

Laser Treatment for Improvement of Oral Health in Elderly

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Abstract. The negative impact of poor oral health on the quality of life in the elderly is an important public health problem, which must be addressed by the policy makers. This paper addresses a cross-sectional study which analyzed the condition in oral health in patients aged 60 years and older, in the Republic of Macedonia. The clinical protocol was conducted in 100 subjects who completed the questionnaire. We used the clinical protocol to evaluate the actual condition in oral health through a dentist clinical examination. The clinical examination of our subjects showed findings of dental plaque, dental calculus and periodontal pockets. Dental plaque seen only by sound on the marginal gingiva was found in 45% of subjects; dental calculus of the upper molars was present in 51% of subjects, and more than half of the subjects had dental calculus on the lower incisors located supra and/or sublingually (56%). The results obtained in our research provide important basic data on various aspects of oral health of people aged 60 years and older. To improve dental and periodontal status among elderly, the using a laser in a dental treatment would be of a great benefit. Plaque and calculus removal, coagulation, faster tissue ablation and healing, no or minimal pain, no or few sutures, instant sterilization, little tissue shrinkage and depigmentation are main factors favoring laser application in periodontics. Our findings have indicated a very low level of oral health behavior of this population in R. Macedonia leading to a very poor oral health. Laser dentistry can be a precise and effective way to perform many dental procedures. Some dental laser technology has been developed that can be used to generate both hard and soft tissue laser energy, depending upon the patient’s needs.

Keywords: Oral health · Elderly · Prevention · Dental and periodontal status · Laser dentistry.

1 Introduction

Negative influence of the poor dental oral health on quality of life in the elderly is an important public health problem, which has to be addressed and resolved by the

health policy creators. Many tools and instruments are available for enhancing the implementation and conveying the program of dental health care, and hence it is a huge challenge to apply the knowledge in action programs for oral health in the elderly. Recommendations of the World Health Organization are that a large number of countries have to accept strategies for improvement of oral health in the elderly. National health authorities should develop policies and measurable goals for oral health. National public health programs should be included in the promotion of oral health and prevention of diseases that share common risk factors [1].

1.1 Dental and periodontal state in population older than 60 years

A well preserved gum/teeth is a precondition for good quality of life. In spite of the improvements made in preventive dentistry, edentulousness is still a huge health problem worldwide. For example, in the USA, the number of edentulous people older than 60 years is 9,000,000 or 25% of the total population. According to some studies, teeth loss may influence the general health condition in a few ways:

- Smaller consumption/intake of fruit and vegetables, fibers and carotene, due to mastication problems results in increased cholesterol and triglyceride levels, which increases the risk of cardiovascular diseases and gastrointestinal disorders (onset of peptic or duodenal ulcer);
- Increased risk of type 2 diabetes;
- Increased risk of electrocardiographic abnormalities, hypertension, heart failure, ischemic heart disease, coronary heart disease;
- Increased risk of chronic kidney diseases;
- There is association between toothlessness and sleep and breathing impairment, including obstructive sleep apnea.

Toothloss has a negative effect not only on the oral function, but on the social life and everyday activities of the individual, as well. Affected oral function is also associated with reduced self-confidence and reduced psychosocial well-being [2].

The state of the periodontium is of substantial importance for the oral health of every human being. The most common and most serious disease in the field of dentistry nowadays is periodontal disease. It is a progressive and degenerative disease of the supportive apparatus of the teeth, including the gums, jaw bone and periodontal fibers that are a link/connection between the teeth and jaw bones. It usually starts without pains and insidiously, but it is a long-term disease and appears mainly after the age of 35 years. Pain is felt if secondary gum infection develops.

The main cause for onset of periodontal disease is the appearance of dental plaque, which is formed due to consumption of squashy and soft food, which along with the poor and inadequate hygiene of the mouth and teeth result in formation of sticky, colorless film of bacteria and microorganisms. With mineralization, or precipitation of saliva minerals, dental plaque is transformed into dental calculi and dental concretions, which can be removed only with ultrasound or hand-held instruments for removal of dental calculi in a dental office. Therefore, regular dental controls, at least twice a year, are very important in order to recognize this disease in

its initial phase by a dental practitioner and to prevent development of eventual periodontal disease.

General factors that diminish the immunity/resistance of the organism and periodontium thus alleviating and hastening the action of the dental plaque are: some blood dyscrasia (leukosis, agranulocytosis, hemorrhagic syndrome), endocrine disorders (diabetes), presence of toxic materials (lead, bismuth, mercury, arsenic), inherited predisposition (periodontal disease is not an inherited disease, but the anomalies regarding the position and shape of the teeth are inherited) and the older age.

During aging atherosclerotic changes in the blood vessels appear. All tissues are affected by atrophy. Similar changes happen in the periodontium. In the elderly population the ability for regeneration and reparation of periodontal tissue is reduced, and hence the effect of all harmful agents is stronger, including those from the dental plaque. The appearance of periodontal disease in adults and older persons is the most common form of parodontopathy [3].

The research in the area of dental public health among elderly in the Republic of Macedonia has been addressed in several papers. Some of them assessed the oral health and the impact it has on the quality of life in the elderly [4], as well as the knowledge and attitudes to preserve oral health among older people aged 60+ [5]. Others refer to the oral health strategy for elderly over 65 years, which is recognized as one of the public health priorities in the Republic of Macedonia [6]. The association between the level of education and the oral health status among elderly over the age of 60 is addressed in [7].

1.2 Lasers as tools in oral health

Dentistry increasingly uses new technologies including material science, engineering and Information and Communication Technology (ICT). This affects the dental practice, education of people that work in the field of dentistry and oral health, the research in oral health and dental care in general.

Addressing the problem in focus, recent research has indicated that application of lasers in dentistry is of great help in treatment of periodontal diseases.

Lasers have made their way in dental treatment since 1994. The term "LASER" stands for "Light Amplification by Stimulating Emission of Radiation". Modern techniques using lasers can control the spread of harmful bacteria and limit tooth loss compared to standard periodontal treatment options. Some benefits of laser treatment for gum disease include: elimination of cutting and bleeding, soreness and discomfort of the gums, isolation of deep periodontal pockets, reduction in tooth loss, and regeneration of bone and ligament tissues.

Optical properties of a tissue decide the interactions with lasers. When radiant energy is absorbed by tissue, four basic types of interactions occur:

1. Photochemical interaction
2. Photothermal interaction
3. Photomechanical interaction
4. Photoelectrical interaction

Photochemical interaction includes bio-stimulation, which describes the stimulatory effects of laser light on biochemical and molecular processes that normally occur in tissues such as healing and repair.

Photothermal interactions include photoablation, or the removal of tissue by vaporization and superheating of tissue fluids, coagulation and hemostasis.

Photomechanical interaction includes photo-disruption or photo-disassociation, which is the breaking apart of structures by laser light.

Photoelectrical interactions include photoplasmolysis, which describes how tissue is removed through the formation of electrically charged ions and particles that exist in a semi-gaseous high energy state [8].

2 Methodology of the research

This is a transversal, cross-sectional study, which presents the clinical aspects of oral health in subjects older than 60 years. The clinical protocol was conducted in 100 surveyed patients, who were treated at the University Clinical Dental Center in Skopje, Clinic of Mouth and Periodontal Diseases, and in the Health Center – Skopje. This research was conveyed during 2015. The clinical examination was made in order to assess the current condition of oral health by a dental practitioner. The examination referred to assessment of dental and periodontal condition in the mouth.

Clinical protocol for objective assessment of the condition of the teeth and periodontium was used in this study. The protocol helped us to assess the current state of the oral health with clinical examination done by a dental practitioner, which comprised dental and periodontal condition in the mouth (according to the protocol – annex 2). The clinical protocol consisted of two segments: the first one was based on the standard questionnaire created by WHO (1997); the second segment included findings of clinical examinations of almost half of the subjects that filled in the questionnaire, based on the modified version of Silness-Löe index.

The clinical examination was done by using standard light, mirror and dental and periodontal probe in line with the WHO recommendations. Prior to the clinical examination, no previous cleaning of the teeth is necessary/required.

The measurement of the state of oral hygiene, according to Silness-Löe plaque index, is based on recording soft debris and mineralized deposits on targeted teeth. The plaque index system shows moderate accumulation of soft deposit on the teeth and gingival margin or within gingival pockets that can be seen with naked eye. Each of the four surfaces of the teeth (buccal, lingual, mesial and distal) is given a score from 0-3. The results of the four surfaces of the tooth are added and divided by four in order to give the plaque index for one tooth. The indices for the following six teeth may be grouped to designate the index for the adequate group of teeth: 16, 12, 24, 36, 32, 44. The index for the patient is obtained by summing the indices for all six teeth and dividing by six.

In addition, a patient questionnaire was developed, which contained questions about the oral health behavior in the elderly, as well as the sources of information concerning the individual oral health care and treatment. This questionnaire was used to obtain correlations between oral health behavior and results from clinical examinations.

3 Results

Based on the analyses obtained upon the clinical examination of the teeth and parodontium, results are obtained by which the situation of the oral health in persons aged above 60 in the Republic of Macedonia can be seen.

Of the subjects, 59.1% were females, and 40.9% were males. Regarding age, subjects aged 60-69 years of age were predominant (54.9%), and the rest (45.1%) were subjects older than 70. In terms of educational status, the majority of subjects had completed secondary education (46.6%), followed by subjects with high education (24%) and primary education (22.3%). Of the entire cohort, most of the subjects had between 1 and 15 teeth (49%), whereas 13% of the subjects had between 16 and 20, as well as more than 21 teeth, respectively. The percentage of female subjects who had more than 21 teeth (16.7%) was almost twice higher in comparison with the male subjects (7.6%). There was a statistically significant difference in the number of teeth according to age ($X^2=15.357$, $df=3$, $p=0.002$); the larger percentage were subjects with 1-15 teeth in the age group of 60-69 years, in comparison to 43.7% of the elderly who had 1-5 teeth. In the following subsections some of the important findings of this study will be addressed.

3.1 Dental plaque – upper molars

More than half the subjects (68%) had a clean finding for a dental plaque of the upper molars; 29% had plaque when checked only using a probe on a marginal gingiva, and only 3% had a dental plaque which was visible on the marginal gingiva (Fig. 1).

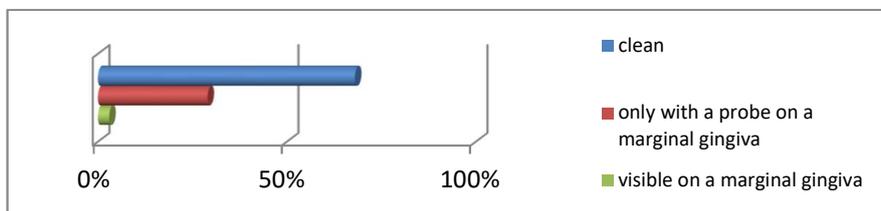


Fig. 1. Number and percentage of subjects with clinical findings for dental plaque (n=100).

Table 1 shows the correlation between the clinical finding for the dental plaque of the upper molars and the results generated from the answers obtained from the questionnaire, which concern subject oral health and behavior.

Table 1. Correlation of the clinical finding for dental plaque of the upper molars and the subject oral health and behavior.

	Toothbrushing frequency	Fluoride toothpaste use	Toothbrushing in the morning	Toothbrushing in the evening	Interdental areas cleansing
Spearman	-,052)	-,075)	-,053)	-,215)	-,023)
P	,601	,651	,456	,312	,534
N	100	100	100	100	100

3.2 Dental plaque of lower molars

45% of the subjects had dental plaque on their lower molars, upon clinical examination visible with a probe on the marginal gingiva, 20% had dental plaque which is visible on the marginal gingiva, and in somewhat more than a third (35%) the finding was a pure surface (Fig. 2).

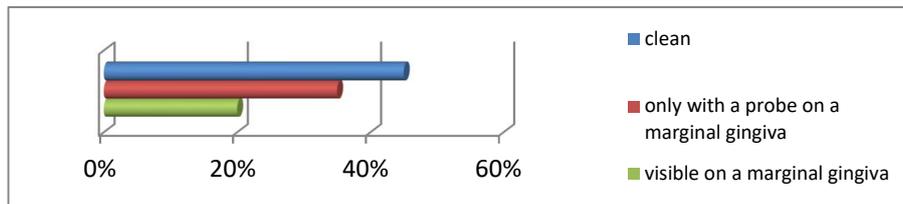


Fig. 2. Percentage of subjects with a dental plaque on the lower molars upon clinical examination.

Table 2 shows the correlation between the clinical finding for the dental plaque of the lower molars and the results generated from the answers obtained from the questionnaire, which concern subject oral health and behavior.

Table 2. Correlation of the clinical finding for dental plaque of the lower molars and the subject oral health and behavior.

	Toothbrushing frequency	Fluoride toothpaste use	Toothbrushing in the morning	Toothbrushing in the evening	Interdental areas cleansing
Spearman	-,071)	-,055)	-,053)	-,145)	-,041)
P	,821	,275	,456	,125	,254
N	100	100	100	100	100

3.3 Dental calculus – lower incisors

More than half of the subjects in the research had calculus on their lower incisors which is found supra and subgingival (56%). In 40% of the subjects, calculus was detected supragingivally, and in only 4% no calculus was detected on lower incisors (Fig. 3).

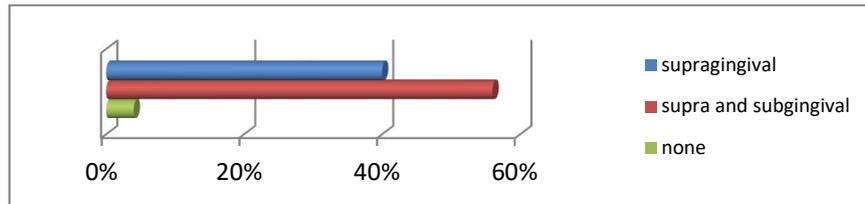


Fig. 3. Percent of subjects with clinical findings for dental calculus on lower incisors.

Table 3 shows the correlation between the clinical finding for the dental calculus of the lower incisors and the results generated from the answers obtained from the questionnaire, which concern subject oral health and behavior.

Table 3. Correlation of the clinical finding for dental calculus of the lower incisors and the subject oral health and behavior.

	Toothbrushing frequency	Fluoride toothpaste use	Toothbrushing in the morning	Toothbrushing in the evening	Interdental areas cleansing
Spearman	-,358	,245	,134	-,044	-,682
P	,089	,655	,121	,147	,492
N	100	100	100	100	100

3.4 Periodontal pockets on the upper molars

Periodontal pockets on the upper molars was not present in only 19% of the subjects. In subject that had periodontal pockets upon the clinical check, mostly they were found supragingival (46%), and somewhat less supra and subgingival (35%) (Fig. 4).

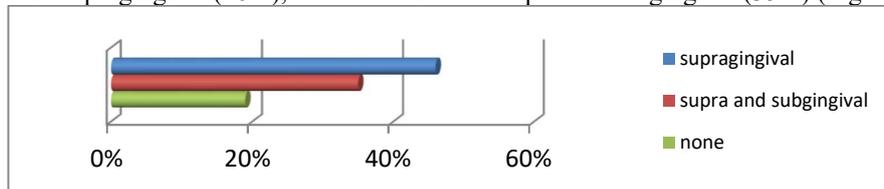


Fig. 4. Distribution of the findings for existence of periodontal pockets in upper molars upon clinical examination.

Table 4 shows the correlation between the clinical finding for the periodontal pockets of the upper molars and the results generated from the answers obtained from the questionnaire, which concern subject oral health and behavior.

Table 4. Correlation of the clinical finding for periodontal pockets of the upper molars and the subject oral health and behavior.

	Toothbrushing frequency	Fluoride toothpaste use	Toothbrushing in the morning	Toothbrushing in the evening	Interdental areas cleansing
Spearman	-,134	-,011	-,111	-,014	-,006
P	,176	,911	,263	,889	,955
N	100	100	100	100	100

3.5 Periodontal pockets – lower molars

Periodontal pockets on the lower molars were present in 69% of the subjects upon clinical examination, in 40% the pockets were located supragingivally, and in 29% supra and subgingival (Fig. 5).

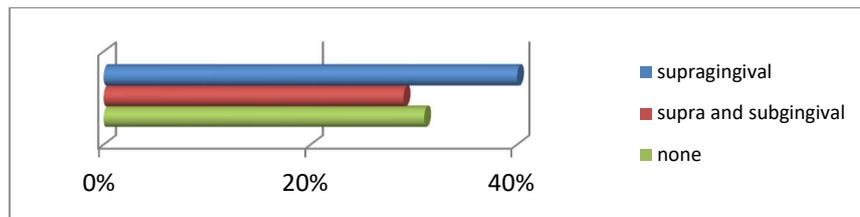


Fig. 5. Distribution of the findings for existence of periodontal pockets on the lower molars upon clinical examination.

Table 5 shows the correlation between the clinical finding for the periodontal pockets of the lower molars and the results generated from the answers obtained from the questionnaire, which concern subject oral health and behavior.

Table 5. Correlation of the clinical finding for periodontal pockets of the lower molars and the subject oral health and behavior.

	Toothbrushing frequency	Fluoride toothpaste use	Toothbrushing in the morning	Toothbrushing in the evening	Interdental areas cleansing
Spearman	-,277**	-,023)	,013	-,213*	-,169)
P	,005	,818	,901	,031	,089
N	100	100	100	100	100

4 Discussion: motive for introduction of lasers in dental practice

Assessment of oral health in the elderly population, people older than 60 years, has shown that demographic characteristics of the subjects contribute to differences in the oral-health state determined during the clinical examination of our patients.

Although dental plaque is a primary etiological agent responsible for the development of periodontal diseases, there is a significant difference in the grade and severity of tissue damage among individuals, teeth and their location. The clinical finding for presence of periodontal pockets in the upper molars showed that only 17% of patients had no periodontal pockets, indicating the existence of periodontal disease in the larger number of our patients. Introduction of lasers in dentistry would significantly improve the treatment of teeth and soft tissues.

The results differ from those obtained from the clinical examination in the study in Lithuania [9], where only 1% of the subjects did not have periodontal pockets, while 60% of the subjects had periodontal pockets with depths of 4-5 mm, and in 70% of the examinees the depth of the pockets was 6 mm and more. In the Lithuanian study, dental plaque, calculus and periodontal pockets were present in all clinically examined subjects, and in 70% of them periodontal pockets were recorded, with a depth of 6 mm and more.

The results of the research in Lithuania show that only 13% of the subjects did not detect the presence of dental plaque, 35% were present in the marginal gingiva, and 52% was visible only with a probe of the marginal gingiva.¹⁸ Compared with the results of our research leads us to conclude that the condition of periodontal and teeth in elderly patients is at a very low level both in Lithuania and in the Republic of Macedonia.

A survey done in the UK for the presence of dental plaque at different ages of the examined groups [10] suggests that the prevalence of dental plaque and periodontal disease was 33% in adult patients over 60 years of age who had natural teeth in the mouth, while in 54% of adults the periodontal pockets were deeper than 3.5 mm. Although a severe form of periodontal disease was relatively rare in the findings, 31% of people aged 65 years and more noted the existence of deep periodontal pockets, with a depth of 6 mm or more. It has been found that if more teeth are preserved in old age, there is a possibility of improving oral hygiene among a large number of older people in the United Kingdom.

The results in our study also differ from the results of a recent cross-section study in Denmark [11], which was conducted on a random sample of 1,115 adult respondents grouped in age groups 35-44 and 65-74 years old. A large percentage of older respondents found a serious disorder of the periodontal condition, i.e., more than 82% had pockets with depths of 4-5 mm or deeper, while in the younger group, this percentage was twice lower (42%). In both age groups, the average number of teeth that had periodontal pockets deeper than 4-5 mm was higher for people with low levels of education. Analyzes of the results of the clinical trial showed that respondents with low or middle level education had significantly more teeth with shallow and deep periodontal pockets than those with higher education.

Laser dentistry can be a precise and effective way to perform many dental procedures. As the applications for dental lasers expand, greater number of dentists will use the technology to provide patients with precision treatment that may minimize pain and recovery time.

4.1 Benefits

- Procedures performed using soft tissue dental lasers may not require sutures (stitches).
- Certain procedures do not require anesthesia.
- Minimizes bleeding because the high-energy light beam aids in the clotting (coagulation) of exposed blood vessels, thus inhibiting blood loss.
- Bacterial infections are minimized because the high-energy beam sterilizes the area being worked on.
- Damage to surrounding tissue is minimized.
- Wounds heal faster and tissues can be regenerated [12].

4.2 Types of Dental Lasers

The Food and Drug Administration (FDA) has approved of a variety of hard and soft tissue lasers for use in the dental treatment of adults and children. Because dental lasers boast unique absorption characteristics, they are used to perform specific dental procedures.

Hard Tissue Lasers: Hard tissue lasers have a wavelength that is highly absorbable by hydroxyapatite (calcium phosphate salt found in bone and teeth) and water, making them more effective for cutting through tooth structure. Hard tissue lasers include the Erbium YAG and the Erbium chromium YSGG. The primary use of hard tissue lasers is to cut into bone and teeth with extreme precision. Hard tissue lasers are often used in the “prepping” or “shaping” of teeth for composite bonding, the removal of small amounts of tooth structure and the repair of certain worn down dental fillings.

Soft Tissue Lasers: Soft tissue lasers boast a wavelength that is highly absorbable by water and hemoglobin (oxygenating protein in red blood cells), making them more effective for soft tissue management. Commonly used soft tissue lasers include Neodymium YAG (Nd:YAG) and diode lasers, which may be used as a component of periodontal treatment and have the ability to kill bacteria and activate the re-growth of tissues. The carbon-dioxide laser minimizes damage to surrounding tissue and removes tissue faster than the fiber optic method. Soft tissue lasers penetrate soft tissue while sealing blood vessels and nerve endings. This is the primary reason why many people experience virtually no postoperative pain following the use of a laser. Also, soft tissue lasers allow tissues to heal faster. It is for this reason that a growing number of cosmetic dental practices are incorporating the use of soft tissue lasers for gingival sculpting procedures [13].

A very common phenomenon discovered in the elderly is fibrous hyperplasia, which appears as a result of long-term wearing of uncomfortable prosthesis that leads

to irregular oral functioning. Fibrous hyperplasia is treated by surgical incision using a scalpel, together with removal of the source of chronic trauma. However, scalpel techniques do not provide the hemostasis that is necessary when dealing with highly vascular tissues.

The results presented in the study of M.B.F. Amaral et al. demonstrated that diode laser surgery can be used in the management of oral tissues due to its high absorption by water and hemoglobin, and has provided good results in both periodontal surgery and oral lesions. They compared the effects of diode laser surgery to those of the conventional technique in patients with fibrous hyperplasia. A randomized clinical trial was performed in which surgical and postoperative evaluations were analyzed. On comparison of the laser-treated (study group) patients to those treated with a scalpel (control group), significant differences were observed in the duration of surgery and the use of analgesic medications. Over a 3-week period, clinical healing of the postoperative wound was significantly faster in the control group as compared to the study group. They concluded that diode laser surgery proved to be more effective and less invasive when compared to scalpel surgery in the management of fibrous hyperplasia [14].

Laser Assisted New Attachment Procedure (LANAP) is a relatively new treatment option that helps remove plaque and calculus, while limiting bacterial infection to help fight periodontitis by regenerating rather than resecting tissues. LANAP helps to remove infection causing bacteria in a safe and painless procedure that promotes epithelial and periodontal fiber attachments in the affected area. The use of the laser is guided by a microscope offering a less invasive, highly precise approach. Modern techniques using lasers can control the spread of harmful bacteria and limit tooth loss compared to standard periodontal treatment options. Some benefits of laser treatment for gum disease include: elimination of cutting and bleeding, soreness and discomfort of the gums. Isolation of deep periodontal pockets. Reduction in tooth loss. Regeneration of bone and ligament tissues [15].

The study published by Marteli et al. revealed that the application of PERIODontal Bio Laser Assisted therapy might “eradicate” the periodontal disease. This study, the world's largest to date with the longest recorded microbiological follow-up period of 24 months, demonstrated that the PERIOBLAST treatment successfully eradicated periodontal disease in 100% of 2,683 patients. Treating periodontal disease with antibiotics and invasive surgery or tooth extraction is ineffective in eradicating the disease, as the periodontal pathogens live below the gum line and colonise in poorly or non-vascularised areas. The antibiotics can reduce the presence of pathogens in the pockets but they cannot penetrate the biofilm to reach the dentine where further bacteria live. PERIOBLAST involves microbiologically-guided Nd:YAG laser irradiation of periodontal pockets, in conjunction with scaling and root planning. The use of the laser is guided by a microscope offering a less invasive, highly precise approach [16].

The results obtained in other studies, which demonstrate the benefits of lasers in treatment of oral diseases, have motivated us to conduct an investigation for application of laser therapy in the elderly population. We expect to get interesting and significant results in the future.

5 Conclusions

This paper presents a cross-sectional study which analyzed the condition in oral health in patients aged 60 years and older, in the Republic of Macedonia.

The results obtained in our research provide important basic data on various aspects of oral health and oral health behavior of people aged 60 years and older, with a special accent on knowledge, attitudes and oral health habits of these subjects. Education is a significant factor in oral health behavior, but, for improving oral health habits, continual education is necessary, as well as broadening the knowledge for better oral health in this population in R. Macedonia. Our results have pointed out that there are many areas in the dental education that are to be resolved within the framework of the programs for the elderly: programs aimed at overcoming the lack of knowledge related to oral health in the elderly, periodontal diseases and oral cancer, by which those who seek dental care would greatly benefit. Subjects with higher level of education had better knowledge about the oral health and better oral health behavior.

The clinical finding of dental plaque is in a positive correlation with sex and age of patients, and in a negative correlation with the degree of education. Clinical examination of our subjects showed findings of dental plaque, dental calculus and periodontal pockets. More than a half of our patients had dental plaque on the lower incisors, and only 19% of the patients had no periodontal pockets at the time of the clinical examination. In the time when engineering and ICT are becoming integral part of dentistry, and thus oral health, the introduction of laser dentistry would significantly improve the treatment of teeth and soft tissues in this age-category of adults. Soft tissue lasers are particularly important since they may be used as a component of periodontal treatment as well as after tooth extraction for faster tissue healing. Also, presently there are no studies comparing laser treatment methods and traditional methods. Additional research is necessary in order to determine this, as well as the broader effect of laser therapy in dental practice.

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