

Comparative Analysis of Clinical and Functional Parameters of the Dental Gingival Complex in Patients with a Low Height of the Clinical Crown of the Tooth

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Abstract

Currently, one of the most common types of prosthetics are restorative crowns or bridges, which cannot provide high-quality retention and long-term fixation with a low crown of supporting teeth. For an orthopedic dentist, the question arises of choosing a method of preparation before prosthetics.

In this work, a comprehensive examination and treatment of 95 patients with a low crown of supporting teeth was carried out, who were randomized (: better to say divided or distributed) into 3 groups according to the methods of preparation for orthopedic treatment – gingivoretraction, gingivectomy and gingivoplasty. The change in the state of the dentoalveolar “may be periodontal complex I don't know” complex was carried out clinically and functionally. The hygienic index API, papillary bleeding index PBI, the index of need for periodontal treatment - CPITN, gum recession and depth of probing were determined. Laser Doppler flowmetry was used to assess the state of local blood flow and vasomotor activity of vessels. The studied parameters were evaluated before the start of preparation for orthopedic treatment and after 14 days.

During the study, complications and side effects were not revealed, however, clinical and functional indicators indicate that preference should be given to gingivoplasty as one of the qualitative methods of preparing the dentoalveolar complex in patients with a low crown of supporting teeth.

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Introduction

A low clinical crown height is a common phenomenon in the clinic of orthopedic dentistry^{1,2}. This fact causes a lot of inconvenience, and sometimes it is a relative contraindication to prosthetics, since adequate fixation of fixed orthopedic structures requires a sufficient height of the stump of the tooth to ensure the longest possible path of insertion of the prosthesis³. The so-called contact area is necessary for the mechanical retention of the

structure. For prosthetics of patients with this problem, it is necessary to resort to a number of methods aimed at improving the conditions affecting the fixation of the future prosthesis. There are many ways to improve the fixation conditions features⁴.

The low crown of the supporting teeth is one of the main aspects when drawing up creating an orthopedic treatment plan. The small area of the stump tooth does not provide high-quality and reliable fixation of the orthopedic structure⁵. The dentist is faced with the task of choosing the right method of preparing the tooth for the upcoming prosthetics. The methods of choosing preparation for orthopedic treatment are such methods as gingivoretraction, gingivectomy or gingivoplasty, providing macroscopic retention of the manufactured tooth crown and the necessary height of the supporting tooth⁶.

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Gingivoretraction is a dental manipulation for the temporary expansion and deepening of the dental sulcus. Mechanical retraction using a retraction thread cord is one of the most common methods at a dental appointment. However, it should be remembered that if this manipulation is carried out poorly, damage to the dental gingival complex may occur with the development of an inflammatory process at the initial stage, which later leads to a gum recession.

The gingivectomy method is used quite often with the growth of gingival tissue in the oral cavity. This dental manipulation involves cutting off the excess part of the soft tissue with a scalpel. This method is used extremely rarely, mainly in patients with a "gingival" smile⁷. After the procedure, it is mandatory to carry out antiseptic treatment and applying a special bandage for 48 hours to prevent infection and quickly stop the inflammatory potential probability.

Today gingivoplasty is one of the most frequently used methods in aesthetic dentistry. In orthopedic dentistry, when performing this manipulation, the doctor is guided by the goal of removing excess, increasing the retention area of the stump of the supporting tooth⁸.

Thus, despite the wide variety of methods used to prepare for orthopedic treatment of supporting teeth, many areas require a more thorough clinical analysis and search for the most optimal suitable method that determines the success of orthopedic prosthetics. To date today, there are no unified specific clinical criteria for assessing the condition of the dental gingival complex at all stages of treatment, there are no basic principles of a differentiated approach to orthopedic treatment of patients with a low crown of supporting teeth⁹.

Currently, there are many ways that a dentist can use to increase the retention area of the supporting tooth, however, no clinical and functional assessment of the indicators of the dentoalveolar complex against the background of a particular method of preparation for orthopedic treatment has been carried out, which was the purpose of this study.

The purpose of the study: – to conduct carry out a comparative analysis of the clinical and functional parameters of the dental gingival complex in patients with a low height of the clinical crown of the tooth.

Materials and methods

A clinical comprehensive examination and treatment of 186 patients who applied for dental orthopedic care was carried out. According to the criteria for inclusion/exclusion of patients presented below, the research group included 95 people.

Criteria for inclusion of patients in the study:

1. Patients with low clinical tooth crowns
2. Patients with healthy periodontal tissues (no loss of clinical attachment)
3. Informed consent of patients.
4. Patients from 25 to 44 years old (young age according to WHO).

Criteria for excluding patients from the study:

1. Lack of informed consent of patients.
2. Patients with general somatic pathology in subcompensated and decompensated forms.

The average age of the patient was 34.4 ± 4.2 years. At the stage of orthopedic prosthetics, 108 crowns were made for patients, of which 87 (80.6%) were metal–ceramic, 9 (8.3%) were metal–free, and 12 (11.1%) were solid–cast. All patients according to the methods of preparation for orthopedic treatment were randomized divided into 3 groups. Gingivoretraction of the gum was performed in group I patients (32 people), gingivectomy was performed in the second group (31 people), and gingivoplasty of the dentoalveolar complex was performed in the third group (Fig. 1).



Figure 1. A patient at the stage of preparation for orthopedic treatment.

The clinical study included anamnesis collection and clinical examination according to

the "gold standard" principle. Particular attention was paid to the measurement of the dentoalveolar complex to the top of the alveolar ridge using a graduated probe, in order to determine the position of the alveolar ridge and the biological width.

The clinical success of treatment was assessed by the odds ratio, which is expressed by the ratio of increased risk and normal susceptibility. To determine the risk factors, the so-called predictor factors that can provoke the development of inflammation of the dental gingival complex, the following indices were used – approximate plaque index - API, papillary bleeding index (PBI), periodontal index of need for treatment (CPITN), gum recession index according to Miller. The algorithm of diagnosis and management of patients was as follows. A comprehensive step-by-step examination was carried out. At the first stage, an anamnesis of the patient's life and diseases was collected with the identification of existing risks (acquired or genetic level). At the second stage, clinical data were collected before the start of preparation for orthopedic treatment: assessment of periodontal status, the level of gum recession, furcation involvement, pocket activity, tooth mobility, assessment of gum inflammation with hygienic indices (Fig. 2).



Figure 2. Determination of hygiene indices in the oral cavity.

At the primary level, clinical data was recorded (the "gold standard"). Initially, visual diagnostics was performed using a dental mirror, special attention was paid to the accumulation of plaque, the detection of gum recession (Fig.3).



Figure 3. Determining the type of gum recession.

The clinical examination at each stage included measuring the depth of pocket probing and attachment loss (Fig.4).

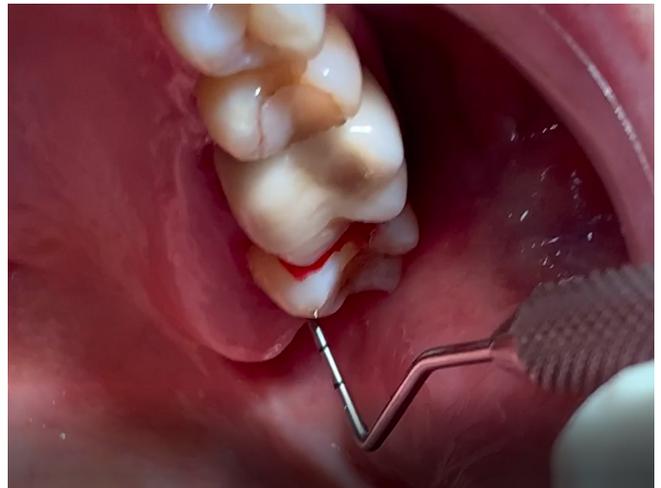


Figure 4. Determination of the depth of sounding by a graduated probe.

The probing force was 0.20 N, which corresponds to 25 g.

At the third stage, the assessment of the state of local gingival blood flow was performed using laser Doppler flowmetry. A laser Doppler flowmetric study was conducted carried out to analyze hemodynamic parameters. The assessment of microcirculatory changes in capillary blood flow, as a consequence of a local inflammatory (vascular) reaction against the background of the treatment.

The results of the study of the condition of the dentoalveolar complex were evaluated before the start of its preparation for orthopedic treatment and on the 14th day after treatment.

Processing and analysis of the received information was carried out using the Microsoft

Windows 10 operating system. Statistical processing of the obtained results was performed in the Statistica 13.0 program. Statistical analysis will be carried out by the method of variational statistics with the determination of the average value (M), its average error ($\pm m$), evaluation of the reliability of the difference between groups using the Student's criterion (t), at $p < 0.01$, $t \geq 2$.

Results

Prior to the start of the preparation of the dentoalveolar complex, oral hygiene was determined in patients with a low crown of supporting teeth, based on the indicators of which professional teeth cleaning was performed. Thus, API was 69%, papillary bleeding index PBI - 28%, CPITN - 2.1 ± 0.3 points. When probing the dentoalveolar furrow periodontal sulcus, the depth of immersion was determined to be 2.7 ± 0.2 mm.



Figure 5. Suturing after gingivoplasty.

After 14 days, the following values were obtained when evaluating clinical indicators (Table).

Indicators	API, %	PBI, scores	CPITN, scores	Miller	Depth of sounding, mm
Before starting therapy	69 \pm 14,3	2,1 \pm 0,2*	2,1 \pm 0,3	1,1 \pm 0,1	2,7 \pm 0,2
14 days after gingivoretraction	38 \pm 9,6	2,0 \pm 0,1*	0,8 \pm 0,2	1,0 \pm 0,2	2,7 \pm 0,2
14 days after gingivectomy	34 \pm 11,2	2,1 \pm 0,2*	1,2 \pm 0,1	1,3 \pm 0,1	2,7 \pm 0,2
14 days after gingivoplasty	26 \pm 4,1	0,8 \pm 0,2*	0,5 \pm 0,1	1,1 \pm 0,2	2,7 \pm 0,2

Table 1. Clinical indicators before the start of therapy and after 14 days according to the methods of preparation for prosthetics.

Note: * - statistical significance of differences relative to the indicators of the third group, at $p < 0.05$.

Then, according to randomization, patients underwent one of the methods of preparing the dentoalveolar complex for orthopedic treatment - gingivectomy, gingivoretraction and gingivoplasty (Fig.5)

Based on the presented table, it follows that the depth of sounding has not changed both in all groups and in its original indicators and corresponds to the normalized values. The PBI bleeding index is a fairly sensitive indicator of the stage of gingival inflammation. With the help of this index, it is possible to judge the effectiveness of the treatment. Thus, the PBI in the third group was 0.8 ± 0.2 points, which indicates mild inflammation after the treatment. These values are statistically significantly different relative to the comparison groups and the initial data. In the first and second groups, the bleeding index practically did not change and characterizes the average inflammation of the dentoalveolar furrow periodontal sulcus. The CPITN index in patients of all groups decreased statistically significantly relative to the indicator before treatment. Thus, the index of need for periodontal treatment in patients after gingivoretraction decreased by 2.6 times (at $p < 0.05$), in the second group - by 1.75 times ($p < 0.05$) and in the third - by 4.2 times ($p < 0.05$), which indicates that there is practically no need for professional oral hygiene.

The level of oral hygiene in the study groups significantly improved in all groups relative to its initial indicator ($p < 0.05$), there was no statistically significant difference in the comparison groups ($p > 0.05$). As for the gum recession, it is visualized within the free edge of the gum, its complete elimination is possible.

Based on the clinical indicators, it can be concluded that no complications were detected in any group, the prognosis for the restoration of dental attachment is favorable.

During the laser Doppler flowmetric study, the following values were obtained (Table 2).

Indicators	M, пф.ед.	σ , пф.ед.	Kv, %
Before starting therapy	28,4 \pm 2,2	3,04 \pm 0,2	10,8 \pm 0,2
14 days after gingivoretraction	27,3 \pm 4,1	2,28 \pm 0,4	8,3 \pm 0,5
14 days after gingivectomy	26 \pm 2,8	1,63 \pm 0,5	6,2 \pm 0,4
14 days after gingivoplasty	28,3 \pm 3,1	4,34 \pm 0,2	15,3 \pm 0,6

Table 2. LDF-metric indicators at the stages of the study.

The microcirculation parameter (M) and the mean square deviation standard deviation (σ) are variable components, on the basis of which it is almost impossible to judge the state of local blood flow in the studied area. A reliable and accurate indicator is the coefficient of variation (Cv), which significantly increased in the group of patients who underwent gingivoplasty and amounted to $15.3 \pm 0.6\%$, which is 1.4 times more than the same indicator before the start of preparation for orthopedic treatment ($p < 0.05$). Statistically, the significance of the differences in this indicator is also noted relative to the first and second comparison groups. An increase in the coefficient of variation, an improvement in vasomotor activity of blood vessels, and an improvement in the state of basal blood flow in the fourth group of patients indicates that gingivoplasty may be one of the methods of choosing preparation for orthopedic treatment of patients with a low crown of supporting teeth.

Discussion

Today in orthopedic dentistry, restorative crowns are one of the most common forms of prosthetics. Currently, the problem of orthopedic treatment of patients with a low coronal part of the tooth is relevant at the dental appointment. Factors - predictors are increased abrasion, dental anomalies, deformation of the occlusal surface. A number of authors propose an improved non-removable one-piece inlay-crown design, which makes it possible to solve the problem of reliable fixation of single crowns¹⁰. However, a sufficient retention area of the abutment tooth is essential for a high-quality construction. At the moment, there is no systematization of methods of preparation for orthopedic treatment with a low crown of abutment teeth. Correct, competent preparation of the periodontal sulcus in patients with a low crown of abutment teeth is the key to successful prosthetics. One of the unsolved problems is the quantitative determination of the calculation of the required retention area, the analysis of the area taking into account the biomechanical characteristics of the tooth would make it possible to carry out a differentiated and reasonable choice of preparation of the periodontal joint, while not additionally injuring the dentoalveolar attachment. The literature contains data on the development of average

values of clinical crowns of abutment teeth, together with an analysis of the magnitude of stresses arising in abutment teeth under the action of a functional load, allows to substantiate the clinical tactics of choosing support elements for non-removable orthopedic structures.

Verstakov D.V. and the authors have developed an algorithm for the management of patients with a low crown of abutment teeth. However, this did not take into account the possibilities and approaches to increasing the height of the crown of the tooth by correcting the gingival margin¹¹. In the work of other scientists "Preparation and prosthetics of patients with low clinical crowns of teeth", surgical lengthening of the clinical crown of the tooth was performed with further assessment of periodontal tissues after surgical correction by Doppler flowmetry, the difference in biotypes was not taken into account and a differentiated approach was not applied in treatment based on the results of the study of the gingival complex¹². Thus, the problem of restoring teeth with low crowns of abutment teeth has not been completely solved. Emphasis should be placed on the functionality of the crown part of the tooth, first prepare the working field for prosthetics, including one of the proposed methods - gingivotomy, gingivoretraction or gingivoplasty. Thus, the issues of studying the features of the preparation of periodontal tissue for orthopedic treatment with a low crown of abutment teeth require further multifaceted research based on a biomechanical approach and the principles of evidence-based medicine.

Conclusions

As a result of the study, clinical and functional values of the dentoalveolar joint periodontal or gingival ligament were obtained before and after one of the methods of preparation for orthopedic treatment: gingivoretraction, gingivectomy and gingivoplasty. As a result of a comprehensive clinical examination, objective data were obtained indicating the success of the therapy. No complications were detected at any stage. Subject to further cooperation of patients with the attending physician and compliance with all recommendations, the prognosis is favorable. However, based on the data on the state of local blood flow and according to the clinical examination, preference should be given to

gingivoplasty as the most gentle method of preparing for orthopedic treatment of patients with a low crown of supporting teeth.

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Declaration of Interest

The authors report no conflicts of interest pertaining to any of the products or companies discussed in this article.

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