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Editorial
How things change but remain the same

Dental calculus was the subject of extensive research in the early 20th century in the quest to find the causative agent in destructive periodontitis. After the experimental gingivitis studies by Loe and co-workers in 1965[1], where it was shown that the plaque biofilm is actually the aetiological agent in the development of periodontal diseases, the shift away from calculus began. The shift occurred because studies at that time showed that it is the plaque biofilm on the calcified calculus deposits that initiated the disease. Calculus per se did not initiate periodontitis and thus the interest in calculus faded.

In recent times, the discovery of nanoparticles/ nanobacteria otherwise known as calcifying nanoparticles (CNPs) and their role in mineralization of calcifications in the body, has reignited interest in calculus. Calculus is mineralized plaque and requires an initiator for calcification to begin. Nanoparticles are now being attributed to be the initiators of calculus mineralization as well as kidney stones [2]. A link between kidney stones and calculus formation has been suggested. Thus, calculus formation could be an indicator of what else is happening in the rest of the body[3].

If the same nanoparticles causing kidney stones are also initiators of calculus formation, then it is in the interest of the profession to investigate this phenomenon with the intention of finding ways of preventing mineralization and thus slowing down calculus formation and by extension also kidney stones. A study by Kati et al, 2018, showed that the group of subjects with kidney stones, had a significantly higher percentage of dental calculus formation than the group without stones ($p < 0.05$)[3]. If calculus formation is slowed down or prevented, then maybe kidney stone formation could be slowed down or prevented as well.

The oral systemic link has been shown not only in this case of calculus and kidney stones but also in periodontal disease and poor pregnancy outcomes, cardiovascular disease, cerebrovascular events and poor sugar control in diabetics among others. In most of these conditions, the oral bacteria have been isolated in areas far away from the oral cavity like in the placenta, the atheroma in cardiovascular disease and the arteries in peripheral artery disease. This link could be extended further to nanoparticles. Possibly, the same nanoparticles in the oral cavity could be finding their way into the blood stream and initiating kidney stones and even atheroma formation.

In calculus formation, nanoparticles are thought to contribute to the mineralization process through their effect on the gingival epithelial cells which when exposed to CNPs, showed gross vacuolization. The CNPs have been shown to enter the cells and the calcification appears in the intracellular vacuoles. This was shown in an Electron Microscopy study by Shiekh et al 2006 [4]. These findings have been confirmed by immunofluorescence and laser scanning confocal microscopy studies. Additionally, in calculus formation, it has also been shown that a crystal – binding molecule, phosphatidylserine increases the attachment of calcium oxalate and calcium phosphate crystal to the surface of cells and forms a calcified cell matrix which then helps in the calcification process [5,6].

The theories on calculus formation include the seeding theory whereby seeding agents induce small foci of calcification which enlarge and coalesce to form calculus. The seeding agents are not clearly known, but suspected agents are intercellular matrix of plaque, carbohydrate-protein complexes and bacteria from plaque. CNPs could also act as the seed initiating the mineralization process in calculus formation by forming calcium phosphate crystals under the sub-saturation level of calcium and/or phosphate. This apatite formation process was found to be in direct association with the calcium level, halted only by decreasing calcium level by half and the phosphate levels nearly to zero [7,8].

In conclusion, calculus and kidney stone formation may be influenced by CNPs. Therefore, it is important to undertake further studies of calculus and find ways of slowing down its formation. In an article in this journal issue, Miraa, a locally grown plant in Kenya, was shown to have an inhibitory effect on calculus formation. Therefore, the study of Miraa in calculus formation warrants further investigation.

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Utilization of Computerized Systems Amongst Dentists in Nairobi County

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Keywords: computerized systems, usage, dentists

Abstract

Background: The health sector has witnessed improvement in service delivery through computerization of patient record management, financial management and communication. Software programs that are explicitly dedicated for health institution management have been developed and are in use. Despite all this progress, there is paucity of published data regarding level of utilization of computerized systems in Kenya especially in dentistry.

Objective: This study aims to determine the level of utilization of computerized systems amongst dentists in Nairobi County and their benefits.

Study Design: Descriptive cross-sectional study

Study population: Dentists practicing in Nairobi County

Data collection: A convenience sampling method was used to select 134 dentists, out of approximately 1,000 practicing dentists. A self-administered questionnaire was delivered to the dentists' clinics and collected after it was duly completed. The data obtained through the questionnaire was analyzed using a statistical package for social sciences (SPSS) software.

Results: Out of the 134 questionnaires distributed, 120(90%) were returned duly completed. The respondents were in private practice, 81(67.5%), and in the public sector, 39(32.5%). Individuals who participated in this study 104(87%) reported using computerized systems in their practice, 75 (72%) in private practice and 29 (28%) in public practice. Chi-Square test of independence showed that there was a statistically significant higher usage of computerized systems by dentists' in the private sector compared to those working in the public sector ($X2 = 6.078$, $df = 1$, $p = 0.014$)

Majority of the dentists 88(80%) had Wi-Fi internet connection whereas 22(20%)of the dentists had cable internet connection. Majority of the dentists 74(27.7%) use email for official enquiry with dental insurance providers, 34 (12.7%), for making patient appointment, 39 (14.6%), sending appointment reminders, 52 (19.5%), making orders for dental materials and equipment, 57 (21.3%). Majority of the dentists who participated in the study 65 (54.17%) reported that the ease of retrieval of records is the greatest benefit in the use of computerized systems, 25 (20.83%) others, found that computers eased the management of financial records and 21 (17.5%) reported that the safe storage of clinical records was the greatest benefit. Only 9 (7.5%) dentists reported that computerized systems made the management of patient appointments easier.

All the dentists participating in the study 100% agreed that it is necessary to computerize the dental practice.

Conclusion: There is a high utilization of computerized systems among private dental practitioners working in Nairobi. It is less in the public sector. There is a positive attitude towards the use of computerized systems among dentists in Nairobi County and most agree that it is necessary in dental practice.

Introduction

Provision of quality and affordable healthcare is the focus of governments in both developed and developing countries. Kenyan government committed itself to providing equitable, affordable and quality healthcare of highest standards to all Kenyans through the Constitution 2010 under the Bill of Rights [1]. Computerization in healthcare has been gaining acceptance over the past decade as a solution to the challenges that hinder the provision of quality care. One of such programs is the Digital India Initiative that was implemented by the government in the Indian subcontinent[2]. This digital program developed an online registration system that links various hospitals in the country to centralized based internet registration and appointment system

through Hospital Management Information Systems (HMIS) [3, 4] .The resolution on digital health has been adopted by the World Health Assembly, which makes decisions on behalf of the United Nations global organization for health.

Computers have been used in almost all spheres of the economy with outstanding benefits. In healthcare computers have replaced conventional service delivery methods such online booking and registration instead of the traditional queuing and manual registration, improved accuracy and quality of data recorded in health records, enhanced access to patient health records from previous medical appointments through linked records between hospitals and practitioners, improved quality of care due to efficiency of access to information, reduced cost of healthcare.

A demonstration project initiated by the government in United Kingdom (UK) back in the year 2008, a telehealth trial for chronic illness showed a 14% decrease in the days of hospitalization,14% decrease in admission for elective treatment, 15% decrease in visits for emergency care, decrease of 45% in deaths and 20% decrease of admission for emergency treatment. [5,6]. The Health ICT group in Ireland published a report that recommended that the Irish government prioritize resourcing of a modern information technology enabled healthcare system citing among others Trinity Health in the United States of America that has deployed electronic health records with commendable results.

Many factors contribute to the attitudes of healthcare staff towards information technology. They include the flexibility of the computer system to the purpose is to the purpose they serve, the confidence of the staff in the system and the experience they have in the use of the systems. A study by Pod suggest that the attitude of professionals in the healthcare practice plays a significant role in the effectiveness in the implementation of modern technology for the practice of dentistry. The study further suggested that training of the professional was a factor in encouraging the use of computers.[7]

Computerized charting and electronic heath recording in dentistry has improved organization, treatment monitoring and patient record retrieval enhancing communication in the practice of dentistry which resulted in optimum patient care. The future of dentistry is comprehensive application of software technology in operatories. The wider usage includes: periodontal charting, digital radiography and storage, computer based records, digital x-rays, online booking and scheduling and dental insurance information and processing.[8]

This study intends to provide relevant information to dentists and managers of dental practices that will form a basis for decision making when implement ing computerized systems in the future. The findings will also fill the knowledge gap that exist on this area.

Methodology

This was a descriptive cross-sectional study on dental practitioners registered by the Kenya Medical and Dentist Board working in Nairobi County in both public and private dental clinics. There is an estimated one thousand (1000) practicing dentists in Kenya with 30% (300) of them practicing in Nairobi. Considering that study of the entire population of dentists is not practical, a representative sample of 134 was obtained using a formula proposed by Cochran.

This study used convenience sampling method. A minimum of 134 dentists were sought and recruited into the study. The selection was influenced by their availability during the study period.

Data Collection Management

Self-administered Questionnaires were delivered physically to the clinics then collected after they were duly completed.
All the data was kept confidential throughout the study. Data analysis was done using SPSS software and presented using charts and tables.

Ethical Consideration

The approval for the study was obtained from the Kenyatta National Hospital- University of Nairobi committee of Ethics and Research (KNH-UON ERC). The purpose of the study and all the details were given prior to participation and written consent obtained. All the information obtained from participants was kept confidential.

Results

A total of 134 dentists participated in the study. Majority of the respondents 120(90%) responded to the questionnaire. Among the respondents 81(67.5%) where in private practice while 39(32.5%) where in public sector.

A total of 104 (87%) reported use of computerized systems in their practices, 75 (72%) in private practice and 29 (28%) in public practice. Sixteen participants reported not using any computerized systems in their practice, and they were 10(62%) in public practice and 6(38%) in private as shown (Table 1). The study showed a significantly higher uptake of computerized systems in the private sector than in the public sector dental practice. The findings where statistically significant (X2=6.078, df= 1, p=0.014).

Table 1: Participants response on the use of any computerized systems

		Participants' responses on the use of any computerized system in their practice		**Total**
		No	**Yes**	
Nature of practice	Private	6	75	81
	Public	10	29	39
Total		16	104	120

Computer based application use were as follows 88(58.8%)for digital radiography and storage, 6 (3.9%)use computerized voice recognition for periodontal charting, 38 (24.5%), intraoral cameras, 4 (2.6%) computer controlled local anesthesia delivery,1 (0.6) billing , 1 (0.6%) health information management systems, 14 (9.0%), financial records, 1 (0.6%), interdepartmental communication and 1 (0.6%) patient database management (Table 2).

Table 2: Computer Based Applications Used

		Responses		Percent of Cases
		N	Percent	
Computer-based applications used	Computerized voice recognition program for periodontal charting	6	3.9%	5.0%
	Digital radiography and storage	88	56.8%	73.3%
	Intra oral cameras	38	24.5%	31.7%
	Computer controlled local anesthesia delivery	4	2.6%	3.3%
	Billing	1	0.6%	0.8%
	None	14	9.0%	11.7%
	Software HMIS	1	0.6%	0.8%
	Financial records	1	0.6%	0.8%
	Inter departmental communication	1	0.6%	0.8%
	Patient database management	1	0.6%	0.8%

Majority of the dentists who took part in the study 109(90.83%) had internet connection in their practice while 29(9.167%) did not have internet connection (Figure 1). Majority of the dentists 88(80%) had Wi-Fi internet connection whereas 22(20%) of the dentists had cable internet connection. Sixty four (58%) allowed access to the internet by staff only and 46(42%) allowed anyone who visited their practice to access the internet.

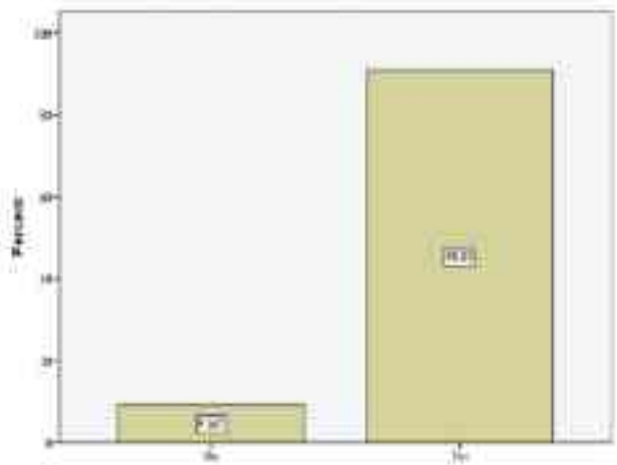

Figure 1: Participants response on having internet connection

Majority of the dentists 74(27.7%) use email for official enquiry with dental insurance providers, 34 (12.7%), for making patient appointment, 39 (14.6%), sending appointment reminders, 52 (19.5%), making orders for dental materials and equipment, 57 (21.3%), personal use by clinic staff, 1 (0.4%) communication between departments, 4 (1.5%) no email services available, 1 (0.4%) advertisements, 2 (0.7%), all forms of communication within the hospital, 1 (0.4%) email not used for communication and 1 (0.4%) radiographic consultation respectively (Table 3).

Table 3: The usage of email services

		Responses		Percent of Cases
		N	Percent	
How the email is used	Making patient appointment	34	12.7%	28.3%
	Official inquiry with dental insurance provider	74	27.7%	61.7%
	Sending appointment reminders to patients	39	14.6%	32.5%
	Making orders for dental materials and equipment	52	19.5%	43.3%
	Personal use by clinic staff	57	21.3%	47.5%
	Communications between different departments within the hospital	1	0.4%	0.8%
	No emails available.	4	1.5%	3.3%
	Advertisements	1	0.4%	0.8%
	All forms of communication within practice e.g. meeting memos, minutes, communication on training, CPDs	2	0.7%	1.7%
	Emails not used for communication	1	0.4%	0.8%
	Radiologic consultation	1	0.4%	0.8%
	Internal communication	1	0.4%	0.8%

Majority of the dentists who participated 80 (67%) have a website for the practice while 40 (33%) did not have a website for their practice. Most of those with websites 76 (55.9%) used the website to publicize the dental services available, 34 (25%) for providing dental education, 23 (16.9%) for patient online booking, and 1 (0.7%) for other uses (Table 4).

Table 4: Use of the website

		Responses		Percent of Cases
		N	Percent	
The use of the website	Publicizing the dental services available at the practice	76	55.9%	95.0%
	Providing dental health education for patients	34	25.0%	42.5%
	Patient online booking and scheduling	23	16.9%	28.8%
	It is run by the hospital administrator	1	0.7%	1.2%
	Only record, billing and pharmacy request available in the HMS	1	0.7%	1.2%
	Information website	1	0.7%	1.2%

All the dentists participating in the study 120 (100%) agreed that it is necessary to computerize dental practices.

Some of the participating dentists 50 (40.83%) reported that high initial cost is the main challenge in implementing computerized systems in dental practice, 25 (20.83%) reported high cost of maintenance as a challenge, 20 (16'6%) said that the need for trained personnel was the hindrance and 26 (21.67%) reported that the dental team was reluctant to move to the computerized systems.

Majority of the dentists who participated in the study 65 (54.17%) reported that the ease of retrieval of records is the greatest benefit in the use of computerized systems, 9 (7.5%) the ease of managing patient appointments, 25 (20.83%) the ease of managing financial records and 21 (17.5%) reported that the safe storage of clinical records was the greatest benefit (Figure 2)

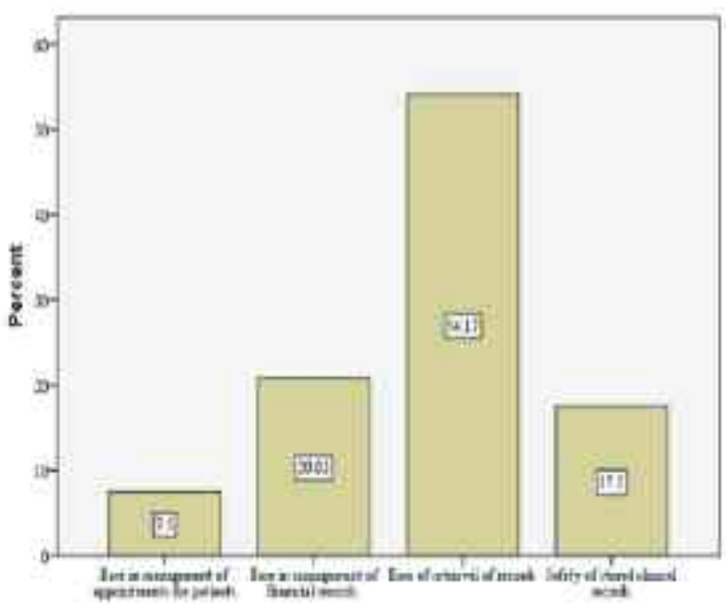

Figure 2: Participants' responses on what the greatest benefit in use of computerized systems

Discussion

A total of 134 dentists where included in the study. Majority of the respondents 90% responded to the questionnaire. This response was comparable to a study by John et al, 2003 in Britain where the results reported that 88% of those given questionnaires returned them[24].

A total of 104(87%) reported use of computerized systems in their Practice,72% in private practice while 28% were in public practice. Of those who participated in the study16(13%) participants reported that they did not use any computerized systems in their practice of these 62%where in private practice while 38% were in public practice. The level of use of computerized systems was similar to a study done in Thames region in the UK in 2003 were 77% of practices used computerized systems [24]. This similarity could be very different now due to the developments that have taken place over the years in Britain including the National Health System (NHS) having been computerized.

The Chi-Square test of independence showed that there was a statistically significant association between the type of practice and the implementation of computerized systems among participants with more private practitioners using computers in their practices. This could be attributed to availability of funds to implement the computerized systems in the private sector compared to the public sector.

Computer based application used where 58.8% for digital radiography and 24.5% intraoral cameras. In a related study in South Africa by Nyati et al, 2010 participants reported to have embraced digital radiography and there was an increasing number of radiology departments purchasing digital units [21].

This study revealed that most dental practices in Nairobi County have internet connection. Majority of the dentists who took part in the study 91% had internet connection in their practice while 9% did not have internet connection. Wi-Fi mode of internet connection was the most popular. There was a wide range of use of the internet with the majority of the dentists 28% using email for official enquiry with dental insurance providers, 15% for sending appointment reminders, 19.5% making orders for dental materials and equipment, 21% personal use by clinic staff among other uses. Majority of the practices 67% had a website for the practice while 33% did not have a website for their practice. The extensive use of internet can be attributed to benefits of its use and the recent development in internet infrastructure in the country and the Nairobi County in particular.

Majority of the participating dentists 41% reported that high initial cost is the main challenge in implementing computerized systems in dental practice, 21% the high cost of maintenance, 17% the need for trained personnel and 22% reported that the dental team was reluctant to move to the computerized systems. Similarly, the study published in 2003 by the British Dental Journal [25] reported that perceived initial cost for implementing computer systems was a challenge and likewise recommended training of personnel to resolve the reluctance of the dental team to migrate to the electronic systems. This shows that challenges appear to be similar all over the world and are not unique to the Kenyan set up.

According to a report published by the World Health Organization, Western Pacific region, on Electronic Health Records, a manual on digital health records for developing countries 2006, it was recognized that new technologies will go a long way in improving the provision of healthcare both in the developing and the developed nations[2]. In the present study, similarly, majority of the dentists who participated in the study 54.17% reported that the ease of retrieval of records is the greatest benefit in the use of computerized systems,20.83% the ease of managing financial records and 17.5% reported that the safe storage of clinical records was the greatest benefit showing that use of electronic health records was of value.

All the dentists participating in the study 100% agreed that it is necessary to computerize dental practices. Based on the finding of this study, there is need to encourage implementation of computerized systems in public practice and training of the dental teams to ensure a higher uptake of this systems so as to benefit from the convenience brought about by their use in dentistry.

The limitation of this study is that it is not representative of the Kenyan dentists' population since the investigation was based in Nairobi.

Conclusion

There is a high utilization of computerized systems among private dental practitioners working in Nairobi. However, the usage is far much less in the public sector.

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Calculus formation and its relationship to chewing of Muguka and Miraa

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Keywords: muguka, miraa, khat, calculus, calcifying nanoparticles (CNPs)

Abstract

Background: Quantity of calculus and location of formation are population specific and are affected by personal oral care procedures and plaque control measures. Muguka/miraa (otherwise known as Khat) chewing has been found to be associated with occurrence of calculus. The aim of this study was to determine the difference in the occurrence of calculus between individuals in miraa and muguka growing areas

Methods: A cross sectional design study of randomly selected 835 individuals in Meru miraa growing area and Embu Muguka growing area, was performed in 2016. Details of the study population, setting, participant recruitment, sample size calculation, ethical consideration and consent have been published by Ongeri et al 2019 [19].

Oral examination involved probing of the cervical surface of teeth with a periodontal probe for subgingival and supragingival calculus.

Results: The Relative risk(RR) of currently chewing muguka/miraa whenever chewed muguka was 16.9 (95%CI=10.2-28.1), miraa was 45 (95%CI =19.1-108.5), both muguka and miraa was 38.2(95% CI=17.2-84.1) in Embu. In Meru, the Relative risk(RR) of currently chewing muguka/miraa whenever chewed miraa was 7.4(95% CI=5.5-10.03), for both miraa and muguka was 120(95% CI=30.2-477).

Only one participant chewed muguka in Meru. The presence of calculus occurred at a higher level in the Embu participants tooth surfaces than on the Meru tooth surfaces. The percent calculus free surfaces were above 80% in the Meru tooth surface distributions than in the Embu tooth surface distributions.

Conclusion: There was more calculus found in those chewing muguka in Embu than the participants in Meru who were mainly chewing miraa. Miraa has an inhibitory effect on calculus formation.

Introduction

Calculus is calcification of plaque on the tooth cervical surface. The cause of periodontal diseases is the accumulation of the microbial dental plaque which adheres on calculus. Calculus was originally thought to consist of amorphous and/ or finely granular organic matrix containing mass of variety of gram positive and gram negative coccoid bacteria and filamentous form. Numerous gram- negative filaments were on superficial layers of subgingival calculus while in deep and middle zones gram-positive filaments were predominant. [1,2,3]

Nanobacterium or calcifying nanoparticles(CNPs) discovered in various pathological calcifications, such as kidney stones and arterial plaques have also been found in calculus. These microorganisms may be considered as potential risk factors for chronic periodontal diseases and pathological calcifications in human. The possible role of nanobacteria in periodontal disease was first proposed based on association between the oral hygiene and the incidence of the cardiovascular disease, which was probably mediated via the oral infection inflammation pathways. [4,5,6,7] Nanobacteria, as the smallest known self-replicating bacteria, are classified as Gram-negative organisms.

Nanobacterium is one of the most controversial issues in current biological studies since they may represent mineral-protein complexes without any relation to living organisms. [8,9,10]

Quantity of calculus and location of formation are population specific and are affected by personal oral care procedures and plaque control measures; access to professional care, diet, age, ethnic origin, time since last dental cleaning; systemic disease, the use of prescription medications and level of pocketing [1]. Khat chewing has been found to be associated with occurrence of calculus. [11,12] Several local studies have examined the effect miraa has on oral tissues. [13,14] Khat is used or chewed differently depending on its type.

The type that is used in Meru(Miraa) involves the peeling of the bark from the twigs and chewing it. The Khat from Embu involves the chewing of the leaves(Muguka). Miraa/muguka use consist of chewing 100 to 300 g to form a bolus that is held against the cheek on one side of the mouth while swallowing its juices; a typical "khat session" lasts for 3 to 4 hours. The presence of theses juices and the bolus over such a long period of time affects calculus formation [11,12].

The classical methods of calculus removal are being replaced with plaque biofilm removal and influence of miraa chewing on this process might provide an alternative approach. [15,16,17] The aim of the study was to determine the difference in the occurrence of calculus between individuals in miraa and muguka growing areas.

Methods

A cross sectional design study of randomly selected 835 individuals in Meru miraa growing area and Embu Muguka growing area was performed in 2016. Details of the study population, setting, participant recruitment, sample size calculation, ethical consideration and consent have been published elsewhere. [19]

Oral examination involved probing of the cervical surface of teeth with a periodontal probe for subgingival and supragingival calculus. Presence of no calculus was scored as 0, subgingival calculus as 1, supragingival calculus as 2, both subgingival calculus and supragingival calculus as 3. Lack of a surface due to missing teeth was scored as 4.

Results

The findings were that in Embu, muguka was preferred whereas in Meru it was Miraa as shown in table 1.

Table 1: Distribution participants current use of muguka/ miraa by having ever chewed muguka/ miraa in Embu and Meru.

Area	Currently using muguka/ miraa	Have you ever chewed muguka/ miraa			
		Muguka	Miraa	Both Miraa and muguka	Never chewed any
Embu	Yes	33	3	24	
	No	14	5	6	223
	Total	47	8	30	223
Meru	Yes	1	212	36	
	No	0	37	2	238
	Total	1	249	38	238

The Relative risk(RR) of currently chewing muguka/miraa whenever chewed muguka was 16.9 (95%CI=10.2-28.1), miraa was 45 (95%CI =19.1-108.5), both muguka and miraa was 38.2(95% CI=17.2-84.1) in Embu. In Meru, the Relative risk(RR) of currently chewing muguka/miraa when ever chewed miraa was 7.4(95% CI=5.5-10.03), for both miraa and muguka was 120(95% CI=30.2-477). Only one participant chewed muguka in Meru.

Figure 1 illustrates the percent distribution of participants' use of miraa and muguka and it shows that muguka was mainly chewed in Embu whereas Miraa was chewed in Meru. Chewing both muguka and miraa was more common in Embu since only one participant chewed muguka in Meru.

Key: Vertical axis: Percent of participants. Horizontal axis: Current use of muguka/ miraa in the two sites. Series 1: Ever chewed muguka Series 2: Ever chewed miraa Series 3:Ever chewed both muguka and miraa

Figure 1: Percent distribution of participants current use of muguka/ miraa by having ever chewed muguka/ miraa in Embu and Meru.

The presence of calculus on four surfaces of the first quadrant molar teeth is shown in figure 2 to illustrate the methodology used to determine calculus deposits on each tooth in all the participants.

Figure 2. Data on calculus collected from the upper right molars.

Key for figure 2: no calculus was scored as 0, subgingival calculus as 1, supragingival calculus as 2, both subgingival calculus and supragingival calculus as 3 . Figure 3 and 4 show detailed tooth surface labels i.e Cal_18_M- Calculus on tooth 18 mesial surface .. e.t.c)

Figure 2 illustrates proportions of calculus present in the upper right quadrant molar surfaces.

Figure 3- Percent distribution of calculus in Embu

Figure 4- Percent distribution of participants calculus in Meru participants

KEY: Figure 3 and 4.
Vertical axis- Percent and Horizontal axis- Tooth surfaces
Series 1- No calculus. Series 2- Subgingival calculus. Series 3- Supragingival calculus Series 4- Supra and subgingival calculus. Series 5- Missing surface

Tooth surface series- Cal_18_M- Calculus on tooth 18 mesial surface with subsequent surfaces in the following order: Cal_18_F, Cal_18_D, Cal_18_L, Cal_17_M, Cal_17_F, Cal_17_D, Cal_17_L, Cal_16_M, Cal_16_F, Cal_16_D, Cal_16_L, Cal_15_M, Cal_15_F, Cal_15_D, Cal_15_L, Cal_14_M, Cal_14_F, Cal_14_D, Cal_14_L, Cal_13_M, Cal_13_F, Cal_13_D, Cal_13_L, Cal_12_M, Cal_12_F, Cal_12_D, Cal_12_L, Cal_11_M, Cal_11_F, Cal_11_D, Cal_11_L, Cal_21_M, Cal_21_F, Cal_21_D, Cal_21_L, Cal_22_M, Cal_22_F, Cal_22_D, Cal_22_L, Cal_23_M, Cal_23_F, Cal_23_D, Cal_23_L, Cal_24_M, Cal_24_F, Cal_24_D, Cal_24_L, Cal_25_M, Cal_25_F, Cal_25_D, Cal_25_L, Cal_26_M, Cal_26_F, Cal_26_D, Cal_26_L, Cal_27_M, Cal_27_F, Cal_27_D, Cal_27_L, Cal_28_M, Cal_28_F, Cal_28_D, Cal_28_L, Cal_48_M, Cal_48_F, Cal_48_D, Cal_48_L, Cal_47_M, Cal_47_F, Cal_47_D, Cal_47_L, Cal_46_M, Cal_46_F, Cal_46_D, Cal_46_L, Cal_45_M, Cal_45_F, Cal_45_D, Cal_45_L, Cal_44_M, Cal_44_F, Cal_44_D, Cal_44_L, Cal_43_M, Cal_43_F, Cal_43_D, Cal_43_L, Cal_42_M, Cal_42_F, Cal_42_D, Cal_42_L, Cal_41_M, Cal_41_F, Cal_41_D, Cal_41_L, Cal_31_M, Cal_31_F, Cal_31_D, Cal_31_L, Cal_32_M, Cal_32_F, Cal_32_D, Cal_32_L, Cal_33_M, Cal_33_F, Cal33_D, Cal_33_L, Cal_34_M, Cal_34_F, Cal_34_D, Cal_34_L, Cal_35_M, Cal_35_F, Cal_35_D, Cal_35_L, Cal_36_M, Cal_36_F, Cal_36_D, Cal_36_L, Cal_37_M, Cal_37_F, Cal_37_D, Cal_37_L, Cal_38_M, Cal_38_F, Cal_38_D, Cal_38_L.

The presence of calculus occurred at a higher level in the Embu participants tooth surfaces than on the Meru tooth surfaces. The columns with percent calculus free surfaces were above 80% in the Meru tooth surface distributions than in the Embu tooth surface distributions.

Figure 5: Cumulative percent distribution of calculus free surfaces in Embu(red-series 2) and Meru(green-series 3).

The cumulative calculus free surfaces percentage were higher in the Meru participants than the Embu participants. This translates to higher occurrence cumulative percent distribution of surfaces with calculus in the Embu participants.

Discussion

Miraa/muguka are barks and leaves from shrubs/ trees grown in Eastern Kenya. Users of muguka chew the leaves and miraa it is the bark which is peeled off the stem and chewed. Miraa/muguka is otherwise known as khat in other countries and is a stimulant causing euphoria, excitement and alertness. It is the young branches or twigs that are harvested for use. The stimulants are cathinone and cathine which are derived from the juices of the chewed curd. These stimulants are known to have a central nervous system effect and cause the release of dopamine in the brain which is responsible for the euphoric effect and also the release of stress hormone norepinephrine which is responsible for the alertness experienced by users of miraa/muguka.

Chewing of miraa/muguka is prevalent in the Eastern region of Kenya. The chewing of Muguka (the leaves of the tree) was more prevalent in Embu and the relative risk (RR) of currently chewing muguka in Embu was 16.9 (95%CI=10.2-28.1) and chewing both muguka and miraa in Embu was found to be 38.2(95% CI=17.2-84.1). People in Embu also chew the bark (miraa) and the RR was 45 (95%CI =19.1-108.5). Whereas in Meru, the Relative risk(RR) of currently chewing miraa (the bark of the harvested branches) was 7.4(95% CI=5.5-10.03) and both miraa and muguka was 120(95% CI=30.2-477). Muguka was not popular in Meru and only one person in the sampled population used it in Meru.

The percent calculus free surfaces were above 80% in the Meru tooth surface distributions than in the Embu tooth surface distributions. This means that there was more calculus in the those who chewed muguka and they were mainly participants from Embu. It appears that chewing Miraa seems to have a protective effect on calculus formation. The theories of calculus formation are the Booster mechanism, epitactic concept, inhibition theory, transformation theory, bacterial theory and enzymatic theory. We can then postulate that some constituents in miraa may be interfering with any one or more of these calculus formation mechanisms.

Recently, nanobacterium or calcifying nanoparticles(CNPs) discovered in various pathological calcifications have been associated with calculus formation. In 1998, Kajander and Ciftçiog˘lu [20] discovered unknown cell cultures contaminants and called them nanobacteria and these were considered as being the smallest form of living organisms. However, later, it was shown that they are non-living mineral particles that mimic living microorganisms in various ways like having a similar morphology, ability to increase in size and ability to bind with biological molecules (carbohydrates, lipids, metabolites, nucleotides and proteins) [21,22]

For this reason, they were later known as calcifying nanoparticles (CNPs). CNPs have been detected in high concentrations in patient serum with dental calculus and periodontitis [23,24]. We could then postulate that miraa seems to have an effect on CNPs and subsequently the formation of calculus. The chemical composition of CNPs found in various biological human fluids is mainly calcium carbonate ($CaCO_3$) and calcium phosphate ($Ca_3(PO_4)_2$ [24].

These minerals could contribute to calculus formation through the booster mechanism in contributing some of the calcium phosphate ions that form as saliva ph. becomes more alkaline through loss of carbon dioxide. This theory is subject to further investigation. Demir et al 2008 [25], proposed that CNPs present in dental calculus may be respon¬sible for the mineralization process from the beginning thus giving credence to our postulation. CNPs contributing to various pathological processes in the human body is still controversial and only further research will reveal their role.

In conclusion, the finding that chewing miraa may have an inhibitory action on calculus formation is interesting and requires further research to identify the constituents responsible. The juices from miraa could be used in management of periodontal diseases through disruption of calculus formation. It is also important to investigate the effect of miraa on CNPs and their role in calculus formation.

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Immediate implant placement at the time of root (s) extraction in the anterior maxilla.

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Keywords: implant dentistry, immediate implant, anterior maxilla

Abstract: This article discusses Type one (1) immediate implants placement within one (1) week after root(s) extraction to restore esthetics and function. Dental implants, mimic the natural tooth. The immediate type reduces the total treatment time and their placement has no biological cost to the adjust teeth.
Several studies have compared Type 1 immediate implant placement with conventional implants and reported no evidence of a difference in either prosthesis failure or implant failure with a survival rate of up to 97% in 5years.
Clinical relevance: The need to replace retained root(s) of maxillary anterior teeth without major disruption of the patient's routine is essential in the practice of dentistry. This article evaluates the use of Type 1 immediate implants placement and loading as an alternative to conventional loading.

Introduction

In clinical practice, patients often present with a need to have immediate replacement of retained roots of maxillary anterior teeth. This is as a result of damage to the teeth caused by advanced caries, trauma, or due to catastrophic failure of crown and bridge prosthesis (Figure 1).

Figure 1: Retained roots of previously crowned 11 and 12.

In such cases, there is an immediate need to restore aesthetics and function within a short period of time. The available fixed treatment options include immediate implant supported crowns for single or multiple teeth [1,2] which needs to be done by a skilled, competent and experienced clinician [3].

Osseo-integrated dental implant

Immediate implant placement has been accepted for partially dentate patients who meet the criteria for implant placement due to their advantages of no biological cost to the adjust teeth and reduction in total treatment time [1,2]. Initially implant placement and loading required long waiting periods for healing to take place and multiple surgical procedures which were unfavorable. The evolution of immediate implant loading protocols has overcome these challenges.

Further, the morphological, dimensional and histologic changes that follow tooth extraction and healing has been used to classify implant placement into four types [4];

- Type 1-Immediate implant placement as a part of extraction procedure.
- Type 2-Early placement, 4-8 weeks of soft tissue healing.
- Type3-Early placement, 12-16 weeks of soft tissue healing and partial bone healing.
- Type 4-Late placement, more than 6months with fully healed extraction site.

Type 1-Immediate implant placement

Immediate implant placement into an extraction socket protocol was developed 43 years ago by Schulte and Heimke, (1976)1 and has progressively gained popularity due its advantages of;

- Three dimensional implant positioning,
- Shorter total treatment time and reduced number of surgical procedures,
- Preservation of extraction site, maintenance of socket walls, less soft tissue trauma,

- Conservation of tooth structure of adjust teeth,
- Mimic natural tooth, restore function and aesthetics and
- Decreased patient's anxiety, discomfort and high patient acceptance [5, 8].

Several prerequisites are needed to achieve a predictable treatment outcome in the anterior maxilla with Type I immediate implant including [4, 5, 7]. Patient selection, esthetic expectations and host factors.

- Tooth position, shape and smile line.
- Soft tissue quality, quantity, and morphology.
- Periodontal health status and plaque control.
- Biotype of the periodontium.
- Bone anatomy and characteristics at the implant site.
- Type and position of the implant.
- Coronal prosthesis.
- Condition of adjacent teeth.

Case selection

A case with retained roots in the aesthetic zone may have high expectations which need to be managed by assessing whether it is achievable by Type 1 immediate implant placement. This is in view of the concerns that gingival recession may occur post implant insertion which may compromise aesthetic outcome [4, 8].

According to Bryington, et al., (2014) [9] all systemic and local contraindications which affect healing of the implant site or osseo-integration potential or affect the manual dexterity and plaque control by the patient must be ruled out Some of the systemic considerations include; radiotherapy of the jaw, untreated intraoral pathology or malignancy and untreated periodontal disease. Previous history of periodontitis and inability to control plaque has a direct cause-effect relationship with peri-implant disease [10]. Further, Serrino and Strom, (2009) [11] found that implant sites with adequate plaque control had rare occurrences of peri-implantitis.

Use of bisphosphonates has a possible risk of osteonecrosis of the jaws and is contraindicated in dental implant placement. Other medicines like anticoagulants, chemotherapy and immunosuppression therapy are temporary contraindications 9 Other risk factors for Type 1 immediate implant placement are smoking and uncontrolled drug abuse [12].

Smoking

The frequency and number of cigarettes consumption, has been associated with poor wound healing and increased risk of peri-implant infection. As little as 10 sticks per day has been shown to affect healing. Further, when combined with a history of treated periodontitis, accelerated crestal bone loss around the implant occurs lowering the survival rate of the implant [13, 14]. There is therefore, a need to encourage smoking reduction eventually leading to cessation for implant cases. The other prerequisite to Type 1 immediate implant placement is a wholesome multidisciplinary clinical assessment, evaluation of the articulatory system, soft and hard tissue health status review and finally a detailed examination of the implant site and the surrounding area.

Occlusal analysis:

The articulatory system is critical in treatment planning for Type1 immediate implant placement and loading to ensure no occlusal over load takes place which may affect the primary stability with catastrophic effects [15]. The application of the, Examine, Design, Execute and Check (EDEC) principle for indirect restorations coupled with the use of an occlusal sketch and clinical photographs to prescribe, plan, design and verify occlusal scheme is key to a successful treatment outcome [15]. An occlusal sketch allows for accurate transfer of occlusal contact points at both static and dynamic occlusion in the mouth to the laboratory as shown in Figure 2 for accurate reproduction.

Figure 2: Occlusal marks for accurate occlusal reproduction.

Periodontal tissues

Thin, scalloped gingival biotype is associated with thin bone, higher risk of buccal plate resorption and gingival recession [4, 8]. Recession in the anterior maxilla would compromise aesthetics and therefore augmentation therapies at the time of implant placement (Type 1) are recommended [4]. However, other factors like size of the buccal plate, implant mal-positioning, existing facial bony defects and biomaterials used contribute to buccal recession [2]. On the other hand, thick biotype has a less scalloped gingival margin with an intact buccal plate thus, less augmentation therapies are indicated [4]. It is also associated with scaring and possible black triangle formation which is unaesthetic.

Inadequate band of kera¬tinized mucosa is associated with bleeding around the implant affecting implant maintenance and plaque control which may adversely affect type 1 im-plants [8-10]. Signs of periodontal disease or its history requires management and meticulous plaque control. Periodontal management by a periodontist may be necessary before immediate implant placement. The other critical factor in type 1 immediate implant placement is the supporting structure, the bone [8, 12].

Bone

To attain a stable vertical dimension of the alveolar crest, 1–2mm of buccal bone width is needed over the dental implant, however majority of extraction sites in the anterior maxilla have thin (1mm) buccal walls [16]. Hence in most Type 1 implant placements, augmentation procedures are required to attain adequate bone contours around the implant [3, 16]. Also, flapless, less traumatic extraction techniques preserve the thin buccal and palatal plates minimizing the buccal bone plate resorption due to the preservation of supraperiosteal vascularization. Bone analysis with Computerized tomography (CBCT) 3D, is needed before implant placement to assess the;

- Anatomic landmarks that could limit implant positioning,
- Bone quantity (volume) and quality,
- Vertically height and bucco-lingual and mesio-distal width of the extraction site,
- Bone pathology,
- Estimation of tissue thickness,
- Signs of apical periodontitis of the root(s) to be extracted which is a concern in type 1 and
- Implant placement due to the effect on implant prognosis [3, 9, 12].

Periapical infection

Most clinicians would postpone immediate implants placements in sites with periapical infection. However, available evidence from controlled clinical trials have reported survival rates of 92% to 100% at 12 months after immediate implant placement in infected sockets [17, 18]. It is therefore recommended that in cases with periapical disease immediate implants may be inserted after;

- Complete debridement of the socket,
- Attainment of primary implant stability,
- Use of antibiotics and
- Adherence to a good clinical protocol [7, 12].

Clinical protocol

Type I immediate implant placement is a single stage protocol, where the implant is placed and loaded immediately in occlusion or it may be left out of occlusion [4, 18]. In order to get a favourable outcome in immediate placement and loading, five elements have to be determined and achieved [1, 8, 20];

- Less traumatic root extraction.
- Implant design.
- Presence of a buccal plate.
- Primary stability.
- Filling of the gap between the buccal plate and the implant.

Less traumatic root extraction

One of the factors that influence the success of type 1 immediate implants is the preservation of peri-implant tissue to facilitate osseointegration and aesthetics. Therefore, less traumatic extraction of the retained root(s) is critical to preserve the soft tissue and the buccal plate [1, 20]. Benex extractor (Benex ® Kaufmannweg, Luzern) utilizes the pulley technique, with minimal invasive force compared to conventional extraction (Figure 3a and b) resulting in minimal trauma to hard and soft tissues.

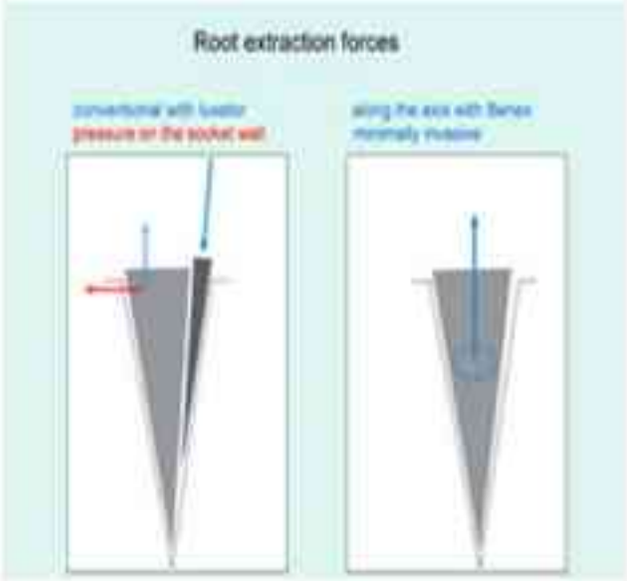

Figure 3 a): Shows a comparison conventional tooth extraction compared to Benex extraction method.

Figure 3b: Shows the Benex ®extractor assembly for upper left central incisor (21) root extraction. (Benno S.http://www.benex-dent.com)

The vertical and horizontal positioning of immediate implants in relation to the alveolar bone walls is paramount, hence the need to inspect the extraction site for the amount of buccal plate. Minimal apically directed osteotomy to achieve a tapet for good fit of selected implant should be undertaken while adhering to the manufacturer's instructions on implant site preparation. The site should be cleaned, all granulation tissue removed and sterilized especially in infected sites [12,17].

Primary stability

Primary stability is the biometric stability immediately after implant insertion as a result of mechanical engagement of the implant with the surrounding bone. This stability is critical in the long-term success of the implant. The bone quality and quantity, implant morphology, atraumatic extraction and the filled residual gap (Figure 4) affects implant stability [17, 21]. The residual gap that may arise after implant placement could be filled with bovine bone matrix, collagen membrane or Oss and Bio-Gide 19. In addition, augmentation procedures are thought to be more successful when used with immediate implant placement [5, 22].

a b

Figure 4a&b. Implant placed in extraction socket with buccal gap shown with arrow (a) and a well stabilized implant, the gap is filled with bone (arrow) (b), (Becker, 2006).

Attaining primary implant stability is vital in ensuring osseointegration and can be measured during the implant placement with the insertion tor¬que and resonance frequency analysis (RFA) using the Ostell Mentor device [18]. The values of over 60 ISQ give adequate primary stability. If the attainment of primary stability is not adequate then immediate loading with or without parafunctional habits should be differed and then conventional loading would be indicated [19]. The other factor that is critical in implant stability is the design of the implant, whether it is tapered or cylindrical [23]. A threaded, tapered design (Figure 5) increases the surface area of the implant with a higher percentage of bone-to-implant contacts compared to a cylindrical design.

Figure 5: Selected threaded implant ready for

insertion in a prepared extraction socket. (http://teethandtitanium.com/category/implants-advanced).

Also, the size of the selected implant affects primary stability. The implant should not be too wide or too narrow in relation to the extraction socket. A narrow implant will jeopardise the primary stability and a wider implant can lead to compression necrosis of the bone [24].

Immediate loading

Immediate loading of dental implants is defined as being earlier than 1 week subsequent to implant placement and considered a viable treatment option 19. The ultimate goal of immediate loading in the esthetic zone is to obtain a successful treatment and achieve esthetics which is limited to cases with the following;

- Primary implant stability (insertion torque ≥ 20 to 45 Ncm and/or implant stability quotient (ISQ) ≥ 60 to 65,
- No medical or local contraindications,
- No parafunctional activities, large bone defects, and need for sinus floor elevation and
- When the clinical benefits exceed the risks according to Gallucci, et al., (2014) [25].

Immediate loading can be done with provisional or with definitive restoration (Figure 6).
Two types are commonly used screw retained or cemented restoration.

Figure 6. Loading with definitive crown (http://www.bicon.com).

The latter can be connected to the implant through the screw retained abutment or cementation of a restoration fabricated conventionally or with the CAD/CAM technologies [28]. The biomechanical effects of the provisional or definitive restoration should be controlled by limiting and distributing occlusal contact in, centric occlusion, removing all excursive contacts, limiting the effects of cantilevers, off-axis loading and splinting where necessary [15, 25].

Survival/success rates of immediate implants

In a systemic review of 46 studies of 2908 Type 1 implants, a 2-year average survival rate of 98.4% (97.3-99%) was reported with 4-year survival rate of 97.5% 23. In another meta-analysis review of 15 randomized controlled trials (RCTs), out of which six were in the maxilla, immediate loading was compared to conventional loading and no evidence of a difference in either prosthesis failure or implant failure was found in the first year [27].

This is also supported by the findings of a systemic and meta-analysis review done by Benic and Hämmerle, (2014) [28] on 10 RCTs comparing immediate and conventional loading and 1 RCT comparing immediate and early loading where they concluded that immediately and conventionally loaded single-implant crowns are equally successful regarding implant survival and marginal bone loss [28]. Further other systematic reviews and meta-analysis of immediate loaded single crowns compared to conventional protocol showed similar survival rates (Table 1).

Survival rates of Type 1 immediate single crown (Benic and Hämmerle 2014) [28] modified.

Study and year	Loading protocol	No of implants	Mean follow up (year)	Survival rate %
Degidi, et al., (2009)	Immediate	30	3	100
	Conventional	30		100
Donati, et al., (2008)	Immediate	50	1	98
	Conventional	57		100
Prosper, et al., (2010)	Immediate	60	5	97
	Conventional	60		97
Shibly, et al., (2010)	Immediate	30	2	97
	Conventional	30		93
Stanley et al.,(2017) [29]	Immediate-anterior maxilla	41	1	100
Velasco-Ortega et al., (2018) [30]	Immediate- maxilla	89	4	97.4
Cosyn et al., (2019) [31]	Immediate	233	4.5	94.9
	Conventional	240		

In addition, a high cumulative success rate of 91.8% after 10 years has been reported for implant placed in extracted sites 32. These studies demonstrate that, immediate implant placement into extraction sockets is a successful and predictable clinical method of replacing teeth in esthetic zone to restore function and esthetics.

Conclusion and clinical relevance

There is adequate data to verify that placing implants immediately after extraction is an alternative option to implant placement after socket healing with similar survival rate. This gives credence to use of immediate implants in the maxillary anterior region if all other factors for implant placement have been considered, plus attainment of primary stability and good plaque control and maintenance. Furthermore, a successful treatment should achieve its intended purpose, be free of mechanical, biological and technical complications which should be attained through more efficient treatment options based on sound scientific evidence to meet the patient's needs.

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Journal of the Kenya Dental Association (JKDA)

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