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# Comparative evaluation between accuracy of implant impression techniques: A Systematic Review

Dr. Babita J. Yeshwante[1,] Dr. Sonali Vikas Gaikwad[2], Dr. Nazish Baig[3],Dr.Sonali Patil, Dr.Wahab A Shaikh
[1,2,] *Department of prosthodontics and crown & bridge, C.S.M.S.S. Dental College Aurangabad MUHS Nasik, India)*

***Abstract:*** *Precise fit between dental implants and the superstructure is important for the long term success of implants and implant supported prosthesis. To create an accurate definitive cast, it is critically important to obtain an intraoral impression that accurately captures the 3-dimensional (3-D) spatial orientation of a patient's implants. Traditionally there are two implant impression techniques pickup (direct or open tray) and transfer (indirect or close tray) technique, and various other factors like splinting or non-splinting, impression material, tray, implant angulation etc .which affect the accuracy of implant impression. All these techniques and factors were introduced and investigated for accuracy, but results were not always consistent. The purposes of the present review were to investigate the accuracy of reported implant impression techniques and to examine the clinical factors affecting the implant impression accuracy.*

***Keywords:*** *implant , implant impression, implant material, splinting*

## I. Introduction

A dental impression is a negative imprint of an oral structure used to produce a positive replica of the structure for use as a permanent record or in production of a dental restoration or prosthesis.[1] Accuracy of definitive cast is dependent upon the accurate impression; hence accurate impression is essential to fabricate prosthesis with good fit. The key factor affecting the treatment outcome is the impression procedure involved in fabrication of implant prosthesis. The objective 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. An inaccurate impression may result in improper fit of prosthesis leading to failure of implant. Improper fit of prosthesis may leads to biological as well as mechanical complication. Mechanical complication may include screw loosening, screw fracture, and occlusal inaccuracy[2-7]; biologically marginal discrepancy from misfit may cause unfavourable soft and /or hard tissue reactions due to increased plaque accumulation[8-10]. Even though obtaining absolute passive fit is practically impossible, minimizing the misfit to prevent the complications is a generally acceptable goal of prosthodontic implant procedures[11]

## II. Material And Method

Electronic searches were performed in November 2014 with the key words implant, implants, impression and impressions. Year limit of publication was not used so that the search could include the first available year of the particular database to December 2013. The keywords were type in combination form(implant or implants) AND (impression or impressions). As a result, 660 articles were found..

Inclusion & exclusion criteria were selected. To be included in the study, articles had to be published in an English peer-reviewed journal and be an experimental study investigating the accuracy ofimplant impressions. Exclusion criteria were includes :clinical or technical reports simply describing a particular material or technique, structurally incomplete publications such as abstracts only.in addition, a hand search of the following journals was performed to enriched the results for the time period from January 1980 to December 2013: the journal of prosthetic dentistry, The international journal of oral and maxillofacial implants, The international journal of prosthodontics, implant dentistry, The international journal of periodontics and restorative dentistry, journal of prosthodontics, clinical oral implant research experimental, and clinical implant dentistry and related researches. After executing the search strategies, 50 articles were select.

## III. Results

All the selected articles were in vitro studies. Of the 18 studies that compared the accuracy between the splint and non-splint techniques (Table 1),[12-29] 7 articles reported the splint techniques[13,19,22,23,24,25,28], 4 advocated the non-splint technique,[16,18,20,29] and 7 advocated the no difference.[12,14,15,17,21,26,27] It was found that more studies reported more accurate implant impressions with the splint technique than with the non-splint technique.

Eighteen studies compared the accuracy of pick-up and transfer impression techniques,[12,15,17,,23,24,26,27,29-32,35-38,43,45] and 9 showed more accurate impression with the pick-up techniques,[15,20,23,26,29-32,37] 2 with transfer technique,[12,35] and 7 showed no difference.[17,24,27,36,38,43,45]

In addition to the simple comparative finding, a relation was found between the impression techniques (pickup and transfer) and number of implants. There were 6 studies using 3 or fewer implants,[27,31,35,36,38,45] and 4 showed no difference between pickup and transfer techniques[27,36,38,45]. The one study showed more accurate impression with transfer technique[35] and one show more accurate impression with pickup technique.[31] Ten studies compared the accuracy of pickup and transfer impression technique in situations in which 4 or more implants were placed.[12,15,17,20,23,24,26,30,37,43] Six showed more accurate impressions with pickup technique,[15,20,23,26,30,37] one with transfer technique[12] and 3 showed no difference.[17,24,43] For situations in which there were 3 or fewer implants, most studies showed no difference between the pickup and transfer techniques, whereas for situations in which there were 4 or more implants, more studies showed more accurate impressions with pickp technique than the transfer technique. There were four studies that explain the accuracy of the snapfit impression technique.[18,39,40,44] Two studies reported that the snapfit technique was more accurate than the transfer technique,[18,39] and 1reported that snap fit technique was more accurate than transfer technique[44] and one reported there were no difference between the snapfit and pickup technique.[40]

Thirteen studies compared the accuracy of polyether and vinyl poly-siloxane (VPS),[15,23,30,32,34,39-44,48,49,] and 11 of 13 reported no difference between the 2 materials[15,23,32,34,39-44,48] and only two studies reported that PVS was more accurate than PE.[30,49] Five studies examine the effect of implant angulation on the accuracy of impressions.[23,28,33,36,37] Three studies reported the higher accuracy with straight implants,[23,33,37] while the other 2 reported there was no angulation effect.[28,36]

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**Table I. Studies Comparing Accuracy Of Splint And Non-Splint Impression Technique**

| Author (year) | Implant number | Specimen number | Splint material | Splint method | Impression material | Implant manufacturer | Connection level | Impression accuracy |
|---|---|---|---|---|---|---|---|---|
| Humphries et al(1990) | 4 | 4 | AAR | Splint 30min before impression | VPS | N | A | No difference |
| Assif et al(1992) | 5 | 15 | AAR | Polymerize on individual coping, then rejoin 15 min before impression | PE | N | A | Splint better |
| Inturreguietal(1993) | 2 | 10 | Impression plaster AAR | Splint & wait for 10 min splint, section then rejoin 15 min | PE | N | A | Nonsplint better |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | | before impression | | | | |
| Barrett etal(1993) | 6 | 8 | DF+AAR | Splint 10 min before impression | VPS | N | A | No differen ce |
| Hsu etal(1993) | 4 | 14 | DF+AAR stainless steel orthodont ic wire+AA R | Splint 20 min before impression<br>Splint 20 min before impression<br>Polymerize on eachl copings then join 20min before impressionon | PE | N | A | No differen ce |
| Phillips et al(1994) | 5 | 15 | DF+AAR | splint | PE | N | A | Nonsplin t better |
| James K.Schmitt | | 35 | AAR | Splint | VPS | N | A | Nonsplin is better |
| Assif et al(1996) | 5 | 15 | AAR | Splint<br>Splint coping to custom tray | PE | N | A | Splint better<br>No differen ce |
| Burawietal(1997 ) | 5 | 15 | DF+AAR | Splint 24hr before impression,section, then rejoin 15 min before impression | VPS | SL | A | Nonsplin t better |
| Herbstetal(2000) | 5 | 4 | DF+AAR | Splint 20 min before impression | VPS | SI | A | No differen ce |
| | | | | | | | | |
| vigoloetal(2003) | 6 | 15 | AAR | Splint 1 day before impression,section,the nrejoin just before impression | PE | B | A | Splint better |
| Naconecyetal(20 04) | 5 | 5 | Steel pin+AA R | Splint 30 min before impression | PE | N | A | Splint better |
| Vigoloetal(2004 ) | 4 | 15 | AAR | Splint 1 day before impression,section,the nrejoin just before impression | PE | B | I-I | Splint better |
| Assuncaoetal(20 04) | 4 | 5 | AAR | splint | Polysulfide,PE,VPS,conden sation silicon | C | I-I | Splint better |
| Kim etal(2006) | 5 | 5 | Light polymeri zing resin | Splint, section,thenrejoin before impression | PE | N | A | No differen ce |
| | | | | | | | | |
| Cabral etal(2007) | 2 | 15 | DF+AAR | Splint 3min before impression<br>Splint 17 min,section,thenrejoin before impression | VPS | SIN | I-I | Splint better |
| Choi etal(2007) | 2 | 10 | AAR | Splint, section,thenrejoin 15 min before impression | VPS | AT | I-I | No differen ce |
| Del'acquaetal(2 008) | 4 | 5 | AAR | Splint, section, thenrejoin before impression | PE | C | A | No differen ce |

AAR: autopolymerizing acrylic resin; DF: dental floss; VPS: vinylpolysiloxan;PE:polyether;

N: nobelbiocareAB,Sweden; SL:strykerleibingerGmbH,Freiburg,Germany; SI: southern implants,Irene,South Africa; B:biomet 3i,palm beach gardens, fla; C: Conexao prosthesis system Ltda,Sao Paulo, Brazil; SIN: Sistema de implanteNacionalLtda, Sao Paulo, Brazil; AT: Astra Tech AB,Molndal,Sweden; A: abutment; I-I: implant internal

**Table II. Studies comparing accuracy of transfer and pickup impression techniques**

| Author(Year) | Implant number | Specimen number | Impression material | Implant manufacturer | Connection level | Impression accuracy |
|---|---|---|---|---|---|---|
| Humphries et al(1990) | 4 | 4 | VPS | N | A | T |
| Carr(1991) | 5 | 7 | PE | N | A | P |
| Carr(1992) | 2 | 10 | PE | N | A | No difference |
| Barrett et al(1993) | 6 | 8 | VPS | N | A | P |
| Phillips et al(1994) | 5 | 15 | PE | N | A | P |
| Herbst et al(2000) | 5 | 4 | VPS | SI | A | No difference |
| De La Cruz et al(2002) | 3 | 10 | VPS | N | A | T |
| Naconecy et al(2004) | 5 | 5 | PE | N | A | No difference |
| Daoudi et al(2004) | 1 | 10 | VPS | N | I-E | No difference |
| Assuncao et al(2004) | 4 | 5 | Polysulfide, PE,VPS, Condensation silicone | C | I-I | P |
| R.Madhan,SanjanaNayar,H.Annapoorani(2006) | 4 | 30 | PVS, PE | SI | A | T |
| Conrad et al(2007) | 3 | 10 | VPS | B | I-E | No difference |
| Cabral et al (2007) | 2 | 15 | VPS | SIN | I-I | No difference |
| Wenz et al(2008) | 5 | 5 | VPS | DF | I-I | No difference |
| Del'Acqua et al(2008) | 4 | 5 | PE | C | A | P |
| T.BalaMurugan. P Manimaran (2013) | 2 | 20 | PVS | MIS Israel | I-I | P |
| | | | | | | |

VPS: vinyl polysiloxane; PE: polyether; T: transfer impression was superior; P: pickup impression was superior; N: nobelbiocare AB; SI: southern implants; C: conexao prosthesis system Ltda; B: Biomet 3i; SIN:sistema de implantenacionalLtda; DF: Dentsplyfriadent, Mannheim,Germany; A: abutment; I-E: implant external; I-I: implant internal
MIS:Mini implant system.

## IV. Discussion

The primary purpose of this review was to compare the accuracy of pickup and transfer implant impression technique and to compare the accuracy of splinted verses non-splinted impression technique. The secondary outcome were to access the effect of different factors like impression material, implant angulation, number of implants, impression tray etc. on the accuracy of the implant impression.

### 5.1Comparison between pickup and transfer technique:

The scientific evidence on the accuracy with pickup (direct, open tray) vs transfer (indirect, close tray) impression techniques was based on 18 in vitro,[12,15,17,,23,24,26,27,29-32,35-38,43,45] and supports (18 studies, 9 open-tray; 2 closed-tray ; 7 no difference ) open-tray implant impression techniques.

Tapered copings and closed tray were used in the impression with transfer technique. Before impression copings were connected to implants and impression was made. After removal of impression coping were removed from implant located intraorally and connected to implant analogs, then the coping- analog assemblies were reinserted in the impression before fabricating the definitive cast.

Whereas in pickup impression square coping and open tray were used which allows the coronal end of impression coping to be exposed .coping are unscrewed before removing the impression, then the implant analogs are connected to the copings to fabricate the definitive cast.

The primary source of error in the transfer impression technique is that copings never returned to the original position and this error is increased in case of impression with multiple implants. This investication was reported by Daoudiet al[52] with 3 different group of peoples: senior dentists, postgraduate dental students, and dental technicians. It was found that for situations in which there were 4 or more implants, more studies showed more accurate impressions with the pick-up technique than the transfertechnique.

**5.2Comparison between splint and non-splint technique:**

The scientific evidence on splinted vs non-splinted techniques relied on 18 in vitro[12-29]andsupports (18 studies,7 splint; 4, nonsplint; 7, no difference) the technique of splinting the impression copings for implant impressions. Still there are various possible problems with splint technique like distortion of splint material[50], fracture of splint material and coping[18], the conclusion of Kim et al shows that splint technique was more accurate during the cast fabrication procedure while the nonsplint technique was more accurate during the impression-making procedure.

Acrylic resin is a material of choice during splinting due to its less shrinkage. Even then some authors section the splint material connection to minimize the shrinkage.[13,16] or some authors connected all copings with splint material and waited for complete polymerization of the material.[14,24]

From the above literature it is found that further studies are require to access the effect of splint technique on accuracy of impression.

**5.3Other factors:**

**1.3.1 Impression material:**

The scientific evidence on the accuracy of impression techniques with different impression materials relied on 13 in vitro studies[15,23,30,32,34,39-44,48,49] and demonstrates no difference (13 studies, 11 no difference; 1, polyvinyl siloxan is more accurate) between Polyvinyl siloxan and polyether.

Various impression materials were tested but polyvinyl siloxan and polyether both are the material of choice for making accurate impression.

Wenz et al [43] reported that one step impression using both putty and light body simultaneously is more accurate than the two step impression.

Wee[34] reported that torque resistance ofpolyether material is greater which may be favourable for manipulation of material.

Lee et al[49] reported that putty and light body of polyvinylsiloxan impression material was more accurate than medium- body polyether impression material when implant was placed subgingivally.

**5.3.2Angulation:**

Regarding implant angulation, five studies examine the effect of implant angulation on the accuracy of impressions.[23,28,33,36,37] Three studies reported the higher accuracy with straight implants,[23,33,37] while the other 2 reported there was no angulation effect.[28,36]

Distortion of impression material may occurs when multiple implants are used. So more studies are require to determine the relation between implant angulation and number of implant.

**5.3.3Otherfactor which may affect the accuracy of implant impression are:**

Studies reported the effect of various factors on the accuracy of implant impression such as implant level,[4] abutment level,[56] impression tray,[57] depth of implant,[49] time duration between impression making and stone pouring.[4]

## V. Conclusion

Within the limitation of this study, the conclusion based on literature review are:

1) Pickup impression technique is marginally better than transfer impression technique formaking the accurate impression.
2) Splinting and non-splinting of impression coping does not have great effect on accuracy ofimpression especially with multiple implant impression.
3) Polyvinylsiloxan and polyether are the material of choice for making accurate impressionamong which polyvinyl siloxan gives more accurate impression.

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