J Oral Res
research in oral sciences

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Decisions about the diagnostic and treatment criteria of dental caries among a group of dental students, faculty staff and dentists within the city of Medellin, Colombia.

Decisiones sobre los criterios de diagnóstico y tratamiento de la caries dental entre un grupo de estudiantes de odontología, profesores y odontólogos de la ciudad de Medellín, Colombia.

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Receipt : 12/10/2020 Revised: 06/03/2021
Acceptance: 10/30/2021

Cite as: Agudelo-Suárez A, Martínez-Delgado C, Díaz-Garavito M, Moncada-Cardona F, López-Trujillo L, Gómez-Correa M, López-Muñoz M & Restrepo-Rodríguez Á. Decisions about the diagnostic and treatment criteria of dental caries among a group of dental students, faculty staff and dentists within the city of Medellin, Colombia.
J Oral Res 2021; 10(5):1-14.
doi:10.17126/joralres.2021.062

Abstract: Objective: To analyze the criteria for diagnosis and treatment decision-making in relation to dental caries in different participants (teachers of dentistry, dental students at dental schools, and dentists practicing at public oral health services) in the city of Medellin (Colombia). Material and Methods: A cross-sectional study was applied in the period September 2015-december 2016 by means of an international validated questionnaire in 340 participants (dental teachers: 69, dental students: 193, dentists: 78). The survey addressed several topics related to detection and restorative threshold, preferences of preparation type, restorative materials used and opinions about diagnosis and treatment for dental caries. A descriptive analysis was carried out and Chi square tests were applied to observe statistically significant differences between the study variables. Results: 340 participants were surveyed among teachers who teach cariology, health care dentists, and undergraduate final-year students. Most participants were women (70%). The age mean was higher for DDSs (46 ± 9 years). On average, practicing dentists and dental teachers had a work experience of 21 ± 9 years. In case of treatment decisions, the majority of the surveyed would use immediate operative restorative treatment for advanced carious lesions (inner one-third of the dentin for approximal and grade 5 for occlusal). In addition, respondents reported different cavities diagnosis for clinical occlusal cases and some significant statistically differences were found for restorative treatment decisions and type of materials according to the type of participant. Conclusion: Criteria for diagnosis and treatment of dental caries differed among the student, dentist and dental teachers with variety in diagnosis and treatment concepts. However, a conservative tendency for restorative treatment decisions was observed. Strategies for incorporating non-restorative and minimal measures in professional practice should be considered in curricula of universities.

Keywords: *clinical decision-making; dental caries; operative dentistry; clinical practice patterns; dental care; dentists.*

Resumen: **Objetivo:** Analizar los criterios para la toma de decisiones diagnósticas y terapéuticas en relación a la caries dental en diferentes participantes (docentes, estudiantes de odontología de las facultades de odontología y odontólogos de los servicios públicos de salud bucal) de la ciudad de Medellín (Colombia). **Material y Métodos:** Se aplicó un estudio transversal en el período septiembre 2015 - diciembre 2016 mediante cuestionario internacional validado en 340 participantes (profesores de odontología: 69, estudiantes de odontología: 193, odontólogos: 78). La encuesta abordó varios temas relacionados con la detección y el umbral de restauración, las preferencias del tipo de preparación, los materiales de restauración utilizados y las opiniones sobre el diagnóstico y el tratamiento de la caries dental. Se realizó un análisis descriptivo y se aplicaron pruebas de Chi cuadrado para observar diferencias estadísticamente significativas entre las variables de estudio. Resultados: Se encuestó a 340 participantes entre profesores que imparten clases de cariología, odontólogos y estudiantes de último año de pregrado. La mayoría de los participantes eran mujeres (70%). La edad media fue mayor para los odontólogos (46 ± 9 años). En promedio, los odontólogos y los profesores de odontología tenían una experiencia laboral de 21 ± 9 años. En caso de decisiones de tratamiento, la mayoría de los encuestados utilizaría tratamiento restaurador quirúrgico inmediato para lesiones cariosas avanzadas (tercio interno de la dentina para proximal y grado 5 para oclusal). Además, los encuestados informaron diferentes diagnósticos de caries para los casos clínicos oclusales y se encontraron algunas diferencias estadísticamente significativas para las decisiones de tratamiento restaurativo y el tipo de materiales según el tipo de participante. **Conclusion:** Los criterios para el diagnóstico y tratamiento de la caries dental fueron diferentes entre los estudiantes, odontólogos y profesores de odontología con variedad en los conceptos de diagnóstico y tratamiento. Sin embargo, se observó una tendencia conservadora para las decisiones de tratamiento restaurativo. Las estrategias para incorporar medidas mínimas y no restaurativas en la práctica profesional deben ser consideradas en los planes de estudio de las universidades.

Palabras Clave: *toma de decisiones clínicas; caries dental; operatoria dental; pautas de la práctica clínica; atención odontológica; odontólogos.*

INTRODUCTION.

In recent years, research on dental caries has presented numerous advances related to a change of paradigms regarding aspects such as its definition, diagnosis criteria and treatment alternatives.[1] This pathology is recognized as a continuous and natural process.[2] Clinical app roaches are based on the evaluation of the individual risk factors and considering the stage of the carious lesion. In this sense, dental professionals can opt for non-restorative or operative management; these alternatives treat the disease by controlling and preventing its advancement or by stopping it.[3-5]

Findings demonstrate a high variability amongst the dentists who recommend different management for the same dental carious lesion.[6-13] In 1997, Bader and Shugars,[14] had drawn attention to these aspects and they mentioned three factors that could influence this variability and can be related to the profession:

1) The biases due to the subjectivity that occurs when involving their own opinions in relation to the materials to be used, the usefulness of the treatment, their preferences and the diagnostic techniques applied;

2) Personal characteristics that include age, ability, knowledge and tolerance towards uncertainty and finally,

3) Aspects related to the professional practice, such as the workplace, auxiliary personnel and available equipment.

Particularly in Colombia, research about the possible variations in the decision criteria for diagnosis and treatment of dental caries is scarce.[15] This situation seems very important since dental faculty who teaches cariology courses and other related topics are updating diagnosis and treatment techniques in cariology.[16-18] There is no consolidated scientific evidence of what happens in public and

private oral health services either. Dental caries is a public health issue considering the high prevalence of dental caries in Colombian population, especially in children under five years old.[19]

A change in the training of new dental professionals is essential based on considering new approaches to the disease and its treatment. This change will contribute to the improvement of the quality of public and private oral health services by means of the adoption of a conservative approach in light of current scientific evidence. Accordingly, this study aims to analyze the criteria for diagnosis and treatment decisionmaking in relation to dental caries management with different actors (university teachers and students of dental schools and dentists of public oral health services) in the city of Medellin (Colombia).

MATERIALS AND METHODS.

Ethical considerations

Confidentiality was guaranteed and all respondents gave oral and signed informed consent to participate. This research followed international guidelines (Declaration of Helsinki) and the legal regulations of Colombia (Resolution No 008430, October 4th, 1993, Ministry of Health). The study protocol was approved by the Ethical Committee of the E.S.E METROSALUD (the public health network services in the city of Medellín) by Act 02-2014. This paper was written according to the STROBE guidelines for reporting observational studies.[20]

Study design, sample and data collection

A cross-sectional study was conducted by means of a personal structured survey (printed form). Three kinds of study participants were chosen according to the research purposes: Dentists -DDSs- (general dental practitioners from governmental oral health services of the city of Medellin), dental students (STs), and teachers (DTs).

STs and DTs proceeded from the four Dental Schools of the public and private institutions. A convenience sample was used. In case of DDSs, they were selected according to the list provided for the institutions for those people working in the different health centers and hospitals. We selected dental faculty who were in charge of the cariology and operative dentistry courses, and adult/child clinics. Lastly, the fifth-year dental students were invited to participate as well. The participation was voluntary for all participants.

We invited the participants through diverse strategies such as emails, direct contact during the classes and clinical activities (in case of dental students), and direct invitations through deans and directors of faculties and the dental coordinators of health centers (for governmental oral health services). In addition, intentional sampling strategies, including snowball sampling and referrals, were used. A questionnaire was used for research purposes, called: "Questionnaire on the treatment of approximal and occlusal caries". This questionnaire was originally designed by Espelid *et al.*,[7] and modified by Tubert-Jeannin *et al.*,[21] and adapted to Spanish language and validated by a research group in Chile.[22] This self-reported survey consists of 17 closed-ended questions and multiple answer (questionnaire availability put it at the end of the manuscript with the conflict of interest).

A clinical case of a 20-year-old patient with photographs and radiographs is illustrated with a questionnaire where several answers are presented for each question, grouped into four dimensions:

1) Restorative treatment criteria for proximal carious lesions;

2) Restorative treatment criteria for occlusal carious lesions;

3) Dental caries diagnosis of questionable occlusal caries lesions;

4) Knowledge and beliefs about dental caries.

Sociodemographic variables such as sex, work experiences, postgraduate/specialty, report of other jobs, average time for operative treatment are part of the questionnaire. Other variables of the questionnaire were: proximal restorative criteria, proximal microcavity preparation technique and restorative material, occlusal restorative criteria, preparation technique for occlusal microcavity, restorative material for occlusal microcavity, occlusal caries or not, type of treatment for occlusal lesion, radiographic and clinical depth comparison in proximal lesion and average time of evolution of occlusal caries. Five dentistry students

ISSN Print 0719-2460 - ISSN Online 0719-2479.

were trained to get quality surveys by offering the necessary advice and resolving issues if necessary.

A pilot test was conducted in 20 people to correct the language, cultural adaptation of the questions and the overall consistency of the questionnaire. The study's fieldwork was conducted between September 2015 and December 2016. We did not have incomplete questionnaires.

Data analysis

SPSS software version 22.0-IBM® was used to carry out all of the analyses. First, absolute and relative frequencies were calculated for each of the sociodemographic variables. Second, a bivariate analysis was conducted for each of the variables related to the questionnaire according to the type of participants. For comparison between different categorical variables the Chi-square test was used with the level of a statistically significant set at p-value <0.05.

RESULTS.

There was no sampling frame for the study and the type of sampling should be considered (non-probabilistic for convenience). This situation had implications in response, participation, or cooperation rates. At the beginning of the study, we considered a possible estimated number of 380-400 surveys, and that means a response rate ranging from 81% - 85%. A total of 340 participants were surveyed among teachers who teach cariology, health care dentists, and undergraduate final-year students.

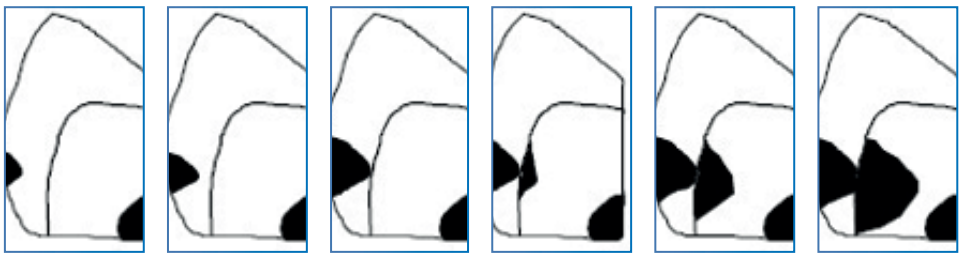
Table 1 details the sociodemographic characteristics of the sample. Most participants were women (70%). The age mean was higher for DDSs (46 ± 9 years). On average, DDSs and DTs had a work experience of 21 ± 9 years.

Restorative treatment criteria for proximal carious lesions

Figure 1 shows the different radiographic stages in the progression for an approximal dental caries in a second upper premolar and the participants' opinion about the lesion that requires immediate operative restorative treatment. The responses were not exclusive and the majority of the surveyed considered that cavities should be intervened in moderate and severe stages (outer middle and inner one-third of the dentin of the carious lesion).

Regarding the cavity preparation technique for restorative intervention (considering the smallest proximal lesion), 48.5% responded that they treat the tooth with a Class II cavity preparation (DDSs: 44.0%; DTs: 60.6%; STs: 46.0%); 21 participants did

Figure 1. Approximal lesion restorative threshold. Opinion of the participants. Medellín, 2015.*



Type of participant	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)
DDS	7 (9.0)	17 (21.8)	42 (53.8)	58 (74.4)	65 (83.3)	72 (92.3)
Dentistry teachers	7 (10.1)	17 (24.6)	31 (44.9)	47 (68.1)	55 (79.7)	62 (89.9)
Dentistry students	20 (10.4)	35 (18.1)	90 (46.6)	138 (71.5)	156 (80.8)	171 (88.6)
All	**34 (10.0)**	**69 (20.3)**	**163 (47.9)**	**243 (71.5)**	**276 (81.2)**	**305 (89.7)**

***Note: Percentages not exclusive. Positive response to each item.**

Note: The guide question for this figure is as follows: "The picture illustrates different radiographic stages of caries progression (approximal lesion, grade 1 to 6). Starting with which lesion size do you think an immediate restorative treatment is required? In other words—pick the figure number with the smallest lesion size for which you would not postpone restorative treatment under any circumstances even if the patient has low caries activity and good oral hygiene."[7,20,21,29]

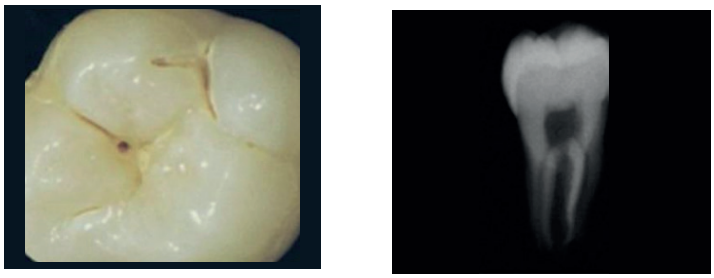
Figure 2. Occlusal lesion restorative threshold. Opinion of the participants. Medellín, 2015.*

Type of participant	Grade 1 n (%)	Grade 2 n (%)	Grade 3 n (%)	Grade 4 n (%)	Grade 5 n (%)
DDS	1 (1.3)	9 (11.5)	46 (59.0)	67 (85.9)	75 (96.2)
Dentistry teachers	3 (4.3)	13 (18.8)	40 (58.0)	63 (91.3)	68 (98.6)
Dentistry students	5 (2.6)	25 (13.0)	106 (54.9)	171 (88.6)	176 (91.2)
All	**9 (2.6)**	**47 (13.8)**	**192 (56.5)**	**301 (88.5)**	**319 (93.8)**

***Note: Percentages not exclusive. Positive response to each item.**

Note: The guide question for this figure is as follows: "The picture 2 illustrates different clinical appearances of occlusal caries in a lower second molar (grade 1 to 5). Starting at which lesion do you think immediate restorative (operative) treatment is required? Please, pick the smallest lesion size you think requires immediate restorative treatment. In other words, that is the lesion for which you would not postpone restorative treatment under any circumstances". grade 1, white or brownish discoloration in the enamel, no cavitation, no radiographic signs of caries; grade 2, minor loss of tooth substance with a break in the enamel surface or discolored surface or discolored fissures with gray or opaque enamel or caries confined to the enamel, no radiographic signs of caries; grade 3, moderate loss of tooth substance or caries in the outer one-third of the dentin according to the radiograph; grade 4, considerable loss of tooth substance or caries in the middle one-third of the dentin according to the radiograph; and grade 5, considerable loss of tooth substance or caries in the inner one-third of the dentin according to the radiograph.[7,20,21,29]

Figure 3. Caries diagnosis considering clinical and radiographic appearance according to the participants' opinion (Case 1). Medellín, 2015.



Type of participant	No caries n (%)	Enamel caries n (%)	Dentin caries n (%)	Do not know n (%)	*p*-value*
DDS	28 (36.4)	38 (49.4)	6 (7.8)	5 (6.5)	
Dentistry teachers	22 (32.8)	36 (53.7)	5 (7.5)	4 (6.0)	0.208
Dentistry students	44 (23.2)	126 (66.3)	13 (6.8)	7 (3.7)	
All	94 (28.1)	200 (59.9)	24 (7.2)	16 (4.8)	

*Missing values (n=6)

not answer this item. There were not statistically significant differences between the type of participant and the cavity preparation technique (p=0.286). The majority (71.1%) of participants use the resin-based composite as a restorative material (DDSs: 64.9%, DTs: 72.7%; STs: 73.0%). There were no statistically significant differences between the type of participant and the restorative dental material (p=0.124).

Restorative treatment criteria for occlusal carious lesions

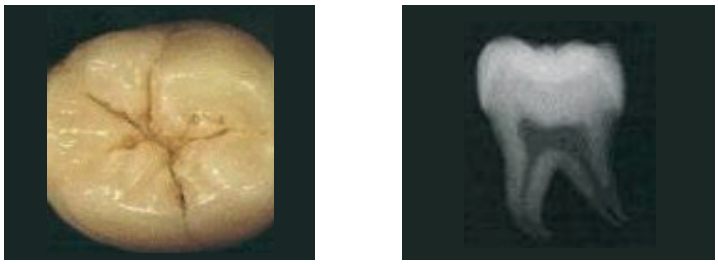
Figure 2 shows the different clinical stages in the progression of an occlusal carious lesion in a second mandibular molar and the participant's opinion

ISSN Print 0719-2460 - ISSN Online 0719-2479.

about the lesion that requires immediate operative restorative intervention. Similar to Figure 1, more than 50% considered that dental carious lesions should be intervened in moderate stages (Grade 3) and more than 85% answered that dental carious lesions should be treated in extensive stages (Grade 4 and Grade 5).

A total of 94.4% of surveyed individuals would remove caries tissue and treat the initial occlusal carious lesion such as a defect specific cavity preparation (DDSs: 97.4%; DTs: 95.6%; STs: 92.7%). 5.6%, would make a cavity preparation that extends all the pits and fissures (DDSs: 2.6%; DTs: 4.4%; STs: 7.3%). There were no statistically significant differences between the type of participant and the cavity preparation technique (p=0.281). Dental

Figure 4. Caries diagnosis considering clinical and radiographic appearance according to the participants' opinion (Case 2). Medellín, 2015.



Type of participant	No caries n (%)	Enamel caries n (%)	Dentin caries n (%)	Do not know n (%)	*p*-value*
DDS	57 (73.1)	14 (17.9)	3 (3.8)	4 (5.1)	
Dentistry teachers	39 (58.2)	14 (22.4)	6 (9.0)	7 (10.4)	0.144
Dentistry students	122 (63.9)	53 (27.7)	7 (3.7)	9 (4.7)	
All	218 (64.9)	82 (24.4)	16 (4.8)	20 (6.0)	

*Missing values (n=4)

Table 1. Sociodemographic characteristics of the sample. Medellín, 2015.

Variables		Type of Participant: DDS n	DDS %	Dentistry Teachers n	Dentistry Teachers %	Dental Students n	Dental Students %	All n	All %
Sex*	Male	29	37.7	22	31.9	51	26.4	102	30.0
	Female	48	62.3	47	68.1	142	73.6	237	70.0
Age	Mean (±SD)	45.6	9.1	40.6	11.7	23.9	2.7	32.2	12.0
Specialty	Yes	21	26.9	52	75.4	--	--	73	49.7
	No	57	73.1	17	24.6	--	--	74	50.3
Has another job	Yes	31	39.7	57	82.6	--	--	88	59.9
	No	47	60.3	12	17.4	--	--	59	40.1
Working experience (years)	Mean (±SD)	22.1	8.5	19.0	9.9	--	--	20.7	9.3
Time for assisting a patient	Mean (±SD)	30.1	2.1	38.5	21.0	57.6	33.7	47.4	29.6
(operative dentistry)	All	78	22.9	69	20.3	193	56.8	340	100.0

* Missing values: sex (n= 1)

Table 2. Participants' opinion about the type of treatment considering the occlusal dental caries diagnosis. Medellin, 2015.

Occlusal clinical/ radiographic case		Type of participant DDS n (%)	Dentistry Teachers n (%)	Dentistry Students n (%)	All n (%)	*p*-value
Figure 3						
Type of treatment	No treatment	11 (14.7)	3 (4.5)	7 (3.7)	21 (6.3)	<0.001
	Fluoride treatment	19 (25.3)	13 (19.4)	27 (14.2)	59 (17.8)	
	Pits and fissures sealant	17 (22.7)	19 (28.4)	46 (24.2)	82 (24.7)	
	Prepare only the decayed area of the fissure	18 (24.0)	13 (19.4)	31 (16.3)	62 (18.7)	
	Prepare only the decayed area of the fissure plus sealing of the rest of the fissures	10 (13.3)	19 (28.4)	76 (40.0)	105 (31.6)	
	Cavitary preparation that includes all the pits and fissures	0 (0.0)	0 (0.0)	3 (1.6)	3 (0.9)	
Type of restoration *(in case of considering the decision to do it)* n=330	Amalgam	6 (8.6)	2 (3.5)	5 (2.7)	13 (4.2)	0.019
	Composite resin.	31 (44.3)	41 (71.9)	106 (57.9)	178 (57.4)	
	Ionomer	26 (37.1)	11 (19.3)	47 (25.7)	84 (27.1)	
	Other	7 (10.0)	3 (5.3)	25 (13.7)	35 (11.3)	
Figure 4						
Type of treatment	No treatment	33 (42.3)	23 (34.3)	45 (23.6)	101 (30.1)	0.072
	Fluor treatment	23 (29.5)	14 (20.9)	46 (24.1)	83 (24.7)	
	Pits and fissures sealant	10 (12.8)	14 (20.9)	52 (27.2)	76 (22.6)	
	Prepare only the decayed area of the fissure	4 (5.1)	6 (9.0)	21 (11.0)	31 (9.2)	
	Prepare only the decayed area of the fissure plus sealing of the rest of the fissures	7 (9.0)	9 (13.4)	21 (11.0)	37 (11.0)	
	Cavitary preparation that includes all the pits and fissures	1 (1.3)	1 (1.5)	6 (3.1)	8 (2.4)	
Type of restoration *(in case of considering the decision to do it)* n=269	Amalgam	2 (3.2)	0 (0.0)	3 (1.9)	5 (1.9)	0.171
	Composite resin.	30 (48.4)	23 (51.1)	74 (45.7)	127 (47.2)	
	Ionomer	22 (35.5)	8 (17.7)	38 (23.5)	68 (25.2)	
	Other	8 (12.9)	14 (31.1)	47 (29.0)	68 (25.7)	

Missing values: Type of treatment (Case 1: n= 8, Case 2: n=8).

ISSN Print 0719-2460 - **ISSN Online** 0719-2479.

Table 3. Participants' opinion about the type of treatment considering the occlusal dental caries diagnosis. Medellin, 2015.

Questions		Type of participant				*p*-value
		DDS	Dentistry Teachers	Dentistry Students	All	
		n (%)	n (%)	n (%)	n (%)	
1. Do you think that the radiographic appearance of an approximal caries, compared to clinical observations, usually indicates:	Underestimation of the actual depth	48 (61.5)	47 (70.1)	131 (68.2)	226 (67.1)	0.740
	The real depth	15 (19.2)	8 (11.9)	29 (15.1)	53 (15.4)	
	Overestimation of the actual depth	15 (19.2)	12 (17.9)	32 (16.7)	59 (17.5)	
2. How much (on average time) do you think it takes for an approximal caries to progress from the surface of the enamel to the dentine (in permanent dentition)?	Less than 6 months	55 (70.5)	37 (56.1)	109 (57.1)	201 (60.0)	0.059
	12 months	14 (17.9)	19 (28.8)	67 (35.1)	100 (29.9)	
	from 13 to 23 months	8 (10.3)	7 (10.6)	13 (6.8)	28 (8.4)	
	More than 24 months	1 (1.3)	3 (4.5)	2 (1.0)	6 (1.8)	
3. If a proximal lesion is detected radiographically near the dentin-enamel junction (DEJ), it must be kept under observation without being restored for at least 6 months to determine if it is active and evaluate its rate of progression. Regarding this statement, you are:	In agreement	37 (47.4)	28 (40.6)	47 (24.4)	112 (32.9)	0.001
	In disagreement	39 (50.0)	33 (47.8)	123 (63.7)	195 (57.4)	
	Not sure	2 (2.6)	8 (11.6)	203 (11.9)	33 (9.7)	
4. Cavitation of an approximal lesion is usually not visible to the naked eye even when the lesion has reached the DEJ. Regarding this statement, you are:	In agreement	43 (55.1)	36 (52.2)	115 (59.6)	194 (57.1)	0.540
	In disagreement	29 (37.2)	26 (37.7)	56 (29.0)	111 (32.6)	
	Not sure	6 (7.7)	7 (10.1)	22 (11.4)	35 (10.3)	
5. What is the most important thing for you?	It is more important to restore all decayed teeth (accepting the risk of some unnecessary restorations)	7 (9.2)	5 (8.1)	30 (16.2)	42 (13.0)	0.317
	It is more important not to unnecessarily restore healthy teeth (accepting the risk of not restoring some caries lesions)	40 (52.6)	37 (59.7)	97 (52.4)	174 (53.9)	
	The risks of making an error are of equal importance	29 (38.2)	20 (32.3)	58 (31.4)	107 (33.1)	
6. In case of an incipient active caries lesion you always perform a restoration technique based on cavity preparation. Regarding thisstatement, you are:	Strongly agree	2 (2.6)	1 (1.6)	11 (5.9)	14 (4.3)	0.308
	In agreement	15 (19.5)	12 (19.0)	48 (25.7)	75 (22.9)	
	In disagreement	45 (58.4)	39 (61.9)	88 (47.1)	172 (52.6)	
	Strongly disagree	15 (19.5)	11 (17.5)	40 (21.4)	66 (20.2)	

***Missing values: Question 1 (n=3), Question 2 (n=5), Question 5 (n=17), Question 6 (n=13).**

composite selected as the dental material for the initial occlusal carious lesion (n=227; 68.2%). Other restorative materials would use glass ionomer cement and dental amalgam. The remaining (n=19, 5.7%) would use other kinds of treatment (*i.e.*, preventive treatment such as fluoride varnish, 5000 fluoride toothpaste, etc.). There were no significant differences between types of dental practitioner and types of restorative material (p=0.05).

Dental caries diagnosis of questionable occlusal caries lesions

Figure 3 and Figure 4 shows the answers on the survey about the different occlusal cavity preparations options from all the dental practitioners. The scenario was the hypothetical patient who was 20 years-old and had a dental exam annually, and a low caries risk patient with optimal oral hygiene. In the first scenario (Figure 3), 60% (n=200) of dental practitioners recognized the existence of dental caries at the enamel surface, 4.8% (n=16) of participants do not know/are not sure about the diagnosis of carious lesions. We did not find significant differences between the type of dental practitioner and occlusal dental caries diagnosis (p=0.208).

Considering the treatment for Figure 3 (Table 2), 49% (n=162) would use minimal invasive dental treatment. DTs would use a preparation including only the defect specific area of the fissure and sealing of the rest of the fissures (n=76; 40%). Significant differences between the type of treatment and type of dental practitioners were found (p<0.001). In the case of deciding to conduct an operative restoration, 57% (n=178) would choose resin-based composite. In addition, significant differences between the restoration material and type of participant were found (p<0.05).

Figure 4, 65% (n=218) considered that the teeth do not present dental carious lesions; 6,0% (n=20) of dental practitioners, did not know/were not sure about the cavity diagnosis. We did not find statistically significant differences between type of participant and occlusal dental caries diagnosis (p=0.144). According to the treatment for Figure 4 (Table 2), 55% (n= 184) of dental practitioners who answer the questionnaire would use preventive treatment with fluoride and 43% (n=144) would treat the tooth with a preventive resin restoration (including/not including pit and fissures).

There were no significant differences between the type of dental treatment and type of dental practitioner (p=0.072). In the case of deciding to conduct an operative restoration, 47% (n=127) would choose resin-based com-posite. No significant differences between the restorative material and type of dental practitioner were found (p=0.171).

Knowledge and beliefs about dental caries

Table 3 shows the dental practitioner's survey answers about diagnosis, progression, and treatment of dental caries management.

Question number 1: 67% (n=226) answered that the radiographic appearance of an approximal carious lesion, compared to a clinical observation, usually indicates underestimation of its actual depth (no significant dif-ferences were found by type of dental practitioner (p=0.740).

Question number 2: 90% (n=301), the dental practitioners who answer the survey thought that an approximal carious lesion progress from the surface of the enamel to the dentine (in permanent dentition) on an average of 12 months or less (no significant differences were found by type of dental practitioner p=0.059).

Question number 3: More than half of the dental practitioners who answered were in disagreement with the fact that a proximal lesion is detected radiographically near the Dentin-Enamel Junction (DEJ). The participants must be kept under observation, without being restored for at least 6 months to determine if it is active and evaluate its rate of progression (significant differences according to the type of participant p<0.01).

Question number 4: 57 percent (n=194) the participants agreed with the fact that cavitation of a proximal carious lesion is usually not visible, without significant differences by type of participant (p=0.540).

Question number 5: More than half of dental practitioners answered that it is very important to treat these carious lesions with preventive treatments and evaluate for re-mineralization in future dental appointments

ISSN Print 0719-2460 - **ISSN Online** 0719-2479.

(accepting the risk of not restoring some caries lesions) (no significant differences were found by type of dental practitioner p=0.317). Finally, for question number 6, 53% (n=172) of dental practitioners disagreed with the statement that in case of an initial carious lesion always perform a restoration technique based on a defect specific cavity preparation (no significant differences were found by type of participant p=0.308).

DISCUSSION.

This study reports different perspectives of dental tea-chers, dental students from four dental faculties and dental practitioners of public oral health services, about the diagnosis and treatment criteria regarding dental caries management, according to personal, academic and professional experiences, probably the existence of many schools of thought that imply different approaches.

It should be considered that the current trend is towards a non-restorative treatment approach that promotes remineralization instead of restorative strategies.[23] For dental practitioners, to the factors considered above, their treatment decisions could be limited for the health system, while teaching dentists (DTs) usually base their treatment decisions according to books and articles derived from research and, consequently, it is the way they transmit knowledge to their students. In case of dentists, who reported an extensive professional experience (principally in public dental health services), it is clear that there are established treatment protocols, even in case of initial carious lesions. Likewise, it has been reported that preventive treatments are applied in the maintenance appo-intments of asymptomatic patients instead of administering to those who have a high caries risk.[24]

In other words, there is a technological over-response to oral health problems.[11] In Latin American dental schools, Abreu-Placeres *et al.*,[15] evaluated the cariology courses. They found that 5.8% of participants performed restorative treatments when observing a white or brown spot lesion on a tooth structure and 42.3% when radiographically the dental caries involved the inner half of the enamel. The authors suggest the poor appropriation of the new concepts in dental caries management implying a change of conservationist paradigm in relation to the management of the carious lesion in these schools.[15]

Tubert-Jeannin **et al.,**[21] were surveyed 180 dental teachers about knowledge and beliefs related to certain aspects of diagnosis and treatment strategies for dental caries management. The authors found that 20.7% of participants would restore an occlusal lesion limited to enamel. 8.0% chose a preparation including all the occlusal pits and fissures and the majority (92%) using dental composite materials (including resin modified glass ionomer cements) for restoring the occlusal surface. Our results show that it is important to emphasize the fact that our dental practitioners' survey answers proceed only in case of moderate or extensive carious lesions, not on the initial stages and they would have prepared a cavity for a lesion in the Dentin-Enamel Junction (DEJ) and would have waited until the tooth had the carious lesion.

However, it is clear that in the Colombian health system, users have little access to oral health services allowing the rapid progression of early lesions if prompt preventive treatment is performed and aggravation of those injuries already established.[19] Lubisich *et al.*,[25] in a study conducted with 1943 eligible patients randomly assessed for the location of and treatment provided for caries lesions diagnosed within the past 12 months. They found that molars were more likely to be restored with amalgam than other types of teeth. Similarly, lesions included the occlusal surface were more likely to be restored with amalgam (0.42 times), in comparison to restorations that did not include the occlusal surfaces and this probability increased, when the lesions involve mesial o distal surfaces, when the lesion included buccal surfaces, the probability to use amalgam is reduced.[25]

In our study, the findings were similar, in terms of the use by almost all dental practitioners of a conventional Class II preparation. Nevertheless, it differs in the materials used because dental amalgam

restoration is preferred for extensive carious lesions and dental composite for initial carious lesions.

About the occlusal carious lesion that requires im-mediate treatment, it is remarkable there is a percentage of dental practitioners that would restore Grade 1 and 2 carious lesions. In a very low percentage, the dental practitioners who participated in the survey would do a cavity preparation covering all the pits and fissures. This fact represents the use of less invasive dentistry.

Rindal *et al*.,[26] reported a discrepancy between the treatment and diagnosis for non-cavitated occlusal carious lesions in 49% of cases and only 2% for cavitated occlusal carious lesions. The authors found that the use or not of the amalgam was associated with non-cavitated carious lesions than those reported for the cavitated carious lesions on the occlusal surfaces (p= 0.0007). Fellows *et al*.,[27] stated that patients of dentists who assess caries risk were less likely to have enamel restorations enrolled for occlusal lesions. Batista da Silva *et al*.,[28] con-cluded that a significant proportion of dental students in the last year of dentistry would use an immediate minimal invasive dental treatment.

A study carried out about dentists in California,[29] evaluated the management strategies for approximal and occlusal carious lesions. The authors emphasized the variability regarding the decisions for restorative treatment and diagnosis and most of them restored teeth earlier than the literature recommendations.

Barzotto *et al*.,[30] evaluated the decision making for the diagnosis and treatment for tooth enamel initial carious lesions by teachers and students of the cariology course, and reported that dental students and dental faculty considered having difficulty in the differential diagnosis in clinical practice. However, the majority of dental students and dental faculty were correct in the diagnosis of caries.

Considering the opinions of dentists about of ap-proximal carious lesions, it is evident that there is not a clear understanding of the carious process.[21] In this case, enamel lesions were restored but they could be treated with more conservative treatment.[26] In addition, the use of radiographs is more evident in case of approximal caries diagnosis in comparison to the occlusal caries.[31]

It seems to notice that the questionnaire used for our study did not ask for caries risk stratification in relation to treatment decisions and it is clear that the balance was tilt to perform operative dentistry restorations depending on the dental caries risk management. A study conducted in Croatia showed a high percentage of restorative treatment in lesions that were confined to the enamel and its development could still be stopped.[9]

Analyzed scientific literature confirms the importance improving remineralization no cavitated lesions and to offer measures no invasive/minimally invasive.[18] The dental curricula at the universities should establish a critical surveillance of the teaching methods for diagnosis and treatment of dental caries management based on clinical evidence.[18] It seems of relevance, to analyze the sensitivity and specificity of conventional and specialized methods for diagnosis of dental carious lesions in order to improve the performance of dental students, faculty and professionals.[32] Further qualitative research, could help to understand the perspectives, opinions and difficulties perceived for dental practitioners regarding diagnosis and treatment for dental carious lesions in the context of public and private dental health services. Many researchers have conducted several studies about diagnosis and restorative treatment regar-ding dental caries.[6-13,25,26,29,30] The questionnaire developed by Espelid *et al*.,[7] and the modification of the questionnaire by Tubert-Jeannin *et al*.,[21] allow international comparisons.

For the study purposes, we formatted the survey validated in Spanish in Chile,[22] and this situation could be a strength for this study. In addition, the survey was tested by means of a pilot study and this allowed the accuracy of the questions for the dental practitioners. However, in the interpretation of findings, the methodology limitations should be considered. Even though the study focused on several dental practitioners' groups, and the sample is enough for obtaining a first approach according

ISSN Print 0719-2460 - **ISSN Online** 0719-2479.

to the research purposes, the non-random sampling selection makes generalizing conclusions difficult.

CONCLUSION.

Findings of this study highlighted that there are decisions regarding diagnosis and dental treatment that dentists, dental teachers, and dental students carried out depending on various factors such as the type of dental care, dentist status, patient preferences, and patient-dentist relationship and incertitude diagnostic influence significantly in dental caries management.

This study characterized the criteria for diagnosis and treatment decision-making in relation to dental caries in different actors. More than 50% considered that dental carious lesions should be intervened in moderate stages (Grade 3) and more than 85% answered that dental carious lesions should be treated in extensive stages (Grade 4 and Grade 5) and all dental practitioners approve of a conventional Class II preparation.

It is recommended to establish strategies to improve the diagnostic criteria and increase the ability to discriminate the depth of caries and avoid unnecessary invasive treatments. These results also suggest that from the academy the changes towards a more conservative and less restorative dentistry should be produced by updating dentistry concepts and educational activities for dental professionals.

Conflict of interests: The authors have no actual or potential conflicts of interest.
Ethics approval: Not applicable.
Funding: The study protocol was approved by the Ethical Committee of the E.S.E METROSALUD (the public health network services in the city of Medellín) by Act 02-2014.
Authors' contributions: Conceptualization: AAAS, CMMD, MVDG; Data curation: CMMD, MVDG, FMC, LVLT, MGC, MAML, APRR; Formal Analysis: AAAS; Funding acquisition: AAAS, CMMD, MVDG; Methodology: AAAS, CMMD, MVDG; Writing – original draft: AAAS, CMMD, MVDG; Writing – review & editing: AAAS, CMMD, MVDG, FMC, LVLT, MGC, MAML, APRR.
Acknowledgements: None.

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