

East African Medical Journal Vol. 94 No. 12 December 2017

SELECTION OF IMPRESSION MATERIALS AND TECHNIQUES EMPLOYED BY DENTISTS IN KENYA

Bernina Kyale Kisumbi, Senior Lecturer, Department of Conservative and Prosthetic Dentistry, Division of Biomaterials Science, School of Dental Sciences, University of Nairobi, Hazel Orengo Simila, Lecturer, Department of Conservative and Prosthetic Dentistry, Division of Biomaterials Science, School of Dental Sciences, University of Nairobi, Olivia Awino Osiro, Lecturer, Department of Conservative and Prosthetic Dentistry, Division of Biomaterials Science, School of Dental Sciences, University of Nairobi, Ben Isaac Omondi, Lecturer, Department of Conservative and Prosthetic Dentistry, Division of Prosthetic Dentistry, School of Dental Sciences, University of Nairobi

Corresponding Author: Bernina Kyale Kisumbi, Department of Conservative and Prosthetic Dentistry, Division of Biomaterials Science, School of Dental Sciences, University of Nairobi. Argwings kodhek Road, Nairobi P.O Box 19676 – 00202, KNH, Nairobi. Email: berninakisumbi@gmail.com

SELECTION OF IMPRESSION MATERIALS AND TECHNIQUES EMPLOYED BY DENTISTS IN KENYA

B.K. Kisumbi, H.O. Simila, O.A. Osiro and B.I Omondi

ABSTRACT

Objectives: The aim of the study was to determine the preferred impression material and impression recording technique employed by the dentists in Kenya for specific clinical procedures.

Design: A descriptive cross sectional study.

Setting: Dental clinics/institutions within Kenya.

Participants: Dentists registered by the Medical Practitioners and Dentists Board as at 2015.

Methods: A sample n=322 was randomly selected among the 1000 dentists registered in 2015. Data was collected using a pre-tested self-administered questionnaire that was distributed via online web-based survey monkey software and off-line by data collection assistants. Data was analysed using SPSS version 20 and Microsoft Excel 2013. Results were presented in tables, pie and bar charts.

Results: Ninety seven dentists (30.1%) returned the questionnaires, 57 (58.8%) completed the hard copy version while 40 (41.2%) responded via the on-line tool. Majority of the respondents were males 52 (53.6%), 44 (45.4%) females while one dentist (1%) did not respond. Nearly half of the dentists 44 (46.4%) had 0-5 years clinical experience and a sizeable number 72 (74.2%) were general practitioners. Majority 56 (57.7%) considered availability, cost, ease of use and degree of accuracy in selecting impression materials (IM's). The most commonly used (IM) was alginate whereas the least applied were polysulphide and vinyl siloxanether. Alginate was used in primary and final impressions of all procedures except border moulding, mostly in study model 88 (90.7%) and least in complete denture final impression 4 (4.1%). Addition and condensation cured silicones were preferred for fixed restoration impressions with majority 40 (41.1%) using single

mix impression technique. One dentist used digital impression recording technique.

Conclusion: Selection of (IM's) is influenced by availability, cost, ease of use and degree of accuracy. Alginate and silicone impression materials were most utilised. The single mix impression technique was more popular while digital impression technique is yet to be widely embraced by dentists in Kenya.

INTRODUCTION

Impression making is an indispensable procedure within contemporary dental practice, entailing the use of impression materials (IM's) and digital imaging techniques to record negative replica of teeth and adjacent oral structures (1). From these, positive replicas in form of physical or virtual casts and dies are produced. These are subsequently used as study casts and or as master casts in the construction of crowns, fixed partial dentures, veneers, inlays, implant supported restorations, removable partial and complete denture, orthodontic appliances and maxillofacial prostheses. The accuracy of casts and dies is dependent on the detailed reproduction and dimensional accuracy of IM's which in turn affects the success of various restorations and prostheses manufactured (2,3). Oral pathologies, trauma and congenital conditions may culminate in partial or total hard and soft tissue loss. The aforementioned restorations and prostheses find a major application to restore morphology, function and aesthetics in such cases (2,3).

There is a host of impression materials available for making impressions which can be broadly classified into elastic and rigid types depending on their physical state after setting. The rigid category includes; impression plaster, modelling plastic impression compound (MPIC), Zinc oxide Eugenol impression paste (ZOE) and impression wax (IMW). On the other hand the elastic impression materials comprise of hydrocolloids, namely agar (AGA) and alginate (ALG) and the five non-aqueous

elastomers polysulphides (PS), polyether's (PE), addition and condensation cured silicones (CCS) and the recently developed Vinysiloxanether her (VSE) (4). The demand for accuracy in dental impressions is very high, thus impression materials should demonstrate ability to record fine details, dimensional stability, elasticity, tear strength, wettability and low viscosity (5). Comparatively, Addition cured silicones (ACS) demonstrates superior accuracy and it is the most widely used in final impressions for indirect restorations such as crowns, fixed partial denture, veneers, inlays, implant supported restorations, removable partial and complete dentures; it is followed by polyether (6,7). In addition, ALG is indicated in recording impressions for; preliminary casts for numerous restorations and prostheses, orthodontic working models, study models and also final impression for removable partial dentures (RPD's) (8,9,10).

The choice of the impression material and technique is left at the discretion of the dental practitioner. This has been reported to be influenced by availability of the material, properties of the IM, prostheses for which the procedure is intended, personal preference and cost. Additionally, Dental Schools' teaching with regard to selection of impression materials and techniques, also plays a role and has been shown to differ marginally among schools. Nonetheless dental practitioners have been reported to select inferior materials for precision recording (11,12,13,14,15). Furthermore, failure to perfectly capture intended details like margins in indirect restorations construction is common and has been

reported to occur in half of conventional dental impressions (16). The performance of an impression material can be compromised by improper indication and manipulation by the clinician.

In the United Kingdom, ACS is the most used material for final impression in the construction of indirect restorations and Fixed Partial denture (FPD), followed by PE9. For the same applications dentists in India use elastomeric impression materials and ALG whereas among Sudanese dental practitioners, ALG was the frequently used material with ACS being least applied. The selection of IM's for final impression in the fabrication of complete dentures is varied, ACS is most popular among prosthodontists in the USA and dentists in India whereas PS is employed in US Dental schools. Conversely ALG is used for the same application in the UK while Zinc oxide eugenol is employed by specialist practitioners in Pakistan and several states in India (11,17). The indications of impression materials have been studied and whereas most dentists select IM's appropriately, some dentists have been shown to select inferior materials for precision recording (10,11). This is contrary to best practice and teaching. Notably, the use of alginate an aqueous elastomer which is subject to dimensional instability has been employed to record final impressions for precision recordings. This may be attributed to economic considerations as the mean cost when using ACS has been shown to be higher than using alginate (18).

One-stage or two-stage full-arch impression techniques, in the production of complete dentures has been practised. Two-stage impression involves a preliminary impression, border moulding custom trays and recording final impression. On the other hand one-stage impression technique utilises a single impression on stock trays. Both one-stage and two-stage full-arch impression techniques have been reported as

appropriate. With regard to final impression for FPD, crowns, inlays or veneers, some of the techniques for final impressions using elastomeric impression materials entail, single (monophase) mix, putty wash/reline with spacer, putty wash/reline without spacer and multiple mix approaches (17,19,20,21).

The introduction of computer aided impression making in 1980's provided an alternative technique to conventional impressions whose acceptance has continued to increase gradually (22). The available digital impression techniques include intraoral scanning systems and digital impression devices that export 3D images in-house to a milling machine or to the dental laboratory via the internet. Though not yet widespread, digital impression technique is efficient, more acceptable and preferred by the patient and has a higher treatment comfort compared to conventional impression technique (22,23). In Kenya and indeed in most African countries, the commonest dental treatment is tooth extraction (24,25). Subsequently there is a possibility of frequent use of impressions as it is one of the stages in tooth and soft tissue replacement procedures. Further, an impression, is a crucial step in the production and success of the intended restorations and prostheses as it subsequently determines the outcome of the planned treatment of the dental patient. Hence, the aim of this study was to determine the selection of dental impression materials and techniques employed by dental practitioners in Kenya.

MATERIALS AND METHODS

The study area comprised the dental clinics and institutions in Kenya and the population was the 1000 dentists registered by the Medical Practitioners and Dentists Board as at 2015. A descriptive cross sectional study was done on a sample n=322 randomly

selected among dentists. Data was collected using a pre-tested, structured, self-administered questionnaire distributed via online web-based survey monkey software and off-line. The hard copy questionnaire was distributed by data collection assistants in Nairobi and at the 33rd Kenya Dental Association annual conference held in Eldoret in October 2015. Care was taken to ensure that a single respondent did not provide information via both modes. Statistical analysis was done using SPSS version 20 and Microsoft Excel 2013 and results presented in form of tables and charts. Ethical approval was granted by the Kenyatta National Hospital/ University of Nairobi ethics and research committee.

RESULTS

Distribution of the Respondents and socio-demographic data: Ninety-seven dentists spread over 16 counties returned the questionnaires, a response rate of 30.1%. The highest response rate was from Nairobi 32 (33%), Uasin Gishu 18 (18.6%) and a county entered as 'Kenya' 19 (19.6%) (Figure 1). Majority of the respondents were males 52 (53.6%), 44 (45.4%) were females and one (1%) did not respond the M: F ratio was 1.2:1. Most respondents 72 (74.2%) were general practitioners of which 41 (42.3%) were males and 31 (32%) were females. There were 23 specialists who were distributed over four counties Nairobi 11 (11.3%), Uasin Gishu 3 (3.1%), Mombasa 1(1%) and 'Kenya' 7 (7.2%). A sizeable number of the dentists 44 (46.4%) had practiced dentistry for a duration of 0-5 year. There was almost an equal number of dentists who practiced in public 27 (27.8%) and private 26 (26.8%) sectors (Table 1). Thirty eight (39.1%) of the respondents worked in more than one institution.

Figure 1
Distribution of the dentists across the counties

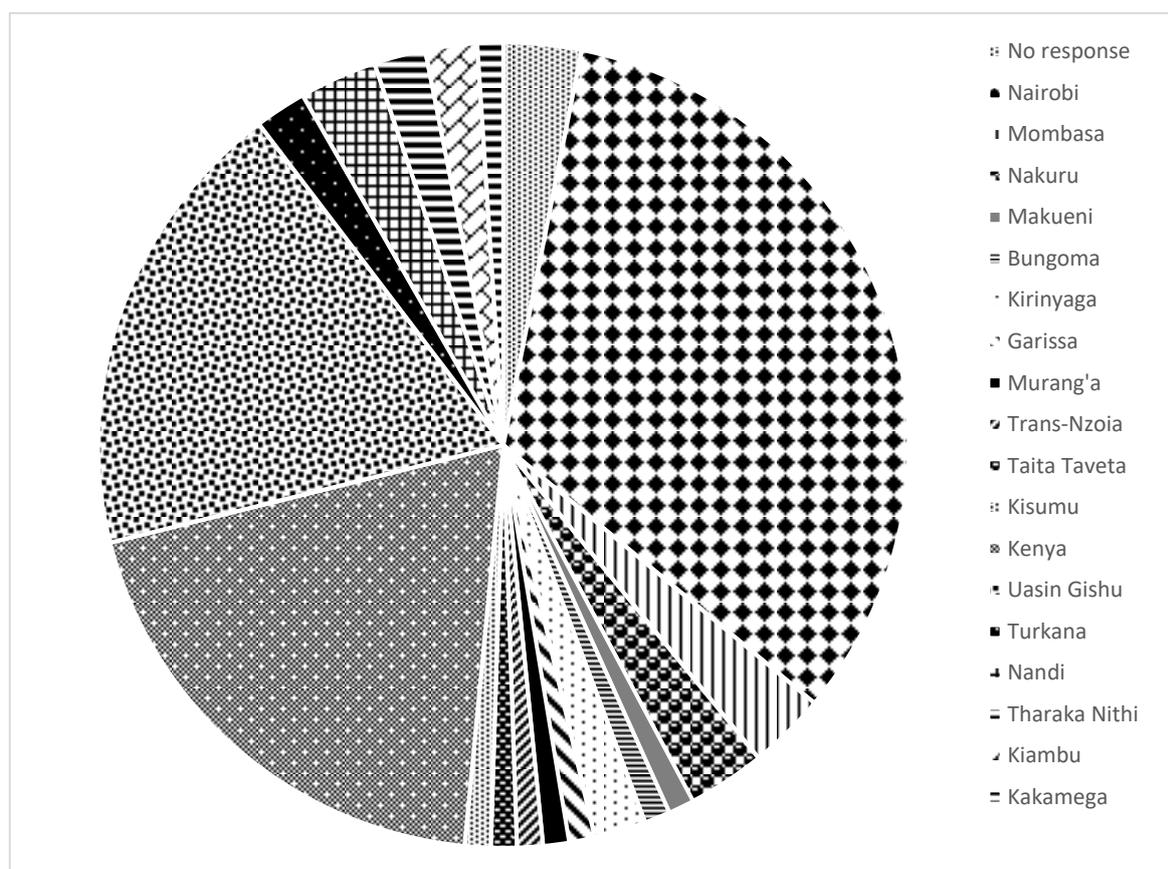


Table 1

Distribution of the dentists according to type of practice institution and number of years in clinical practice

Type of Practice/Institution	Number of years in clinical practice					TOTAL
	No Response	0-5 yrs	6 - 10 yrs	11 - 15 yrs	More than 15 yrs	
No response	1(1%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	1 (1%)
Public sector	0 (0%)	21 (21.6%)	4 (4.1%)	0 (0%)	2 (2.1%)	27(27.8%)
Private sector	0 (0%)	7 (7.2%)	6 (6.2%)	6 (6.2%)	7 (7.2%)	26 (26.8%)
Faith based	0 (0%)	2 (2.1%)	2 (2.1%)	1 (1%)	0 (0%)	5 (5.2%)
Public and private	0 (0%)	5 (5.2%)	3 (3.1%)	0 (0%)	5 (5.2%)	13 (13.4)
Teaching and private	0 (0%)	1 (1%)	6 (6.2%)	1 (1%)	4 (4.1%)	12 (12.4%)
Teaching and public	0 (0%)	8 (8.2%)	2 (2.1%)	2 (2.1%)	1 (1%)	13 (13.4%)
TOTAL	1 (1%)	44 (45.4%)	23 (23.7%)	10 (10.3%)	19 (19.6%)	97 (100%)

Selection of impression materials by dentists

The study revealed that all types of impression materials were available to the dentists including the VSE which is a relatively novel product. Majority of the

dentists used alginate to record impressions for making study models 88 (90.7%), orthodontic work models 71 (73.2%) and space maintainers 57 (58.8%) fabrication. In making primary impressions for complete

denture construction, the dentists selected IM's as follows; Modelling plastic impression compound cakes (MPICC) 51 (52.6%), ALG 8 (8.2%), IMCS 4 (4.1%), ACS 1 (1%), with 9 (9.3%) indicating not applicable while 24 (24.7%) did not responding to the question. Majority of the dentists 68 (70.1%) used ALG to take primary impressions for RPD whereas a minority 1 (1%) each applied ACS, CCS and IMCS. The distribution of the dentists according to the selection of

materials for final impressions in the fabrication of complete and removable partial dentures is presented in Table 2. The most preferred IM for the final impression was; ZOE 48 (49.5%) for CD, Modelling plastic impression compound sticks (MPICS) 49 (50.5%) for border moulding for CD and ALG 52 (53.6%) for removable partial denture (RPD). No dentist reported using AGA and PS.

Table 2

Distribution of the dentists according to materials used for final impressions in fabrication of complete and removable partial dentures

Intended Use/Impression material	Complete Denture	Border Moulding for Complete Denture	Removable Partial Denture
IMCC	0 (0%)	3 (3.1%)	0 (0%)
IMCS	1 (1%)	49 (50.5%)	0 (0%)
ZOE	48 (49.5%)	1 (1%)	3 (3.1%)
IMW	0 (0%)	5 (5.2%)	0 (0%)
ALG	4 (4.1%)	0 (0%)	52 (53.6%)
ACS	4 (4.1%)	1 (1%)	8 (8.2%)
CCS	4 (4.1%)	1 (1%)	3 (3.1%)
PE	2 (2.1%)	0 (0%)	2 (2.1%)
VSE	1 (1%)	0 (0%)	0 (0%)
Not applicable	9 (9.3%)	9 (9.3%)	6 (6.2%)
No response	24 (24.7%)	27 (27.8%)	23 (23.7%)
Total	97 (100%)	97 (100%)	97 (100%)

With regard to final impressions for indirect restorations and fixed prostheses the selection of IM's by the respondents is shown in (Table 3). Addition cured silicone 16 (16.5%) for veneers, CCS 19 (19.6%) for tooth supported FPD, CCS 14 (14.4%) for implant supported FPD and ACS 11 (11.3%)

for maxillofacial prostheses. In total the three most used IM's for recording final impressions were, ALG 75 (77.3%), ACS 64 (66%) and CCS 63 (65%) while AGA was the least indicated 1 (1%). No dentists reported using MIPC and IMW for final impressions.

Table 3

Distribution of the dentists according to materials used for final impressions in fabrication of indirect restorations and fixed prostheses

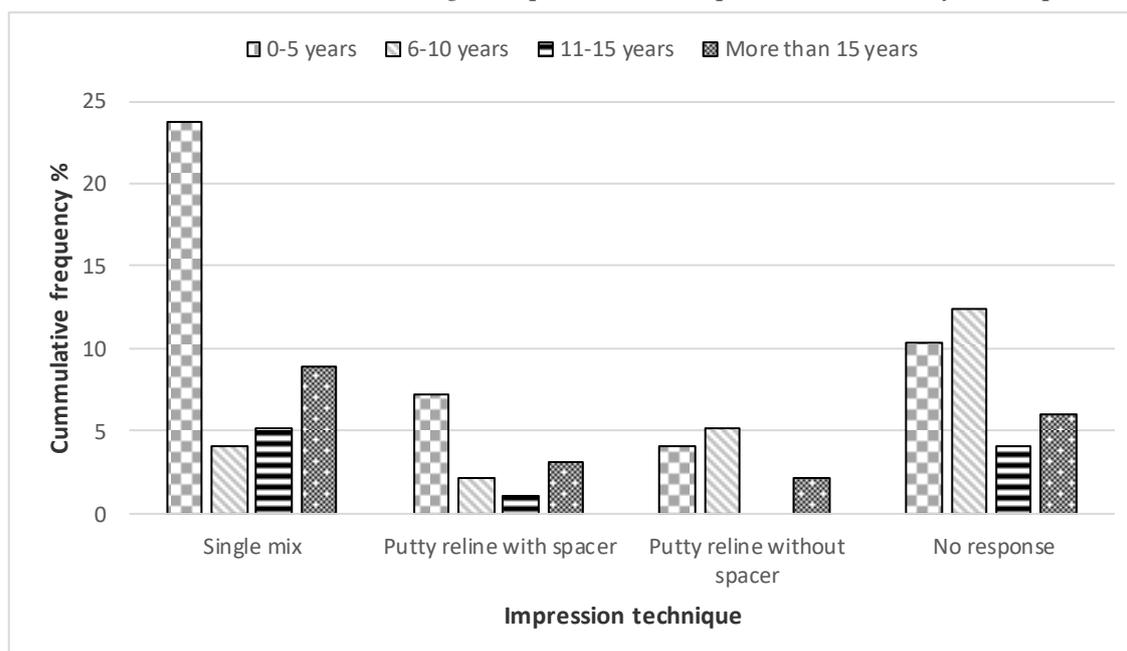
Intended Use/Impression materials	Veneer	Tooth Supported FPD	Implant Supported FPD	Maxillofacial prostheses
ZOE	0 (0%)	0 (0%)	1 (1%)	1(1%)
ALG	8 (8.2%)	6 (6.2%)	5 (5.2%)	0 (0%)
AGA	0 (0%)	0 (0%)	0 (0%)	1(1%)
ACS	16 (16.5%)	18 (18.6%)	6 (6.2%)	11 (11.3%)
CCS	15 (15.5%)	19 (19.6%)	14 (14.4%)	7 (7.2%)
PE	12 (12.4%)	8 (8.2%)	2 (2.1%)	5 (5.2%)
PS	0 (0%)	1 (1 %)	0 (0%)	1 (1%)
VSE	1 (1%)	1 (1%)	1 (1%)	2 (2.1%)
Not applicable	19 (19.6%)	21 (21.6%)	41 (42.3%)	29 (29.9%)
No response	26 (26.8%)	23 (23.7%)	27 (27.8%)	27 (27.8%)
Total	97 (100%)	97 (100%)	97 (100%)	97 (100%)

In response to an open ended question where respondents were asked to give the factors they considered in selecting impression materials, majority of the dentists' decision were guided by combined factors; availability, cost, ease of use, degree of accuracy and specific procedure 57 (57.7%). Followed by accuracy 5 (5.2%), material properties 4 (4.1%), intrinsic material properties and final product intended was considered by a few dentists 4 (4.1%) each. In addition a sizeable number of the dentists 75 (77.3%) selected IM's as they were taught in dental school 50 to 100% of the times and only 1 (1%) never applied knowledge gained at dental school.

Impression techniques employed by the dentists: Digital impression technique was used by one dentist, however the respondent did not indicate the type of equipment. Almost all dentists 95 (97.9%) used the conventional impression technique and one did not respond to this question. The most preferred technique for final impressions with elastomers was the single mix technique by 40 (41.1%), and least preferred was putty reline without spacer 11 (11.3%) (Figure 2). Majority of the dentists who preferred single mix technique had a working experience of 0-5 years whereas none of the dentists who had worked for 11-15 years used the putty reline without spacer technique.

Figure 2

Distribution of the dentists according to impression technique and number of years in practice



As pertains to disinfection of impressions, almost half 43 (44.3%) of the respondents practiced routine impression disinfection while 41 (42.3%) did not. Of the respondents who disinfected impressions, 24 (55.81%) used sodium hypochlorite and 6 (14%) used glutaraldehyde while a minority used

chlorhexidine, Ethylene diamine tetra acetic acid, amisiodyme and hydrogen peroxide. Among the 41 (42.3%) respondents who did not practice impression disinfection, majority 34 (82.9%) did not respond to this question whereas 5 (5.2%) cited unavailability of materials as a deterrent.

DISCUSSION

The study attracted dentists from 16 counties garnering a rather low response rate of 30.1%. Similar to findings in recent studies done in Kenya (26,26). However it contrasts with other studies where high response has been attained via use of off-line and on-line questionnaires (9,11,27). This could be attributed to the busy nature of dental practice as well as the current research culture among dentists in Kenya. Most of the respondents were general practitioners and had practiced for 0 to 5 years. The relatively short practice period of most of the respondents could be due to the on-line questionnaire mode where younger dentists are probably more internet savvy. The higher percentage respondents from Nairobi

corresponds with the geographical distribution of the dentists in Kenya. Dentists who indicated Kenya as their county may have willingly chosen not to declare their county as there is a lot of ethnic desensitisation currently.

The study recorded few specialists which is also reflected by the comparatively higher number of respondents who indicated they did not perform specialised treatment procedures namely tooth and implant supported fixed partial dentures and maxillofacial prostheses. The few number of specialists may be explained by the fact Kenya's dental postgraduate courses currently train less than 12 specialists per year and most programmes are less than 10 years old. In addition the cost of postgraduate training abroad is dear for the

average Kenyan dentist. The specialists were distributed over four counties that have major towns in Kenya, this corresponding to the former provincial hospitals.

Notably all impression material types were available to the respondents including the novel vinylsiloxanether. Majority of the dentists used ALG for preliminary impressions which corresponds to both teaching in dental schools and practice among dental practitioners globally (14,27,28). Furthermore ALG is universally used for making impressions for orthodontic working models, study models and casts for ante-mortem records in forensic dentistry. The most preferred IM's for fixed restorations in decreasing order were ACS, CCS, PE and ALG. The use of CCS as a final impression material was equivocal with that of ACS in this study. While the use of ACS and PE concurs with practice in other studies it differs from other studies where CCS is less popular (9,29). The use of CCS by respondents in this study may be explained by the IM's the multiple factors, indicated by the respondents and perhaps the teaching in dental school. Moreover, if handled well CCS's offer acceptable accuracy and detail for clinical applications (30).

In this study, a proportion of dentists used alginate for final impression for construction of fixed restorations and removable prostheses. This is comparable to reports from India, Sudan but differ from those of UK (9,11,17). Alginate being an aqueous elastomer has poor dimensional stability and tear strength as well. An impression is a fundamental procedure in the sequence of steps undertaken by the dental practitioner for construction indirect restorations and prostheses. Therefore the reasons for using ALG may partly stem from the cost of health care, the mean health care cost when using ACS has been found to be higher than when using alginate (18). Majority of the respondents indicated MPICC for primary and ZOE for secondary impressions in the

construction of complete denture. This differs with the use of ALG for primary impression by prosthodontics in USA, Turkish, Portuguese, Spanish and North American dental schools. In addition ZOE is not preferred by most practitioners and teaching in some schools. For instance, most dental practitioners in the UK use ALG, Prosthodontists in the USA use ACS, North America and USA dental schools use PS whereas PE, ACS, ALG and ZOE are applied equally in Turkish and Portuguese dental schools (14,15,19,28). Therefore the use of majorly ZOE and MIPC for complete denture fabrication is on the decrease in dentistry. The dentists' use of IMPCS for border moulding concurs with teaching in North America Schools, whereas other materials have been employed for the same application include PE and ACS putty (28,31).

The most preferred impression technique while using elastomers was single mix. This entails the use of a monophasic viscosity material on a custom tray to record the impression. This differs with other studies where dual phase impression technique has been preferred and shown to be more accurate (32,33). This may be attributed to multiple factors dentists considered in selecting impression materials in this study that included cost and ease of use. The study revealed that most dentists considered availability, cost, ease of use, degree of accuracy and specific procedure combined factors while selecting impression materials. While a few dentists reported considering accuracy, and material properties, intrinsic material properties and final product intended were considered separately. The results showed that more than half of the dentists considered combined factors while selecting impression materials. The results differ with findings from a study where dentists chose IM's basing on personal preferences and past experience with particular materials (34).

Disinfection of impressions was practiced by almost half of the dentists, this contrasts with findings among Sudanese dental practitioners and where more than half of the respondents disinfected impressions. Conversely a lower proportion of dental colleges in India was reported to use chemical disinfection with majority simply rinsing the impressions under running water (11,35). In this study, most respondents skipped the question on why they did not disinfect impressions. The reason given by the few dentists who responded was unavailability of disinfectants which is questionable as the mostly used Sodium hypochlorite is available in many outlets all over Kenya. It is probable that the attitude towards the practice of disinfection may be poor as the respondents are aware of the transmittable pathogens.

With one dentist using digital impression technique in this study, the concept appears to be just beginning to take off in Kenya. The delayed embrace may be due to the prohibitive capital investment and affordability of fixed restorations by the average Kenyan dental patient (10,36). Though very slow, the uptake of the digital impression technique is in line with projected slow growth of the digital concept among dentists worldwide. Currently digital impression technique offers an efficient alternative to conventional impressions, shortening treatment durations and superior comfort, however it is not yet applicable to full-arch impressions (37,38).

CONCLUSION

Selection of impression materials was guided by availability, cost, ease of use and degree of accuracy of impression materials. Alginate and silicone impression materials are most utilised for final impressions. The single mix technique is more popular and digital impression technique is yet to be widely embraced by dentists in Kenya.

RECOMMENDATIONS

1. In this era of diverse and efficient communication, the dental professionals in Kenya should embrace participation in research from the comfort of their choice.
2. The challenges associated with lack of disinfection of impressions by more than half of the dentists should be investigated and overcome.
3. A study on quality of impressions recorded by dentists should be undertaken and correlated to oral health related quality of life of patients using restorations and prostheses fabricated.

ACKNOWLEDGEMENTS

We wish to thank the dentists who for participating in this study, The Kenya Dental Association for assisting with the distribution of the on-line questionnaire link, Dr Mercy Makhanu for assisting with data collection and Samuel Ndoto Kyalo for assisting with data analysis.

REFERENCES

1. The glossary of prosthodontic terms. *J Prosthet Dent* 2005; 94: 10–92. (18)
2. German M.J, Carrick T.E, Mc Cabe J.F. Surface detail reproduction of elastomeric impression materials related to rheological properties. *Dent. Mater* 2008; 24:951-956.
3. Craig RG and Sun Z. Trends in elastomeric impression materials. *Operative Dentistry* 1994; 19: 138-45.
4. Anusavice J.K (eds.) Phillip's Science of dental materials. 11th ed, Philadelphia; WB Saunders 2003. pp.205-254.(8)
5. ISO 4823 for elastomeric impression materials. International Standard Organisation for Standardisation (ISO) Technical committee: Tc 106/Sc 2; 2000. (New)

6. Christensen G.J, What category of impression material is best for your practice. *J Am Dent. Assoc.* 1997; 129: 1026-1028.
7. Donovan T.E, Chee W.W A review of contemporary impression materials and techniques. *Dent Clin North Am.* 2004; 48:445-470. (13)
8. Idis D, Zeynep O, Ender K. Predoctoral prosthodontic curricula on removable partial dentures: Survey of Turkish schools. *Journal of Dental Education* 2013;77: 85-92.
9. Brunton P.A, Christensen G.J, Cheung S.W, Burke F.J, Wilson N.H. Contemporary dental practice in the UK: Indirect restorations and fixed prosthodontics. *Br Dent J.* 2005; 198:99-103.
10. Donovan T.E, Chee W.W A review of contemporary impression materials and techniques. *Dent Clin North Am.* 2004; 48:445-470.
11. Mohammed A.B, Neamat H.A, Assessment of crown and bridge work quality among Sudanese dental practitioners. *Journal of Indian Prosthodontic Society* 2010;10: 53-56.
12. Al-Ahmar A.O, Lynch C.D, Locke M, Youngson C.C. Quality of master impressions and related materials for fabrication of complete dentures in the UK. *J Oral Rehabil* 2008; 35:111-115.
13. Javier M, Raquel C.O, Alberto A. Curricula for teaching complete dentures in Spanish and Portuguese dental schools. *Med Oral Patol Oral Cir Buccal* 2013; 18:106-114.
14. Petropoulos VC and Rashed B. Removable partial denture education in U.D dental schools. *J Prosthodont* 2006;15:62-68.
15. Idis D, Zeynep O, Ender K. Predoctoral prosthodontic curricula on removable partial dentures: Survey of Turkish schools. *Journal of Dental Education* 2013;77:85-92.
16. Christensen GJ. The state of fixed prosthodontic impressions: room for improvement. *J AM Dent. Assoc* 2005; 136:343-346.
17. Moldi A, Gala V, Puranik S, Karan S, Deshpande S, Neela N. Survey of Impression Materials and Techniques in Fixed Partial Dentures among the Practitioners in India. *ISRN Dent.* 2013 Apr 22; 2013: 430214. doi: 10.1155/2013/430214. Print 2013.
18. Hulme C, Yu G, Browne C, O'Dwyer J, Craddock H, Brown S, Gray J, Pavitt S, Fernandez C, Godfrey M, Dukanovic G, Brunton P, Hyde TP. Cost-effectiveness of silicone and alginate impression materials for complete dentures. *J Dent.* 2014;42:902-907.
19. Mehra M, Vahidi F, Berg RW. A complete denture impression technique survey of postdoctoral prosthodontic programs in the United States. *J Prosthodont* 2014;23:320-327.
20. Kakatkar VR. Complete denture impression techniques practiced by private dental practitioners: a survey. *J Indian Prosthodont Soc.* 2013;13:233-235.
21. Carrison G.E, Ortop A. Omar R. What is the evidence base for the efficacies of different complete denture impression procedure? A critical review. *J Dent.* 2013;41:17-23.
22. Birnbaum NS, Aaronson HB (2008) Dental impressions using 3D digital scanners: virtual becomes reality. *Compend Contin Educ Dent* 2008;29: 494-505.
23. Emir Y, Hanef K, Rana T and Halenur B. Comparison of digital and conventional impression techniques: evaluation of patient's perception, treatment comfort, effectiveness and clinical outcomes. *BMC Oral Health* 2013;10: 1-7.
24. Kaimenyi JT, Sachdeva P, Patel S. Cause of tooth mortality at the dental unit of Kenyatta National Hospital of Nairobi, Kenya. *Odontostomatol Trop.* 1988;11:17-20
25. Kisumbi B.K, Gathece L.W., Koyio L.N, Wamai, J. Dental amalgam waste management by dentists in East Africa. *International Dental Journal* 2013: 63 (Suppl. 1) Abstract No. P684.
26. Osiro A.O, Kisumbi B.K, Simila H.O: Selection of direct restorative and root filling materials Kenyan dentists in 2016. *East Africa Medical Journal* 2016;93; 27-32.
27. Vohra F, Rashid H, Hanif A, Ghani S.M, Najeed S, Trends in complete denture impressions in Pakistan. *J Ayud Med Coll abttabad* 2015; 27:108-112.
28. Frazier K.B and Mjor I.A, The teaching of all-ceramic restorations in North America dental schools: materials and techniques employed. *J Esthet. Dent.* 1997; 9:86-93.
29. Brunton P.A, Sharif M.O, Creanor S, Burke F.J, Wilson N.H. Contemporary dental

- practice in the UK in 2008: indirect restorations and fixed prosthodontics *Br Dent. Journal* 2012; 212:114-119.
30. Virendra B. Dhuru. Contemporary dental materials. Oxford University press 2004. pp.101-110.
31. Petrie CS, Walker MP, Williams K. .A survey of U.S. prosthodontists and dental schools on the current materials and methods for final impressions for complete denture prosthodontics. *JProsthodont.* 2005;14:253-262
32. Nissan J, Rosner O, Barnea E, Assi D. Full arc impression techniques utilising addition type polyvinyl siloxane for fabricating of tooth borne fixed partial dentures. *Refuat Hapeh Vehashinayim* 2006; 23:42-46.
33. Singh K, Sahoo S, Prasad K.D, Goel M, Singh A. Effect of impression techniques on the dimensional accuracy of impressions using various elastomeric impression materials: an invitro study. *J Contemp Dent Prac* 2012; 13: 98-106.
34. Rubel B.S. Impression materials: a comparative review of impression materials most commonly used in restorative dentistry. *Dent. Clin North Am.* 2007; 51: 629-642.
35. Marya C.M, Shukla P, Dahiva V, Jnaneswar A. Current status of disinfection of dental impressions in Indian dental colleges: a cause of concern. *J Infect Dev Ctries.* 2011; 5:776-780.
36. Patzelt SB, Lamprinos C, Stampf S and Att W. The time efficiency of intraoral scanners: an vitro comparative study *J AM Dent. Association.* 2014; 145:542-51.
37. Christensen G.J, Child P.L Jr. Fixed prosthodontics: Time to change status quo? *Dent Today.* 2011; 30: 70-73.
38. Ahlholm P, Sipila K, Vallitu P, Jakonen M, Kotiranta U. Digital versus conventional impressions in fixed prosthodontics: A review. *J Prosthodont.* 2016;Aug 2. doi: 10.1111/jopr.12527. [Epub ahead of print]