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ORIGINAL ARTICLE

DENTAL ANXIETY LEVEL IN DENTAL STUDENTS AND STUDENTS FROM OTHER FACULTIES

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Abstract: Currently, dental anxiety affects up to 50% of the population and represents the emotional and physical response to an anticipated experience, which the individual perceives as threatening. Background: The objective of this study was to compare the level of dental anxiety in a group of students of Dental Medicine compared with a group of students from other faculties. Methods: The study was carried out over a period of 6 months, on 148 participants, who were divided into two study groups and assumed the completion of a questionnaire related to the state of anxiety they have in the dental office as a patient. Results: Of the students with a high level of anxiety, 68.75% are women and only 31.25% are men. The high level of anxiety is present only in 3.57% of the students of the faculty of dental medicine, these being female. For students of other faculties, the situation is significantly different: 15.21% have a high level of anxiety, 56.25% of them are women, and 31.25% are men. Conclusions: Anxiety towards dentistry considerably influences the dental treatment plan of patients with a high level of anxiety. Through the adequate management of anxious patients, the dentist manages to control their stress, thus obtaining the prerequisites for the success of the dental treatment.

Keywords: dental anxiety, dental medicine, fear, phobia.

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1. Introduction

Anxiety towards the dentist is frequently found in people who have had unpleasant dental experiences in the past. The dentist who comes into contact with the anxious patient has a difficult task, because in addition to the stress that dental treatment generally bring on patients, there is also the stress generated by the patient's fear, which makes him remember the unpleasant events in the office or to imagine that the pain he will have to endure for a certain treatment is very high [1-3].

Visits to the dental office have always been recognized as an unpleasant, if not painful, moment. Nowadays, this idea remains imprinted in the minds of some of the patients, despite the major efforts made by doctors to create an atmosphere of relaxation and trust [1,4]. The objective of the treatment of the "patient's fear" is for him to experience the feeling of success of the dental treatment, so the dentist must create a treatment plan in stages, starting with less traumatic and less painful therapies, to win patient trust [1,2,5].

Dental anxiety affects up to 50% of the population and represents the emotional and response physical to an anticipated experience, which the individual perceives as threatening. Identifying the specific traits of patients with anxiety problems could allow the introduction of specific stress control measures and the implementation of strategies to break the vicious circle of fear of dental interventions [3,6]. Trakyali G. et al. define anxiety as a set of behavioral manifestations that can be divided into states of anxiety and anxious character [7]. The state of anxiety is a transitory emotional state that varies in intensity and fluctuates over time, while the anxious character is a characteristic of the personality that remains the same over time. It involves a tendency towards fear and manifestations of anxiety even in the absence of external factors [2].

A lot of research has been done on how parents influence the development of anxiety in children, and they have identified numerous factors that can have an impact as a basic factor on the child's anxiety: modeling, encouragement, overprotection, interference or control, tolerance, support, promotion of avoidance. rejection, interpretation of parents, validation of emotions, expression of emotions. attachment, family conflict and parental psychopathology [6,8,9]. Some authors believe that the onset of this type of anxiety would have its origin in childhood, the peak period reaching the first part of the maturation period and then decreasing with age [8,10].

Enrico Facco et al. considered that dental fear is a universal phenomenon, since everywhere in the world about 25% of patients avoid visits and treatments, and about 10% reach the level of phobia [11]. Multiple causes have been discovered such as conditioned fear generated by a previous unpleasant experience, lack of trust in the dentist and intraoperative somatic reactions that can change depending on the dental experience [3,12]. Quentish Taani said that the main cause of anxiety in patients is the fear of facing pain. The sensation of pain is very complex, having biological, psychological and social dimensions [13]. Prabhakar A. et al. [14] have shown that anxiety lowers the pain threshold. The explanation lies in the fact that the patient who is stressed several days before he has an appointment with the dentist has a high level of anxiety and, respectively, a high level of plasma catecholamines that reduce the pain threshold [14]. Thus, the anxious patient perceives pain at the dentist much more acutely than the less anxious patient [14,15].

Anxiety plays an important role in how the patient remembers the pain caused by the dental treatment. Negative emotions act more strongly than pain intensity in memorizing a painful experience. Usually, the dentist's perception of pain is correct at the time and two weeks after, whereas after 6 months, an anxious patient tends to exaggerate the intensity of previously perceived pain [5].

Santhosh Kumar et al. consider that dental anxiety differs significantly with age and with the frequency of dental consultations [16]. Dental fear in children was determined in 3-21% of cases, more in girls than in boys [17]. The studies show that fear reaches its maximum at the age of 9-11 years, then gradually decreases. Exaggerated feelings of fear are rare in childhood and generally disappear by themselves; if they persist, they turn into phobias or clinical fear, situations that require appropriate treatment [6,17]. Following the studies done by Santhosh Kumar et al. it turns out that most females and older people show higher anxiety than males and their younger counterparts [16]. Stepwise linear regression analysis revealed that the best predictors of anxiety are, in descending order: occupation, sex and education [18].

A wide range of questionnaires are used to describe dental fear, the most used being the Corah Dental Anxiety Scale (DAS) and the Dental Fear Scale (DFS) [19,20].

The main objective of this study was to compare the level of anxiety towards the dentist that students of Dental Medicine have as patients with that felt by students from other faculties who do not have the same education.

2. Materials and method

The study was carried out over a period of 6 months, on a number of 148 participants, who were divided into two study groups, respectively 56 students of the Faculty of Dental Medicine and 92 students from other faculties. The participants were included in the study groups following written informed consent.

The study involved completing a questionnaire regarding the state of anxiety they have in the dental office as a patient. The questionnaire contained 4 sections with questions, after which information was obtained about personal data, about the general state of health, about dental health and about the level of anxiety felt in the dental environment.

The first section was related to the respondents' personal information and included questions related to name, date of birth, gender, domicile, marital status, professional status and monthly income.

The questions from the "General medical information" section were the following:

- 1. Have you had a serious health problem for which you were operated/hospitalized in the last 5 years?
- 2. Do you drink alcohol?
- 3. Do you smoke/have you smoked?
- 4. Are you addicted to drugs?
- 5. Are you allergic or have you had allergic reactions?

The "Dental information" section included questions such as:

- 1. How often do you brush your teeth in a day?
- 2. How often do you go to the dentist?
- 3. How would you rate your dental health in general?
- 4. How important is it to you to receive dental care?
- 5. Why did you go to the dentist last time?
- 6. Which of the following reasons, if any, prevented you from going to the dentist?
 - Fear
 - An unpleasant experience in the past
 - Costs

The last section of the questionnaire contained questions related to the anxiety felt towards the dental environment, to which the respondents were asked to answer in different forms, as follows:

- please circle the number that best indicates the feeling you feel in the dental office for the following statements:

- I think I'm choking on the dental items placed in my mouth.
 1-not at all; 2-a little; 3-how much;
 4-a lot; 5-very much.
- I am afraid when I hear the sound of instruments applied to my teeth.
 1-not at all; 2-a little; 3-how much;
 4-a lot; 5-very much.
- 3. I'm afraid the dentist might hurt me.1-not at all; 2-a little; 3-how much;4-a lot; 5-very much.
- 4. I think about the appointment many days in advance and worry about how it will go.
 1-not at all; 2-a little; 3-how much;
 4-a lot; 5-very much.
- 5. I am afraid of passing out following anesthesia or treatment.
 1-not at all; 2-a little; 3-how much;
 4-a lot; 5-very much.

- please mark with "X" the situation encountered in your case for the following statements:

1. If you should go to the dentist tomorrow: ...I would look forward to it as a pleasant

experience ...I wouldn't care

...I would be a little worried

...I would be afraid it would be unpleasant or painful

...I would have been scared of what the dentist would do to me;

- 2. When you are waiting for your turn in front of the dental office, how do you feel?
- ...relaxed
- ...a little restless
- ...strained
- ...stirred
- ...so scared that I sweat or feel physically ill
- 3. On the chair in the dental office, before using the dental instruments, how do you feel?
- ...relaxed
- ...a little restless
- ...strained
- ...stirred
- ... so scared that I sweat or feel physically ill
- 4. On the chair in the dental office, waiting for the teeth cleaning procedure, how do you feel?
- ...relaxed
- ...a little restless
- ...strained
- ...stirred
- ...so scared that I sweat or feel physically ill
- please assign a number to each of the
- following questions related to your situation:
- (always = 5; very often = 4; often = 3;
- sometimes = 2; very rarely = 1; never = 0)
- 1. How often are your teeth or gums
- sensitive to hot, cold or sweet?...

2. How often do you use medicines to relieve pain from the teeth or oral cavity?...

3. How often do you worry or feel worried about your dental problems?...

4. How often are you nervous because of your dental problems?...

- please circle the appropriate answer, thinking about what you have felt and experienced about how your teeth affect your life.

The teeth or prosthetic works you have have a good (positive), bad (negative) effect or no effect on (A= good effect; B= bad effect; C= no effect):

- 1. comfort. A / B / C
- 2. confidence. A / B / C
- 3. food. A / B / C
- 4. the taste of food. A/B/C
- 5. the duration of life. A / B / C
- 6. chewing and biting. A / B / C
- 7. the images you have in front of others. A / B / C
- 8. mental states. A/B/C
- 9. kissing. A/B/C
- 10. general conditions. A/B/C
- 11. social activities. A/B/C
- 12. success at college. .A / B / C
- 13. smile and laughter. A / B / C
- 14. speech. A / B / C
- 15. breathing. A/B/C
- 16. the foods you choose to eat. A/B/C
- 17. the pleasures of living. A / B / C
- 18. romantic relationships. A / B / C
- 19. social life. A/B/C
- 20. happiness in general. A/B/C

The statistical analysis was carried out with the help of the Google Docs program, the section dedicated to the "Google Forms" forms.

The study was approved by the Ethics Committee of the University of Medicine and Pharmacy in Craiova (Approval Number 55/29.01.2024) and was carried out in accordance with the ethical principles of the Declaration of Helsinki (version 2013).

3. Results

Among the students included in the study, 102 (69%) were female, while 46 (31%) were male. The groups studied were the following: the group of students in Dental Medicine (group A), composed of 56 students, 38 girls and 18 boys, and the group of students from other faculties (group B) composed of 92 students, 64 girls and 28 of boys (Table 1).

Table 1. Distribution of study participants in the two groups.

No.	Group A	Group B	Total	Percentage (%)
Female	38	64	102	69%
Male	18	28	46	31%
Total	56	92	148	100%

According to the place of origin of the participants in the study, 82% come from the

urban environment and 18% come from the rural environment (Table 2).

Table 2. The distribution	of study participants	according to the fa	culty where they study.
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No.	Grou	р A	Grou	ıp B	Total	Percentage (%)	
1.00	Female	Male	Female	Male	1000	Tercentuge (70)	
Urban	35	17	48	22	122	82%	
Rural	3	1	16	6	26	18%	
Total	38	18	64	28	148	100%	

The subjects included in the study have a monthly income that is in most cases below 600 RON per month (Table 3). 53.5% of Dental Medicine students brush twice a day, while 37.5% brush three times a day, especially girls.

Only 8.9% of group A students brush their teeth once a day. In the case of students from other faculties, 63% brush their teeth twice a day, 16.3% three times a day, and 21.7% only once a day (Table 4).

Table 3. Distribution of participants according to monthly income

No	Grou	ір А	Grou	ıр B	Total	Percentage (%)
	Female	Male	Female	Male	Iotai	Tercentuge (70)
Less than 600 RON	27	9	29	13	78	52%
600- 1000 RON	8	7	20	3	38	26%
More than 1000 RON	3	2	15	12	32	22%
Total	38	18	64	28	148	100%

Table 4. Distribution of study participants according to the frequency of tooth brushing.

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No.	Grou	ір А	Grou	up B	Tatal	Damaanta aa9/
	Female	Male	Female	Male	Total	Percentage%
Not at all	0	0	0	2	2	1%
Once a day	2	3	9	11	25	17%
Twice a day	17	13	41	14	85	57%
Three times a day	19	2	14	1	36	25%
Total	38	18	64	28	148	100%

Most of the students in the study (54.72%) visit the dentist "when necessary". Thus, 42.85% of group A students, as well as

61.95% of group B students go to the dentist "when necessary" (Table 5).

Table 5. Distribution of study participants according to the frequency of visits to the dentist.

No. –	Grou	ıp A	Grou	Group B		Doroontago %)
	Female	Male	Female	Male	- Totai	Percentage %)
Never	0	0	1	4	5	3%
When necessary	15	9	39	18	81	56%
Once a year	5	1	15	3	24	16%
Once every 6 months	11	6	6	1	24	16%
More often than 6 months	7	2	3	2	14	9%
Total	38	18	64	28	148	100%

The reasons for visits to the dentist are represented by treatment (57.14%) and cleaning (62.5%) in the case of group A students and only in 8.9% of cases it is about pain. Among group B students, in 32.6% of cases the reason is pain, in 61.9% dental treatment and in 45.65% of cases it is teeth cleaning (Table 6). To the question "I think I'm suffocating with the dental objects placed in my mouth", group A students answered 76.7% - not at all, 16.07% - a little, 3.57% quite a bit and 3.57% have answered a lot, and the group B students 48.9% answered - not at all, 28.26% - a little, 18.47% - somewhat, 4.37% - a lot (Table 7).

Table 6. Distribution of study participants according to the reason for the last visit to the dentist

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No	Grou	ір А	Grou	ıр B	Total	Democrate as (9/)
	Female	Male	Female	Male	- Totai	rercentage (70)
Pain	3	2	22	8	35	24%
Dental treatment	22	10	41	16	89	60%
Teeth cleaning	21	14	29	13	77	52%
Total	38	18	64	28	148	100%

Table 7. Participants' responses to the question "I think I'm choking on the dental objects placed in my mouth."

No	Gro	up A	Grou	p B	Total	
	Female	Male	Female	Male	- 10tai	Percentage (%)
Not at all	27	16	33	12	88	59%
A little	7	2	15	11	35	24%
Somewhat	2	0	13	4	19	13%
A lot	2	0	3	1	6	4%
Total	38	18	64	28	148	100%

Among the surveyed students from the group A, they answered as follows: -55.35% are not afraid "at all", -32.04%,, a little",-7.42%,, "how much" and only -5.34%,, a lot", and of those surveyed from group B,

32.60% are not afraid "at all", 29.16% are afraid,, a little", 20.52% answered that they are afraid,, how much by how much" and much 17.29% (Table 8).

Table 8. The answers of the participants to the question "I am afraid when I hear the sound of instruments applied to my teeth".

No. —	Grou	ір А	Grou	ıp B	Total	Domontogo (9/)
	Female	Male	Female	Male		rercentage (%)
Not at all	17	14	17	13	61	41%
A little	14	4	22	5	45	30%
Somewhat	4	0	15	4	23	16%
A lot	3	0	10	6	19	13%
Total	38	18	64	28	148	100%

55.35% of group A students are not afraid that the doctor could hurt them, compared to 31.32% from group B; 26.7% from group A answered that they are afraid it could hurt them, and 39.96% from group B; only 5.34% answered that they were somewhat afraid compared to 17.28% from Group B; 7.56% from group B and 7.12% from group A fear a lot, and very much 3.56 from group A and 3.24% from group B (Table 9).

No -	Grou	ір А	Grou	ıр B	Total	Demoentage (9/)
10.	Female	Male	Female	Male	Total	Percentage (%)
Not at all	19	13	16	13	61	42%
A little	11	4	29	8	52	35%
Somewhat	3	0	11	5	19	13%
A lot	4	0	6	1	11	7%
Very much	1	1	2	1	5	3%
Total	38	18	64	28	148	100%

Table 9. Participants' answers to the question "I'm afraid that the dentist might hurt me".

Group A students 60.52% do not think at all about programming before this, 24.92% think a little, 8.9% somewhat, 3.56% think a lot compared to those from group B where 50 .76% do not think at all, 25.92% think a little, 23.4% think a little and only 6.48% think a lot, and 2.16% think a lot (Table 10).

Table 10. Participants' responses to the question "I think about the appointment many days in advance and worry about how it will go".

No. —	Grou	ір А	Grou	ıр B	- T-4-1	D
	Female	Male	Female	Male	lotal	Percentage (%)
Not at all	23	11	27	20	81	55%
A little	8	6	20	4	38	26%
Somewhat	5	1	11	2	19	13%
A lot	2	0	4	2	8	5%
Very much	0	0	2	0	2	1%
Total	38	18	64	28	148	100%

Regarding the fear of fainting in the dental office, 65.86% from group A answered not at all, as well as 62.64% from group B; from group A 14.24% fear less than those from group B -17.28%; an almost equal percentage between group A 10.64% and

In addition, the study participants were invited to answer the Corah questionnaire. The answers were marked with 1 and 5 in order from a to e, the possible total being 20 those from group B-10.8% who are very afraid; those from group B 7.56% are more afraid compared to 7.12% from group A and "very much" those from group A are afraid 1.78% and 1.08% from group B (Table 11).

(only answers e). Anxious individuals have the index measured by the Corah scale around 13 or more.

No. —	Grou	ıр A	Gro	up B	Total	Percentage
	Female	Male	Female	Male		(%)
Not at all	26	11	41	17	95	64%
A little	4	4	13	3	24	16%
Somewhat	3	3	3	7	16	11%
A lot	4	0	6	1	11	8%
Very much	1	0	1	0	2	1%
Total	38	18	64	28	148	100%

Table 11. The participants' answers to the question "I am afraid of passing out as a result of anesthesia or treatment".

The Corah Questionnaire

Circle the answers as you think:

1. If you had to go to the dentist tomorrow, how would you feel about it?

a. I would consider this a pleasant experience;

- b. I wouldn't feel at all;
- c. I would be a little affected;
- d. I would be afraid of pain;

e. I would be very afraid of what the dentist might do to me.

- 2. How do you feel when you are sitting in the waiting room at the dentist and waiting for your turn?
- a. relaxed;
- b. a little uncomfortable;
- c. tense;
- d. anxious;
- e. so anxious that I'm sweating and sick.
- 3. When you are in the dental chair and the dentist prepares his bur, how do you feel?

- a. relaxed;
- b. a little uncomfortable;
- c. tense;
- d. anxious;
- e. so anxious that I'm sweating and sick.
- 4. You are in the dental chair and have come to clean your teeth. How do you feel when you wait for the dentist to prepare the tools with which he will clean your teeth?
- a. relaxed;
- b. a little uncomfortable;
- c. tense;
- d. anxious;
- e. so anxious that I'm sweating and sick.

Using the Corah questionnaire on the two groups of students showed that 89.18% of all students participating in the study have a low level of anxiety, while only 10.8% have a high level of anxiety. Of these, 10.8% half have a phobia towards dental treatment (Table 12).

Anxiety level -	Group A		Group B		Tatal		
	Female	Male	Female	Male	- Iotai	Percentage (%)	
5	13	12	10	6	41	28%	
6	3	2	5	2	12	8%	
7	0	0	6	2	8	5%	
8	8	3	9	3	23	16%	
9	6	1	14	3	24	16%	
10	5	0	10	3	18	12%	
11	1	0	1	2	4	3%	
12	0	0	0	2	2	1%	
13	1	0	5	2	8	5%	
14	0	0	3	1	4	3%	
15	0	0	0	1	1	1%	
16	0	0	1	1	2	1%	
17	1	0	0	0	1	1%	
18	0	0	0	0	0	0%	
19	0	0	0	0	0	0%	
20	0	0	0	0	0	0%	
Total	38	18	64	28	148	100%	

Table 12. Distribution of participants in the study groups according to the level of anxiety measured with the Corah scale.

Of the patients with a high level of anxiety, 68.75% are women and only 31.25% are men. The high level of anxiety is present only in 3.57% of group A students, these

being female. For group B students, the situation is significantly different: 15.21% of all group B students have a high level of anxiety, 56.25% of them being women, and 31.25% being men (Table 13).

 Table 13. Distribution of study participants according to the level of anxiety measured with the Corah scale.

Anxiety level	Group A		Group B			Percentage
	Female	Male	Female	Male	Total	(%)
5-12 Normal	36	18	55	23	132	90%
13-15 Anxiety	1	0	5	2	8	5%
16-20 Phobia	1	0	4	3	8	5%
Total	38	18	64	28	148	100%

4. Discussions

Among the students included in the study, 102 (69%) were female, while 46 (31%) were male. Most of the participants in the study (82%) come from the urban environment and

only 18% come from the rural environment. The subjects included in the study present a monthly income that is in most cases (52.7%) below 600 RON per month. For students in group A, the income is below 600 RON for 64.28%, between 600 and 1000 RON for 26.78% and over 1000 RON in 8.9% of cases. For students in group B, the average monthly income is below 600 RON for 45.65%, between 600 and 1000 RON for 25% and over 1000 RON in 29.35% of cases.

53.57% of students at the Faculty of Dental Medicine brush twice a day, while 37.5% brush three times a day, especially girls. Only 8.9% of students in group A brush their teeth once a day. In the case of students from other faculties, 63% brush their teeth twice a day, 16.3% three times a day, and 21.7% only once a day. Most of the students in the study (54.72%) visit the dentist "when necessary". Thus, 42.85% of students from group A, as well as 61.95% of students from group B, go to the dentist "when necessary". Students go for checkups once a year or once every 6 months in 16.21% of cases. Only 9.45% of all students visit the doctor more frequently than 6 months. More conscientious are the female students from group A who, in the proportion of 60.5%, go to the dentist at least once a year, while the female students from group B go to the dentist at least once a year in proportion of 37.5%. For male students from group A, we never encountered the situation of never going to the dentist, while for male students from group B, this occurs in 5.43% of cases. The reasons for visits to the dentist are represented by treatment (57.14%) and cleaning (62.5%) in the case of students from group A and only in 8.9% of cases it is about pain. In students from group B, in 32.6% of cases the reason is pain, in 61.9% dental

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treatment and in 45.65% of cases it is teeth cleaning.

The importance of behavioral sciences and psychology is increasing both in the field of dental education and in clinical practice. A high percentage of patients are so afraid of dental care that they postpone or avoid going to appointments. Apart from avoidance behavior, dental anxiety has a wide and dynamic impact on a person's life. Therefore, careful assessment of anxiety and treatment is an essential step for appropriate patient management and overall quality of care [1,15].

The assessment of dental anxiety can be carried out with a wide range of approaches, including several psychological tests able to explore general aspects related to anxiety and / or dental anxiety [19,20]. A comprehensive review of the main tests for anxiety and pain assessment in dentistry was published by Newton and Buck [21]. Of the 15 tests mentioned by Newton and Buck, the results of the Corah Dental Anxiety Scale (CDAS) are the most widely used. The CDAS outlines 4 situations, each including 5 responses about high anxiety; the sum of the answers varies between 4 and 20 and scores higher than 12 indicate anxious patients and scores higher than 15 indicate a phobia level [21]. The diffusion of CDAS in clinical practice depends on the fact that it is validated, reproducible, focused on dental fear simply and quickly. This questionnaire has been used for both adults and children. demonstrating high internal consistency and test-retest reliability and is available in 4

European languages (German, Norwegian, Dutch and Hungarian) [22,23].

The use of the Corah questionnaire on the two groups of students in the study showed that 89.18% of all students participating in the study have a low level of anxiety, while only 10.8% have a high level of anxiety, half of them presenting even phobia of dentistry. Of the patients with a high level of anxiety, 68.75% are women and only 31.25% are men. The high level of anxiety is present only in 3.57% of the students in group A, these being female. For students from group B, the situation is significantly different: 15.21% of all students from group B have a high level of anxiety, 56.25% of them being women, and 31.25% being men. Dental fear is a universal phenomenon, since everywhere in the world about 25% of patients avoid visits and treatments, and about 10% reach the level of phobia. Multiple endogenous and exogenous causes have been cited: the latter includes conditioned fear, lack of trust in the dentist, and intraoperative somatic reactions that may change with dental experience [24].

The problem is of critical importance for several reasons: (a) avoidance causes a deterioration of oral health and quality of life; (b) high levels of anxiety or phobia can affect the dentist/patient relationship, prevent adequate dental treatment and be a cause of

The educational level of the patient does not seem to influence the presence of a high level of stress, despite previous descriptions stating that the degree of anxiety is negatively correlated with the educational achievements intraoperative complications; and (c) the stress response caused by anxiety can generate a harmful reaction, such as vasovagal syncope, hypertension, tachycardia, and cardiovascular events. The latter is extremely important in high-risk patients (i.e. ASA class II and higher) where the diagnosis and treatment of dental anxiety becomes essential for patient safety [12,17].

In this study, several aspects of anxiety (e.g. fear as a general reaction in life, dental fear and anxiety as a personal characteristic) as well as the level of oral hygiene were assessed in student patients to verify how dental care affects the state and dental anxiety. Students in group B presented a higher level of anxiety than students in group A (generated by dental care), girls being significantly more anxious than boys, while a better knowledge of dental hygiene was not sufficient to decrease the level of anxiety, suggesting the need for specific preventive care for anxious patients. According to Popescu et al., dental health education and behavioral factors like sweet consumption and chewing gum use are correlated with level of dental anxiety [24].

The study by Vazquez et al. argues that women are more anxious than men because female patients achieve higher levels of stress than their male counterparts [4].

of the subject [4,25]. The high rate of anxiety that women experience when it comes to surgery should be taken into account by professionals during clinical treatment, as women seem to be more likely to ignore their oral health due to anxiety about dental procedures [4].

5. Conclusions

Dental anxiety is frequently encountered in patients who have had unpleasant dental experiences in the past (failed dental treatments, treatment complications, pain experienced during dental treatment). In the present study, 10.8% of the subjects show a high level of anxiety, and half of them even have a phobia towards the dentist. Also, almost half of the participants in the study (regardless of the faculty) avoid visits to the dentist, going only "when necessary". Regardless of the level of training and education received, anxiety plays a very important role in maintaining oral health.

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Females are more anxious than males, obtaining higher levels of stress than males. Although students from other faculties presented a higher level of anxiety than those from the Faculty of Dental Medicine (who benefit from professional knowledge about oral health care), still a better knowledge of dental hygiene was not sufficient to reduce the level of anxiety, which emphasizes the importance of specific preventive care for anxious patients.

Anxiety towards dentistry considerably influences the dental treatment plan of patients with a high level of anxiety. Through the adequate management of anxious patients, the dentist manages to control their stress, thus obtaining the prerequisites for the success of the treatment.

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Will be provided on request.

Ethics statement

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ORIGINAL ARTICLE

IMPLANT-PROSTHETIC REHABILITATION OF PARTIALLY EDENTULOUS PATIENTS WITH SURGICAL GUIDES

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Abstract: Nowadays, the main goal of the oral rehabilitation treatment plan is not only to insert an implant into the bone, but to insert and integrate it so that the surrounding hard tissues and soft tissues are adequate. In this way, the long-term success of the treatment plan will be achieved. Background: The main purpose of the study was to present the advantages and disadvantages of using the dental implant insertion technique through the surgical guide as well as to evaluate the degree of its use among implantologists. Material and Methods: The study involved 120 patients who presented in the dental clinic requesting complex oral rehabilitation with restorations supported by implants. Following the anamnesis, intraoral clinical examination, laboratory and radiological evaluation, the type of edentulism was diagnosed, for which classical and alternative treatment plans were proposed. Results: From the group of edentulous patients, 40 patients chose the implantprosthetic rehabilitation. Among them, 29 patients chose the guided method of implant insertion. Conclusions: Guided placement implant restorations are a viable solution for a painless and successful protocol in implant oral rehabilitation.

Keywords: partially edentulous patients, surgical guides, free-hand technique, dental implant restorations.

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1. Introduction

Clinical implantology has evolved significantly in recent years, starting from the improvement of implant design and surface topography to the development of protocols. surgical Thus, nowadays. implant-prosthetic treatment is a common practice in the field of dentistry, which has evolved from a state of optimism regarding the success of implant therapy, to a more rigorous expectation of long-term success, based on continuous experience development of the field, but also on the research evidence provided bv the specialized literature [1].

The field of modern oral implantology, and especially implant prosthetics, depends on establishing a correct diagnosis of certainty, as well as precise and comprehensive planning to ensure the longterm success of the treatment plan and the desired outcome. Also, the treatment plan must meet both the patient's and the dentist's expectations, which are often high [2].

The success of implant-prosthetic therapy is based on careful planning, as well as meticulous execution and careful followup by the medical team (surgeon, prosthodontist and auxiliary staff), along with the cooperation of the patient. Today, the goal of the treatment plan is not just to insert an implant into the bone, but to insert and integrate it so that the surrounding hard tissues and soft tissues are adequate. In this way, the long-term success of the treatment plan will be achieved, both functionally and aesthetically [2].

Currently, a dilemma faced by every surgeon is the choice to place the implants with the help of a surgical guide or by the hand" technique. "free Using good technique, surgical guides can be a predictable and confidence-building method for implant placement. The digital planning of the implant-prosthetic treatment provides a varied range of interesting perspectives regarding the establishment of the diagnosis, the individualized planning of the treatment plan and the exact surgical-prosthetic implementation [3].

The concept of microinvasiveness has gained ground, flapless surgery can be performed in association with guided placement of implants [1]. Surgical guides represent the latest advances in dental implant technology. Creating a surgical guide involves performing a sequence of well-established steps. It exactly reproduces the surfaces in the patient's oral cavity and helps the surgeon to insert the implants into the bone with much improved precision. When used appropriately, surgical guides can increase the predictability of implant treatment results. To make the surgical guide, it is necessary to use a CBCT (Cone Beam Computed Tomography) analysis, a digital scanner for dental impressions, as well as a three-dimensional planning system for implants insertion. In this context, digital implant planning and guided implant surgery is based on three-dimensional radiographic data and digitized intraoral surfaces. They provide valuable information and allow excellent planning to optimize

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implantological aspects and prosthetic outcome, improving the safety and efficiency of the surgical procedure and making the restorative outcome much more predictable in terms of biological and aesthetic function [4].

Guided surgery allows dentists to develop a restoration-driven surgical plan with the ultimate goal of achieving positive patient-centered results. Several guided options are available, and the dentist must choose the one that leads to the best result for each specific case. The threedimensional visualization of the anatomy of the structures and the improved evaluation of the available bone volume and its quality facilitate a more precise diagnosis, the early identification of possible problems, allowing a high score of the level of predictability in surgical planning. In most cases, threedimensional planning includes the option to virtually anticipate the prosthetic result. The best prosthetic corridor can then be defined, resulting in a more prosthetically precise orientation of the implant position. This planning allows not only to choose an implant suitable for the specific anatomical situation and prosthetic demands, but also to inform prosthetic planning decisions, not least in terms of restorative materials or design details [4].

The use of guided surgery requires a series of steps, each of them necessary to make an accurate treatment plan that will use surgical guides. All these steps together form a "digital workflow". Correct virtual

planning minimizes surgical risks, especially for less experienced surgeons.

Virtual surgery will always lead to a better understanding of patient-specific factors. If during planning, an implant is inserted too close to vital structures or adjacent teeth, or implant insertion is impeded by other vital structures, the software alerts the surgeon to the problem and the implant can be repositioned to eliminate the possible risk. With the mastery of the digital workflow, benefits will be obtained, both from the point of view of a better positioning of the implant next to the prosthetic result, but also a better efficiency in implant placement [5].

Accurate implant positioning is essential to achieve favorable esthetic and prosthetic results. Prosthetically guided implant surgery is recommended as it will ensure adequate prosthesis design, favoring longterm stability of the peri-implant hard and soft tissues. Surgical approaches combined with computer-assisted static implant surgery can overcome the likely deviations in unguided implant placement [6].

Regarding the advantages of the technique, the use of guided implant surgery consists in the insertion of implants using This minimizes flapless surgery. the patient's discomfort, reduces the operative time and ensures the placement of the implants in the best restorative position. Another advantage of flapless surgery is that at the end of the intervention there is no need for sutures, which for patients represents discomfort in the post-operative days. Clearly, the use of guided surgery with appropriate planning improves prosthetic outcomes and reduces surgical complications [3].

The digital planning and insertion of implants is a method used more and more frequently in dental offices because it provides consistently better results, especially in partially edentulous patients. Placing an implant that is "restorable" is no longer an aspiration of the dentist. Properly performed guided surgery, in association with appropriate treatment planning, raises the level of excellence while increasing efficiency and safety [3].

The main objective of the study was to present the advantages and disadvantages of using the dental implant insertion techniques through the surgical guide, as well as to evaluate the degree of its use among implantologists.

2. Material and method

The retrospective study included 120 patients presented in the dental clinic for the complete rehabilitation of the stomatognathic system in the period of October 2022-October 2023. Dental charts were used to collect data obtained from the anamnesis and intraoral clinical examination that conducted to the diagnosis of the type of edentulousness of the patients (lateral, terminal, frontal). Also, treatment options proposed, both classic solutions and alternative solutions, that is, by the freehand method or with guided implantprosthetic therapy were noted. From the group of edentulous patients, a number of 40 patients opted for implant-prosthetic rehabilitation. Among them, 29 patients chose the static guided method of implant insertion.

The dental chart completed for each study participant included a questionnaire on general health status, with: personal data, hereditary and personal antecedents, eating habits, oral hygiene status, as well as diagnosis and treatment plan. All participants signed the agreement for the management of personal data (GDPR) and completed the standard form for inclusion in the medical research study according to law no. 46/2003. For all implant rehabilitation cases, a CBCT and intraoral scans were performed. Both of the aforementioned investigations were processed in the Blue Sky Plan 3D dental software, which was used to create the draft surgical guide. Data were interpreted and processed using SPSS and Microsoft Excel programs.

The clinical study was approved by the Ethics Committee of the University of Medicine and Pharmacy of Craiova, with no 52/29.01.2024. Declaration of Helsinky was respected in the study.

3. Results

In the retrospective study, 120 patients aged between 18 and 68 years were included. From the group of edentulous patients, 40 patients opted for implantprosthetic rehabilitation, and among them, 29 patients chose guided method of implant insertion. 72.5% were male and 27.5% female, the environment of origin being in a larger proportion urban, respectively 80% of the patients come from the urban environment and only 20% of the patients come from the rural environment.

Analyzing the age category of the patients, 4 age ranges were obtained as

> 40% 35% 30% 25% 20% 15% 10% 5% 0% 18-35 years 36-46 years 47-56 years 57-68 years

The patients presented certain systemic conditions. Thus:

• 75% did not present serious systemic conditions

- 15% of patients had hypertension
- 5% had diabetes

• 5% liver diseases (hepatitis, hepatic steatosis)

Among female patients, 2 presented partial anterior edentulism, 5 partial posterior edentulism, and 9 patients presented posterior terminal edentulism. In the case of male patients, we identified 6 with partial anterior edentulism, 7 with partial posterior edentulism and 11 with posterior terminal edentulism (Table 1).

Depending on the type of surgical intervention, it was found that most patients, both female and male, underwent the intervention through the guided surgical method. In addition, guided surgery was used in 29 (73%) patients, of which 14 (49%) patients had partial posterior terminal edentulism, 10 (34%) partial posterior edentulism, and 5 (17%) patients had partial anterior edentulism (Table 2).



follows: 18-35 years (20.2%), 36-46 years (16.5%), 47-56 years (27.5%), 57 -68 years (35.8%) (Figure 1).

Conder	Partial Edentulism type				
Gender	Anterior	Posterior	Terminal	- 10tai	
Female	2	5	9	16	
Male	6	7	11	24	
Total	8	12	20	40	

Table 1. Distribution of patients according to the edentulism type by gender.

Table 2. Distribution of patients according to intervention by gender.

Condor	Interven	Total		
Genuer	Free-hand technique Guided technique			
Female	6	12	18	
Male	7	17	24	
Total	11	29	40	

Considering the edentulism type and the systemic conditions, the patients included in the study can be divided as follows (Table 3):

- patients with partial anterior edentulism did not present systemic conditions,
- among the patients with partial posterior edentulism, 6 did not have systemic diseases, but 2 had diabetes and 5 HTN;
- in the case of posterior terminal edentulism patients, 15 had no systemic diseases, but 3 had HTN and 2 liver diseases.

Edentulism type	Systemic disorders				Total
-	Diabetes	N/A	HTN	Liver diseases	_
Partial Anterior	0	7	0	0	7
Partial Posterior	2	6	5	0	13
Terminal Posterior	0	15	3	2	20
Total	2	28	8	2	40

Table 3. Distribution of patients according to systemic conditions and edentulism type.

One of the cases presented in the dental clinic is that of a 50-year-old male patient without serious systemic diseases. The odontal diagnosis is: multiple simple and complicated odontal lesions, treated and untreated. Prosthetic diagnosis according to Costa: non-prosthetic right lateral mandibular edentation and non-prosthetic

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right lateral maxillary edentation, and according to Kennedy: non-prosthetic Kennedy class III mandibular edentation and non-prosthetic Kennedy class III maxillary edentation.

In the case of the edentulous cleft in quadrant 4, the insertion of an implant (Bredent GmbH & Co.KG, Germany) with the help of the surgical guide made of resin (NextDent SG, Vertex-Dental B.V., The Netherlands) was proposed as a treatment plan. After obtaining informed consent, the patient underwent CBCT analysis to assess the quality of the remaining post-extraction bone structure. To design and make the surgical guide, an intraoral scan was performed, and then the actual surgical stage began. The implant prosthesis was made 3 months postoperatively, with a zirconium crown (Figure 2).



Figure 2. a.b. Edentulous cleft quadrant IV c. Initial CBCT image d. Surgical guide used for insertion of the IV quadrant implant e. Intraoperative aspect f. Intraoperative aspect - gingival former g. Postoperative aspect – suture h. Control CBCT - implant inserted in quadrant IV

4. Discussions

In recent years, numerous scientific papers have been published in specialized literature with the aim of evaluating the of the implant-prosthetic accuracy restoration techniques of edentulous ridges. The data from the specialized literature highlight the fact that the technique of guided surgery can offer a good level of precision, under the conditions of choosing the most suitable surgical protocol and the ability of the practicing surgeon to implement it. This translates into practice, on the one hand, by avoiding serious complications, such as damaging nerves or blood vessels, and on the other hand, by being able to apply these protocols even in more complex cases, such as those with severe bone atrophy.

The use of CBCT-guided implant planning and placement does not obviate the need for the surgical and restorative team to diligently adhere to the basic principles of implant surgery and prosthetic dentistry. The well-established concepts of implant spacing, insertion depth and angles, case engineering, planning and minimally invasive soft and hard tissue manipulation, bone grafting, soft tissue and osseointegration healing time, soft and hard tissue healing, heat generation, dental materials, ideal occlusion and more must be maintained and respected. Guided implant surgery facilitates the placement of dental implants in an ideal position according to a restoration-oriented treatment plan.

Currently, most of the surgical guides used for the insertion of dental implants are based on 3D scanning and 3D printing technology, and their accuracy is closely related to the accuracy of their execution [19]. Guided surgery allows the planning and scanning of edentulous ridges using the planning software, thus improving the threedimensional orientation of the implants, along with the overlay of the bone ridge image, which makes it possible to assess the emergence profile of the implant [20]. Intraoral optical scanning can reduce postoperative preparation steps, therefore the time required to obtain virtual models is much shorter. It includes 3D computer simulation and guide fabrication. Guidance systems can be used to directly import Digital Imaging and Communication in Medicine (DICOM) data into an interactive diagnostic and treatment planning tool. Using these softwares, the implant site can be predicted and the placement can be simulated and visualized from different perspectives. This simulation can visualize the implant in the cortical and trabecular bone in the 3D virtual model based on CT or CBCT imaging. This allows accurate planning based on available data. A surgical guide then transfers this pre-surgical planning to the surgical field [21].

Errors that may occur due to guidance systems may also be influenced by other factors, such as the quality of the image obtained, the experience and knowledge of the system operator. The accumulation of errors may increase if there are additional errors during the production of the guide. While no definitive statement can be made about which system is better, it is certain that the software affects the deflection and can be as important as the implant itself. To evaluate the benefits and results of guided surgery, the costs of these procedures must also be evaluated, as well as the training of clinicians. It is very important that doctors are well trained in new digital procedures, as well as conventional ones, because they can be needed and applied in any unpleasant event during surgical procedures. Mainly, with the help of guided surgery, the operative time is much shorter compared to conventional techniques, but it seems that more time needs to be invested in preoperative planning [22].

A multitude of factors are responsible for determining the effectiveness of guided surgery, from the diagnosis and planning phase to the actual surgical intervention. Each of these aspects must be carefully analyzed in order to benefit from a welldesigned surgical protocol. The level of experience of the surgeon affects the accuracy of implant placement using the tooth-supported surgical guide. Therefore, the use of computer-guided surgery through a partially guided protocol does not fully compensate for the experience level of the operator. However, such a surgical guide can be used in the complete training of novice surgeons, as it can bridge the gap between in vitro simulation training and freely performed surgery [23].

Due to the planning and placement of implants, in accordance with the prosthetic treatment plan, surgery with the help of a surgical guide can bring significant benefits to oral rehabilitation procedures.

In this way, the provisional prosthetic works can be prepared before the clinical phases, thus, immediately after the stages of the implant surgery, the functional loading of the newly inserted implants can be easily achieved. At the same time, it is possible to use a single prosthetic abutment, both for provisional rehabilitation and for definitive rehabilitation, thus time and costs can be improved [22,23].

5. Conclusions

In most clinical situations, oral implants can be inserted without a guidance system, but the accuracy is apparently much better with the help of the surgical guide for a successful outcome. New technologies based on three-dimensional patient for dental implants have assessment significantly transformed dental practice, facilitating more accurate diagnosis, more detailed planning and more predictable treatment.

It is crucial that practitioners acquire a deep understanding of these technologies and invest in continuing education to ensure their correct and effective application for the benefit of patients. It is essential that practitioners are aware of the costs and benefits associated with the use of these technologies in order to make informed decisions. The software used in planning the surgical guide must allow the creation of a virtual prosthetic configuration, the choice of different tooth models or the use of standard tooth shapes. Deficiencies in bone support may limit the applications of this technique. However, guided implantology is used more and more nowadays, but an improvement of the work protocol is

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necessary in cases with a limited amount and quality of bone.

In conclusion, guided implantology can represent a successful solution in the insertion of implants, both in cases with partial edentulism, and in cases with total edentulism.

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Will be provided on request.

Ethics statement

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ORIGINAL ARTICLE

DENTAL IMPLANT INSERTION – HOW TO PLAN AND PREDICT SUCCESS

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Abstract: For decades, implant placement protocols and implant loading protocols were addressed independently from one another. With the healing of the alveolar socket post-extraction, the implant placement protocol and the surgical technique are determining factors for selection of an appropriate implant loading protocol; these should be considered as codependent variables. The objectives of the study were to highlight factors influencing the implant placement and loading protocol. Material and methods. The retrospective study included patients presented for teeth extraction and oral rehabilitation treatment plan that included implant restorations between October 2020 and October 2022. Factors influencing implant placement and loading protocol were analyzed for each case. Representative cases were presented with details. Results. 10 clinical cases were included in the study, in which implanto-prosthetic treatment was performed using different insertion protocols. Three representative cases were presented. Conclusions. Implant insertion protocols are closely related to multiple factors, so the clinician nowadays must carefully decide the time elapsed from tooth extraction to the moment of dental implant insertion. The insertion protocol should be chosen only if the factors influencing that protocol led to the success of the implant-prosthetic treatment.

Keywords: insertion protocol, implant loading, dental implant.

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1. Introduction

Fixed dental prostheses supported by implants have become a well-documented and reliable treatment option. Excellent survival rates of both the multiple-unit prostheses and their supporting implants have been reported notably for conventional metal-ceramic restorations [1].

The ultimate goal of the clinician is to counteract the effect of tooth extraction on bone which begins the slow process of remodeling just after extraction [2].

All the contemporary treatment and fabrication concepts have aimed to minimize treatment durations and patient visits while maintaining optimal clinical and patientrelated outcomes [3]. This quest for greater also resulted efficiency has in a diversification of implant placement and loading protocols. Contemporary options include immediate, early, or placement, as well as immediate, early, or conventional loading [4].

Reviews of the timing of dental implant placement suggest that immediateand delayed-implant placement exhibit similar behavior when the survival rate and tissue remodeling are similar [5]. It has been suggested that tooth extraction procedure (in the least disruptive way possible) has a major effect on clinical outcomes, whereas the dental implant positioning may have just a minimal effect [6].

Numerous reviews have been published to classify these protocols and define their indications [7]. While both immediate / early placement and immediate / early loading can yield excellent results, they are subject to biological limitations and a need for careful patient selection and site assessment. Immediate or early placement requires a fair amount of residual bone for good primary stability of the implant [8].

Cone beam computerized tomography (CBCT) is a very suitable diagnostic instrument for the planning of prosthetic rehabilitation supported by implants; moreover, the comparison of the pre-operative and post-operative scans can be used for the analysis of three-dimensional changes of the peri-implant tissues [9].

For decades, implant placement protocols and implant loading protocols were addressed independently from one another. With the healing of the alveolar socket postextraction, the implant placement protocol and the surgical technique are determining factors for selection of an appropriate implant loading protocol; these should be considered as codependent variables. Moreover, it is important that treatment planning should commence once the indication for tooth extraction has been confirmed, and the implant placement and loading protocol should both be planned prior to the extraction of the tooth [10].

In clinical practice the decision to place an implant following tooth extraction is usually determined by the attainment of specific soft and hard tissue characteristics of the healing socket. These events do not necessarily follow rigid time frames and may vary according to site and patient factors. To avoid time-based descriptions, this classification uses numeric descriptors types 1 to 4—that reflect the hard and soft tissue changes observed: Type 1 - Implant placement immediately following tooth extraction and as part of the same surgical procedure;

Type 2 - Complete soft tissue coverage of the socket (typically 4 to 8 wk);

Type 3 - Substantial clinical and/or radiographic bone fill of the socket (typically 12 to 16 wk);

Type 4 - Healed site (typically more than 16 weeks) [11].

Regarding implant loading, Cochrane reviews are recognized as a gold standard in evidence-based health care. Recently, Esposito and coworkers published an updated version of their systematic review regarding different times for loading dental implants, and based it on the following definitions:

• Immediate loading was defined as implants in function within 1 week after their placement. No distinction was made between occlusal and nonocclusal loading.

• Early loading was defined as putting implants in function between 1 week and 2 months after placement.

• Conventional loading was defined as putting implants in function after 2 months [12].

The placement definitions established by the ITI Treatment Guide Vol.3 [13] and loading definitions establishedby the 4th ITI Consensus Conference [14]:

- Type 1A Immediate placement + immediate restoration/loading
- Type 1B Immediate placement + early loading
- Type 1C Immediate placement + conventional loading

- Type 2A Early placement with soft tissue healing + immediate restoration/loading
- Type 2B Early placement with soft tissue healing + early loading
- Type 2C Early placement with soft tissue healing + conventional loading
- Type 3A Early placement with partial bone healing + immediate restoration/loading
- Type 3B Early placement with partial bone healing + early loading
- Type 3C Early placement with partial bone healing + conventional loading
- Type 4A Late placement + immediate restoration/loading
- Type 4B Late placement + early loading
- Type 4C Late placement + conventional loading [15].

Immediate implant placement has been a popular treatment concept for patients as well as for clinicians since it reduces the number of surgical interventions and the total treatment time. In addition, it was assumed for many years that the immediate insertion of an implant into a fresh extraction socket counteract the three-dimensional could alterations of the alveolar process because of tooth extraction. However, preclinical and clinical studies failed to show this, making it a potentially risky procedure from an aesthetic point of view. After all. considerable post-extraction

bone remodelling may be expected, mainly at the buccal aspect often resulting in a deficient alveolar ridge. Given this, the immediate installation of an implant into a fresh extraction socket may lead to a lack of buccal convexity and even midfacial recession [16].

2. Material and methods

The retrospective study collected data from dental charts in a private practice setting in the period April - June 2021.

Inclusion and exclusion criteria All patients who required extraction of teeth and subsequent implant placement presented in the period of October 2019-October 2020 in the dental clinic were consecutively enrolled according to the following inclusion criteria:

• Dental implants planned for replacement of the teeth.

• Periodontal probing pockets < 4 mm.

• Adjacent natural teeth were periodontally sound with no periodontal attachment loss.

• Adjacent teeth with healthy dental pulps, or if non-vital, had satisfactory endodontic status and were free of symptoms.

Patients were excluded if they smoked cigarettes.

Data obtained from dental charts were analyzed and presented according to a template.

Ethics approval for this study was granted by the University of Medicine and Pharmacy of Craiova (Ethics ID 52/29.01.2024) and was performed in accordance with the principles established in the Declaration of Helsinki.

3. Results

The study included 10 patients who required one or more teeth extraction and subsequent implant placement. All clinical cases in which implanto-prosthetic treatment was performed were included. The cases included anterior and posterior area edentulism. each with different local conditions for the implanto-prosthetic treatment. Different dental implant and prosthetic insertion protocols were used in these cases, offering different treatment modalities depending on the factors and indications specific to each case (Table 1).

Table 1	L. Distribution	of patients	according to	the edentulism	type by gender
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Condor	Partial Edentulism type		Total
Genuer	Anterior	Posterior	
Female	1	3	4
Male	3	3	6
Total	4	6	10

Case 1.

A 37-year-old man, non-smoker, with no history of systemic disease visited the dental clinic unhappy with the aesthetics in the frontal maxillary area. The intraoral and radiological examenination showed the congenital absence of tooth number 1.2 with the persistence of deciduous tooth number 5.2. After CBCT evaluation it was establieshed that there is sufficient height and width of the alveolare ridge and satisfactory bone density (850 Hounsfield units) for placing an implant after the subsequent extraction of the deciduous tooth (Figure 1).

Extraction of tooth 5.2 was easily performed and considering the CBCT findings it was decided that implant placement can be performed immediately after the extraction. was Occlusal loading carried out immediately with the help of a provisional crown made from the extracted tooth (tooth 5.2), without occlusal contact (Figure 2). The immediate insertion protocol in this case was of choice due to the ideal conditions present: non-smoking patient, good oral hygiene, periodontal absence of disease and satisfactory alveolar bone volume.



Figure 1. (A) Intraoral aspect (B) Initial panoramic x-ray (C) CBCT examination (D)3D simulation of implant placement



Figure 2. (A) Postextraction alveolus (B) Inserted implant with the prosthetic abutment (C) Provisional crown made from the extracted tooth 5.2 and the post-insertion radiological image (D) Choosing the color of the definitive crown and the cemented definitive Crown at the level of the implant abutment

Case 2.

A 43-year-old female pacient, nonsmoker, with no history of systemic disease visited the dental clinicpresented with discomfort and pain after a bite on the left maxillary premolar. After clinical and radiological examination it was decided that extraction of tooth 2.4 was necessary (Figure 3). After one week of antibiotic treatment (Amoxicillin 500 mg every 8 hours), the ablation of the fixed prosthetic and then the extraction of tooth 2.4 was performed. The radiological examination showed the amount of remaining bone and enabled the planning of the positioning of the implants. The complete disappearance of the vestibular bone plate in the area of tooth 2.4 can be observed, this defect was remedied by the process of guided bone regeneration with the help of gelatinous A-PRF membranes (Figure 4.). After 2 months, in which healing of the local soft tissues took place, a surgical flap was performed and two "Bluesky Bio I Internal Hex" dental implants (Bredent TM, Germany) were inserted (Figure 5.). After a healing period of 4 months a gingival conformer will be fixed and the rest of the prosthetic stages will continue.

The type 2C insertion protocol was chosen in this case because the presence of

local infectious processes requires a healing period, a period in which the cellular immunological response helps to achieve local healing.



Figure 3. Initial intraoral and panoramic x-ray aspect.



Figure 4. CBCT implant placement planning



Figure 5. Implant placement

Clinical case number 2 had an insertion according to protocol type 2C (early insertion with gingival healing). The insertion protocol chosen in this case was given by the presence of infectious processes in the area of implant insertion. Although the patient wanted an esthetic rehabilitation as

Case 3.

A 52-year-old female pacient, nonsmoker, with no history of systemic disease visited the dental clinic presented with mobility of the right maxillary lateral incisor. During the clinical examination, a loosening of the corono-radicular device was observed. Upon CBCT examination a vertical fracture of the root of the lateral incisor was observed (Figure 6.). Thus, it was decided to perform soon as possible, clinical signs of local infection prevented this. However, within the type 2 insertion protocol, the treatment time is much shorter compared to conventional implant placement protocol. This approach offers high aesthetic results and a low risk of recession of the gingival mucosa.

the extraction of tooth 1.2. Considering the fact that the patient din does not smoke, had good oral hygiene, no periodontal disease, no signs of local infection were present and the CBCT analysis showed good volume of alveolare bone the decisins to perform an immediate insertion of a dental implant with immediate occlusal loading was taken (Figure 7).





Figure 6. Initial intraoral and CBCT aspect.



Figure 7. Implant insertion and immediate loading of the implant.

Clinical case no. 3 presents an immediate insertion protocol, type 1A, with immediate occlusal loading. This case is similar to clinical case no. 1, but case no. 3 presents a thin vestibular cortex and tooth 1.2 is present with a vertical fracture. The lack of infection

4. Discussions

Immediate implant placement has become widely accepted despite the controversial beginning. The primary advantages of immediate implant placement

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adjacent to tooth 1.2, the sufficient bone substrate, the gingival phenotype of adequate thickness, together with the patient's desire to restore the aesthetic function as quickly as possible were key factors in choosing the immediate insertion.

are a reduction in time and surgical episodes and preservation of the bone and gingival tissues [17]. One of the factors involved in the success of osseous integration and the long-term success of implants is the implant primary stability; it is defined as the biometric stability of the implant immediately after its placement within the bone. Primary stability is related to the mechanical engagement of the implant with the surrounding bone after implant insertion. Secondary stability depends on bone formation and remodeling at the implantbone interface, and is influenced by the implant surface and wound-healing time [18].

The placement of implants in extraction sockets can be difficult. In addition, it can be difficult to secure primary stability and complete debridement of infected tissue [19].

There is a constant debate about the placement of implants using an immediate protocol versus the traditional or delayed placement protocol. A study by Assery et al showed a survival rate of 97.2% obtained after a 22- year follow-up indicates an excellent prognosis for an immediate implant placed in fresh sockets without bone augmentation procedures [20].

Other studies agree with these findings and have shown no statistically significant differences in the implant outcomes (risk of implant failure) between the early implant placement protocol and the immediate or the delayed implant placement protocols. However, it was found that the early implant placement protocol results in less marginal peri-implant bone loss compared with the immediate placement protocol. No other significant differences were found between the protocols. Significantly lower marginal peri-implant bone loss was found for

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implants placed according to the early placement protocol compared with those placed immediately into fresh extraction sockets. The greater marginal peri-implant bone loss in the immediate placement group may be attributed to the horizontal and vertical resorption of the extraction socket walls that begin immediately after tooth extraction. Implant placement protocols were also compared based on the peri-implant probing depth and peri-implant soft tissue level. No significant differences were found between the early and immediate placement protocols for these two variables, indicating that peri-implant health and soft tissue stability can be achieved using both implant placement protocols [21].

The study we carried out on the previously presented clinical cases shows the multitude of factors that must be taken into account when deciding the moment of implant insertion. Local anatomical conditions, factors related to the patient as well as the final three-dimensional position of the implant are key elements in the insertion of a dental implant in the dentomaxillary apparatus. Although the presented cases included only implant insertion according to type 1 and 2 insertion protocol, they show us a change in the direction of therapeutic conduct, thus, the cases where the patient has to wait as long as possible for the implant insertion are increasingly exceptional. Currently, great emphasis is placed on an oral rehabilitation as fast and as efficient as possible, so the vast majority of

patients want the aesthetic results of the implant-prosthetic treatment in the shortest possible time. In 2 of the 3 cases presented in this report, the implants were immediately placed according to type I protocol.

Evaluations of the clinical performance of dental implants should include the function and appearance of the surrounding soft tissues or bone, as these are essential parameters for evaluating treatment outcomes and characterizing implant success.

The decision of implant insertion and the moment of its prosthetic loading has to take into consideration a series of factors that influence the subsequent evolution of the implanto-prosthetic restoration:

- Factors related to the patient: the patient's desire to restore the aesthetic function as quickly as possible, the absence of personal pathological history, poor dental hygiene, , the absence of tobacco smoking
- The periodontal factor
- No clinical sign of local infection

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- Quantity and quality of alveolar bone
- The vestibular cortex of the alveolar process
- Inocclusion of the provisional crown
- Absence of post-insertion pain
- Primary stability
- Surgical and prosthetic techniques and implant design
- Final three-dimensional position of the implant

5. Conclusions

In conclusion, implant insertion protocols are closely related to multiple factors, so the clinician nowadays must carefully decide the time elapsed from tooth extraction to the moment of dental implant insertion. The insertion protocol should be chosen only if the factors influencing that protocol lead to the success of the implant-prosthetic treatment.

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ORIGINAL ARTICLE DIGITAL IMPRESSION VERSUS CONVENTIONAL IMPRESSION FROM THE POINT OF VIEW OF DENTIST PREFERENCES

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Abstract: Nowadays digital impression represents a new breakthrough for dental offices, since more and more dentists use dental scanners. From the point of view of the dentist's preferences, there are not many studies regarding the use of the digital impression in comparison with the conventional impression. (1) Background: The aim of this study was to make a comparison between the digital impression and the classic impression and highlight the advantages and disadvantages of using the two methods, both in terms of the patient and the dentist; (2) Methods: To fulfill the objectives of this study, the Google Forms Platform was used to distribute a questionnaire regarding digital impression and classic impression. The questionnaire included 14 questions with the possibility of choosing only one answer and was addressed to dentists. (3) Results: 42 responses were recorded to the 14 questions contained in the questionnaire; (4) Conclusions: Intraoral scanning dental impression compared to traditional impression has less effect on patient gag effect, breathing difficulties, stress and anxiety, and results in better patient perception and comfort.

Keywords: digital impression, analog impression, dentist preferences.

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1. Introduction

CAD-CAM systems consist of 3 components: a digitizing tool-scanner that transforms the geometry into digital data that can be processed by the computer, a software that processes the digital data and, depending on the application, produces a data set to be manufactured the desired product and a product technology that transforms the data set into that product [1,2].

Intraoral scanners are devices for obtaining an optical impression of dental arches able to replace conventional techniques with impression trays and impression materials that cause discomfort to patients [3,4,5]. For this reason and for their multiple uses such as establishing the diagnosis and making the study model [6], fixed prostheses [4,5], orthodontics [7], surgery with guided implants [8], are increasingly present in dental practices and an increasing number of dentists are purchasing intraoral scanners and using this technology [3-7, 9-12].

In the field of dental medicine, the scanner is a data collection device that measures three-dimensional structures of the oral cavity and transforms them into digital data [2].

The intraoral scanner projects a light source, which can generally be a laser beam or a structured light network with a known geometry, on the surface of the oral tissues and captures its deformation with highperformance cameras, and with the help of the acquisition software, generates a cloud of points and then triangulation produces a 3D surface model (mesh) [3,4].

Accuracy [7,13-16] and resolution [17] are the most important mathematical characteristics that an intraoral scanner must have.

When discussing the accuracy of dental impressions, the terms "accuracy," "true" and "precision " should be distinguished from one another. According to the International Organization for Standardization (ISO 5725-1) definition of 1994, "accuracy" indicates the combination of "correctness" and "precision", where "correctness" is defined as "the closeness of agreement between the arithmetic mean of a large number of test results and true or accepted reference value". Meanwhile, "precision" has been defined as "the closeness of agreement between different test results" [18].

In other words, an ideal intraoral scanner should be able to reconstruct and therefore reproduce as faithfully as possible the surface of the scanned oral tissues, which means that it should have a high accuracy and in addition it should also have a high precision, thus providing consistent and repeatable results without deviations from scanning the same surface [15,16].

As for measuring the accuracy of an intraoral scanner, in vivo, it can be done very easily by performing different consecutive scans of the same arch saved as 3D models and with the help of reverse engineering software to be superimposed and the minimal deviations between the models indicate a high accuracy of the scanning device [14,15].

Regarding the assessment of the accuracy of an intraoral scanner, in vivo, it is more difficult, because to do this operation with the help of reverse engineering software we need a reference model (RM) on which to superimpose the intraoral scans [14,15]. A reference model can only be obtained using complex technology such as articulated arms or coordinate measuring machines (CMMs), devices that physically probe the surface to detailed collect 3D information. or alternatively industrial optical scanners or strong office [15]. Considering that the patient's dental arches cannot be detached to be placed inside a coordinate measuring machine or an industrial optical scanner to obtain a reference model, it is impossible to calculate the accuracy of an intraoral scanner in vivo [19,20].

The resolution is given by the density of the number of points generated by the acquisition software's processing of the scan data which are then triangulated resulting in a number of triangles, which leads to the conclusion that the resolution is also given by the number of triangles of the 3D surface model (mesh) [17]. Resolution has particular importance in visualizing details such as the margin or preparation limit of the natural tooth [17].

The aim of this study was to make a comparison between the digital impression and the classic impression in order to highlight the advantages and disadvantages of using the two methods, both in terms of the patient and the dentist, but also to evaluate the limitation regarding the use digital impression technique by intraoral scanning.

2. Materials and method

To fulfill the objectives of this study, the Google Forms Platform was used to distribute a questionnaire regarding digital impression and classic impression. The questionnaire included 14 questions with the possibility of choosing only one answer, and was addressed to dentists. Dentists received all relevant information about the purpose of the study.

QUESTIONNAIRE QUESTIONS:

1. Are you familiar with the classic intraoral impression method?

b) no.

2. Have you experienced intraoral impression technology?

3. How many years have you been practicing dentistry in the office?

- a) 0-5 years;b) 5-10 years;c) 10-15 years;
- d) 15-25 years;
- e) more than 25 years.

4. Consider that, from the point of view of the gag reflex caused to patients, a lower impact has:

a) impression by intraoral scanning;

a) yes;

a) yes;

b) no.

b) the classic impression;

c) there are no differences between the two methods.

5. Consider that from the point of view of breathing difficulties caused to patients, a lower impact has:

a) impression by intraoral scanning;

b) the classic impression;

c) there are no differences between the two methods.

6. Consider that, in terms of stress and anxiety caused to patients, a lower impact has:

a) impression by intraoral scanning;

b) the classic impression;

d) there are no differences between the two methods.

7. Consider that in terms of perception and comfort generated for patients, better results are obtained using:

a) impression by intraoral scanning;

b) the classic impression;

c) there are no differences between the two methods.

8. Consider that the adaptation of fixed prosthetic works and inlays in the oral cavity is better using:

a) impression by intraoral scanning;

b) the classic impression;

e) there are no differences between the two methods.

9. Consider that in the course of rehabilitation of total edentulous where the treatment solution consists of restoration with total removable prosthesis, better results are obtained using:

a) digital impression by direct intraoral scanning;

b) the classic impression made with high-precision impression materials;

c) there are no differences between the two methods.

10. Consider that during the rehabilitation of total edentulous where the treatment solution consists of supported restoration on multiple implants, better results are obtained using:

a) digital impression by direct intraoral scanning;

b) the classic intraoral impression made with high-precision impression materials.

c) there are no differences between the two methods.

11. Consider that for the performance of an implant-supported single-unit dental fixed prosthesis, better results are obtained using:

a) impression by intraoral scanning;

b) the classic impression made with high-precision impression materials;

c) there are no differences between the two methods.

12. Consider that from the point of view of execution time regarding the

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impression phase in oral rehabilitation a shorter time is obtained by using:

a) impression by intraoral scanning;

b) the classic impression;

c) there are no differences between the two methods.

13. Consider that the transmission of the intraoral impression from the dental office to the dental laboratory is easier and cheaper using:

a) impression by intraoral scanning;

b) the classic impression;

c) there are no differences between the two methods.

14. Do you consider an impediment to the use of intraoral scanning impression to be:

a) the purchase price of the technology;

b) learning curve.

3. Results

42 responses were recorded to the 14 questions contained in the questionnaire.

<u>Question 1</u> highlights the fact that all doctors participating in the questionnaire used the classic impression method (100%) (Figure 1).

<u>Question 2</u> highlights the fact that 37 participants (88.1%) used the digital impression method by intraoral scanning and 5 participants (11.9%) did not use this method (Figure 2).



Figure 1. - The answers to question 1



Figure 2. - The answers to question 2

The following answers were recorded to <u>*Question 3*</u> regarding the years of practice of dental medicine in the office:

- 0-5 years: 15 people (35.7%)
- 5-10 years: 9 people (21.4%)
- 10-15 years: 7 people (16.7%)
- 15-25 years: 7 people (16.7%)
- more than 25 years: 4 people (9.5%) (Figure 3).



Figure 3. - The answers to question 3

<u>Question 4</u> was designed to find out which of the 2 impression methods has a lower impact in terms of gag reflex in patients and the following responses were recorded:

- impression by intraoral scan: 40 responses (95.2%)
- classic impression: 0 answers
- there are no differences between the 2 methods: 2 answers (4.8%) (Figure 4).



Figure 4. - The answers to question 4

<u>Question 5</u> was designed to find out which of the 2 dental impression methods has a lower impact in terms of breathing difficulties caused to patients and the following answers were recorded:

- impression by intraoral scan: 39 responses (92.9%)
- classic impression: 1 answer (2.4%)
- there are no differences between the 2 methods: 2 answers (4.8%) (Figure 5).



Figure 5. - The answers to question 5



<u>Question 6</u> was designed to find out which of the 2 dental impression methods has a lower impact in terms of stress and anxiety caused to patients and the following responses were recorded:

- impression by intraoral scan: 37 responses (88.1%)
- classic impression: 1 answer (2.4%)
- there are no differences between the 2 methods: 4 answers (9.5%) (Figure 6).



Figure 6. - The answers to question 6

<u>Question 7</u> was designed to find out which of the 2 dental impression methods generates better results in terms of patient perception and comfort, and the following responses were recorded:

- impression by intraoral scan: 39 responses (92.9%)
- classic impression: 0 answers
- there are no differences between the 2 methods: 3 answers (7.1%) (Figure 7).



Figure 7. - The answers to question 7

<u>Question 8</u> was designed to find out which of the 2 dental impression methods has the effect, after use, of a better adaptation in the oral cavity of fixed prosthetic works and inlays, and the following answers were recorded:

- impression by intraoral scan: 21 answers (50%)
- classic impression: 10 answers (23.8%)
- there are no differences between the 2 methods: 11 answers (26.2%) (Figure 8).



Figure 8. - The answers to question 8

<u>*Question 9*</u> was designed with the aim of finding out which of the 2 dental impression methods produce better results during the rehabilitation of total edentulous where the treatment solution consists of restoration with a removable total prosthesis and the following answers were recorded:

- impression by intraoral scan: 3 responses
 (7.1%)
- classic impression made with highprecision impression materials: 36 responses (85.7%)
- there are no differences between the 2 methods: 3 answers (7.1%) (Figure 9).



Figure 9. - The answers to question 9

<u>Question 10</u> was designed with the aim of finding out which of the 2 dental impression methods produce better results in the course of total edentulous rehabilitation where the treatment solution consists of supported restoration on multiple implants and the following answers were recorded

- impression by intraoral scan: 13 answers (31.7%)
- classic intraoral impression made with high-precision impression materials: 23 responses (56.1%)
- there are no differences between the 2 methods: 12 answers (12.2%) (Figure 10).

<u>Question 11</u> was designed to find out which of the 2 dental impression methods produce better results when a single-unit implant-supported fixed prosthesis is desired, and the following responses were recorded:

- impression by intraoral scan: 28 responses (66.7%)
- classic impression made with highprecision impression materials: 3 answers (7.1%)
- there are no differences between the 2 methods: 11 answers (26.2%) (Figure 11).



Figure 10. - The answers to question 10



Figure 11. - The answers to question 11

<u>Question 12</u> was designed to find out which of the 2 dental impression methods has a shorter execution time in terms of the impression phase in oral rehabilitation and the following responses were recorded:

- impression by intraoral scan: 29 responses (69%)
- classic impression: 7 answers (16.7%)

- there are no differences between the 2 methods: 6 answers (14.3%) (Figure 12).



Figure 12. - The answers to question 12

<u>*Question 13*</u> was designed to find out which of the 2 dental impression methods are easier and cheaper to transmit to the dental laboratory and the following responses were recorded:

- impression by intraoral scan: 39 responses (92.9%)
- classic impression: 2 answers (4.8%)
- there are no differences between the 2 methods: 1 response (2.4%) (Figure 13).



Figure 13. - The answers to question 13

<u>*Question 14*</u> was designed to highlight the impediments that could prevent the use of intraoral scanning impression, and the following answers were recorded:

- the purchase price of the technology: 38 responses (90.5%)

- learning curve: 4 answers (9.5%) (Figure 14).





4. Discussions

In a literature review study by Paris Matos T et al. [21] regarding patients' preferences in relation to the digital impression versus the classic impression concluded that for patients presenting sensitivity to taste, gag reflex and breathing difficulties digital presence by intraoral scanning is a more suitable solution than the conventional impression technique [21].

In another study by Mangano A et al. [22] on 30 patients with orthodontic problems in whom both a digital impression and a classic impression with alginate were taken concluded that most patients preferred intraoral scanning as the impression method, which improved the patient's comfort, and had better results good regarding the gag reflex and breathing problems, while requiring a bit more execution time than the classic alginate impression, and the two techniques were comparable in terms of stress [22].

Bosoni C et al. [23] in a clinical study carried out on 24 child patients between the ages of 6 and 11 we concluded that 75% of the patients opted for the digital impression, which compared to the alginate impression had a better impact on patients in terms of comfort, gag reflex and difficulty breathing. Newer intraoral scanning technology and the lack of second molars in pediatric patients led to a shorter execution time of the digital impression made with the intraoral scanner compared to the classic alginate impression [23].

In a study by Yiyang Wang et al. [24] who aimed to analyze the specialized literature up to that point concluded that direct intraoral digital impressions cannot be considered to replace the classic impression of completely edentulous arches, in vivo, because in the peripheral areas the accuracy is poor and the location and morphology of mobile tissues in their functional state cannot be determined, which leads to the difficulty of establishing a fully digital workflow for the fabrication of total prostheses, requiring more in vivo studies [24].

Alfaraj A. et al. al. [25] in an in vitro study to evaluate the impact of the extent of the edentulous area on the accuracy of the intraoral scanning impression taken with two different types of intraoral scanners concluded that the accuracy of the impression was influenced by the length of the edentulous areas and the scanner used, this fact leads to an in-depth analysis regarding the selection of the scanner in specific clinical situations, since the accuracy of the intraoral scan can be different depending on the scanner and the edentulous situation [25].

In a study carried out by Ahmed S. et al [9] they stated that the poor development of the infrastructure or the lack of financial means of some dental offices to buy digital impression systems can limit the use of this technology and at the same time it is possible that certain users cannot cover the expenses associated with the implementation and maintenance of digital impression systems, and in conclusion they showed that digital intraoral scanning impression have the compared to advantages. the classic impression, of improving the comfort of the patient as well as of the operator, reducing the number of visits and improving the efficiency of the practice the operator [9].

Unkovskiy A. et. al [26] in a presentation of a case study in which direct intraoral digital scans were performed for the purpose of designing the total mandibular prosthesis resorted to a realignment of the impression, for the total determination of the prosthetic field, by scanning a record by the classical method, noting that the scanning process of the edentulous mandible required more time, being devoid of anatomical landmarks, and using a recording of the prosthetic field by the classical method improves the retention of the total prosthesis made, but at the same time, limits the completely digital workflow [26]. Jamjoom Z. F. et al [27] in an in vitro study to determine the effects of scanning strategy and the accuracy of fully edentulous arches impressions taken with 2 different intraoral scanners concluded that the type of scanner and the scanning strategy has an important effect on the accuracy of the

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impressions of the fully edentulous arches, there being a significant link between the scanner and the scanning strategy, and the scanned fully edentulous arch had a major effect on the accuracy of the scan without influencing the correctness, the maxillary arch generating an accuracy better than the mandibular arch [27].

In a study by Srivastava G. et. al. [28] who aimed to review the literature up to that point, concluded that, within the limits of this study, intraoral scanners provide clinically accepted impressions, but some improvements need to be introduced in the registration of mobile mucosa, and studies should standardize methods for evaluating discrepancies and quantifying the clinical effects of these deviations on the clinical correctness and comfort of the resulting total prosthesis. The digital impression bv intraoral scanning is not recommended when the fully edentulous prosthetic field presents an unfavorable anatomy as well as when a compressible impression is needed [28].

5. Conclusions

Intraoral scanning dental impression compared to traditional impression has less effect on patient gag effect, breathing difficulties, stress and anxiety, and results in better patient perception and comfort, and the time required to take the digital intraoral scanning impression depends on each individual clinical situation.

However, current evidence suggests that patients are more likely to prefer the digital workflow than the conventional techniques.

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ORIGINAL ARTICLE

ORAL HEALTH AND THE NEED FOR DENTAL CARE IN A GROUP OF PATIENTS FROM OLTENIA

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Abstract: (1) Background: Oral diseases are a major health burden in many countries and affect people throughout life, causing pain, discomfort, changes in facial physiognomy, and even death. The aim of the study was to determine dental treatment needs in a group of patients from Oltenia; (2) Methods: The retrospective study included 813 people, 341 men and 472 women, aged 6-93 years, presented for diagnosis and dental treatment between 2008-2018. The dental records of patients were used to evaluate the state of oral health, and the treatment needs of the patients. Data were collected and stratified into a database in Excel Windows (3) Results: Dental treatment needs included: oral health education sessions (33%), periodontal treatment (30.62%), fillings or other types of direct or indirect dental restorations (20.04%), including endodontic treatments, non-carious lesions treatment, extractions (27.42%), prosthetic restorations (71.83%), of which 10.08% complete dentures or overdentures with tooth or implant support and 43.9% partial dentures or bridges with tooth or implant support. (4) Conclusions: Social factors (socio-economic status and education of the population) and behavioral factors (diet and dental hygiene) have a great influence on dental health status.

Keywords: oral health, caries, non-carious lesions, edentulism, dental treatment needs

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1. Introduction

Health is defined in the WHO statement as the complete state of physical, mental and social well-being, which does exist only in the absence of disease or infirmity. Oral diseases are a major health burden in many countries and affect people throughout life, causing pain, discomfort, changes in facial physiognomy, and even death. These dental conditions share risk factors with other major chronic diseases [1]. Oral diseases are estimated to affect nearly 3.5 billion people [2].

Untreated dental caries in permanent teeth is the most common oral condition according to Global Burden of Disease 2017 [1]. More than 530 million children suffer from dental caries in temporary teeth. Severe periodontal disease, which can lead to tooth loss, is also very common, with nearly 10% of the global population affected. Oral cancer is one of the three most common types of cancer in some countries in Asia and the Pacific [3-9]. Most low- and middle-income countries are unable to provide services to prevent and treat oral health infections.

Factors that favor dental diseases are an unhealthy diet rich in sugar, tobacco use and excessive alcohol consumption. The uneven distribution of oral health professionals and the lack of adequate health facilities in most countries means that access to primary oral health services is often low. Overall, according to a survey of adults who express a need for oral health services, access ranges from 35% in low-income countries to 60% in lower-middle-income countries, 75% in upper-middle-income countries, and 82% in high-income countries [10]. Even in highincome settings, dental treatment is expensive, averaging 5% of total health expenditures [11].

In post-revolutionary Romania, many changes have occurred in the health system, and especially in dental care. Supported mostly by the state between 1965 and 1989, after 1990 most of the dental offices became private businesses, the offices in the clinics being concessioned to the dentists who worked in the clinics. On the other hand, a network of private offices has developed, in recent years many of them have turned into true polyclinics. This gradual change was accompanied by a decrease in the share of state support in the financing of dental care, with it returning almost 100% to the patient [12].

Also, the entire network of school and student dental offices, as well as dental offices dedicated to some companies, e.g. National Railways, underwent changes, their number gradually decreasing from one year to the next. Those who had the most to lose were children, who could no longer benefit from the prophylaxis programs carried out through these dental offices, as well as from free dental assistance. For quite a long time, there was also a lack of Pedodontics specialists, in recent years this specialty has been introduced and an attempt is being made to bring back the number of doctors dedicated to pediatric dental care. All this resulted in an increase in caries among children, evidenced by the increase in DMFT [12].

Children from the 90s became adults and the teeth affected by caries were lost, mostly generating lost teeth, which were not replaced in most patients.

Social factors represent a complex that contributes to the state of health through its behaviors: age, gender, socio-economic status. These behaviors are essential factors that influence health through the living and working conditions that people can aim for, or through the opportunity to choose a healthy lifestyle and medical services of good standards. There is a close relationship between educational and biological capital, studies show that the most educated people choose health services of very good quality. The level of education influences the life strategies developed by people to have a good life and good health, through a high level of information and knowledge about health and choosing a healthy lifestyle [13].

The socio-economic factors with a large impact on the health of the population in Romania are:

- poverty level
- unemployment rate
- social exclusion
- the structure of household expenses.

In 2019, Romania had GDP / capita in euros (Figure 1) that was equivalent to 70% of the European average according to Eurostat [14]. Also, Romania allocates only a small part of its GDP to health, and very little is allocated to dentistry, 0.33% of the single national health social insurance fund in 2020, the social insurance system allowing dental assistance with a financial cap for doctors are under contract with Romanian National Security Services, so very few patients can benefit from free dental treatments [15].

Four of the country's eight regions (Figure no. 2), North-East (44%), South-Muntenia, South-West Oltenia (54%), and South-East (58%) are below the 60% threshold from the EU average. Bucharest region, which is in Macroregion three, has already exceeded the European average with an impressive result (160% of the EU average) [14].

The purpose of the study was to assess the dental treatment needs in a group of patients who presented themselves for diagnosis and dental treatment in the period 2008-2018 in the Oral Rehabilitation Clinic of the Faculty of Dental Medicine in Craiova. The retrospective study also aimed to evaluate the patients' attitude towards oral health and dental hygiene, as well as the main factors that influence oral health status, including, among others, dietary practices and the frequency of tooth brushing.

Secondary objectives of the study were to find:

- patients presented for diagnosis and treatment in the Clinic for Oral Rehabilitation in the period 2008-2018;

- demographic characteristics of the study group;

- prevalence of systemic chronic diseases in the study group;

- prevalence of oral diseases such as: caries, tooth wear, periodontal disease, edentulism;

- dental treatment needs necessary to solve the oral diseases of the patients in the studied group.

2. Materials and method

The retrospective study was carried out in the City of Craiova, Dolj County, at the Faculty of Dental Medicine of University of Medicine and Farmacy of Craiova on the group of patients presented for diagnosis and dental treatment in the Oral Rehabilitation clinic between 2008-2018.

For the retrospective, analytical study, the dental records of patients from the Oral Rehabilitation Discipline, used by teaching staff, resident doctors and students to assess the state of oral health and the treatment needs of the examined persons, were analyzed. The data from the dental charts were collected and stratified into a database in Excel Windows.

The research activities were carried out in accordance with the existing legislation in force and in compliance with the methodological norms of the research. Prior to this research, all patients were informed about their state of dental health.

Each patient presented in the Clinic signed also an informed consent for the processing of personal data and their use in clinical and epidemiological studies. Each patient was informed about the procedures used in the clinic and their informed consent was obtained.

Data related to several aspects were taken from the files in the archive:

- demographic data,

- data related to vicious habits,

- data related to associated systemic diseases, drug treatments,

- the socio-economic status (low, medium, high) was assessed by registering the profession,

- data related to the state of oral health.

Data from the dental charts were processed and an observation file was created for each examined patient.

Statistical analysis was performed with IBM SPSS Statistics v26 and Microsoft Excel for basic data analysis. The data were structured so that the need for dental treatment could be calculated for the group of patients studied, this being assessed according to the oral conditions present. The level of education and economic status was different for each individual patient, considering that they were selected from several localities within Dolj County.

3. Results

Of the 813 patients studied, 472 were women, representing 58.1%, and 341 were men, representing 41.9% (Table 1).

	No	(%)
F	472	58.1
М	341	41.9
Rural	118	14.5
Urban	695	85.5
6-17	31	3.81
18-35	538	66.17
36-65	190	23.37
66+	54	6.64
Smoker	520	64
Non-smoker	293	36
Alcohol	105	12.92
Non alcohol	708	87.08
Total	813	100.0

Table 1. Demographic data of the study group.

The patients age ranged from 6 years to 93 years. Depending on the age group, most patients belonged to the age category 18-35 years (66.17%), followed by the age category 36-65 years (23.37%), the age

category 66+(6.67%) and the 6-17 age group (3.81%). Depending on the place of residence, most patients came from the urban environment, 695 (85.5%), and from the rural environment 118 (14.5%) (Figure 1).



Figure 1. Distribution of patients according to age

By place of work, 39.5% were students, 30.11% were employed, 12.41% were retired, 7.01% were unemployed, 6.33%

were pupils, 3% self-employed, and 1.73% own a business (Figure 2).



Figure 2. Distribution of patients according to employment status

Of the 813 patients interviewed, 520 reported being non-smokers (64%) and 293 reported being smokers (36%). Regarding tooth brushing habits, 67% of patients

brushed twice a day, 14% only once a day, of which 5% in the evening and 9% in the morning, and 19% of patients brushed their teeth occasionally.

Table 3. frequency of visits to the dental office and periodic check-ups.

	No	(%)	
Tooth brushing			
Once a day	113	14	
Twice a day	545	67	
Occasionally	155	19	
Visit to the dentist			
Periodic check-up	147	18.08	
Treatments	211	25.95	
Emergencies	455	55.96	

Speaking about the frequency of visits to the dental office and periodic check-ups, only 18% of patients go to the periodic check-up once every 6 months, 26% go to the dentist only, when necessary for treatment, and 56% go only in case of emergencies, for pain. (Table 3). Regarding the frequency of systemic diseases, out of 813 patients, 273 (33.57%) suffer from at least one disease or condition. Among them, 76 people suffer from a single disease or condition, representing 27.84% of the total number of patients who declared that they have a condition or disease and 9.35% of the total number of patients, 73 people

suffer from two diseases or conditions, representing 26.74% of all patients who declared that they suffer from one disease or condition and 8.97% of all patients, and 124

people suffer from three or more diseases or conditions, representing 45.42% of all patients who have a disease or condition and 15.25% of all patients (Figure 3).



Figure 3. Distribution according to systemic health status

From the total of 273 patients who declared that they suffer from one or more ailments or diseases, representing 33.57% of the total number of patients surveyed, most declared that they suffer from hypertension (28.93%), allergies (13.55%), anemia (13.18%), sinusitis (10.62%), sleep disorders

(8.42%) and type II diabetes (7.69%). From the 813 patients included in the study, 249 suffered from periodontal disease (30.62%). 129 (15.87%) of them had gingivitis in various stages of evolution, and 120 (14.76%) suffered from periodontitis in various stages of evolution.



Figure 4. Distribution of the prevalence of periodontal diseases within the studied population

Regarding edentulism, of the total of 813 patients, most of them 584 (71.83%) presented one or more classes of edentulism on one or both arches, as presented in table 5. Most of the patients had class II edentulism (37.2%), followed by class IV edentulism, and other classes of edentulism (Table 5).

Kennedy edentulism class	no	(%)
Complete edentulism	27	3.32
Extended edentulism	55	6.76
Class I edentulism	56	6.88
Class II edentulism	301	37.02
Class III edentulism	5	0.61
Class IV edentulism	140	17.22

Table 5. Distribution of the prevalence of edentulism.

Almost half of the study participants (45.51%) had a carious dental condition in various stages of evolution. Among them, 14.76% had one or more teeth with simple caries, 5.28% had teeth with complicated caries, 14.76% of patients had teeth with

complicated apical periodontitis, 12.66% of patients had unrestorable teeth, 1.10% had both simple and complicated caries, and 0.86% had complicated caries with complicated apical periodontitis (Table 6).

Table 6. Distribution of the prevalence of dental diseases.

	No of patients	(%)	
Teeth lesions			
Simple caries	120	14.76	
Complicated caries	43	5.28	
Apical periodontitis	120	14.76	
Extensive caries	103	12.66	
Abrasion	12	22.64	
Abfraction	3	5.66	
Erosion	14	26.41	
Attrition	16	30.19	
Fractures	8	15.10	

Estimation of the need for dental treatment was for a. Oral health education and correct brushing: 33% of patients (who

brushed their teeth once a day or occasionally), b. Periodontal treatments (first stage periodontal treatment, which includes scaling, brushing, education for proper brushing adapted to the dentition, application of local anti-inflammatory substances, periodic checks for evaluation and maintenance): 30.62% of the patient group, c. Dental treatments of simple and complicated carious lesions: 20.04% of the patient group, d. Dental treatments of non-carious lesions: 6.51% of the patient group, e. Extractions of teeth with complicated apical periodontitis or unrestorable: 27.42% of the patient group, f. Prosthetic restorations -71.83%. Total dentures or overdentures on teeth or implants -10.08% of the patient group (patients with subtotal or total edentulism), partial dentures or bridges with teeth or implant support -43.92% of the patient group (patients with terminal edentulism), dental bridges or bridges with teeth or implant support -17.83% of the group of patients (patients with partial limited edentulism) (Figure 5).



Figure 5. The need for dental treatment expressed as (%) patients.

4. Discussion

The group of patients included in the retrospective study is quite well represented, both in terms of gender distribution, 472 being women, representing 58.1% and 341 men, representing 41.9%, as well as in terms of age, including both children, from 6 years to 93 years old. Depending on the age group, most patients belonged to the age category

18-35 years (66.17%), followed by the age category 36-65 years (23.37%), the age category over 66 and between 6-17 age group being in minority. The clinic being in the city of Craiova, most patients came from the urban environment, patients from the rural environment, coming from the villages surrounding the city of Craiova.

Since the clinic has specific university dental assistance, a large part of the patients

were students, a third had various professions, and a small part were retired, unemployed, pupils, self-employed, and owned a business. Most patients were nonsmokers and most did not consume alcohol occasionally or daily.

Although they had a good perception related to oral health, the patients did not actually have a good oral health status. 67% of the 813 patients who completed the form declared that they brush their teeth 2 times a day, and 33% once daily or occasionally, and yet, the prevalence of dental diseases in the studied population is 45%, which can question the correctness of the patients' answers. Patients' perception of the need for dental treatment is always lower than the need for treatment estimated by the dentist, especially in the case of the elderly [16].

Results from another study of elderly Australian men showed that poorer oral health status with fewer remaining functional teeth was associated with patients' perception of needing some form of dental treatment; however, dental caries and the severity of marginal periodontitis were not associated with patients' perception of dental treatment needs related to major dental conditions: (i) edentulous, (ii) caries and (iii) periodontitis [16]. In other words, only patients with extensive or complete edentulism felt the need for dental treatment, while those with caries, periodontal disease or reduced edentulism were considered healthy and did not need dental treatment.

Such patient perceptions of the need for treatment lead to a reduced number of visits

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to the dentist for periodic check-ups, (in our study approximately 18%). Visits to the dentist are reserved for borderline situations when pain occurs (in majority), the patients' motivation being the financial situation and the difficult access to dental services, which is partially true, considering the increase in the number of dental offices in the last 30 years, which led at a ratio of 1 dentist per 1235 inhabitants, similar to countries like Belgium, Portugal. However, since the distribution of doctors and dental offices in urban areas is much higher than in rural areas (87.7% doctors in urban areas and 85.5% dental offices in urban areas) and the number doctor of patients per is much disproportionate, i.e. 1 doctor per 782 inhabitants in the urban environment versus 1 doctor per 3898 inhabitants in the rural environment in 2020 [17, 18].

Regarding disease frequency, almost a third of all patients suffered from at least one disease or condition. Among them, were people that suffered from only one disease or condition, representing a third of all patients who declared that they had one condition or disease, and almost 10% of all patients had two diseases or conditions, representing almost a quarter of all patients who declared that they suffer from a disease or condition, while people that had three or more diseases or conditions were representing almost half of all patients who have a disease or condition. The most frequent systemic diseases in the patients in the studied group hypertension, allergies, were anemia. sinusitis, sleep disorders and type II diabetes.
In a 2017 study conducted on a group of patients from Iasi County, morbidity was by cardiovascular dominated diseases (63.24%), chronic digestive diseases (33.82%), diabetes (29.41%), diseases (27.94%), osteoarticular accidents and traumas (26.47%) and chronic respiratory diseases (23.53%); in the female sex, it was also dominated by cardiovascular diseases (67.82%), followed by diabetes (32.18%), osteoarticular diseases (31.03%) and chronic digestive diseases (24.14%) [19].

It is interesting that in our study, of the 813 patients included in the study, only 249 patients, representing 30.62%, suffered from periodontal disease, while 33% declared that they brush daily but not once a day, or occasionally. Other studies have also found a similar effect, since in women from the north-eastern part of the country a prevalence of 41.33% of periodontal disease was found, with a much lower effect on the male sex [19].

Almost half of the study participants had a carious dental condition in various stages of evolution. Among them, only a small part had one or more teeth with simple caries, the majority had teeth with complicated caries, teeth with apical periodontitis, and unrestorable teeth. Compared to our study, a caries prevalence of 58.55% was observed in a group of patients from Iasi County, the percentages being almost equal in women (59.81%) and men (57.30%) [19].

From the total of 813 patients, only a small part had teeth suffering from non-carious dental conditions. In the group of

patients from Iași County, the prevalence of non-carious oral diseases was much higher, 42.67% in women, men being particularly affected by traumatic injuries (24.24%) [19]. The most affected teeth were those in the frontal area because they are the most prone to accidents, trauma, bad habits, untimely brushing.

Regarding edentulism, most patients from the study group had one type of edentulism, one or more classes of edentulism on one or both arches, edentulism class II being most common, followed by class IV edentulism, and class I, extensive edentulism and complete edentulism. In the previously mentioned study carried out in a population from Iaşi County, a higher prevalence of complete edentulism was observed, namely 27.87% [19].

The estimation of the need for dental treatment was made for the studied group by referring to the percentage of patients affected by a certain type of oral disease. Thus, it was estimated that the 33% of the studied group who did not brush their teeth correctly needed oral health education sessions. the 30.62% with various periodontal diseases needed at least initial periodontal treatment, 20.04% had needs for fillings or other types of restorations, to which endodontic treatments were added, 6.51% needed the treatment of non-carious lesions with the establishment of periodic maintenance sessions, 27.42% of the patients needed extractions. Added to all this is the very high percentage of patients who needed prosthetic treatment -71.83%, of which

10.08% needed complete dentures or overdentures with teeth or implant support and 43.9% partial dentures or bridges with teeth or implant support.

The lack of information and health education is evident among the Romanian population, which requires the need to act in this regard. The retrospective study presented in this work supports this idea and brings new information related to the oral health of the population of our country. Comparing the current situation in our country with the current situation in other European countries, we see that there are major differences. The dental status of the populations in Europe, much more economically developed, is much better. Europeans are less affected by carious lesions and periodontal diseases, the number of extractions following these conditions is lower. This fact is reflected in the higher percentage of people with intact permanent dentition, without prosthetic works or extractions. At the same time, it is observed European citizens that are more conscientious in terms of oral hygiene and the vast majority go regularly for check-ups in the dental office. This difference between the situation of the Romanian population and other European citizens is explained by the fact that at the European level, larger funds are allocated for prophylaxis and health promotion, due to the higher economic level [20].

Another factor that contributes to this better situation of oral health is the legislation as well as the health education that in many European countries is already introduced in schools. Even if a series of promotion programs have been held in Romania in recent years, on World Oral Health Day, they were few and poorly publicized [20].

The main strategy for the primary prevention of carious lesions begins with training patients to improve their diet, reducing their consumption of sugar and high-sugar foods, and avoid eating sweets at several meals [21].

Also, speaking of the patients' habits in terms of oral care at home, they must do the best dental hygiene at home, at least twice a day, in the morning and in the evening after meals, improve the technique of tooth brushing and oral care time [22].

The new approach in caries management involves the early diagnosis of incipient lesions and the level of carious disease risk that the patient has and implementation of the primary prevention strategies. Caries risk indicators are limiting predictors of caries progression and future risk in the evolution of adult caries. The most important predictor of future dental caries is the history of carious disease as well as current caries activity [23].

5. Conclusions

The need for dental treatment in patients from the study group includes:

- oral health education sessions,
- periodontal treatment,
- dental fillings or other types of direct or indirect dental restorations, to which endodontic treatments are added,

- non-carious lesions treatment with the establishment of periodic maintenance sessions,
- extractions,
- prosthetics restorations, that included the need for partial dentures or bridges and for a small part of the patients complete denture.

Social factors (socio-economic status and education of the population) and behavioral factors (diet and dental hygiene) have a great influence on dental health status.

It is necessary for dentists to include in their clinical practice evaluation of caries risk for each individual patient as a periodic examination protocol.

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Dentists need more evidence-based approaches to caries risk assessment, diagnosis and prevention.

Preventive rather than restorative treatment should be the main strategy of the dental practitioner, including changing dietary habits and oral hygiene at home through educational programs.

Regarding the educational aspect, it is necessary to introduce health education into the school curriculum, because it must be started from an early age, so that in the future we get healthy and educated adults able to pass on this information to their children.

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REVIEW

DENTIN-PULP COMPLEX IN DEEP CARIES

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Abstract: Deep caries progress highlights the gradual shift from reactionary to reparative tertiary dentine as main feature illustrated by transition between the secondary and tertiary dentin. Three sorts of odontoblasts are described to exhibit their dentinogenic potential in genesis of reparative dentine, the still active primary odontoblasts, the formerly quiescent odontoblasts recently reactivated by molecular signals sent from carious lesion, and the secondary odontoblasts resulting from pulp stem cells. This complex cellular secretor involvement in dentinogenesis presume a range of resulting matrices that explain the miscellaneous mineralized final structures encountered in natural evolution of deep caries and especially as therapeutic outcome in pulp capping. Depending on intensity of cariogenic stimuli the effect may be either reactionary dentin relying on a mild action or reparative dentin, mirroring a strong microbial action. The histological response of dentin-pulp complex comprises any exclusive reactionary or reparative tertiary dentin feature as both conditions usually may cohabitate as mishmash in the same pulp.

Keywords: deep caries, reactionary dentin, reparative dentin, secondary odontoblasts

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1. Introduction

Main histological feature in deep caries relies on the shift from reactionary dentine to reparative tertiary dentine as defensive hard tissue barrier between tooth decay and vital dental pulp [1-3]. A thickness over 0.5 mm is commonly a equivalent cut off line separating microbiologically from formal pulp exposure [4,5].

Unless the reactionary dentine, the reparative dentine is rather a scar-like tissue than a proper dentine, having an amorphous mineralized structure characterized by a small number of irregular dentinal tubules [1,5].

The transition from the secondary to tertiary dentin, characterized by irregular dentinal tubules apparently disconnected with unaffected juxtaposed secondary dentin, is marked in histological classic staining techniques by calciotraumatic line [6].

Simultaneously with caries progress, the dynamic process related to remodeling of dentin-pulp complex is associated with local replacement of dying primary postmitotic odontoblasts with newcomers, namely the odontoblast-like cells that actually are novel recruits stemming from the undifferentiated pulp stem cells. They start to generate reparative dentin not later than 20-40 days after primary odontoblasts passed away [7,8].

As far as the adequate caries treatment is provided these "secondary odontoblasts" are able to generate reparative dentine resembling the former tissue condition due to the more tubular features of new laded down dentine [3,8]. Though in clinical setting is impossible to differentiate the histological structures either of carious or normal dentine, a more realistic approach to achieving a successful treatment outcome is to respect the concept of "minimal intervention dentistry" [9,10].

2. Overall status of dentin-pulp complex in deep caries

Excepting the rampant caries, the longstanding invasive stroke of tooth decay microbiome is mild to moderate. Accordingly, the rate and amount of reparative dentine secretion is directly related to the rather predictable intensity, duration and pulp-ward in situ extension of caries relevant microorganisms [2,5].

During deep caries progress in lading down of reparative dentine actually are involved in concert three sorts of odontoblasts. the still active primary odontoblasts. formerly quiescent the odontoblasts recently reactivated by molecular signals sent from carious lesion, and the aforementioned newborn secondary odontoblasts [11,12]. However, this triad is not kept any longer and finally only the surviving odontoblast-like cells remain in charge with secretion of tertiary reparative dentine [13].

Unless the recently erupted permanent teeth, in adults the secretion of reparative dentine is orchestrated by BMP family (bone morphogenetic proteins), chiefly involved being its members BMP-2, BMP-4, BMP-6, and BMP-7 [14. In deep caries besides the new generated odontoblast-like cells that are secreting type I collagen matrix of dentine may occurs similar key secretion reactivated pathways of specific dentine matrix noncollagenous proteins (proteoglycans, glycoproteins, dentin phosphoproteins) which are resolutely involved in matrix biomineralization [15-18].

The BMP signaling network follows three interventional paths, on cell membrane and intra- or extra-cellular by using Smadinteracting proteins for transducing the molecular signals from cellular membrane to cell nucleus [11]. Noteworthy, the severe decrease of p38 transcript, as proved during conversion of primary to secondary dentine secretion, highlights the change of odontoblast transcriptom during natural process of cell maturation [11,12].

The secondary, also termed physiological dentine, exhibits a much longer period to be laded down since the in charge with odontoblasts experience a defense process of autophagy directed to keep up their survival in circumstances of local stress injury or starvation [19,20].

Once misplaced, dentine is a tissue that cannot be restored. In deep caries the diffusion of microorganisms or even their proper invasion keep up the response of tertiary dentine that is located in the closest boundary of external injury [21].

Depending on intensity of microbial stimuli, two kinds of tertiary dentine can be generated, either reactionary dentin (mild action) or reparative dentin (strong action). Unlike the reactionary dentine, in which synthesis are involved still surviving primary odontoblasts, in case of reparative dentine secretion are in charge the odontoblast-like cells since the genuine odontoblasts were eventually killed during dangerous deep caries progress [3,6].

Furthermore, when in reactionary dentinogenesis the genuine odontoblasts cooperate with the growth factors of dentine matrix to obtain a fast synthesis response owing to their abilities to prompt or suppress the gene transcription and even change the stem cells gene expression [6,22,23].

Apparently, the reactionary dentine is not a straightforward response of odontoblasts directly tailored to the intensity of external stimuli since its deposition was observed to be done in various rates [21,24]. A hypothetic explanation might be the difference of gene profile in mature odontoblasts versus the new reactivated ones [25].

Basically, the reparative dentinogenesis presumes initially a complex cascade of occurrences consisting in migration of pulp stem cells from their preexisting niches followed by their multiplication and final differentiation in odontoblast-like cells [26-29]. Somehow on micro-scale the synthesis pattern of reparative dentinognesis reproduces tooth morphogenesis [30-32].

Altogether all sorts of odontoblasts try to provide reparative dentine that predominantly has a focal microscopic appearance as much as similar in its tubular structure to genuine secondary dentine. The main differences reside in faster rate of secretion, mild structural irregularities, reduced amount of dentine tubules and, despite the anatomic continuity with preexistent tubules, a frequent angle of deviation angle in their trajectory [2,5].

Particularly in high-rate progress of caries the inadvertent accompanying degenerative and inflammatory pulp lesions result in increased worse quality of dentine. Sometimes connective pulp tissue intrusions occur into the recent laid down layers of dentine as consequence of increased porosity and morphologic defects. Hence the proper dentine condition turned out to be rather fibrodentine than reparative dentine [8].

Presently in carious exposure the common vital pulp therapy by pulp capping with proper biomaterials brings about a mineralized barrier only conventionally resembling dentine since histological actually is either fibrodentin, osteodentin, ectopic calcifications or even dystrophic calcifications of former post-pulp injury reparative scar tissue [5,6,32].

This is not a surprising issue as in progressing deep caries the pulp-dentin complex proved to harbor various types of cells exhibiting dentinogenic potential (primary odontoblasts, reactivated primary quiescent odontoblasts, secondary odontoblasts). Moreover, their secretor involvement in dentinogenesis also presume a range of resulting matrices that explain the miscellaneous mineralized final structures both in deep caries and above all in pulp capping [33].

Though mineralized matrices, both fibrodentin and osteodentin are rather

defensive matrices than genuine hard dental tissue as tertiary dentin. Accordingly, due to the demonstrated quite different phenotype of pulp cells participating in configuration of the mineral barrier it is at least reluctant to consider equality between these morphological structures [33].

To identify differentiated odontoblast from pulp stem cells is less important to recognize cell polarization related to tubular matrix deposition, the alignment in palisade or the conventional columnar shape. Functional odontoblasts should express phosphophoryns (non-collagenous proteins), which are specific biochemical markers for these dentinogenetic cells [33].

Following successful pulp capping merely scarce chronic inflammatory cells might remind the former inflammatory damage excepting the amorphous atubular mineralized tissue that occasionally entraps islands of necrotic pulp remnants [6].

Until now no evidence based on dentin phenotypic markers proved that dentin-like calcified bridge is real dentine tissue but rather atubular mineralized tissue [6]. The most wanted tubular dentine generated by pulp capping occurs in humans only after in vivo experiments on previously unaffected teeth [34-36].

It seems that temporary in deep caries is actually present an encouraging status of preinflammation, which 8-fold enhances the alkaline phosphatase activity and 2-fold expression of 445 genes in charge with regenerative mechanisms. Furthermore, also some recognized powerful pro-inflammatory cytokines, namely TNF- α and IL-1 β , shift their deleterious target to beneficial stimulation of tertiary dentin secretion [12].

Hence, definitely the fragile balance between repair of dentin-pulp complex and ongoing initial mild pulp inflammation is maintained by proper inter-action of local innate and adaptive immune responses [13,37,39].

Morphologic base of putative dentin-pulp complex repair in deep caries relies on proved persistence of dental pulp stem cells even in reversible pulpitis, which allows their migration, multiplication and differentiation [12,37,39].

An attractive hypothesis is the capability of pro-inflammatory cytokines TNF- α and IL-1 β in mild inflammation to recruit the stem cells and support their differentiation in odontoblast-like cells as long as the immune mechanisms enable the pulp defense against final irreversible inflammation [12].

3. Dentin-pulp complex and the relationship repair-regeneration in deep caries

Despite its tremendous operative progress in dental setting, the contemporary trend of pulp regeneration still failed to elucidate the distinction between regeneration and repair during tertiary dentine formation as outcome of successful pulp capping in deep caries exposure as well as their hard to make out inter-relationship [6,39].

Though the lasting deep caries is associated with chronic pulp inflammation as

long as carious microorganism do not invade the dentin barrier a transitory response of reparative dentinogenesis is still preserved. Since normally without operative therapeutic involvement this balance is rapidly overturned, the subsequent irreversible pulpitis definitively stops the secretion of reparative dentine [8].

Nevertheless, in untreated deep caries, despite the one way unwanted evolution facing the pulp survival came up some hopeful issues relying on intricate processes of secondary odontoblasts secretion and pulp regeneration since the healing of dentin-pulp complex benefits from some mechanisms of molecular signals similar to those found in reparative dentine secretion [29,40].

Early pulp responses to caries aggression are interruption of odontoblast layer alignment and the cell volume reduction, followed in underposed connective tissue by vasodilatation and sparse acute and chronic cellular inflammatory infiltrate located in subodontoblastic area [6].

On the other hand, the main histological feature highlighting the specific response of dentin-pulp complex against the cariogenic microbiota, obviously present from the medium depth stadium of carious lesion progress, is tertiary dentine [6].

The tertiary dentine located under still unaffected secondary dentine opposite to the front of microbial attack is a reactionary dentine and is depicted as focal-like deposition. In this stage the primary odontoblasts layer preserved the former position in palisade excepting the original columnar shape, which is changing in a more flattened one [6].

Simultaneously with local demineralization the organic acids elaborated by cariogenic microorganisms also set free from nearby primary and secondary dentin both fossilized growth factors and embedded bioactive molecules [6,27,39]. Similar to the use of acid etch [41,42], calcium hydroxide or calcium silicate cements in operative dentistry [43,44], these aforementioned active biomolecules up regulate via p38-MAP pathway the somehow stagnant dentine matrix secretion of primary odontoblasts [6,11].

As the caries progress, in the proximal pulp location the odontoblasts attempt to survive initially responding by autophagy in order to improve their status of metabolic exchanges [6,45-47]. However. since concurrently occurs odontoblasts apoptosis is hard to define if autophagy is an independent, non-apoptotic programmed cell death or a cellular mechanism to avoiding apoptosis [48,49]. Following to autophagy the odontoblasts. degenerated similar to apoptotic ones. eventually disappear subsequent to macrophages implication [50,51].

Despite the lasting concern to elucidating the issues of autophagy versus apoptosis unfortunately were not recorded the expectations since the information was obtained by experiments done in deep cavities preparations on healthy teeth. Therefore, the histological outcome mirrors the response of healthy odontoblasts nonaffected by previous carious process, which is definitely dissimilar to pulp odontoblasts behavior in deep caries [52,53].

In essence in rapid advancement of deep caries, as long as is still running the synthesis of reactionary dentine, neither new odontoblasts nor other pulpal cells are involved. Furthermore, the continuous decrease of primary odontoblasts results in morphological alteration of reactionary dentine characterized by fewer dentinal tubules and incomplete mineralization [6].

As the caries progress, in the proximal pulp location the odontoblasts dye and are replaced by fibroblast-like cells, which are in charge to secrete a loose collagen matrix and orchestrate the local repair response toward the gradual replacement of resulting pulp scar with atubular calcified tissue [6].

Actually, in long-standing deep caries with unexposed pulp or in long ago already conservatory treated carious lesions there are not found any exclusive reactionary or reparative tertiary dentin histological features. Both conditions of tertiary dentin are not so discrete in the least and may cohabitate habitually as mishmash in the same pulp [6].

Regenerative healing relies on the signals transmitted by transforming growth factors family (TGF-beta), which are compulsory for differentiation and polarization of secondary odontoblasts originating from pulp stem cells [54,55]. The outcome is the complete removal of damaged tissue and its replacement with original healthy one. Practically is achieved a complete tissue restitution [6].

Reparative healing is in fact a fibroproliferative response since only to some extent substitutes the lost tissue with authentic pulp structure and mainly is characterized by intense collagen synthesis leading to scar-like pattern of restitution. Unlike regeneration, the reparative healing only cancels the adverse effect of carious process and does not enable pulp restitution [6]. Furthermore, it seems that when pulp extracellular matrix undergoes a focal disruption of its integrity the new environmental status shifts the pulpal response from regeneration to repair [56].

Moreover, a still running and more fervent debate was focused on the origin of cells replacing the dead odontoblasts, which are in charge with regeneration of dentinpulp complex damaged by deep caries [57].

Once the primary odontoblasts are eliminated, the biomolecules of transforming growth factors family, mainly TGF-beta which are also active anti-inflammatory agents, stimulate both the recruitment and proliferation of stem cells harbored in specific pulp niches and chemotaxis of copious pulp fibroblasts [6].

A competition occurs between the recruitment of pulp stem cells and fibroblasts chemotaxis. Proliferating faster, being more numerous and more adapted in human to various chronic inflammatory locations, the winners are fibroblasts. The additional stimulation of transforming growth factor TGF-beta, which has proficient antiinflammatory effect, also opens the door to enhanced local synthesis of collagen, proteoglycans and fibronectin that eventually results in scar formation [6,58-60].

It seems that the shift between pulp restitution and reparation in deep caries depends on the absence of odontoblasts progenitors just at the site of damage and the faster fibro-proliferative process initiated by fibroblasts since these cells even in the presence of local chronic inflammation are usually involved in connective tissue healing [61-63].

Furthermore, the calcified tissue histological depicted in pulp as consequence of local response to carious process, such as amorphous atubular structures and ectopic pulp stones, are rather dystrophic calcifications and not at all an issue linked to pulp regeneration [64].

In chronic pulp inflammation, which usually accompanies deep caries beside odontoblasts are also involved fibroblasts since their plasticity to change the secretor phenotype according to local environment enable to get mineral dystrophy [65].

The stage-like attempt of dentin-pulp complex to arrest the caries injuries aims a complete restoration of damaged pulp. As lasting pathogenic misbalance hinders a true regeneration and the pulp mechanisms of reactionary or reparative tertiary dentine are exceeded, the local antimicrobial pulp defense shall rely almost exclusively on less efficient scar-like tissues [35,66,67].

4. Conclusions

In deep caries the main histological response of dentin-pulp complex relies on a gradual shift from reactionary to reparative tertiary dentine. The outcome of defensive mechanisms highlights the wide range of miscellaneous mineralized structures encountered in deep caries progress and in

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