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Different impression materials used in dental implants

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PhD in prosthodontics

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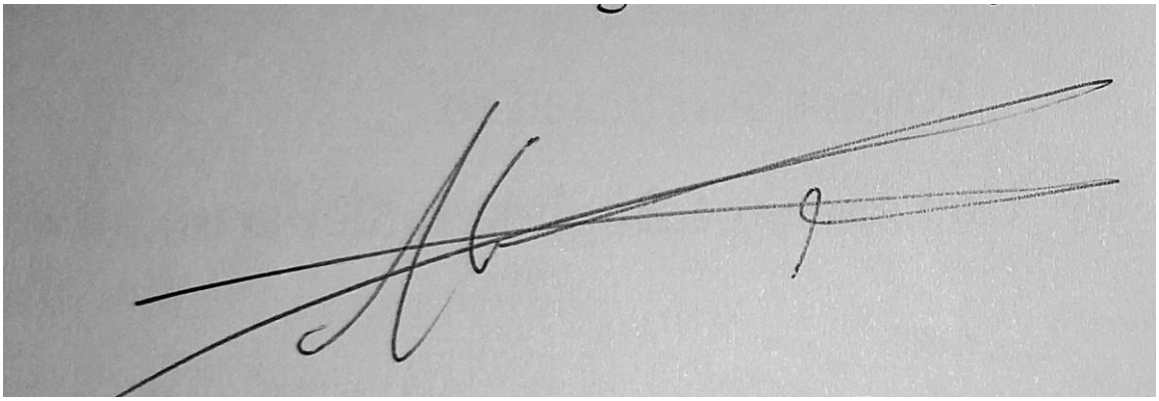
Certification of the Supervisor

I certify that this project entitled **" Different impression materials used in dental implants "** was prepared by the fifth-year student **Alaa Mohammed Qassim** under my supervision at the College of Dentistry/University of Baghdad in partial fulfilment of the graduation requirements for the Bachelor Degree in Dentistry.



Supervisor's name :**Dr. Ali Abdulrazzaq Mohammed**

PhD in prosthodontics

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Dedication

God Almighty who always listen to the pray "**and say, "My Lord, increase me in knowledge**."

My father and mother the great people who helped me in my path of success wish them long healthy life.

My supervisor for standing in every step to reach the best of what I could do regarding my graduation project.

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And finally for everyone who helped and guided me to the right way in bachelor stages.

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Abbreviation	Meaning
VPS	**Vinyl Polysilixone**
IOS	**intraoral scanning devices**
CAD	**computer-aided design**
CAM	**computer-aided manufacturing**

Introduction

A dental implant is a structure made of alloplastic materials implanted into the oral tissues beneath the mucosa and/or periosteum and/or within or through the bone to provide retention and support for a fixed or removable dental prosthesis to replace missing teeth. There use has become an integral treatment modality in dentistry. Its preffered over conventional fixed partial denture by:

1. A high success rate (above 97% for 10 years)
2. A decreased risk of caries and endodontic problems of adjacent teeth
3. Improved maintenance of bone in edentulous site
4. Decreased sensitivity of adjacent teeth

   Implant dentistry the second oldest dental profession; exodontia (oral surgery) is the oldest.**(Gupta R et al.,2021)**

The first and the most crucial step to achieve passive fit is making an accurate impression which precisely transfers interimplant dimensions**.(Mahtab Tabesh et al ., 2018)** An in accurate impression may result in prosthesis misfit, which may lead to mechanical complications Like Screw loosening, screwfracture, implant fracture, and occlusal inaccuracy and/or biological complications like marginal discrepancy that cause unfavorable soft and/orhard tissue reactions due to increased plaque accumulation .minimizing the misfit to prevent possible complications is a generally accepted goal .**(Goodacre CJ et al .,2003)**

many factors effect the precision of implant impressions including impression material, impression technique, splinting of impression copings, level of impression and depth and angulation of implants**.**

(Moreira et al ., 2015)

The object of making an impression in implant dentistry is to accurately relate an analogue of the implant or implant abutment to the other structures in the dental arch. This is affected by use of an impression coping which is attached to the implant or implant abutment.(**Chee, W, and S Jivraj. 2006)**

Aim of the review

To explore the impression material and impression technique used in implant impression and emulate the effect of selection these material and Technique on the accuracy of implant impression, also explore the digital impression and compare it to the current congenital impression.

Chapter one: Review of litreture

1.1 Components used in implant impression :

1. Drivers
2. Lab analogues
3. Screws
4. Impression copings
5. Implant abutment

The function and aesthetics of the implants are dependent on the proper treatment planning and the knowledge of components and instrumentation. The Components that been used in implant impression are drivers, lab analogues, screws and impression copings. Drivers are used to hold the different types of the components of implant to the mouth for smoother placement and removal. The driver head design is different from which can be square, hexagonal and abutment driver and contra-angle torque driver. Laboratory analogue are metal replicas that resemble the implant head or abutment connected to the implant which are used in laboratory to construct working model. Impression copings are used to make the final impression after the soft tissue has matured. These copings have the same flare as the healing abutments and should fully support the soft tissue around the head of the implant. In transfer type when the set impression is removed the coping is remind in the mouth. In pick up type, as the set impression removed, the coping is been removing with the set impression. Abutments are components that resemble the missing coronal structure that contact directly to the head of the implant and extend through the gingiva into the oral cavity. On many factors and soft tissue maturation after second stage surgery should take in consideration in the selection of the abutment. The

abutment must take a count of the position of the implant and the angulation of the implant, height and thickness of the surrounding the softTissue. Also, inter occlusal space and the type of restoration to be placed **(Gayathridevi et al; 2016),**

impression accuracy is less accurate in the presence of undercut **(Sorrentino et al; 2010).** Also, The angulation of implants may effect the accuracy of the implant impression , probably because of the high forces required for the impression removal and when compared to the parallel implant the seem more accurate, and the material that been used may decrease that effect, addition silicon have resulted advantageous in the non-parallel implant **(Sorrentino et al; 2010).** Also the uses of internal connector show less impression accuracy in the angulated implant **(Mpikos et al; 2012).**

1.2 Impression materials used in Implant

The oral cavity environment is a special field that is Distinguished by its moisture cause of saliva are often present along with Crevicular fluid and blood even with the best retraction techniques**.** Which suggests that itshould be dried with air syringes, anti–sialogogues, cotton rolls, and dry pads, for precision with that field polyvinyl siloxane and polyether is the most common elastomeric impression materials currently used.

(Mohammed D et al.,2018)

Requirements of dental implant impression material are excellent flow, high tear strength, and dimensional stability.(**Donovan TE, Chee WW 2004)** hydrophilicity with good wetability is also proffered .(**Walker MP et al., 2008)**

Implant impressions have 2 most crucial elements that must be captured for beautiful implant restoration which presented by the tissue contours and the connection of the abutment to the implant.**(LeeH et al .,2008).**

Impression materials of dental implants has wide variety such as : impression plaster, hydrocolloids and elastomers with four basic types of polysulfides, polyether, condensation silicones and polyvinyl siloxane which is also known as addition silicones **.**

- **Polysulfides and condensation sillicon** have been excluded becouse the first is not dimensionally stable if stored for longer period of time and the second for its shrinkage due to evaporation of volatile by products released in polymerization reactions .

- **Polyether** have dimensional stability, rigidity, tear resistance and hydrophilicity، its chemical structure contains carbonyl and ether functional groups which allow water molecules to interact through hydrogen bonding; therefore if stored in contact with moisture, it may encounter swelling with an accompanying loss of accuracy. (**HusseinLA et al .,2002).**

- **polyvinyl siloxane** which shows many desirable properties of polyether respecting the quality of implant impressions, at a lower cost and its putty and light-body combination that results in more precision than medium-body polyether when implants are located deep subgingivally in addition to its low cost that makes some studies advocate it.**(Mahtab Tabesh et al .,2018)**

- **Vinyl siloxanether** is a new material that possess good mechanical and flow properties on top of excellent wetting characteristics in both unset and set conditions and it achieves its final hardness immediately after setting And its possibility to creat a chemical bond between vinyl siloxanether and polyvinyl siloxane. Yet, the precision of this newly formulated material has to be established.(**Enkling N et al ., 2012)**

  Therfore polyvinyl siloxane and polyether have been suggested as materials of choice becase the Property of impression material to prevent positional distortion between implant analogues caused by

accidental displacement of impression copings which is a key factor**.** (**Mahtab Tabesh et al .,2018)**

1.3Impression techniques in dental implant

They are classified to open-tray and the closed-tray technique.the open-tray technique exhibits greater dimensional accuracy and accurate linear distance measurements than the closed-tray technique,however, the closed-tray technique demonstrates superior results In case of single implant situation. **(Aaina Dhanda et al .,2021)**

1.3.1Direct /Open-Tray Impression Technique

The name is drived from the fabrication of Custom tray that has open occlusal surfaces which made with precaution ,so that the abutment screw comes out through the opening.in this technique implant position, hex orientation, and the soft tissue profile are transferred, the healing screw is removed after 7 to 10 days of its placement. The transfer coping along with the abutment screw is threaded into the implant body. . Impression is made with polyvinylsiloxane impression material. After the material has set, the dentist removes the abutment screwfrom the opening of the tray before removing the impression.After the screw is removed, the impression is removed. The transfer coping also comes out with impression and is embedded in the impression itself. Implant analog is attached to the impression post with the help of abutment screw before the impression is poured. Proper care is taken while threading the abutment screw to the

implant analog that the transfer coping which is seated in the impression should not move. The impression is poured and working model is fabricated.

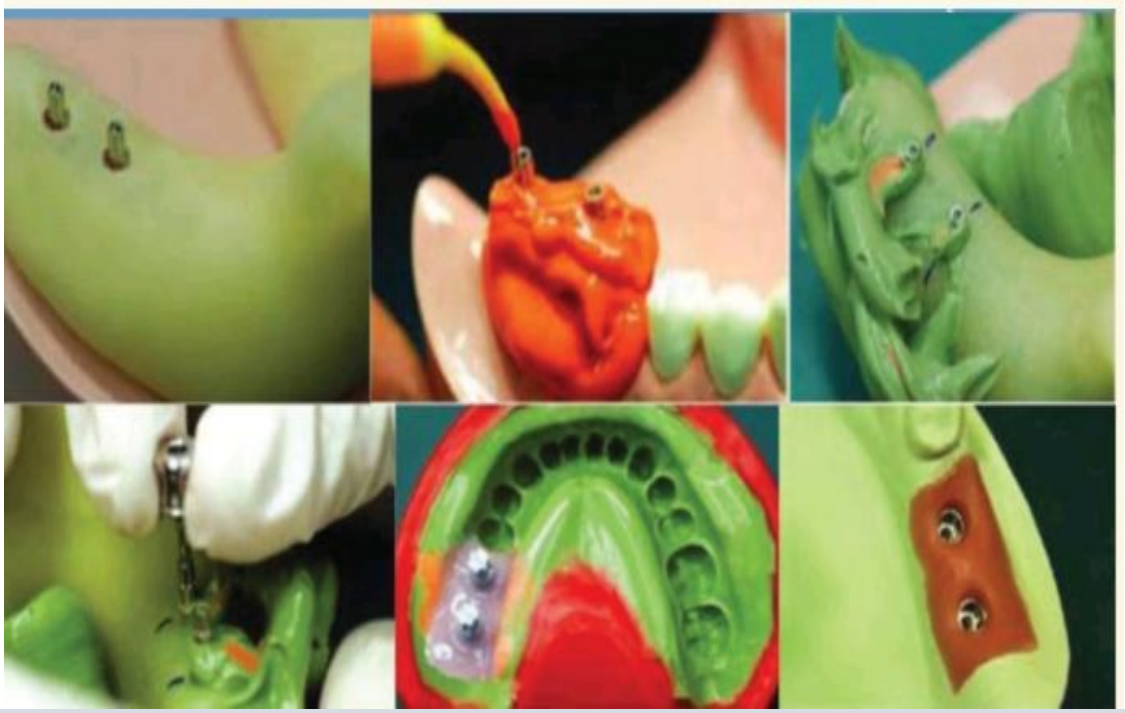

Figure 1:Open-tray impression technique
(Aaina Dhanda et al ., 2021)

Indication: It's used for single tooth restorations, and also for multi-unit restorations and denture supported by implant.

Advantages

screws can easily be accessed and position of the transfer is also correct.
The main advantage of this technique is that the transfer coping comes out with the impression and less disturbances to the position transfers.
This technique is mainly used in nonparallel multipleimplants in which the impression is easy to retrieve without distortion of impression material.

Disadvantages

Additional steps are required and more parts to manipulate. A custom tray with access to the impression coping screws is required or a metal tray with windows is needed in addition to the step of unsecured the screw from the coping after the setting of materialand before the removal of impression ,and it canont be used with limited mouth opening cases due to its need for accessibility.

Along with the type of technique used, the choice of the type of tray also greatly affects the accuracy of the impression making. we can use custom trays as well as stock trays. It was found that for analogs with 20 mm separation, there was a difference in 10 μm in the accuracy between stock tray and custom trays. The impressions made with stock trays were less accurate .therfore the study suggested that the rigid custom trays are preferred over plastic stock trays. **(Burns J et al .,2003)**

1.3.2 Indirect/Closed-Tray Impression Technique

In this technique, only the implant's position and hex orientation are transferred. When the impression is removed from the mouth, indirect transfers remain attached to the implants. The transfer copings are parallel sided or slightly tapered for easy removal of impression from the mouth. The impression is usually made after 7 to 10 days of placement of healing screw. Once the inflam-mation is reduced, the healing screw is removed and the transfer coping is screwed. A radiograph is taken to confirm the tight and

perfect joint of the impression post and implant. The screw hole is blocked with the help of blocking wax to avoid the material to flow into the hole.

The impression is made. As the material sets, the impression is removed from the patient's mouth, and the transfer coping remains in the patient's mouth. The dentist removes the transfer coping/impression post from the

Figure 2:Closed-tray impression technique. (Aaina Dhanda et al .,2021)

implant body, attaches it to the implant analogue, and then reinserts it into the desired position after proper orientation. Proper care has to be taken that the implant analogue along with the transfer coping should be properly oriented and inserted. Once the position has been finalized, the impression model is fabricated.

Indication: the indirect technique can indicated for posterior teeth because of difficulty of access in that region and also in patients with limited mouth opening**.**

Advantages

This technique is indicated in cases of limited mouth opening with hyper gag reflex.

Disadvantages

There might be coping dislodgement during impression removal. Abutments have to be fixed onto the copings, which may lead to an error at this stage. Soft tissue transfer is not very accurate and the size and shape of the abutment cannot be modified. The impressions removal is also not easy. The type of transfer coping used in the closed-tray technique is usually tapered in shape and shorter than those used in the open-tray technique.

1.4 The accuracy of the impression of dental implant

An accurate implant impression has a key role For fabrication of accurate master cast and passively fit framework,therfore,there are number of factors that can affect the accuracy of the impressions like:

impression Techniqus,materials , number of implants, ,Angulation , Type of tray, Splinting and non splinting,depth of implant, Influence of Transfer Copings Surface Abrasion, Approximation of adjacent tooth depth of implant.

- **Technique:** the open-tray technique exhibits greater dimensional accuracy and accurate linear distance measurements than the closed-tray tech-nique.however,the closed-tray technique demonstrates superior results In case of single implant situation (**Daoudi MF et al ., 2001)**

- **Materials and viscosities**:among Hydrocolloid, Polyether,Polysiloxane .. polyether and addition silicone showed maximum dimensional stability,rigidity,good flexture strength that overcome the undercut of the coping , results in accuracy of the master casts(**Lorenzoni et al .,2002).** considering the limitations of this study, there were no significant differences in the accuracy of dental implant impressions between direct and indirect techniques or different PVS viscosities. However, mono-phase recorded the horizontal angle more accurately than the combination of putty/light-body materials .**(Ahmad Ghahremanlc et al .,2017)**

- **Number of implants** : impression of single implant is better results than a technique having to make impression of multiple implants, becouse more are the chances for a dimensional inaccuracy to occur.For single tooth implant ,its unlikely to affect passive fit with the implant if there is a positional errors in the restorative stages but rotational or dimensional discrepancy in the impression is likely to affect

the appearance, contact points, and occlusal requirements. Therfore , the open-tray impression technique along with splinting showed better results than the other techniques For multiple implants.**(Aaina Dhanda et al .,2021)**

- **Angulation**: 0-degree angulation of implant has lesser chances of distortion than15- or 30-degree angulation as in the posteriors. addition silicone is the best material for angulated implants and polyether is the recommended material of choice for parallel implants. (**Conrad HJ et al .,2007**)

- **Type of tray:** custom fabricated trays provide better accuracy than the stock trays as they are prepared according to each individual.

- **Splinting and non splinting** :The review of abutment level or implant level internal connection implants indicated that more studies reported greater accuracy with the splint technique than with the nonsplint technique. For situations in which there were 3 or fewer implants, most studies showed no difference between the pick-up and transfer techniques, whereas for 4 or more implants, more studies showed higher accuracy with the pick-up technique. Results indicated that the 2-step VPS impression was significantly less accurate than the 1-step putty and light-body VPS combination impression, the medium-body VPS monophase impression, and the medium-bo-dy polyether monophase impression.(**DR , Pujari ML et al .,2011)** Among different splinting materials used that are the light cure,

autopolymerizing acrylic resin, dental floss, pattern resin, it was found that splinting with acrylic resin demonstrates better results than the others. **(Bhakta S et al ., 2011).**

- **Depth of implant** There was no effect of implant depth on the accuracy of the VPS group. However, for the polyether group, the impression of an implant placed 4 mm subgingivally showed a greater horizontal distortion compared to an implant placed more coronally. Adding a 4-mm extension to the retentive part of the impression coping eliminated this difference. . **(Lee H et al .,2008)**

- **Influence of Transfer Copings Surface Abrasion and Coping design**: coping shape has the major factor influencing impression accuracy. square and tapered copings are the most frequently used in various implant systems.
  (**RashidanN et al .,2012)**
  In order to enhance the retention of impression copings, modifications like . airborne-particle abrasion or impression adhesives improved precision of the impression when adhesive-coated copings were used have been found.(**Vigolo P et al ., 2000**)However,the surface treatment of copings did not lead to increased accuracy (**Liou AD et al .,1993)**
  casts retrieved from transfer impressions with nonmodified copings and those with airborne-particle abraded adhesive-coated copings were statistically less accurate than casts from square impression

copings splinted with autopolymerizing acrylic resin (**Vigolo P et al ., 2004)**

more retentive element of a square impression coping could lead to better entrapment of the impression material, resulting in less discrepancy.**(Vigolo P et al .,2004).**

In one study, the modified squared and index techniques generated more accurate casts than the squared technique. Other studies confirmed that the shape and design of the impression coping affect impression accuracy more than the impression technique **(Rashidan N et al .,2012).**

The geometrical design of the impression copings did not affect the accuracy of the open or closed tray implant impression techniques in the vertical measurements. In the horizontal measurements, the high retentive coping design of the Osstem implant affected the accuracy in the open tray technique (**Rudolph H et al .,2015)**

1.5 Digital Impression CAD/CAM

1.5.1 Introduction

Duret introduced in 1971 the computer-aided design/computer-aided manufacturing (CAD/ CAM, and he produced the first CAD/CAM used in the dental restoration in 1983. days now, CAD/CAM has been expanded worldwide into the restorative aspects of implant dentistry, and its replacing

the labor-intensive laboratory methods for implant abutment fabrication. The

most frequently used in-office dental CAD/CAM technology appears to be the CEREC system (Sirona). The Analog impression process used elastic impression materials with dental stone.in the traditional impressions procedures, inaccuracy are more possible then in the digital impression .also, the passive fit of CAD/CAM is better than that of traditional analog one**.(lee et al;2008).**

Also its much predictable then the traditional one, and stress-free, and comfortable for the patient. The successful path suggest that digital technology will optimize the treatment workflow with the advantage properties that's offer specially less consuming and less and more comfort to

the patient. Digital impression procedures for implant-supported crowns make use of the designated scan bodies through scanning intraoral **(Cabral et al; 2007).**

A Study showed that the needed to make a digital impression (6 minutes and 39 seconds) is the half time of the time needed to make analog impression(12 minutes and 13 seconds) in Implant **(Cabral et al;2007** digitalization of the clinical situation is a prerequisite For CAD/CAM-assisted fabrication,therfore ,two techniques of data capturing are available: direct,intraoral scanning and indirect digitizing the casts made from conventional impressions, the latter usually carried on by scanning the cast in the dental lab. (**Stimmelmayr M, Güth J-F, Erdelt K, Edelhoff D, Beuer F 2012)**

Recent Advances in Impression Making The use of digital impressions eliminates the need of impression materials, making the procedure

potentially more comfortable for the patients while decreasing error from the analog techniques.

(**Lin WS, Harris BT, Morton D.2013)**

Overcome the problem of shrinkage and distortion of the impression materials as well as unstable repositioning of the analog during the laboratory process that lead to inaccurate transfer of the implant position from a physical impression to a gypsum cast (**Christensen GJ 2009)**

Provide Accuracy,which is described by precision and trueness . Precision represents the degree of reproducibility between repeated measurements. Trueness describes the closeness to the actual dimensions of the object. linear distance measurements were used to investigate the trueness of dental models

the impression is “a negative likeness or copy in reverse of the surface of an object; an imprint of the teeth and adjacent structures for use in dentistry

1.5.2Component of digital impression:

1).digital scanner: it scans the geometry intra orally and send it into the computer (figure 8).

2) Software that used to analysis the data to make a CAD model.

3) Technology that transfer the date from the CAD into the desire product means of CAM

figure 3 : scans the geometry intra orally and send it into the computer

1.5.3 IOS DEVICE:

The intraoral scanning devices use an advance optical surface scanning technology that are similarly to a camera(figure 9), using the sensors measure light reflection times from various texture through processes to capture the object three-dimensionally instead of simply capturing lights and colors in the camera(figure 10). The information is then captured by the 3D software that uses specific alignment algorithms to allow for registration of the object (Gayathridevi et al; 2016).

Most common scanning principles **(Gayathridevi et al; 2016):**

1. Triangulation
2. Active wave-front sampling,
3. Parallel confocal laser scanning

Figure 4: IOS Device **(Logozzo et al; 2011)**

1.5.4 Disadvantages of the current Conventional Impression:

There are many problem that appear with conventional impression which the digital impression solved, some of these problems:

figure 5: Virtual model from digital impression **(Sang J. Lee and German O.Gallucci 2013)**

1. The tray of the conventional impression face errors that been prevented in the digital impression as no need for the tray anymore.
2. Hydrophilicity and the impression material flow have been a limit in the

impression taking procedure.

3. The conventional impression offer less working time for the specialist.

4. Tearing and deformation can happen with the conventional impression during movement of the patient or during removal of the tray.

5. The possibility of void formation in the cast.

1.5.5 Digital impression properties:

A. Advantages of digital impression:

1. It's allows additional re-scans without the need of repeating the whole impression taking procedure. This will reduce the time of treatment.

2. Less difficulties are accounted for digital impression compared with the conventional ones when performed **(Lee, et al; 2012).**

3. Require less experience than the conventional impression, as the latter need more experience to achieve efficiency in the final impression **(lee, et al; 2012).**

4. Less time consuming **(Cabral, et al; 2007).**

5. Precision of passive fit and aesthetic material application **(Jaafar Abduo and Karl Lyons 2013).**

6. Making accurate restoration created on the basic of the digital models.

7. Avoiding the conventional impression errors. Like casting, no layering, baking, and soldering errors.

8. Ability of creating 3D archives (figure10), also support surgery simulation **((Logozzo, et al; 2011).**

B.Disadvantages of the digital impression

1. IOS shows problems when stitching the different shots when more implants were involved, as the abutments involved in the scanning have the same shape and the system couldn't always differentiate which the abutment position **(Wismeijer, et al;** 2013).

2.It isn't easy to scan the proximal areas of the neighboring teeth if it situated too close from the abutment **(Wismeijer, et al; 2013)**

chapter two:

2.1Conclusion

Taking an accurate impression is a primary factor in determining the success of the implant procedure, the most common materials used in implant impression are polyether and vinyl polysilixone, with most studies show no different in the effect of accuracy between them, the most commonly techniques in taking impression are either open tray impression technique, or closed tray impression technique, with more studies tend positively toward the open tray impression and some tend toward the equality between the the two techniques and much less that tend toward the closed tray technique . consideration of the impression making phase is very critical step not just from the viewpoint of generating an accurate master/definitive cast, but also from viewpoint of practical chairside feasibility,therfore Parallel vs non-parallel implants,open tray vs closed tray ,Splinted vs unsplinted are three aspects of chairside clinical therapy that must be considered by the clinician during impression making. In general When implants are parallel or close to parallel, an open or closed tray technique can be used. However, when implants are angulated or non-parallel the use of an open tray is preferred to permit retrieval of the impression,Splinting of impression copings may increase the accuracy of the impression as long as a splinting material that sets up rigidly and which has had polymerization related dimensional changes minimized. A study with its limitations concluded that If a direct technique is considered polyether is the better choice, while for indirect technique polyether and vinyl siloxanether are choices. if polyvinyl siloxane or polyether is the material, less displacement of implants will be achieved using a direct technique.

Choosing the most accurate technique and material for each particular case has become a challenging task , Recent developments over the traditional impression techniques include CAD/CAM optical devices (intraoral scanners) has occur.digital dentistry with its new technologies are finding their way into procedures related to fabrication of implant prostheses as well as a solution to both ease the procedure and overcome the inherent accuracy problems of impression techniques to get better results.

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