



Digital study of interocclusal contact points in patients with partial tooth loss in case of immediate and nearest implantation prosthetics

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Summary

The main purpose of this study was to study the qualitative and quantitative characteristics of occlusal ratios of dentitions in patients with partial loss of teeth replaced by preliminary direct or proximal dental implants-prostheses to prevent complications on the masticatory muscles and the temporomandibular joint.

The article presents a detailed analysis of the interocclusal relations of dentitions in patients with partial tooth loss before and after prosthetics, including an assessment of the interocclusal contact points, their multiplicity, uniformity and strength of masticatory pressure, the presence of premature contacts, the trajectory of the overall direction of occlusal load, occlusal balance between the left and the right sides of dentition.

The assessment of interocclusal relationships in the control and main groups was carried out using an available, simple, and unbiased digital device "T-Scan III" (Tekscan, USA).

Keywords: occlusal balance; inter-occlusal; relations, contact points.

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Introduction. According to the World Health Organization, a partial tooth loss occurs in 75% of the population in various regions of the Russian Federation.¹⁻⁶ Often, prolonged absence of teeth provokes the development of hypertension of the masticatory muscles and changes in the temporomandibular joint.⁷⁻⁹ Optimization of treatment methods for patients with these diseases is the main task for orthopaedic dentists.⁹⁻¹¹

However, the currently available diagnostic and therapeutic means for patients with partial loss of teeth during prosthetics are rather ambiguous and far from always effective.

It is known that a direct and partly an immediate implantation prosthetics contributes to the speedy restoration of impaired aesthetic and functional norms, urgently transferring patients from the state of disability to the category of high quality of life.¹²

The absence of quantitative and qualitative parameters of the nature and strength of the closure of the dentitions in persons with partial tooth loss increases the risk of occurrence or aggravation of the clinical picture due to hypertension of the masticatory muscles proper.^{13,14} The difficulties of its relief at the stage of immediate, as well as the nearest implantation prosthetics explain the need to study this urgent problem and create a comprehensive rehabilitation system for these patients. The peculiarities and the urgent nature of immediate implantation prosthetics often lead to occlusal disorders, the absence of multiple occlusal contacts or smooth articulation movements, blocking the lower jaw movements. All these disorders can provoke or aggravate the appearance of muscle spasms and muscle hypertension. In this regard, it is extremely urgent to develop measures for the prevention and relief of both muscle hypertension itself and partial tooth loss.

Material and methods: A comprehensive examination of 30 patients with partial tooth loss (involved, terminal, combined defects of the upper and/or lower dentition) was carried out. The control group included 40 practically healthy subjects with intact dentitions and orthognathic bite. The inclusion criteria for patients in the study were the presence of positive motivation for implantation prosthetics, the age of the subjects between 40 and 75 years, a satisfactory or good state of oral hygiene, healthy oral mucosa, sufficient volume of the jawbone and its high density, sufficient prosthetic space, absence of endocrine diseases or connective tissue diseases. The exclusion criteria were: lack of positive motivation for implantation prosthetics, age of the subjects under 40 years and over 75 years, poor state of oral hygiene, alcohol and tobacco abuse, chronic periodontitis of moderate and severe degrees, significant atrophy of the alveolar parts of the jaws, insufficient

density of the jawbone, osteoporosis, small (insufficient) prosthetic space, the presence of endocrine diseases, immunodeficiency, blood coagulation diseases, radiation and chemotherapy, systemic corticosteroid therapy. The inclusion criteria for the subjects of control group were the normal tone of masticatory muscles, orthognathic bite.

The exclusion criteria for the control group were increased or decreased masticatory muscle tone, the presence of concomitant diseases.

To study the occlusal relationships, to determine the presence of premature contacts and the distribution of occlusal load between the teeth in the control and main groups, we used the device "T-scan III" (Tekscan, USA), which has the shape of a dental arch with a sensor 0.3 mm thick and the Microsoft Windows software.

For the purpose to check the uniformity and multiplicity of interdental contacts of equal strength throughout the entire dentition, the strength of occlusal pressure was evaluated before and after treatment. The following indices were recorded:

- 1) the presence of premature contacts
- 2) the location of the trajectory of the total (general) direction of the occlusal load:
 - to molars
 - to premolars
 - to central incisors.
- 3) occlusal balance between the left and the right sides of dentitions: 50%-50%; 40%-60%; 30%-70%.

Before starting the diagnosis, the width of the central teeth was measured in the patient, the data obtained were introduced into the corresponding graph of the program and the sensitivity of the sensor was set. After that, the patient was asked to close the teeth several times so that three- and two-dimensional graphical types of teeth closure appeared on the computer monitor. The trajectory of the force centre (the totality of the forces of all occlusal contacts) showed the dynamics of the movement of the force centre from the beginning of record to the current frame (the total trajectory of the occlusal load). The length of the trajectory (occlusal time) shows the time interval and symmetry of closure of the dentition (Kerstein, R.B., 2001). On the occlusiogram, the centre of force was displayed in the form of a diamond-shaped icon in red and white.

Results of research and their discussion

Occlusal contacts were studied in 30 patients with partial tooth loss both before and after treatment: at the stages of immediate (within 24 hours after surgery) and nearest (2-3 days) prosthetics. Characteristic features for persons with this form of the disease were disorders of the qualitative characteristics of the total occlusal load vector, in particular, such as the appearance of deviations in its direction. We assume that the noted changes registering irregularities in the uniformity of occlusal contacts in the position of central occlusion may be associated with a disturbed function of the masticatory muscles. In qualitative terms, occlusiograms obtained in patients with partial tooth loss before treatment differ from similar data of the control group. In particular, the location of the trajectory of the total occlusal load in persons with these forms of diseases before treatment had various options: towards the front teeth, towards the premolars to the right and left, as well as towards the molars to the right and left (Fig. 1a).

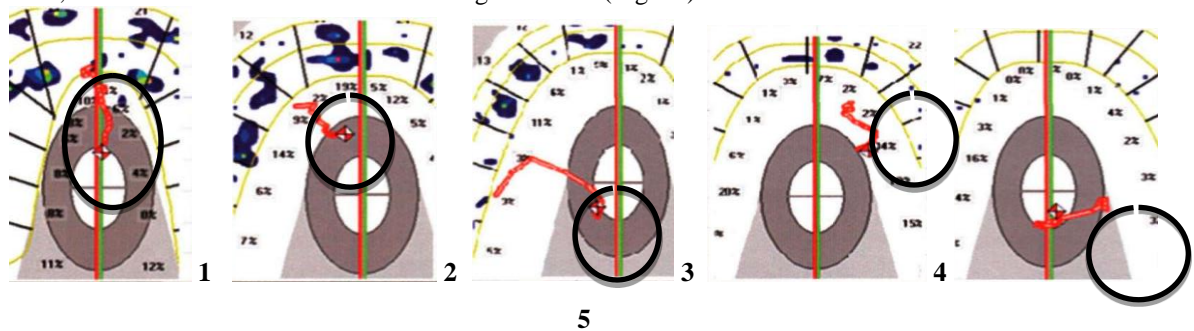
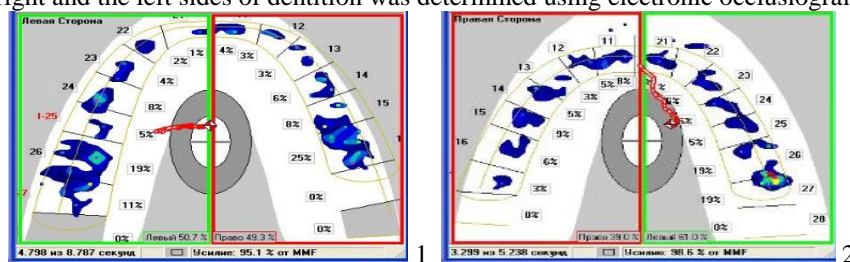


Fig. 1a. The main types of location of the total occlusal load trajectory in patients with partial loss of teeth before treatment: in the sagittal palatine suture area (1); in premolars on the right (2) and left (3); in molars on the right (4) and left (5). In addition, the quantitative distribution of occlusal load between the right and the left sides of dentition was determined using electronic occlusiograms (Fig. 1b).



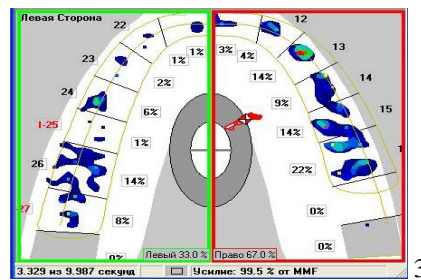


Fig. 1b. The main versions for the distribution of occlusal load in persons with partial tooth loss:
1 – 50%-50% optimal; 2 – 40%-60% satisfactory; 3 – 30%-70% unsatisfactory.

Thus, before treatment, 6 (20%) out of 30 patients with partial tooth loss were characterized by a shift in the trajectory direction of the total occlusal load towards the molars. In the other 10 (33.33%) patients, the trajectory was shifted towards the premolars. In the remaining 14 people (46.67%), the trajectory in the projection of the sagittal palatine suture was located towards the front teeth. On the day of applying the immediate pre-implantation prostheses and restoring the defects of dentitions to the required interalveolar height, the following results were obtained. In 18 (60%) of 30 subjects, the trajectories of the total occlusal load were projected to the sagittal palatine suture. In 7 (23.33%) patients, the trajectories of the total occlusal load were directed towards the premolars, and in 5 (16.67%) patients towards the molars. 2 weeks after the performed treatment, the individuals with partial tooth loss tended to have a straight-line arrangement of the total load trajectory in the position of the central occlusion, approaching the results of the control group. Premature contacts were not revealed. The greatest occlusal effect was observed around the first and second molars. Deviation of the trajectory of the total occlusal load vector, while maintaining the correct trend of direction from the front teeth to the lateral ones, was noted in 22 (73.33%) of 30 patients. The permissible deviation of the trajectory of the total occlusal load vector towards the premolars was observed in 5 (16.67%) of 30 patients, the unacceptable deviation towards the molars in 3 (10%).

Table 1. Results of "T-scan III" occlusal analysis in patients with partial tooth loss (trajectory direction of the total occlusal load)

Characteristics obtained when using the "T-scan III"	Before treatment (n=30)		After treatment (n=30)			
	Abs. number	%	1 day		14 days	
			Ab. number	%	Abs. number	%
The trajectory direction of the total occlusal load:						
Shift towards incisors	14	46,67	18	60,0	22	73,33
Shift towards premolars	10	33,33	7	23,33	5	16,67
Shift towards molars	6	20,0	5	16,67	3	10,0
Total	30	100	30	100	30	100
<i>Note:</i> The number of degrees of freedom is 4; the χ^2 criterion value is 4,505; the critical value of χ^2 at the significance level $p < 0.05$ is 9,488; the relationship between factorial and performance signs is not statistically significant, the significance level is $p > 0.05$ ($p = 0.342$). However, there is a tendency towards a difference, although the volume of observations is apparently insufficient for its statistical implementation.						

Before treatment, in 7 out of 30 (23.33%) patients, the occlusal balance between the left and the right sides of dentition was 50% to 50%. In 14 out of 30 (46.67%) patients, this ratio made 40% to 60%, in 9 out of 30 (30%) patients – 30% to 70%. In our opinion, the detected asymmetry of contacts on occlusiograms was associated with the habit of chewing on one side, which, in turn, is due to partial loss of teeth, unsuccessful previous prosthetic treatment, as well as the presence of hypertension of the masticatory muscles. On the day of applying the immediate pre-implantation prostheses, 18 (60%) out of 30 subjects with partial loss of teeth restored the optimal balance of occlusal load between the left and the right sides of dentition (50% to 50%). In 7 (23.33%) patients with partial tooth loss, the occlusal balance was 40% to 60%, and in 5 (16.67%) – 30% to 70%. At the stage of the nearest pre-implantation treatment, 25 (83.33%) out of 30 patients had the optimal occlusal equilibrium (50%-50%) between the right and the left sides, the permissible one (40%-60%) – in 3 (10%), the unacceptable (30%-70%) – in 2 (6.67%), table 2.

Table 2 Results of "T-scan III" occlusal analysis in patients with partial tooth loss (occlusal balance)

Characteristics obtained when using the "T-scan III"	Before treatment (n=30)		After treatment (n=30)			
			1 day		14 days	
	Absolute number	%	Absolute number	%	Absolute number	%
Occlusal balance:						
Optimal 50%-50%	7	23,33	18	60,0	25	83,33
Sufficient 40%-60%	14	46,67	7	23,33	3	10,0
Insufficient 30%-70%	9	30,0	5	16,67	2	6,67
Total	30	100	30	100	30	100
<i>Note:</i> The number of degrees of freedom is 4; the χ^2 criterion value is 22.255; the critical value of χ^2 at the significance level $p=0.01$ is 13.277; the relationship between factorial and performance characteristics is statistically significant at the significance level of $p<0.01$. Therefore, there is evidence of a difference.						

Thus, the timely diagnostic examination of patients with partial tooth loss contributed to restoration of the optimal occlusal balance, the straight-line direction of the trajectory of the total occlusal load vector, and, therefore, to a uniform occlusal load, close in its values to the analogues of the control group.

Conclusions

A detailed analysis of occlusal relationships, both preserved and artificial teeth, was carried out using the T-scan device. According to the results of the study of qualitative and quantitative characteristics of occlusal relations, the optimal occlusal balance of dentitions after preliminary nearest implantation orthopaedic treatment was observed in majority of patients: 25 out of 30 (83.33%) with partial loss of teeth; satisfactory – in 3 (10.0%) patients with partial loss of teeth, unsatisfactory – only in 2 (6.67%) of the examined subjects with partial loss of teeth. Scanning of occlusal contacts before treatment allowed to determine the displacement of the trajectory of the total occlusal load towards the incisors in 14 (46.67%) of 30 patients with partial tooth loss, towards the premolars – in 10 (33.33%), towards the molars – in 6 (20.0%) people, respectively. After the preliminary nearest implantation orthopaedic treatment, the number of persons in whom the trajectory of the total occlusal load shifted towards the incisors increased to 22 (73.33%) out of 30 patients with partial tooth loss, decreased towards premolars, respectively, in 5 (16.67%) people, and toward molars – in 3 (10.0%) subjects, respectively.

Conflict of interest

Authors declare no conflict of interests.

Compliance with ethical standards

The authors confirm that the rights of people who participated in the study are respected, including obtaining informed consent in cases where it is necessary, and the rules for the treatment of animals in cases of their use in work. Detailed information is contained in the Rules for Authors.

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Ինտերօկլյուզալ կոնտակտային կետերի թվային ուսումնասիրություն ատամների մասնակի կորստով հիվանդների մոտ ուղիղ և անմիջական իմպլանտի պրոթեզավորումով

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Անվտոմում

Այս հետազոտության հիմնական նպատակն էր ուսումնասիրել ատամների մասնակի կորստով հիվանդների մոտ ատամնաշարի օկլյուզալ հարաբերությունների որակական և քանակական բնութագրերը, որոնք փոխարինվել են նախնական անմիջական կամ անմիջական իմպլանտների վրա հենված պրոթեզներով՝ ծամիչ մկանների ՔՄՄ-ի բարդությունները կանխելու համար: Հոդվածում ներկայացված է պրոթեզավորումից առաջ և հետո ատամների մասնակի կորստով հիվանդների մոտ ատամնաշարի միջօկլյուզիոն հարաբերությունների մանրամասն վերլուծությունը, ներառյալ միջօկլյուզիոն կոնտակտային կետերի գնահատումը, դրանց բազմակիությունը, ծամելու ճնշման միատեսակությունը և ուժը, վաղաժամ կոնտակտների առկայությունը, ծամողական ճնշման հետագծի ընդհանուր ուղղությունը, ատամնաշարի ձախ և աջ կողմերի միջև ծամողական հավասարակշռությունը: Գնահատվել է միջօկլյուզիալ հարաբերությունները հսկիչ և հիմնական խմբերում՝ օգտագործելով հասանելի, պարզ և օբյեկտիվ թվային սարք «T-Scan III» (Tekscan, ԱՄՆ):

Цифровое изучение межокклюзионных контактных пунктов у пациентов с частичной потерей зубов при непосредственном и ближайшем имплантационном протезировании

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Резюме

Основной задачей данного исследования являлось изучение качественных и количественных характеристик окклюзионных взаимоотношений зубных рядов у больных с частичной потерей зубов, замещенной с помощью предварительных непосредственных или ближайших зубных имплантационных протезов, с целью предотвращения осложнений со стороны жевательных мышц и височно-нижнечелюстного сустава. В статье представлен детальный анализ межокклюзионных взаимоотношений зубных рядов у пациентов с частичной потерей зубов до и после протезирования, включающий в себя оценку межокклюзионных контактных пунктов, их множественность, равномерность и силы жевательного давления, наличие преждевременных контактов, расположение траектории суммарного (общего) направления окклюзионной нагрузки, окклюзионное равновесие между левой и правой сторонами зубных рядов. Оценка межокклюзионных взаимоотношений у лиц контрольной и основной групп нами проводилась с помощью доступного, простого и объективного цифрового аппарата «T-Scan III» (Tekscan, США).