



## Original article

# A Questionnaire-based Study on Impression Materials and Techniques for Complete Denture Construction among Dentists Practicing in Central/Western Regions of Libya

Rawan Albeshti,<sup>1,2</sup> Mofida Khmaj,<sup>2</sup> Abdulfatah Khmaj,<sup>2</sup> Aihab Albaden,<sup>2</sup> Hoda Almagtof<sup>2</sup>

<sup>1</sup> Libyan Authority for Scientific Research, Tripoli, Libya

<sup>2</sup> Department of Prosthodontics and Dental Materials, Faculty of Dentistry, University of Zawia, Zawia, Libya

## ABSTRACT

**Background:** The success of complete dentures mainly depends on impression-making accuracy; thus, dentists need to select the proper impression materials and techniques to achieve optimal outcomes.

**Objective:** To determine the favoured impression materials and techniques used for complete denture construction among dentists practicing in the Central/Western regions of Libya.

**Materials and Methods:** This study was conducted between July 2023 and September 2023. The questionnaire was comprised of 30 questions, which were divided into two parts including; 11 questions for demographic and professional attitude and 19 questions focused on professional steps of complete denture fabrication for edentulous patients.

**Results:** The response rate for this questionnaire was (66%). It was revealed that (96.1%) of respondents used only irreversible hydrocolloid (alginate) as an ideal option for primary impressions. In response to the same question for final impressions, (45.8%) of participants exhibited that polyvinylsiloxane was the favourite choice. Regarding custom trays, (41.7%) of practitioners preferred using light-cured acrylic resin as a custom tray to take definitive impressions. (87.4%) of prosthodontists border molded the custom tray in sections by (81.9%), using modelling plastic impression compound by (92.1%). The most used philosophy for final impression making was the mucostatic impression technique by (50.4%), while (37.0%) used selective pressure and (12.6%) selected muco-compressive. Implant-supported overdenture was discussed as an alternative treatment by (65.4%). The obtained data was statistically analyzed using SPSS 28.

**Conclusion:** This study reflects a diversity of opinion among Libyan dentists during the construction of complete dentures. The most commonly used material for primary impression was irreversible hydrocolloid (alginate) and for final impression was polyvinylsiloxane, which coincides with professional practices worldwide. Modelling plastic impression compound was the most preferred material for border molding. The mucostatic technique was the predominantly used impression philosophy for final impression making.

**Keywords:** *Impression materials, Impression techniques, Complete dentures, Edentulous patients, Prosthodontics.*

### Corresponding author:

**Rawan Albeshti:** Assistant Professor, Libyan Authority for Scientific Research, Tripoli, Libya

**E.mail:** [ronadent04@yahoo.co.uk](mailto:ronadent04@yahoo.co.uk)

## INTRODUCTION

Edentulism is a major problem in elderly people due to chronic oral diseases, including dental caries and/or periodontal problems.<sup>1</sup> Providing edentulous patients with complete denture (CD) is an essential treatment option in order to re-establish the patient's quality of life (function & aesthetic).<sup>2, 3</sup> Moreover, impression-making is a critical step in determining the success or

failure of CD, thus several contributing factors affect the construction procedures of impressions, such as; selecting a suitable tray, the used technique, the type of the material and the patient's intra-oral condition.<sup>4</sup> However, impression-making is still a widely debatable area for CD fabrication.<sup>5, 6</sup>

The impression is a negative likeness (replica) of oral tissues, it is made by placing an impression material into the mouth using an impression tray.<sup>7</sup> This replica should include all the landmarks of the edentulous mouth (entire denture bearing area & border seal area of maxillary/mandibular arches) to achieve the maximum degree of retention, stability and support for CD.<sup>7, 8</sup> As stated in textbooks and literature, there is a variety of impression materials which available for impression making and they are mainly classified into

elastic and non-elastic (rigid) types, according to their behaviour after setting.<sup>7, 9</sup> The non-elastic impression materials include all; impression plaster, impression compound, zinc oxide eugenol (ZOE) impression paste and impression wax. On the other hand, the elastic impression materials comprise; hydrocolloids and elastomers. The hydrocolloids group includes; agar-agar (reversible type) and alginate (irreversible type), whereas the elastomers include; polysulfide, additional and condensational silicones (polyvinylsiloxane) and polyether.<sup>7, 8, 10</sup>

Nowadays, highly viscous alginate (irreversible, elastic, hydrocolloid impression material) is the most widely used material for recording the primary impression when fabricating a CD.<sup>11</sup> On the other hand, impression compound is a non-elastic (rigid), thermo-plastic (reversible) and muco-compressive impression material, which is classified into two types according to ADA (low fusing & high fusing material).<sup>7, 12</sup> This material now is used relatively little as a primary impression compared to other impression materials, which can be used with low viscosity impression materials such as; ZOE as impression tray.<sup>13</sup> It cannot be used in the presence of undercuts because distortion occurs when the replica is removed from the mouth.<sup>7, 12, 13</sup>

Well known that elastomeric impression materials are rubber-like polymers with a hydrophobic property, commonly used for recording the final impression.<sup>7, 14</sup> They are supplied in different viscosity's ranging from low to high viscosity associated with an elastic behavior at the time of loading.<sup>12, 15</sup> These materials have two advantages over the elastic, hydrophilic impression materials (hydrocolloids): (1) good tear resistance, and (2) dimensional stability.<sup>7</sup> In contrast, ZOE impression paste is an irreversible, non-elastic and mucostatic impression material.<sup>12</sup> It is sufficiently fluid to record all fine surface details in the mouth, but cannot be used in undercut regions for edentulous patients.<sup>12</sup>

Many studies proved that several techniques/philosophies used to make dental impressions for edentulous patients have been affected by the clinical situations of maxillary/mandibular arches, these techniques are divided into three groups; mucostatic (minimal pressure or passive), muco-compressive (definite pressure or functional) and selective pressure techniques.<sup>16, 17</sup> The choice of which impression materials and techniques to use in each edentulous case not only depends on understanding of anatomy, physiology of oral structures and properties of selected materials but also on the individual's oral condition.<sup>18</sup>

Several questionnaires have been conducted in different parts of the world to study the preference of impression materials/techniques that used during CD

fabrication, whereas there is no published information among Libyan dentists. Therefore, the purpose of this study was to assess the favoured impression materials and impression recording techniques used for CD construction by dentists working in the Central/Western regions of Libya.

## MATERIALS AND METHODS

This cross-sectional study was conducted between July 2023 and September 2023 through self-administered questionnaires. A purposive sampling technique was used to choose 190 participants (general dentists and prosthodontists), they were selected based on providing CD prostheses in their routine dental clinical work, and also according to the place of practice which is in Central/Western regions of Libya. Both paper-based and/or online (google form) questionnaires were used for the participants.

This questionnaire was constructed depending on the ideal academic and clinical requirements of CD construction (clinical and laboratory). It was sent to seven specialists in Prosthodontics affiliated with the dental schools, in order to assess the clarity, importance and logical order of the questionnaire's questions. Based on their feedback, the final version of the questionnaire was written and confirmed; as shown in the Appendix (supplement data). The research approval was obtained via the Bioethics Committee at the Biotechnology Research Center, Tripoli-Libya, under Reference Number [NBC: 001. H. 23. 15].

The questionnaire comprised of 30 questions in total, was divided into two parts including; 11 questions for demographic and professional attitude and 19 questions regarding the straightforward CD construction for the cases with no bony undercuts or flabby edentulous ridges. The information was tested in Part 1, demographic information; such as gender, age, working (sector, position, region), years of experience, frequency of providing CD, alternative treatment plan for edentulous patients, asking not to wear the exciting CD for 24-48 hrs prior impression making, selection of impression technique according to individual's intra-oral condition and contributing factors that may affect the selection of impression materials.

Furthermore, Part 2 involved information regarding the professional steps for CD construction (impression materials and their techniques used for fabrication of CD); such as history-taking methods, type of tray used for taking primary impression, using utility wax for tray periphery, type of materials used for primary impression, waiting time until pouring the recorded impression, materials used for custom tray fabrication, use of wax spacer, stoppers and relief holes during fabrication of custom tray, handle shape of custom tray, border molding favoured materials and techniques,

type of materials used for final impression, final impression techniques, recording techniques for posterior palatal seal (PPS), correction of minor deficits for final impression and materials used for disinfection of impression.

**Statistical Analysis:** The collected data were subjected to a statistical analysis using SPSS (Statistical Package for Social Sciences) software package version 28.

**RESULTS**

Out of 190 questionnaires distributed among practitioners, 127 responded, ensuring a total response rate of (66.0%). The highest response rate was from the central regions of Libya (56.7%). The majority of respondents were male (56.7%) and the other participants were female (43.3%). (79.5%) of contributors were general practitioners, while (20.5%) of them were specialists (Prosthodontists). (43.3%) of dentists were working in both sectors (public and private sectors). A sizable number of dentists had practiced dentistry for the duration of 11-20 years (35.4%), the data is summarised in **Table 1**.

**Table 1:** Distribution of Participants according to region, gender, working as, working in and working experience

Percent Distribution of Participants			
According to the Region:			
Central Region		Western Region	
56.7%		43.3%	
According to the Gender:			
Male		Female	
56.7%		43.3%	
Working as:			
General Practitioners		Specialists	
79.5%		20.5%	
Working in:			
Public Sector	Private Sector	Both	
14.2%	42.5%	43.3%	
Working experience:			
< 5 years	5-10 year	11-20 years	> 20 years
21.3%	32.3%	35.4%	11.0%

The CD was routinely provided by (66.1%) of participants in their clinics. (65.4%) of practitioners offered an implant-supported overdenture as an alternative treatment for edentulous patients. (59.8%) of dentists instructed their patients to discontinue wearing the existing CD for 24-48 hrs prior to

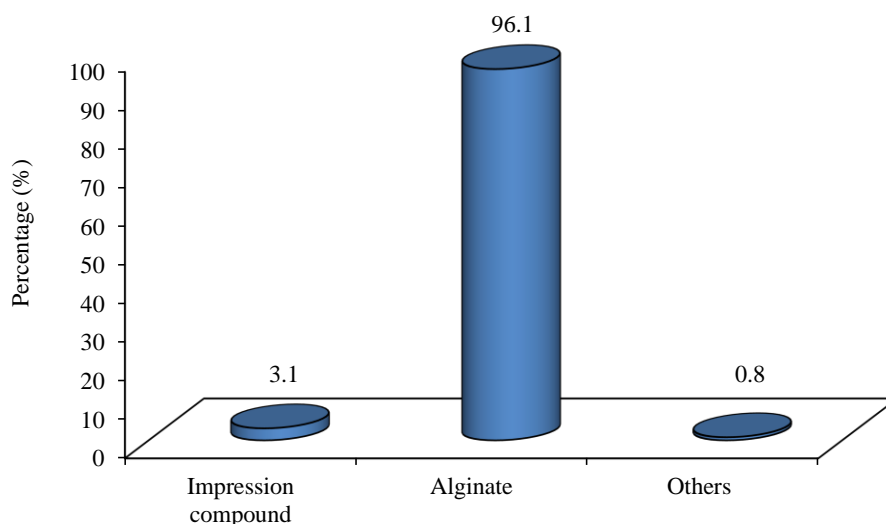
impression making. Further, (73.2%) of contributors evaluated the patient’s intra-oral condition in order to select the correct impression technique during CD construction. The distribution of dentists according to the contributing factors that affecting selection of impression materials is presented in **Table 2**.

**Table 2:** Contributing factors affecting the selection of impression materials

Contributing Factors	Percentage (%)
Availability of the material	22.8
Cost	1.6
Ease of use	0.8
Degree of accuracy	9.4
Status of the ridge	6.3
All of the above	46.4
Availability of the material + Cost	1.6
Availability of the material + Ease of use	2.4
Availability of the material + Degree of accuracy	0.8
Availability of the material + Cost + Ease of use	1.6
Availability of the material + Ease of use + Degree of accuracy	0.8
Cost + Status of the ridge	0.8
Cost + Ease of use + Status of the ridge	0.8
Ease of use + Degree of accuracy + Status of the ridge	0.8
Degree of accuracy + Status of the ridge	3.1

This study revealed that the majority of respondents (90.6%) took the patient's medical/dental history orally, while (9.4%) through written format and none of them approved using the electronic format. (15.0%) of practitioners favoured using metallic trays for recording the primary impression, (32.3%) preferred using plastic trays and (52.8%) of them used both types. (66.9%) of respondents favoured adjusting the

tray periphery using utility wax, while the remainder did not approve this step. It was observed that (96.1%) of dentists routinely used irreversible hydrocolloid (alginate) impression material for recording the primary impression, (3.1%) used impression compound and only one practitioner favoured using a putty material; as seen in **Figure 1**.



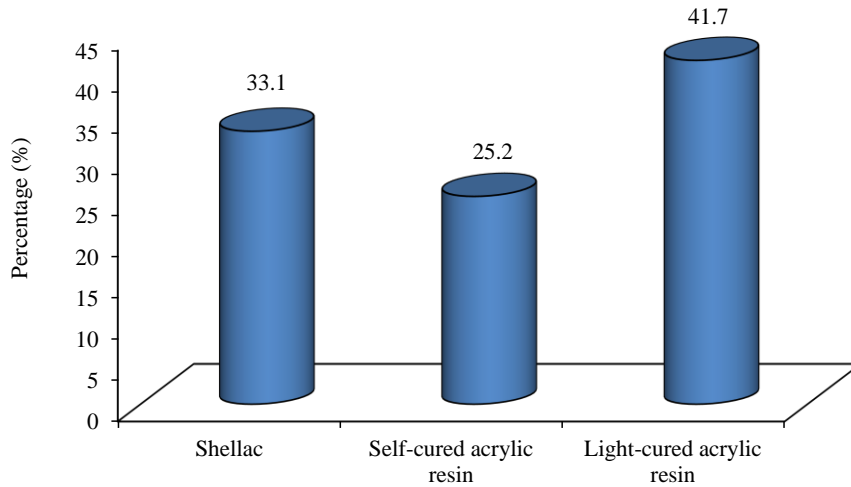
**Figure 1:** Percent distribution of the materials used as primary impressions.

It was exhibited that (16.5%) of this study respondents poured the primary impression immediately, while (27.6%) within 15-30 min, (36.2%) after 1 hr and

(19.7%) postponed this step after 24 hrs. Subsequently, the custom tray was fabricated for final impression making and (33.1%) of dentists selected shellac

material as a material of choice, (25.2%) preferred using self-cured acrylic resin and the majority of (41.7%) favoured light-cured acrylic resin; as shown in **Figure 2**. In addition, (67.7%) of practitioners performed a wax spacer during the designing of a special tray, (65.4%) preferred to add stoppers and

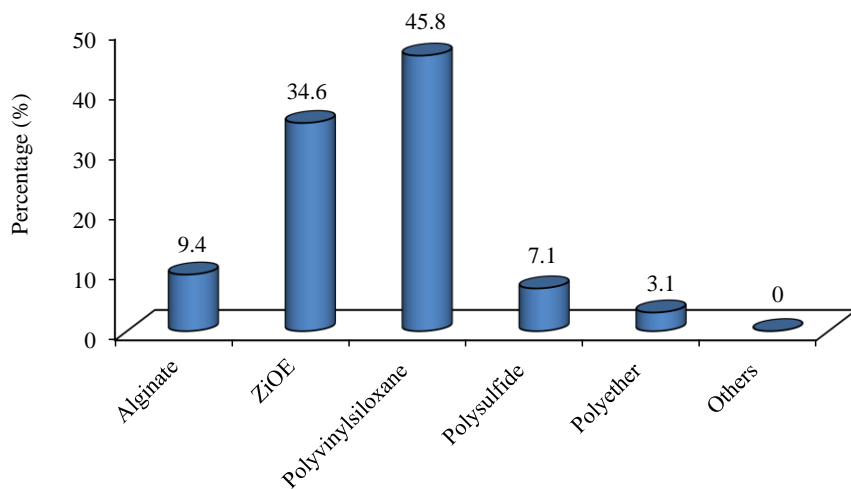
(66.9%) favoured the incorporation relief holes. Majority of contributors desired L-shaped handle for the custom tray (91.3%), whereas (7.9%) chosen a stub-shaped handle and only one participant preferred the construction the custom tray without a handle.



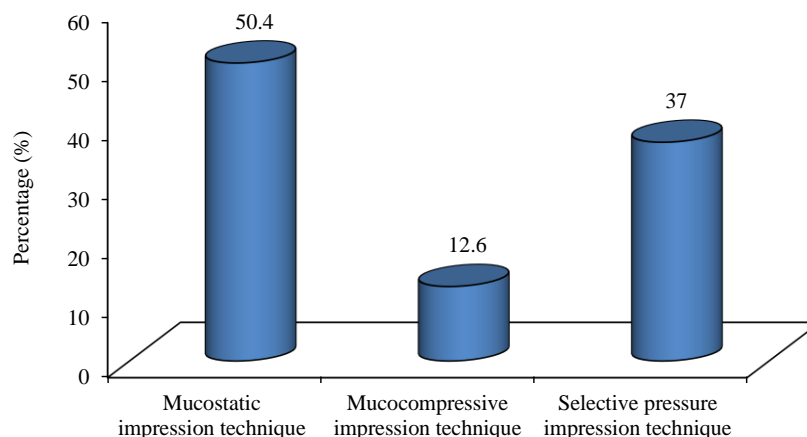
**Figure 2:** Percent distribution of the materials used for custom tray fabrication.

Regarding the border molding procedure, (87.4%) of dentists favoured to make it. Modelling plastic impression compound was used by (92.1%), while (7.9%) preferred using heavy-body elastomers. Further, about (81.9%) selected the sectional technique and others chose the one-step method. It was revealed that (45.8%) of practitioners preferred using polyvinylsiloxane for recording the final impression.

Other materials were selected as options for final impressions; ZOE impression paste (34.6%), alginate (9.4%), polysulfide (7.1%) and polyether (3.1%); as illustrated in **Figure 3**. For impression techniques, (50.4%) of contributors favoured using the mucostatic technique, though muco-compressive and selective pressure techniques were chosen by (12.6%) and (37.0%) respectively; as presented in **Figure 4**.



**Figure 3:** Percent distribution of the materials used as secondary impressions.



**Figure 4:** Percent distribution of the techniques used during impression making.

The data showed that (83.5%) of contributors recorded PPS and the majority (76.4%) used conventional technique for PPS, while (7.9%) used fluid wax technique and (15.7%) used arbitrary scraping method. (68.5%) of dentists performed correction of the minor deficits in the final impression, (31.5%) did not approve this step. Regarding disinfection of impressions, most of the practitioners (55.1%) rinsed the impression under tap water only and others chose different materials; as tabulated in **Table 3**.

**Table 3:** Materials that used for disinfection of impressions

Disinfectant	Percentage (%)
Tap water	55.1
Sodium hypochlorite	17.3
Glutaraldehyde	4.7
Chlorhexidine	8.6
Tap water + Sodium hypochlorite	4.7
Tap water + Glutaraldehyde	2.4
Tap water + Chlorhexidine	2.4
Sodium hypochlorite + Chlorhexidine	2.4
Others	2.4

**DISCUSSION**

It is well known that recording the anatomical landmarks of edentulous patients via impression-making is the key in the success/failure of CD.<sup>19</sup> The main focus of this study was to evaluate the clinical practice concerning impression materials and techniques used for CD fabrication by general dentists and specialists in the Central/Western regions of Libya. The accuracy of impression-making is achieved by

following the manufacturing instructions for each impression material. This could also be attributed to the contributing factors that affect the selection of impression materials. Accordingly, the results of this study revealed that most dentists considered all the factors including; availability of the material, cost, ease of use, degree of accuracy and status of the ridge.

The obtained results from this study exhibited that (96.1%) of respondents favoured using irreversible hydrocolloid (alginate) for making the primary impression. This could be explained by the low cost of material, ease of manipulation, fast setting time, adequate shelf-life and also pleasant for the patients. Our findings are in excellent agreement with the previous studies conducted all over the world. <sup>2, 20, 21</sup> (88.0%) of dental graduates in the UK and (87.0%) of dental undergraduates in the US schools preferred to use alginate as a primary impression material.<sup>20, 21</sup> In another study conducted in Saudi Arabia, (91.7%) of participants used alginate to make primary impressions.<sup>2</sup> In contrast, other studies reported that (93.0%) of Pakistani dental students and (78.0%) of Indian practitioners preferred to use impression compound as a material of choice for making a primary replica<sup>4, 6</sup> This might be due to the differences in teaching and training programs of dental schools. It is also probably because of the low cost of impression compound compared to other impression materials. Based on the responses in the current research, the material of choice for custom tray fabrication was light-cured acrylic resin (41.7%). The main advantages of this material are high strength and rigidity, good handling properties and polymerize with no residual monomer.<sup>22</sup> This finding coincides with the results of previous studies, which showed that the use of a

custom tray for the final impression is a vital step in CD construction, which occurs by choosing light-cured acrylic resin as a favorite material.<sup>21, 23</sup> This is in contrast to the achieved results of the questionnaire-based studies in Pakistan, in which (92.0%) of respondents used self-cured (chemical-cured) acrylic resin for custom tray making.<sup>6, 17</sup> The main limitation behind using self-cured acrylic resin is polymerization shrinkage and stress relaxation during the construction procedure of the custom tray, leading to distortion of the final impression and inaccuracy of the final prosthesis.<sup>24</sup>

In the present study, (87.4%) of prosthodontists border molded the custom tray and (81.9%) of them recorded the border in sections prior to the final impression procedure. Further, modelling plastic impression compound was the preferred material by (92.1%) and some used heavy body elastomeric materials (7.9%). Border molding is a major procedure in order to duplicate the contour/size of the buccal, labial and lingual vestibules, thus the borders of impression will be in harmony with the physiologic action of limiting structures. Our findings are in agreement with earlier studies.<sup>17, 23, 25, 26</sup>

This research exhibited that the majority of participants (45.6%) preferred to use polyvinylsiloxane as a material of choice for the final impression, followed by ZOE impression paste (34.6%) as a second option. It is obvious that there is an increase in the popularity of using elastomeric (non-aqueous) materials. This is owing to the superior degree of reproducibility, dimensional stability of the material, proper working/setting time, ease of handling, multiple casts can be produced from the same impression and also the continuous improvement in the physical/mechanical properties of elastomers.<sup>23, 27, 28</sup> In Saudi Arabia, (52.4%) of dentists preferred to use polyvinylsiloxane as a final impression material, followed by using ZOE impression paste (20.0%).<sup>2</sup> This result is in good agreement with our data. Further, another study conducted for US postdoctoral prosthodontic programs showed that the most commonly used impression material for the final impressions was polyvinylsiloxane (42.0%) and the second option was polysulfide (32.0%), followed by alginate (13.0%), ZOE impression paste (8.0%), polyether (3.0%) and impression plaster (2.0%) respectively.<sup>23</sup>

In comparison with other questionnaire-based studies conducted in Pakistan, (97.0%) and (89.0%) of dental practitioners favoured to use ZOE impression paste to record the final impressions.<sup>6, 17</sup> Another work conducted in India also displayed that (73.0%) of respondents used ZOE impression paste for making the final impressions.<sup>4</sup> In Nepal, (73.3%) of dentists

favoured using ZOE impression paste, followed by polyvinylsiloxane (11.7%), polyether (11.7%), and polysulfide (3.3%) respectively.<sup>26</sup> One of the major drawbacks of ZOE impression material is the rigidity after setting, which cannot be able to use for recording the undercuts.

It was found that the most used impression philosophy in the current study was mucostatic technique (50.4%), which was followed by selective pressure (37.1%) and muco-compressive techniques (13.2%). The mucostatic philosophy (minimal pressure) provides a large amount of space between the tray and the soft tissues of the basal seat. In contrast to our findings, many research indicated that the most approved philosophy for impression making was selective pressure, followed by muco-compressive and mucostatic technique.<sup>2, 29, 30</sup> The selective pressure technique is based on selectively loading on the primary stress-bearing areas and relieving secondary stress-bearing areas.<sup>31</sup> The variation in the selection of proper technique/philosophy for making a CD is multifactorial. It basically depends on the clinical situation, materials availability and clinician's knowledge, experience and performance.

In this study, (55.1%) of dentists disinfected the obtained impressions under running water only, while (17.3%) used sodium hypochlorite and (8.6%) used chlorhexidine as a disinfectant agent. It is more likely due to the dentist's attitude towards the infection control is poor. Consequently, disinfection of dental impressions should be considered as a routine procedure in both dental clinics and laboratories in order to avoid transmission of infection from the patient to the dental staff.<sup>32</sup> However, many studies emphasized that the disinfection of impressions could affect the dimensional accuracy, stability and wettability of the impression materials.<sup>33, 34</sup>

Regarding implant-supported overdenture, this option was discussed as an alternative treatment rather than conventional CD by (65.4%) in the present research. Many studies proved that the patients who are treated with implant-supported overdenture have a higher quality of life in terms of functions and aesthetics rather than the patients who wear conventional CD.<sup>35, 36, 37</sup> Although, the overdenture treatment needs precise surgical techniques, which requires skills of surgeons, corporation of patients, additional time and cost.<sup>38</sup>

This research was limited to the specific regions in Libya as well as was focused on the traditional impression recording techniques that are used during CD making. Thus, further broadening studies are required to be done in order to discuss the popularity of digital impression techniques and also to evaluate the recent advancement in the discipline of prosthodontics.

**CONCLUSION**

This study indicates that the clinician's knowledge, experience and performance have an essential influence on the procedures of CD construction. Within the limitation of this questionnaire-base study; it can be concluded that:

- I. Most commonly used material for the primary impression was irreversible
- II. colloid (alginate) and for the final impression was polyvinylsiloxane (PVS).
- III. Most of practitioners preferred to use light-cured acrylic resin for custom tray fabrication in order to carry the final impression.
- IV. Modelling plastic impression compound was favoured by most participants to border mold the custom trays in sections.
- V. Mucostatic impression technique was the predominantly used impression philosophy for final impression making.
- VI. Implant-supported overdenture will be the most approved treatment plan for edentulous patients in the coming decades.

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