



Original Article

# Prevalence and characteristics of non-carious cervical lesions at the Ouagadougou Municipal Oral Health Center, Burkina Faso

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Received : 05 October 2021

Accepted : 16 March 2022

Published : 24 November 2022

DOI

10.25259/JRDE\_4\_2021

Quick Response Code:



## ABSTRACT

**Objectives:** This work sought to study the prevalence of non-carious cervical lesions (NCCLs) in a Burkinabe population consulting at the Municipal Oral Health Center of Ouagadougou.

**Material and Methods:** This was a descriptive cross-sectional study. It was carried out between August 1, 2020, and October 31, 2020. The study population consisted of all adult patients regardless of the reason for consultation. The diagnoses of abrasion, erosion, and abfraction were based on the morphology of the clinical forms of each of these lesions as already described in the literature.

**Results:** During the study period, 595 patients were examined and 82 of them had at least one NCCL, for an overall prevalence of 13.8%. Abrasion lesions were the encountered the most (47.4%), followed by abfractions (27.1%) and erosions diagnosed in 25.5% of cases.

**Conclusion:** NCCLs are pathologies of the neck of the tooth that is of great concern both in terms their clinical and etiological diagnosis as well as their therapy. The prevalence reported in this study is of importance to all oral health professionals, who need to be well aware that NCCL is increasingly a major reason for seeking care.

**Keywords:** Non-carious cervical lesions, Abrasion, Erosion, Abfraction, Prevalence, Burkina Faso

## INTRODUCTION

Non-carious dental lesions are, by definition, wear and tear on dental surfaces that gradually lead to a loss of dental substance (enamel, dentin, and cementum) without bacterial action.<sup>[1]</sup> With such lesions, the phenomena leading to a loss of dental matter are independent of the carious process, which is microbial. They also differ, however, from alveolodental trauma, for which the loss of substance is abrupt, and the cause is usually a blunt force, whether direct or indirect.<sup>[2,3]</sup> This wear and tear can affect the occlusal part or it can occur in the cervical region of the dental crown. This last characteristic and the topographical location corresponds to a cumulative and progressive loss of mineralized tissue, localized at the enamel-cementum junction.<sup>[4-7]</sup> It is of particular interest due to the close relationship of the dental tissues that are present there, thus exerting an effect of duality in the management of the pathology but especially the multifactorial etiology to which it

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is subject. There are typically three distinct types of cervical lesion: Erosion, abrasion, and abfraction, and these are relatively difficult to distinguish clinically.<sup>[8,9]</sup>

The prevalence of non-carious cervical lesions (NCCLs) ranges from 5% to 85% depending on the various studies that have been carried out around the world.<sup>[10]</sup> In sub-Saharan Africa, it is in Senegal that Faye *et al.* already reported a prevalence of NCCL of 17.10% in 2005.<sup>[11]</sup> In Burkina Faso, only the work of Ndiaye *et al.*,<sup>[12]</sup> followed by those of Kaboré *et al.*,<sup>[13]</sup> all published in 2015, addressed the issue of NCCL. Unfortunately, these publications have still not made it possible to define an objective prevalence of NCCL because they targeted the professionals of oral health. In light of this lack of documentation, and to contribute to a better understanding of NCCLs, it seemed relevant to study these lesions by determining their prevalence within a Burkinabe population consulting at the Municipal Center for Oral Health (MCOH) in Ouagadougou.

## MATERIAL AND METHODS

### Setting, timing, population, and type of study

This was a descriptive, cross-sectional study that was carried out at the MCOH in Ouagadougou between August 1, 2020, and October 31, 2020. The study population consisted of all adult patients regardless of the reason for consultation.

The inclusion criteria were as follows:

- Having consulted between August 1, 2020, and October 31, 2020;
- At least 18 years old;
- Provided informed consent to participate in the study.

The sample did not take into account:

- Any patient with a health condition or disability that compromised their ability to directly answer the questionnaire used for the study;
- NCCL of a temporary tooth, even if the tooth is persistent;
- Patients lacking a tooth group (incisive-canine group, premolar group, and molar group).

The sample was selected using the non-probabilistic convenience method. Thus, all patients in the study population who met the eligibility criteria were selected.

### Data collection

The data collection technique was a combination of maintenance and clinical observation. Our main data collection tool was a questionnaire comprising two subheadings that collected sociodemographic information (age, gender, occupation, and place of residence) and clinical data of the patients (reason for consultation, type of NCCL, side of the most affected tooth, and oral hygiene). Oral

hygiene was determined using Greene and Vermillion's Simplified Oral Hygiene Index.<sup>[14]</sup>

### NCCL diagnostic criteria

The diagnosis of each of the lesions was based on the morphology of the clinical forms of NCCL already described in the literature.<sup>[15,16]</sup> The first criterion was the geometric shape of the lesion; the second was the color of the tooth at the level of the lesion; and the third criterion was the surface condition of the lesion when assessed. The fourth criterion was the presence of lesions or associated manifestations such as wear of the occlusal surfaces, gum recession, dentin sensitivity, and the presence or not of tartar in the worn cervical area.

*Abrasion* was diagnosed in case of the following clinical picture:

- Lesions on a group of teeth (several neighboring teeth);
- "V" lesion with steep edges, elongated in the mesiodistal direction;
- A smooth and hard base when assessed with a dental probe;
- From up close, one can see marks reflecting wear from a toothbrush;
- Absence of tartar in the impact zone and associated gum recessions are characteristics of cervical abrasions.

*Abfraction* lesions were diagnosed according to the following criteria:

- Isolated or generalized lesions;
- "V" lesions in the form of a slit that is clearly deeper than wide, with sharp edges and acute angles;
- The lesion appears to be hard with a rough surface when assessed with a probe;
- There are worn surfaces in occlusion. There can be associated tartar and malocclusions.

Erosion lesions were found through the following semiology:

- A lesion that is wider than it is deep;
- A U-shaped lesion with preservation of a residual cervical strip of enamel;
- The bottom of the lesion is hard and appears polished without presenting a rough surface;
- From an early stage of being etched, the lesion becomes yellowish and translucent (dentin color);
- When it occurs, the lesion is associated with other erosive spots on other portions of the tooth besides the cervical region. Spontaneous or provoked hypersensitivity (probing and spraying) remains one of the key characteristics of erosive lesions.

### Execution of the collection

The consultation team consisted of a dental surgeon and a nurse specialized in dentistry as well as two student trainees

in the final year of dental surgery. These staff members participated in training regarding the use of the questionnaire and the diagnosis of NCCL. The clarification of the technical terms and their translation into the local languages of Mooré and Dioula was carried out for this purpose. A pre-test validated the tools and defined an average time per respondent before the official collection. The data collection was carried out in a consultation room equipped with a dental chair and scalytic lighting. The clinical observation was conducted using the following equipment: A dental examination tray (probes N°6, N°17, a periodontal probe, mirrors, tweezers), articulating paper, a cooling spray, a camera, and pens. Before the dental examination, the teeth were cleaned and dried using a cotton swab to remove plaque and residue. The clinical examination was conducted with great care to make the differential diagnosis concerning the clinical form, and the final diagnosis was confirmed by the dentist. The overall verification of the records was carried out before the data were entered.

### Data processing

The information collected was entered into a form created using EPIDATA software. The data analysis was carried out with EPI-info 7.1.3.3 software. We conducted a detailed descriptive analysis of the sociodemographic and the clinical characteristics. The results are presented as frequencies and percentages.

## RESULTS

### Characteristics of the sample

During the study period, 986 adult patients were received for a consultation. Taking into account the eligibility criteria of the study, 391 patients were excluded, mainly due to oral emergencies involving limitation of the oral opening (cellulitis or bone fractures with trismus) and sizeable edentulous areas. We, therefore, ultimately retained 595 patients (60.3%).

### Overall prevalence of NCCL

A total of 82 of the 595 patients who were examined in this study had at least one NCCL. The overall prevalence of NCCL was, therefore, 13.8%.

### Sociodemographic data of the respondents

The 40–60 years of age bracket was represented the most (51.2%), with extremes of 20 and 79 years. The average age was  $46.28 \pm 12.92$  years. There were more male patients (62.2%), and the sex ratio was 1.64. Civil servants were the most represented professional category (36.6%), and 6 (7.3%) patients resided in rural areas [Table 1].

### Clinical data

During the consultation, 41 individuals (50%) mentioned tooth pain as the reason for their consultation. Patients with good oral hygiene with an Oral Hygiene Index (OHIS) between 0 and 1.2 accounted for 41.5% of the total number [Table 2].

All up, there were 82 patients, with 709 teeth that were affected. Abrasion lesions [Figure 1] were encountered the most, and they concerned 336 teeth (47.4%), followed by abfraction [Figure 2], which was found on 192 teeth or

**Table 1:** Distribution of patients with NCCL by their socio-professional characteristics.

Variable	Number of patients, n=82	Percentage
Age		
20–40	25	30.5
40–60	42	51.2
60–80	15	18.3
Gender		
Male	51	62.2
Female	31	37.8
Area of residence		
Rural	6	7.3
Urban	76	92.7
Socio-professional status		
Farmer	4	4.9
Pupil/student	5	6.1
Housewife	9	11.0
Official	30	36.6
Retired	12	14.6
Informal sector	22	26.8

NCCL: Non-carious cervical lesion

**Table 2:** Distribution of patients with NCCL by their reason for a consultation and the Greene and Vermillion SOHI.

Variable	Number of patients, n=82	Percentage
Reasons for consultation		
Tooth pain	41	50.0
Prosthesis application	17	20.7
Dental sensitivity	11	13.4
Esthetic	7	8.6
Other*	6	7.3
Greene and Vermillion SOHI		
0; 1.2	34	41.5
1.3; 3	32	39.0
3.1; 6	10	12.2
Not evaluable**	6	7.3

\*Dental mobility (4), halitosis (1), and systematic visit (1). \*\*Absence of half of the teeth to be examined. SOHI: Simplified Oral Hygiene Index, NCCL: Non-carious cervical lesion

27.1%, and erosion [Figure 3], which was diagnosed on 181 teeth or 25.5%. According to the dental arches, there was a 61.2% incidence of NCCL on the maxillary teeth [Figure 4], and all the lesions were found on the vestibular side.

## DISCUSSION

### Restrictions, limitations, and strengths of the study

Our study was conducted during the period of the COVID-19 pandemic. As a result, there were certain restrictions in place at the level of dental practices, in particular, the consultation of elderly people was strongly discouraged and limited to emergency care. It was also a single-site study. All of this could constitute a selection bias. However, the target population (survey conducted directly among patients), as well as the prospective nature of the data collection, remain the first of its kind in Burkina Faso, thereby making this work of particular interest. In addition, the clinical diagnoses were made by well-trained and experienced staff.



Figure 1: Dental abrasion lesion (Kaboré, 2020).

### Prevalence of NCCL

In a review of the literature, Levitch *et al.* found a prevalence of NCCL ranging from 5% to 85%.<sup>[10]</sup> Our study, which reported an NCCL prevalence of 13.78%, falls within this range. This prevalence is also close to the 17.10% prevalence determined by Faye *et al.* in 2005 in the Dakar region of Senegal.<sup>[11]</sup> Although this study was undertaken quite some time ago, it has considerable similarity with ours in terms of the sample size (655 vs. 595) and the population studied (urban populations consulting health centers). In the study by Medeiros *et al.*,<sup>[17]</sup> in footballers and published in 2020 in Brazil, NCCL was diagnosed in 39.5% of the participants. Igaraschi *et al.*,<sup>[18]</sup> in Japan in 2017, quantified the incidence of NCCL at 38.7%. In Burkina Faso, dental surgeons have estimated that NCCLs are frequent (60%) according to the work of Ndiaye *et al.*<sup>[12]</sup> in 2015.

This wide variability in the prevalence of NCCL probably depends mainly on the populations studied. The low prevalence of NCCL in our series is likely to be related to the selection of subjects due to COVID-19 restrictions. Furthermore, this prevalence could be explained by the eligibility criteria of the study, which excluded a significant



Figure 3: Dental erosion lesion (Kaboré, 2020).



Figure 2: Dental abfraction lesion (Kaboré, 2020).

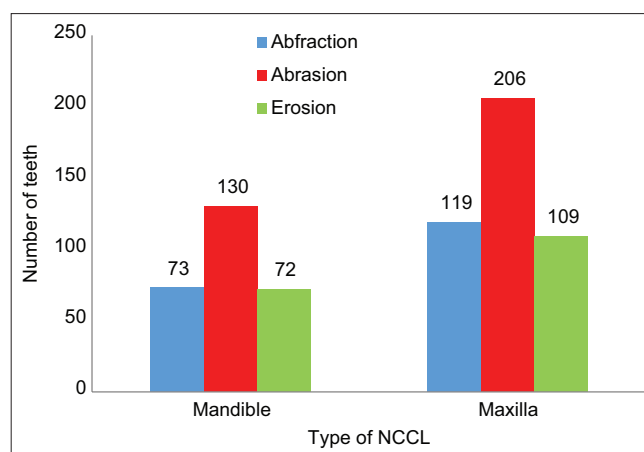


Figure 4: Distribution of NCCLs according to the dental arches (the maxilla and the mandible). NCCLs: Non-carious cervical lesions



number of partially edentulous patients, and given that the demand for dental prostheses at the MCOH remains one of the highest in the city of Ouagadougou.

### Sociodemographic factors

Men were the most affected. This has been found in several studies, although gender is not often mentioned as a risk factor for NCCL.<sup>[19-21]</sup> This can be compared with the results obtained by Kane *et al.*<sup>[22]</sup> in Dakar, who found a male prevalence of 46.06%. A predominance of men with NCCLs may be related to the management of urban and social demands in the setting of a poor country, which can be a source of anxiety and hence expose to the phenomenon of abfraction, which occurred frequently in this study.

This work has revealed an increasing number of patients with NCCL as a function of age, even though this increase was not linear. The average age was 46 years. With a series of 1023 individuals aged between 20 and 69 and an average age of 46.1, Que *et al.*,<sup>[23]</sup> like other authors, have noted this increase in NCCLs with age. Age has always been recognized as a risk factor for NCCLs. Our study found that the 40–60 years of age bracket was the most affected, at 51.2%. Paradoxically, the 60–80 years of age bracket exhibited fewer NCCLs, and this could be due to the non-representativeness of elderly people in the sample due to hesitancy in regard to consulting health services in general and certain specific services including dental surgery in particular during the COVID-19 pandemic.

### Clinical data

The present study identified pain as the predominant reason (50%) for consultation. The esthetic appearance and tooth sensitivity were given as the reason by 8.5% and 13.4% of the patients with NCCL, respectively. For Ndiaye *et al.*,<sup>[12]</sup> the most common reason for consultation for a non-cariou lesion was pain (92%), followed by the esthetic appearance (78%) and sensitivity (74%). These results confirm the symptomatic nature (pain) of oral consultations, which also tend to be delayed in developing countries such as Burkina Faso.<sup>[24]</sup> Indeed, non-cariou lesions, like carious lesions, evolve in stages or grades. They progress from tooth sensitivity to pain if no treatment is provided.

Oral hygiene was determined during this work using Greene and Vermillion's Simplified OHIS.<sup>[14]</sup> It appears that many patients with NCCL had good oral health, that is, a much lower OHIS (between 0 and 1.2). This gives rise to the following considerations:

- On the one hand, the socio-professional status and the place of residence of most patients (civil servants [36.6%] living in urban areas [92.68%]) would make them amenable to the acquisition and application of oral hygiene means;

- On the other hand, focused abrasions, which were predominant in this study, appear to be intimately linked to this predominance of good oral health. Indeed, to have very nice and clean teeth, patients generally expose themselves to the phenomenon of abrasion.

Our study established the following percentages for the various types of NCCLs: Abrasion 47.4%, abfraction 27.1%, and erosion 25.5%. In the scientific literature, clinical forms of NCCLs have heterogeneous proportions. Some studies have classified abrasive lesions as being the most common, followed by abfraction and erosion, thus confirming our results. Indeed, Faye *et al.*<sup>[11]</sup> in 2005 determined the following frequencies for these clinical forms: Abrasion 77.7%, abfraction 12.5%, and erosion 9.8%. Ndiaye *et al.*<sup>[12]</sup> reported the prevalence of clinical forms of NCCL in the same order as we did, with 68%, 18%, and 14% for abrasion, abfraction, and bio-corrosion (erosion), respectively. However, Kane *et al.*,<sup>[22]</sup> in a study on the prevalence of non-cariou dental lesions, found lower prevalences for each clinical form (25.5% for abrasion, 7.22% for abfraction, and 1.68% for bio-corrosion). However, a recent study by Ndiaye *et al.*<sup>[25]</sup> found an abrasion prevalence of 47%, in keeping with our findings. For the other clinical forms, our results are close to the 31% incidence of abfraction, and the prevalence of erosion of 40% remains well above what we have presented.

Other authors, on the other hand, have studied clinical forms of non-cariou dental lesions in isolation, and they noted high percentages. In Nigeria, Oginni *et al.*<sup>[26]</sup> reported a 39% incidence of abfraction injuries. Gunepin *et al.*,<sup>[19]</sup> in a study of dental erosion in military personnel, published a prevalence of 38.8% in 2014. A recent cross-sectional study by Bartlett *et al.*<sup>[27]</sup> of 3187 patients from seven European countries found that 29% of the subjects had erosions. All of these high prevalences of clinical forms revealed by our study are explained by the lack of knowledge of the appropriate techniques for oral hygiene procedures as well as nutrition intake that lacks a dietary basis, all in association with psychologically stressed lifestyles, as the study was conducted in an urban context.<sup>[28]</sup>

### CONCLUSION

NCCLs are pathologies of the collar of the tooth, which are dreaded in regard to their clinical and etiological diagnosis and for their therapy. The prevalences reported by this study are reason for all oral health professionals to bear in mind that these lesions increase over time and are a source of discomfort for patients. Prevention and early management are needed. This is why, thanks to this study, we believe that teaching dietetics, as well as appropriate oral hygiene techniques, should be promoted. Studies of etiological factors will no doubt complement the information needed for proper diagnosis and management.

## Ethical approval

This study protocol has been approved by the Research Ethics Committee of the Regional Health Directorate of the Centre (Deliberation N°2020-014/MS/RCEN/DRSC of February 26, 2020). All of the participants in the study received advice regarding measures to prevent wear and tear injuries, in addition to being referred for their care.

## Authorship contributions

Concept: W.A.D.K., J.V.W.G., and K.D.; design: W.A.D.K., J.V.W.G., and D.N.; supervision: B.F., D.N., and K.F.K.; materials: W.A.D.K. and J.V.W.G.; data: W.A.D.K. and D.K.; analysis: W.A.D.K., D.K., J.V.W.G., and D.N.; literature search: W.A.D.K. and DK; writing: W.A.D.K. and J.V.W.G.; and critical revision: B.F., D.N., and K.F.K.

## Declaration of patient consent

The authors certify that they have obtained all appropriate patient consent.

## Financial support and sponsorship

Nil.

## Conflicts of interest

There are no conflicts of interest.

## REFERENCES

- Candina HJ, Batista AJ, Sosa JG. Lesiones dentales no cariosas en pacientes atendidos en la Clinica estomatologica siboney. *Rev Cuba Invest Biomed* 2018;37:46-53.
- Vallaey K, Chevalier V, Arab-Chirani R. Traumatisme dentaire. *Urgences* 2013;44:7-11.
- Koyuturk AE, Kusgoz A. Multiple dentoalveolar traumatic injury: A case report (3 years follow up). *Dent Traumatol* 2008;24:16-19.
- Terra RC, Poiate IA, Poiate E Jr. Non-carious cervical lesion: Case report. *Int J Med Dent Sci* 2020;9:1913-6.
- Thakur K, Bharadwaj N, Bansal S. Microscopic analysis of the variations of the cemento-enamel junction in Himachali population. *Int J Health Clin Res* 2019;2:1-4.
- Kolak V, Pešić D, Melih I, Lalović M, Nikitović A, Jakovljević A. Epidemiological investigation of non-carious cervical lesions and possible etiological factors. *J Clin Exp Dent* 2018;10:e648-56.
- Grippio JO. Abfractions: A new classification of hard tissue lesions of teeth. *J Esthet Restor Dent* 1991;3:14-9.
- Grippio JO, Simring M, Coleman TA. Abfraction, abrasion, biocorrosion, and the enigma of non-carious cervical lesions: A 20-year perspective. *J Esthet Restor Dent* 2012;24:10-23.
- Goldstein RE, Curtis JW Jr., Farley BA, Siranli S, Clark WA. Abfraction, abrasion, attrition, and erosion. In: Ronald E, editor. *Goldstein's Esthetics in Dentistry*. Vol. 22. United States: Wiley; 2018. p. 692-719.
- Levitch LC, Bader JD, Shugars DA, Heyman HO. Non-carious cervical lesions. *J Dent* 1994;22:195-207.
- Faye B, Sarr M, Kane AW, Toure B, Leye F, Gaye F, *et al.* Prevalence and etiologic factors of non-carious cervical lesions. A study in a Senegalese population. *Trop Dent J* 2005;28:15-8.
- Ndiaye D, Bane K, Niang SO, Seck A, Kabore WA, Ouedraogo CD, *et al.* Fréquence et prise en charge des lésions cervicales non carieuses: Enquête auprès des chirurgiens-dentistes Burkinabé. *Rev Col Odonto Stomatol Afr Chir Maxillo Fac* 2015;22:5-10.
- Kaboré WA, Bane K, Fall M, Niang SO, Faye B. problèmes terminologiques et facteurs étiologiques des lésions cervicales non carieuses. Enquête auprès des chirurgiens-dentistes burkinabè. *Rev Col Odonto Stomatol Afr Chir Maxillo Fac* 2015;22:5-10.
- Greene JG, Vermillion JR. The simplified oral hygiene index. *J Am Dent Assoc* 1964;68:7-13.
- Imfeld T. Dental erosion. Definition, classification and links. *Eur J Oral Sci* 1996;104:151-5.
- Kaleka R, Bonte E, Lasfargues JJ. Lésion cervicale d'usure (LCU) : Diagnostic. *Réal Clin* 2001;12:387-400.
- Medeiros TL, Mutran SC, Espinosa DG, do Carmo Freitas Faial K, Pinheiro HH, D'Almeida Couto RS. Prevalence and risk indicators of non-carious cervical lesions in male footballers. *BMC Oral Health* 2020;20:215-23.
- Igarashi Y, Yoshida S, Kanazawa E. The prevalence and morphological types of non-carious cervical lesions (NCCL) in a contemporary sample of people. *Odontology* 2017;105:443-52.
- Gunepin M, Derache F, Blatteau JE, Richard JM, Maugey B. Prévalence et facteurs de risque de survenue des érosions dentaires au sein de la population militaire. *Méd Armées* 2014;44:479-88.
- Al-Zarea BK. Tooth surface loss and associated risk factors in Northern Saudi Arabia. *ISRN Dent* 2012;2012:1-5.
- Cunha-Cruz J, Pashova H, Packard JD, Zhou L, Hilton TJ, for Northwest PRECEDENT. Tooth wear: Prevalence and associated factors in general practice patients: Tooth wear in Northwest PRECEDENT. *Community Dent Oral Epidemiol* 2010;38:228-34.
- Kane AW, Faye B, Touré B, Sarr M, Lo CH, Ba DA. Prevalence of non-carious dental lesions in the department of Dakar. *Trop Dent J* 2004;108:15-8.
- Que K, Guo B, Jia Z, Chen Z, Yang J, Gao P. A cross-sectional study: Non-carious cervical lesions, cervical dentine hypersensitivity and related risk factors. *J Oral Rehabil* 2013;40:24-32.
- Garé JV, Kaboré WA, Sawadogo A, Ouattara S, Fall M, Bondé L, *et al.* Recours tardif aux soins bucco-dentaires en zone semi urbaine au Burkina Faso: Connaissances et pratiques des populations sur la carie dentaire et ses complications. *Rev Col Odonto Stomatol Afr Chir Maxillo fac* 2019;26:7-12.
- Ndiaye D, Niang SO, Seck A, Diene MN, Diop EH, Faye B. Fréquence et prise en charge des lésions cervicales non carieuses: Enquête auprès des chirurgiens-dentistes dakarois. *Rev Col Odonto Stomatol Afr Chir Maxillo Fac* 2021;28:6-11.

26. Oginni AO, Olusile AO, Udoye CI. Non-cariious cervical lesions in a Nigerian population: Abrasion or abfraction? *Int Dent J* 2003;53:275-9.
27. Bartlett DW, Lussi A, West NX, Bouchard P, Sanz M, Bourgeois D. Prevalence of tooth wear on buccal and lingual surfaces and possible risk factors in young European adults. *J Dent* 2013;41:1007-13.
28. Rusu A, Popescu MR, Dragomir LP, Popescu DM, Arsenie CC,

Rauten AM. Identifying the etiological factors involved in the occurrence of non-cariious lesions. *Curr Health Sci J* 2019;45:227-34.

**How to cite this article:** Kaboré WAD, Garé JVW, Ndiaye D, Kouakou KF, Da K, Faye B. Prevalence and characteristics of non-cariious cervical lesions at the Ouagadougou Municipal Oral Health Center, Burkina Faso. *J Restor Dent Endod* 2021;1:46-52.



Original Article

## Evaluation of staining potential of 5% sodium fluoride varnish and coffee beverage on tooth-colored restorative materials: An *in vitro* study

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Received : 24 September 2020

Accepted : 27 January 2022

Published : 24 November 2022

**DOI**

10.25259/JRDE\_11\_2020

**Quick Response Code:**



### ABSTRACT

**Objectives:** The objective of this *in vitro* study was to evaluate and compare the staining potential of 5% sodium fluoride varnish and coffee beverage on the tooth-colored restorative materials.

**Material and Methods:** Standardized Class V cavities were prepared on the tooth surface on both buccal and lingual/palatal surfaces and were restored with Glass ionomer cement (GIC), resin-modified GIC (RMGIC), and resin composite. The control group ( $n = 7$ ) of each restoration was stored in artificial saliva. The experimental groups ( $n = 7$ ) of each of the restoratives were subjected to the application of 5% sodium fluoride and were analyzed for discoloration using the visual method. In the second part of the study, 5% NaF was applied on all the restorations, namely, GIC, RMGIC, and Resin Composite. The control groups of each ( $n = 7$ ) were then stored in artificial saliva and the experimental groups of each ( $n = 7$ ) were immersed in coffee. After the period of immersion, the control, as well as the experimental groups, were analyzed for staining using the visual method. Data obtained were statistically analyzed using the Chi-square test.

**Results:** All the experimental groups were stained up to a visually perceptible level ( $P = 0.029$ ) when compared to the control group. However, the intergroup comparison of experimental groups was statistically non-significant. Furthermore, RMGIC showed better stain resistance with coffee after application of 5% NaF than GIC and resin composite, although it was not statistically significant.

**Conclusion:** 5% NaF application resulted in a shade change of all the restoratives tested in the study up to a visually perceptible level. The fluoride application did not significantly influence the staining potential of coffee in the restoratives tested.

**Keywords:** Sodium fluoride, Staining potential, Coffee, Glass ionomer cement, Resin modified Glass ionomer cement

### INTRODUCTION

One of the main goals of aesthetic dentistry is to mimic teeth and design a smile that is pleasing to the human eye. The proper color match to the adjacent tooth is important not only in the initial period of service but also over a longer period.<sup>[1]</sup>

Glass ionomer cement (GIC), has been advocated for use because of various reasons, including its physical-chemical bonding to the tooth structure, acceptable aesthetic properties, biocompatibility, fluoride release, inhibition of bacterial acid metabolism, similar coefficients of thermal expansion to that of the tooth structure, and ease of clinical application.<sup>[2]</sup> In order

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to improve the mechanical properties of conventional GIC, Resin Modified GIC (RMGIC) has been introduced, which contain hydrophilic monomers and polymers such as HEMA.<sup>[3]</sup> Properties of Resin Composite such as high aesthetics, conservative approach, adhesion to the tooth structure, and superior mechanical properties make it a good anterior restorative material. Although the quality of composite resin restorations has improved with the advent of new technologies in material science in recent years, discoloration of the composite resin material remains a major long-term clinical problem. The color stability of these restorative materials in a dynamic oral environment is an important criterion influencing its clinical longevity which continues as an inherent challenge to the material.<sup>[4]</sup>

Topical fluoride therapy has various clinical applications such as in the management of dentinal hypersensitivity,<sup>[5]</sup> caries control and prevention,<sup>[6]</sup> and fluoride recharge of appropriate restorations.<sup>[7]</sup> Various studies have been conducted on the staining potential of topical fluorides on several dental restorations and has been documented in the literature.<sup>[8,9]</sup>

Profluorid® Varnish (VOCO, Germany) is a fluoride-containing dental desensitizing varnish used for dentinal hypersensitivity and is claimed to be highly effective. The manufacturer also claims that the product does not impair aesthetics or cause discoloration of the tooth. However, the staining potential of this product on the various dental restorations has not been evaluated to the best of our knowledge.

The objective of the present study was to evaluate the staining potential of 5% Sodium fluoride (VOCO Profluorid® Varnish) on GIC, RMGIC, and Resin Composite. The objective of the second part of the study was to evaluate the effect of 5% sodium fluoride (NaF) on the staining potential of coffee on the above-mentioned restorative materials.

## MATERIAL AND METHODS

### Sample size estimation

Sample size was calculated based on a study conducted by Lin and Huang titled: Staining potential of acidulated phosphate fluoride (APF) foam on dental restorations *in vitro*.

Sample size was calculated based on the comparison of staining rate on teeth/or the restorations of GIC and CR. Sample size was calculated using the following formula:

$$n = (Z_{\alpha/2} + Z_{\beta})^2 * (p_1(1-p_1) + p_2(1-p_2)) / (p_1 - p_2)^2$$

$$Z_{\alpha} = 1.96$$

$$Z_{\beta} = 0.67 \text{ (75\% power of the study)}$$

$$p_1 = 50\%, (1-p_1) = 50\%, p_2 = 17.5\%, (1-p_2) = 82.5\%$$

$$N = 25.825 = 26.$$

42 intact extracted posterior human teeth were collected, debrided with an ultrasonic scaler, and were stored as per OSHA norms. The teeth with intact caries-free surfaces were selected for the study. The teeth were sectioned at the level of CEJ and the roots were discarded. Then the teeth were completely sectioned mesiodistally to obtain two halves (buccal and lingual) from one tooth.

Thus, 84 intact tooth surfaces were obtained to attain the total sample size.

Tooth preparation with cavity dimension of 4 mm (length mesiodistally) \* 3 mm (width occlusoapically) \* 2 mm (depth) was done on each intact tooth surface.

28 samples each were restored with GIC, RMGIC, and Resin Composite, respectively, in the cavities prepared.

### Evaluation of staining potential of sodium fluoride

42 samples were randomly chosen for this part of the study. They were divided into six groups.

The GIC group: The prepared cavities were filled with the GIC (GC Gold Label Universal restorative, Japan) of shade A2. The polishing of the restorations was done after 24 hours with TR-25EF polishing diamond abrasives (Mani Inc, Japan).

The RMGIC group: The prepared cavities were filled with RMGIC (GC Gold Label Light cure Universal Restorative, Japan) of shade A2 and were cured with a curing unit (3M ESPE Elipar, United States) for 30 s. The restorations were then polished with TR-25EF polishing diamond abrasives (Mani Inc, Japan).

The Resin Composite group: The prepared cavities were etched with an etchant (3M ESPE Scotchbond Multipurpose Etchant, United States) for 20 s and the etchant was washed off for 30 s and blot dried. The adhesive (Te-Econom bond, Ivoclar Vivadent, India) was applied and was cured for 15 seconds. The resin composite material (Te-Econom Plus, Ivoclar Vivadent, India) of shade A2 was used to fill the cavities and was contoured with a mylar strip and photo cured for 30 s. The restorations were then polished with TR-25EF polishing diamond abrasives (Mani Inc., Japan).

42 of the restored specimens were divided into control and the experimental groups, which are tabulated in the [Table 1].

All the control group samples were stored in artificial saliva. While the experimental group samples were subjected to a fluoride application procedure and later stored in artificial saliva.

### The fluoride application

Each specimen of the experimental groups was subjected to the application of 5% NaF (VOCO Profluorid® Varnish). The first layer of varnish was applied with an applicator tip

provided by the manufacturer. After automatic drying of the first layer, a second coat was applied likewise. After the fluoride application, the specimens were stored in artificial saliva. At the end of the day, each specimen was cleaned using a toothbrush (20 strokes in mesio-distal as well as occluso-apical direction each) to simulate circumoral musculature, the tongue, and the tooth brushing. The fluoride application process was repeated for a total of 2 consecutive days to simulate the repeated application a patient might undergo during the desensitization procedure or as a caries control measure. All the control and experimental groups were subjected to thermocycling in a water bath between 5°C and 55°C for 500 cycles. The dwell time in each bath was 20 s, and the transfer time between the two baths was 5 s.

On the 3<sup>rd</sup> day, each specimen of the experimental group was compared with a specimen of the corresponding control group for visible shade change or marginal staining by three different blinded examiners who were calibrated earlier. The scoring criteria was introduced by Lin and Huang,<sup>[8]</sup> in terms of yes or no for visible staining on the surface of the restoration or the margins. The score 1 was given for Yes (staining present) and score 0 for No (staining absent) for the documentation and statistical analysis.

### Evaluation of staining potential of coffee

The remaining 42 samples which were already restored with the test materials were taken for further experiments according to the groupings tabulated in [Table 2].

The control groups ( $n = 7$ ): The control groups (Groups 1–3) were subjected to coffee application. The coffee solution was made by dissolving 2.2 g of instant coffee powder (Bru instant) into 250 mL of boiling water along with constant stirring. All the samples were immersed in hot coffee for 10 min. After this period, the tooth specimens were cleaned

using a tooth brush with 20 strokes in both directions. This procedure was followed for 3 consecutive days and coffee was prepared fresh for each day. Later these specimens were stored in artificial saliva.

The experimental groups ( $n = 7$ ): The experimental groups (Groups 4–6) were first subjected to fluoride application with the same protocols as in the first part of the study. Following fluoride application, these were immersed in hot coffee for 10 min and same protocol was followed as in control group. All the control and experimental groups were subjected to thermocycling in water bath between 5°C and 55°C for 500 cycles. The dwell time in each bath was 20 s, and the transfer time between the two baths was 5 s.

On the 4<sup>th</sup> day, each specimen of the experimental group was compared with a specimen of the corresponding control group for visible shade change or marginal staining by three different examiners who were blinded. The scoring criteria were the same as that described earlier.

### RESULTS

2 GIC and 4 each of RMGIC and Resin Composite samples were stained after the application of 5% NaF varnish, that is, 28.60% of GIC and 57.10% each of RMGIC and Resin Composite were stained. Hence, all the experimental groups were stained up to visually perceptible level with a Chi-square test value of 9.001 and with a significance of  $P = 0.029$ , which is represented in [Graph 1].

However, intergroup comparison of experimental groups gave a Chi-square value of 1.167 and it was statistically non-significant ( $P = 0.592$ ) which is tabulated in [Table 3].

In the second part of the study, in the control group (only coffee), the staining rates were as follows: GIC-71.4%, RMGIC - 0%, and Composite - 71.4%. The staining rates for experimental groups (5%NaF applied before immersion in coffee) were: GIC-85.7%, RMGIC-28.6%, and Composite-100%. The GIC group had a significance value of 1.000, RMGIC and Resin Composites of 0.462. The values are tabulated in [Table 4].

This suggested that application of 5%NaF varnish increased the staining potential of coffee, although it was statistically non-significant.

**Table 1:** Groupings in the first part of the study.

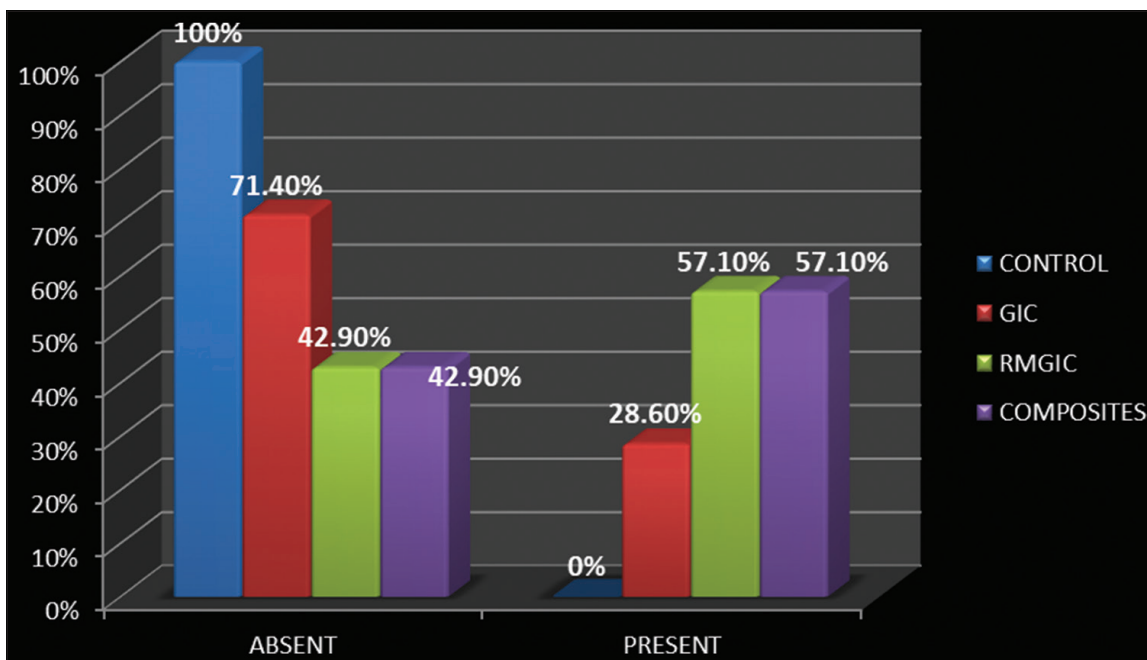
Group A	GIC control group
Group B	RMGIC control group
Group C	Composite control group
Group D	GIC fluoride group
Group E	RMGIC fluoride group
Group F	Composite fluoride group

**Table 2:** Groupings in the second part of the study.

Group 1	GIC fluoride control group
Group 2	RMGIC fluoride control group
Group 3	Composite fluoride control group
Group 4	GIC fluoride and coffee group
Group 5	RMGIC fluoride and coffee group
Group 6	Composite fluoride and coffee group

**Table 3:** Statistics of the first part of the study.

	GIC	RMGIC	RESIN composite	Chi-square value	Significance
Staining absent	5 (71.4)	3 (42.9)	3 (42.9)	1.167	0.592 (N.S)
Staining present	2 (28.6)	4 (57.1)	4 (57.1)		
Total	7 (100)	7 (100)	7 (100)		



Graph 1: Graphical representation of the results of first part of the study.

**Table 4:** Statistics of the second part of the study.

	Staining		Chi-square value	Significance
	Absent	Present		
GIC				
Control	2 (28.6)	5 (71.4)	0.424	1.000 (N.S)
NAF added	1 (14.3)	6 (85.7)		
RMGIC				
Control	7 (100)	0 (0)	2.333	0.462 (N.S)
NAF added	5 (71.4)	2 (28.6)		
Composites				
Control	2 (28.6)	5 (71.4)	2.333	0.462 (N.S)
NAF added	0 (0)	7 (100)		

**DISCUSSION**

GIC, RMGIC, and Resin Composite are the most commonly used restorative materials. These are commonly used in the aesthetically pleasing zone. Hence, the color stability of these restorations is of utmost importance from the esthetic point of view.

Fluoride was introduced into dentistry over 70 years ago, and it is now recognized as the main factor responsible for the dramatic decline in caries prevalence that has been observed worldwide.<sup>[10]</sup> Fluoride present in low, sustained concentrations (sub- ppm range) in the oral fluids during an acidic challenge are able to be absorbed onto the surface of the apatite crystals inhibiting demineralization. When the pH is reestablished, traces of fluoride in solution will make it highly supersaturated with respect

to fluorhydroxyapatite, which will speed up the process of remineralization.<sup>[11]</sup>

The potential to stain the tooth by topical stannous fluoride application<sup>[12]</sup> has been documented in the literature which is largely due to the improper stabilization of stannous ions (Sn<sup>++</sup>) in SnF<sub>2</sub>. Staining potential of APF on various dental restorations has been evaluated by Lin and Huang,<sup>[8]</sup> and they concluded that GIC was more susceptible to staining with APF when compared to RMGIC and composites.

In the current study, the staining potential of 5% NaF was evaluated. This study showed that all the three types of restoratives which were evaluated, showed significant staining when compared to the respective control groups. GIC showed less potential to be stained when compared to RMGIC and Resin Composites, which were more susceptible to staining from 5% NaF. This might be due to the fact that GIC has higher water content which allows lesser water absorption making it less susceptible to color changes.<sup>[13]</sup> This finding was in concurrence with study conducted by Lim *et al.* who demonstrated that RMGIC had a higher susceptibility to surface stain than conventional GICs because of their resin content.<sup>[14]</sup>

Excessive water sorption could reduce the longevity of composites by expanding and plasticizing the resin matrix, hydrolyzing the silane coupling agent, and producing microcracks formations and eventually leading to staining.<sup>[15]</sup> Some studies have reported high surface roughness of composites even after finishing, due to irregularly arranged inorganic filler particles, which could



**Figure 1:** White opaque discoloration over the surface of the resin composite restoration.

result in easier staining over time.<sup>[16]</sup> These might be the reasons for the higher percentage of staining of RMGIC and composites in the present study.

The discoloration observed in the current study was a white opaque discoloration over the surface of the restoration either as a layer or as discrete strands as shown in [Figure 1].

In the second part of the study, application of 5%NaF varnish increased the staining potential of coffee marginally, although not significant statistically. This is in accordance with the first part of our study, in which we observed that application of 5%NaF resulted in the white opaque discoloration over the surface of the restorations. We hypothesize that this layer might have reduced the stain resistance of the restoratives to coffee.

Since the evaluation methods was visual and did not involve an instrumental one like a colorimeter or a spectrophotometer, this study might have been subjected to bias. Further studies also need to be conducted for evaluation of surface and subsurface alterations of these restorations after application of 5% NaF.

## CONCLUSION

5% NaF application resulted in a shade change of all the restoratives tested in the study upto a visually perceptible level. The fluoride application did not significantly influence the staining potential of coffee in the restoratives tested.

## Declaration of patient consent

Patient's consent not required as there are no patients in this study.

## Financial support and sponsorship

Nil.

## Conflicts of interest

There are no conflicts of interest.

## REFERENCES

- Gupta R, Parkash H, Shah N, Jain V. A spectrophotometric evaluation of color changes of various tooth colored veneering materials after exposure to commonly consumed beverages. *J Indian Prosthodont Soc* 2005;5:72-8.
- Savas S, Colgecen O, Yasa B, Kucukyilmaz E. Color stability, roughness, and water sorption/solubility of glass ionomer-based restorative materials. *Niger J Clin Pract* 2019;22:824-32.
- Yli-Urpo H, Lassila LV, Närhi T, Vallittu PK. Compressive strength and surface characterization of glass ionomer cements modified by particles of bioactive glass. *Dent Mater* 2005;21:201-9.
- Roja RJ, Sriman N, Prabhakar V, Minu K, Subha A, Ambalavanan P. Comparative evaluation of color stability of three composite resins in mouthrinse: An *in vitro* study. *J Conserv Dent* 2019;22:175-80.
- Gaffar A. Treating hypersensitivity with fluoride varnishes. *Compend Contin Educ Dent* 1998;19:1088-90.
- Bravo M, Baca P, Llodra JC, Osorio E. A 24-month study comparing sealant and fluoride varnish in caries reduction on different permanent first molar surfaces. *J Public Health Dent* 1997;57:184-6.
- Forsten L. Fluoride release and uptake by glass ionomers. *Scand J Dent Res* 1991;99:241-5.
- Lin D, Huang B. Staining potential of acidulated phosphate fluoride (APF) foam on dental restorations *in vitro*. *J Conserv Dent* 2015;18:30-3.
- Fatima N, Nayab T, Farooqui WA. Effect of fluoride agents on the color stability of esthetic restorative materials. *Tanta Dent J* 2016;13:63.
- Dionysopoulos D. The effect of fluoride-releasing restorative materials on inhibition of secondary caries formation. *Fluoride* 2014;47:258-65.
- Buzalaf MA, Pessan JP, Honório HM, Ten Cate JM. Mechanisms of action of fluoride for caries control. *Fluoride Oral Environ* 2011;22:97-114.
- Ellingsen JE, Eriksen HM, Rölla G. Extrinsic dental stain caused by stannous fluoride. *Scand J Dent Res* 1982;90:9-13.
- Bagheri R, Burrow MF, Tyas M. Influence of food-simulating solutions and surface finish on susceptibility to staining of aesthetic restorative materials. *J Dent* 2005;33:389-98.
- Lim BS, Moon HJ, Baek KW, Hahn SH, Kim CW. Color stability of glass-ionomers and polyacid-modified resin-based composites in various environmental solutions. *Am J Dent* 2001;14:241-6.
- Ferracane JL, Marker VA. Solvent degradation and reduced fracture toughness in aged composites. *J Dent Res* 1992;71:139.
- Guler AU, Kurt S, Kulunk T. Effects of various finishing procedures on the staining of provisional restorative materials. *J Prosthet Dent* 2005;93:453-8.

**How to cite this article:** Vinu V, Ponnappa KC, Nanjappa S. Evaluation of staining potential of 5% sodium fluoride varnish and coffee beverage on tooth-colored restorative materials: An *in vitro* study. *J Restor Dent Endod* 2021;1:41-5.





Review Article

## Digital dental photography – The tool of necessity

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Received : 23 May 2020  
Accepted : 05 April 2022  
Published : 24 November 2022

DOI  
10.25259/JRDE\_6\_2020

Quick Response Code:



### ABSTRACT

Photography in dentistry has revolutionized the diagnosis, treatment planning, marketing, and communication between the patient, dentist, and dental laboratory technicians. With the advancements digital photography has implied in dentistry, the craftsmanship of the practitioners is touching new grounds for education, self-improvement, and documentation. This article tries to solve the enigma of choosing the camera and its lens, the accessories that necessitate achieving professional-like results and also seeking the same results with the next big leap in accessible photography, the smartphone camera. This article intends to broaden the knowledge of the technicality behind digital photography and how the same can be used in dentistry to make a standpoint for the practitioners in their field.

**Keywords:** Dental photography, Dentistry, Smartphone photography, Smartphone dental photography, Dental photography techniques, Dental photography light, Dental photography camera

### INTRODUCTION

“We look with our eyes, but see with our mind.” One can look at a photograph, but it is the mind that needs to see; the possibilities hidden in an otherwise normal visual field. Photography is defined in Greek as “the creation with light.”<sup>[1]</sup> Light rays are captured on a light-sensitive medium when a visual image is recorded. From the cameras obscure and daguerreotypes to the DSLRs and mirrorless cameras today, this process has advanced to perfection and become more user-friendly.

When early dentistry started with drawings and visual representations to describe dental conditions and treatment procedures, photography created a portal of possibilities. The American Journal of Dental Sciences initiated printing as the world's first dental journal. The first pre-operative and post-operative photographs got published by Ide and Thompson.<sup>[2]</sup> Clinical dental photography is a paradigm shift in diagnosis, treatment planning, and education.

### WHY DIGITAL DENTAL PHOTOGRAPHY (DDP)?

Although legal documentation, education, publication, patient/team/laboratory communication, and marketing share the need for DDP, accurate recording of the oral details holds the primary requirement. Recording the stages and steps of the treatment help in follow-up and avoiding misunderstandings with the patient. It can be an educational tool for students and patients. It can also be used while referring to a specialist or a dental technician.<sup>[3]</sup> Projecting and enlarging these images help a dentist in self-evaluation and training.

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## ADVANTAGES OF DIGITAL DENTAL PHOTOGRAPHY

- Images are immediately available and easy to share.
- No expense for film processing.
- No chemical development is required.
- Higher reproducibility.
- Metadata of the images can be produced.
- Image lighting can be adjusted in real-time.

## DISADVANTAGES OF DIGITAL DENTAL PHOTOGRAPHY

- Steep learning curve.
- Planning and proactive management of the files for accessibility.
- Possibility of fakery.

## ARMAMENTARIUM

### Camera

A perfect camera does not exist! The camera is an aid. One must first decide the subject and composition. A single-lens reflex and mirrorless system are recommended.<sup>[4,5]</sup> Spending on the lenses and lighting is advocated rather than on the camera body.

### Camera accessories

- An *eyecup* that prevents the undesirable light from reaching the viewfinder.<sup>[5]</sup>
- A *right-angle finder* if the camera is to be mounted very low on a tripod.
- The *dioptric adjustment lenses*.<sup>[5]</sup>
- A *tripod* ensures no-touch protocols with precise focusing and framing.
- The *bracket* supports the flashes on the camera.
- A *stage* is used in extra-oral bench photographs to focus without touching the lens.
- A *copy stand* ensures uniform lighting and stability to shoot radiographs.
- For cross-infection control, use a *remote release cable*, and operated through foot control or wireless
- An *18% color grey card* helps in white balance and dental shade guide.<sup>[6]</sup>

### Lens

This is the image quality negotiator! Dentistry is more about macro photography; hence, the use of a macro lens is recommended for portraits and to obtain a life-size reproduction ratio of 1:1.<sup>[2]</sup> Some of the suggested lenses are Canon\* 60mm f2.8 and 100mm f2.8, Nikon\* 60mm f2.8 and 105mm f2.8, Tamron\* 90mm f2.8, and Tokina\* 100mm f2.8.

### Lens accessories

- *Close-up lenses*: Attachments on the lens (like filters) to focus more closely on the subject. More than one close-up lens will reduce the image sharpness.
- *Reversing rings*: Accessory to mount the lens in a reverse direction to take extreme close-ups.
- *Extension tube and Bellow's unit*: Metal tubes between lens and camera, fitted to achieve greater magnification.

### Light source

A ring flash and twin flashes are ideal as it provides even illumination, canceling shadows by lighting from all directions.<sup>[5]</sup> They are attached in front of the lens.

### Background

Light neutral color background such as grey, blue, and beige is recommended for standardizing portrait photographs.

### Importance of the background-color

This depends on the subject's color and the purpose of the photograph. A uniform color helps in post-editing processes. Each color is designated for a particular reason.<sup>[2,5,7]</sup>

- *White*: Used for dark subjects. Easy to reproduce in printing.
- *Black*: Black eliminates shadows and produces a pseudo-three-dimensional reproduction giving the object a floating appearance. Also increases the luminous power of the color of the object. However, black color can lead to over-exposure of the object when metered the average by the digital camera setup. In such cases use spot metering or minus correction of exposure. Do a plus correction if the subject is a large white object.
- *Grey*: Universal background color. Grey does not hamper the exposure or the color of the subject. It makes post-editing color correction easier. However, subject isolation will be poor if the image is to be printed in black and white.
- *Colored backgrounds*: Background and object color should be harmonious like red on black, blue, and yellow. The background color should be available visually but should not dominate. Red is the least recommended; blue is near ideal. Non-harmonic combinations such as green-magenta and cyan-red can be omitted.

### Dental armamentarium

- *Cheek retractors* help in retracting cheeks and lips. Bilateral type for anterior teeth and unilateral for

posterior teeth. Plastic pliable is suggested over the metallic for patient comfort.<sup>[8]</sup>

- For shooting occlusal mirror and buccal retracted view use of *modified retractor* advised.
- For retracting the front of the mouth use of a *full crescent retractor* is recommended.
- For both the above shots if the mouth size is small, a *wire retractor* can be used.
- A *front-coated intraoral mirror* to shoot various aspects of the dentition.<sup>[8]</sup> *Occlusal mirrors with handle, bullet-shaped mirror on an angled handle* (buccal retracted view), and *lingual cut mirror* (posterior sextant) are available.<sup>[8]</sup>
- A *contraster* gives smooth black background when placed behind the teeth.<sup>[2]</sup>
- For neutralizing colors for precise color communication a *pensler shield* can be used.
- *Cotton rolls, saliva ejector, and rubber dams*: Moisture control.
- Storage media and computer: Ideally, a minimum 512MB memory card is necessary for clinical purposes.<sup>[1]</sup>

## BASICS OF PHOTOGRAPHY

A photograph is a delicate balance of *shutter speed, aperture, and ISO* that creates the style and esthetics funded by creativity. This exposure trinity should be prioritized in a way that best presents your subject.

### Shutter speed

The measured time is between the opening and closing of the camera shutter. A fast shutter speed is needed to freeze action. A low or slow shutter speed will give motion blur. Shutter speed, say, 1/60 s will allow half the light as its preceding 1/30 s but twice the succeeding 1/125 s.<sup>[2,5]</sup>

### Aperture

The size of the hole lets light into the camera. It is denoted by “f number.” Smaller the f number wider will be the hole and vice versa. A wider aperture lets more exposure, giving a very narrow area of focus. The larger the f stop, the smaller the depth of field. The smaller the aperture, the more overall focus on the image.

### Exposure/ISO

The amount of light allowed to pass through the lens to reach the sensor. If the subject is well lit, then a brief exposure will give a crisp result. Longer exposure is necessary for low light conditions. Modern cameras have a built-in meter to calibrate the correct exposure using special photoelectric cells that measure the light reflected from the subject.<sup>[5]</sup> Unfortunately,

in clinical conditions in dentistry with a deep oral cavity, this metering is biased by low light.<sup>[2,5]</sup> A first-hand knowledge of the right exposure settings will help in such situations.

## Composition

Framing an image by attending to the subject, its position with respect to other objects in the image, and how well the subject matter is expressed is the essence of the composition of a photograph. A good composition is visually pleasing and stimulating to look at. A poor composition distracts the viewers’ attention. Image composing can be learned by familiarizing with the rules and by practicing them judiciously.

The composition can be improved by eliminating the background and foreground until only the most obvious choice is left. The same subject shot from different *perspectives* can render a different meaning to each shot. Focusing on the subject of interest grabs the viewers’ attention, thereby also providing a sense of scale. As per the *rule of thirds*, if one divides the frame into nine grids forming four intersections, and the subject is placed at any of these intersections, it adds to a pleasing effect.<sup>[1,6,7]</sup> Use landscape (horizontal) and portrait (vertical) when necessary so that frame is filled with the subject. The negative/empty space if present in an image can be used wisely to obtain amazing results. The thumb rule is to use the negative space in front of the subject.<sup>[2]</sup>

## IMPORTANCE OF LIGHT IN DENTAL PHOTOGRAPHY

Dental photography is bound by the space, color, and time for a visual experience. When *time* decides the movement, sparkle, flicker, glitter, and fluctuation; the hue, value, and Chroma define the *color*. Transparency, depth, texture, size, and form are described by the *space*. By eliminating Chroma and hue you achieve a black and white image called chrominance.<sup>[5,9]</sup>

Light can be incident or backlighting. The reflection of a single light source can cause an unwanted reflection called halation/hot spot.<sup>[2]</sup> This eliminates the details below the reflecting layer (dentine structure beneath the reflecting enamel). Thus, two light sources are used on both sides of the camera at 45° in the horizontal plane. The angle of incidence of one light equals the angle of reflectance of the other.<sup>[2]</sup>

The light that travels only in a straight line needs to be manipulated to achieve desired details. A ring flash gives a 360° naked uniform illumination. The use of flags and opaque objects can block the light to present a shadow on a plaster cast (blocking). Materials such as linen cloth or Perspex with a range of opacities when in front of light can reduce the output contrast with smoother lighting (diffusion).

To eliminate unwanted hot spots and highlight the areas opposite the light source, a reflective surface can be used against the light (reflection).

A subject receives less light as the light source is moved further away. The larger the light source, relative to your subject size, the softer the light. For example, a softbox is a larger light source when kept near the subject. However, it becomes a smaller light source when it is moved further apart. This is explained by the inverse square law.<sup>[2,9]</sup>

### Types of lighting

- Daylight/North light: The daylight from the geographic North direction diffused by a drawing paper can achieve professional images on zero budget.<sup>[2,5]</sup>
- Artificial light: Used when the daylight dependency becomes demanding. It is of two types – flash lighting (ring flash/twin flash) and continuous lighting (softbox).<sup>[2,9]</sup>

### CAMERA SETUP FOR DENTAL PHOTOGRAPHY

Whether it is a Canon or Nikon camera, the following settings [Table 1] will be optimum for dental photography.

For the portrait photography position, your subject is at 6 feet (2 m) from the camera and shoots by holding the camera vertically. Make sure to stabilize the camera with a tripod or hand support while shooting any image. And keep flash in manual mode.

### Photographing small objects in dentistry

The aim is to attain maximum details, filling the frame with a highly perceptible image for documentation. A *macro lens* with 50 mm or 60 mm is used with a circular *polarizing filter* on a camera with a *lens hood*, operated with a *wireless device* or self-timer. Polarizer removes reflections on shiny surfaces like glass. Place the object perpendicular to the optical axis in a way that the object axis is parallel to the lower and upper edge of the photograph. For better perception of a three-dimensional object, shoot from a top oblique view.

The camera must be stabilized with a tripod or copy stand while the object has to be stabilized with an adhesive, soft

wax, silicon impression materials, alligator clips, and rod sets (Novoflex). A shooting table such as Novoflex macroscopy stand or Magic studio or Top-table (Kaiser) helps in isolating and shooting the object. For isolating an object, in a horizontal level shoot, place the object far from the background and illuminate it in such a way that the shadows of the object are outside the viewing field. For, “from-the-top” shots, use a glass plate 15–20 cm from the base to keep the object. One can also place the object on a black glass plate or tile, even on the case of your smartphone to get a dramatic reflection.<sup>[5]</sup>

### Photographing a radiograph

For a diagnostic quality photograph, we need a 100 mm macro lens on a smaller aperture mounted on a camera with a tripod. The X-ray film was cello-taped on the x-ray viewer. Orient the viewer vertically, perpendicular to the floor. Shoot after switching off all lights except that of the X-ray viewer at larger f-number like f/11 or f/16.<sup>[2]</sup>

### SMARTPHONE DENTAL PHOTOGRAPHY

With accessibility turning the cards, smartphone photography is picking up pace. With technology, the latest smartphones are capable of producing professional standard photographs but they might need color correction using spectrophotometry to attain the exact value.<sup>[10]</sup> The smartphone lens due to the difference in focal point can distort the edges of the lens and may not be appreciated in macro photography.<sup>[10]</sup> The smartphone flash can sometimes wash out the surface textures of the enamel or ceramic prosthesis. There are attachable lenses available easily in the market that when mounted in front of the camera lens, yield the desired effect. For lighting the subject, USB ring flashes and point flashes can be mounted. Smile MDP frame is an affordable luxury in smartphone lighting.

### Intraoral smartphone photography

1. Retract the lips and cheek.
2. Disinfect the smartphone. Place it at 45°.
3. Use the chair light to illuminate the scene. For diffused lighting loosely cover the light using a white cloth or tracing paper. To get more texture in the image, place the lamp on the patient at about 90°. You can also use a ring flash on the mobile.
4. Focus on the area of interest. “Lock-focus” if there is an option. Shoot!

### Extraoral smartphone photography

- Ask the patient to smile naturally. Judiciously use facial asymmetries.
- Eliminate plaque and. excess restorations before the shoot.

ISO	Shutter speed	Aperture	White Balance	Focus
100–200 (>200 causes grainy image)	1/125 s	For intraoral: f22 For portraits: f5.6 or less	5500K flash	Single point autofocus (S-AF)

- Centre the nose to the image.
- Use a white or black background
- Place the patient about 50–60 cm in front of the fundus to reduce the shadow.<sup>[11]</sup>
- Place the mobile phone at the level of the patient's eyes

## CONCLUSION

Photography in dentistry is revolutionizing diagnosis, treatment planning, marketing, and patient-dental team communication and relations. Constant integration of knowledge and technology in digital dental photography can help a normal dental practitioner to mutate his practice to stand ahead of the market. It also favors a niche for self-evaluation and learning; segregating materials for training and publications. If channeled well, the dentist can develop an exciting hobby as well.<sup>[12,13]</sup>

## Acknowledgments

For material and matter support - Dr. Akanksha Bhatt, Dr. Monisha, Dr. Rajesh Swami. (Postgraduate students, Maratha Mandal's Nathajirao. G. Halgekar Institute of Dental Sciences and Research Centre, Belagavi, Karnataka).

## Declaration of patient consent

Patient's consent not required as there are no patients in this study.

## Financial support and sponsorship

Nil.

## Conflicts of interest

There are no conflicts of interest.

## REFERENCES

1. Ahmad I. Digital dental photography. Part 1: An overview. *Br Dent J* 2009;206:403-7.
2. Vyas MB. *Clinical Photography in Dentistry*. 1<sup>st</sup> ed. New Delhi: Jaypee Brothers Medical Publishers; 2008.
3. Ahmad I. Digital dental photography. Part 2: Purposes and uses. *Br Dent J* 2009;206:459-64.
4. Ahmad I. Digital dental photography. Part 4: Choosing a camera. *Br Dent J* 2009;206:575-81.
5. Bengel W. Wolfgang Mastering Digital Dental Photography. Quintessence Publishing Co, Ltd.; 2006.
6. Desai V, Bumb D. Digital dental photography: A contemporary revolution. *Int J Clin Paediatr Dent* 2013;6:193-6.
7. Loiacono P, Pascoletti L. *Photography in Dentistry: Theory and Techniques in Modern Documentation*. 1<sup>st</sup> ed. Pocket Dentistry; 2012.
8. Ahmad I. Digital dental photography. Part 5: lighting. *Br Dent J* 2009;207:13-8.
9. Ahmad I. Digital dental photography. Part 7: Extra-oral set-ups. *Br Dent J* 2009;207:103-10.
10. Godlevsky LS, Bidnyuk E, Bayazitov N, Kresyun N, Kovalenko A, Lyashenko A, *et al*. Application of mobile photography with smartphone cameras for monitoring of early caries appearance in the course of orthodontic correction with dental brackets. *Appl Med Inform* 2013;33:21-6.
11. Dental Photography, Tricks with a Mobile. Available from: <https://www.dentaltix.com/en/blog/dental-photography-tricks-mobile>. [Last accessed on 2020 May 23].
12. Antar F, Zebouni E. Comparative review of DSLR cameras and smartphones in dental photography: Indications and limitations. *Int Arab J Dent* 2018;9:107-15.
13. Payne KF, Tahim A, Goodson AM, Delaney M, Fan K. A review of current clinical photography guidelines in relation to smartphone publishing of medical images. *J Vis Commun Med* 2012;35:188-92.

**How to cite this article:** Manayedath AC, Pujar M. Digital dental photography – The tool of necessity. *J Restor Dent Endod* 2021;1:36-40.