Denture Prosthesis-A Review', *International Journal of Current Advanced Research,* 09(02), pp. 21217-21222.
DOI: http://dx.doi.org/10.24327/ijcar.2020. 21222.4164

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