

DOI: 10.34921/amj.2023.2.015

Ye.V.Patalaxa¹, L.V.Çerkaşina², A.S.Şklyar³,
L.I.Kiptenko⁴, O.A.Yejova⁴, L.B.Vinniçenko⁴, N.V.Demixova⁴

ALT ÇƏNƏNİN SINIĞI OLAN XƏSTƏLƏRİN MÜALİCƏSİNİN VƏ REABİLİTASIYASININ MÜXTƏLİF MƏRHƏLƏLƏRİNDƏ AĞIZ BOŞLUĞU MAYESİNİN DƏYİŞMƏ DİNAMİKASI

Kiyev Tibb Universiteti¹, Xarkov Diplomdansonrakı Təhsil üzrə Tibb Akademiyası²,
Xarkov Milli Tibb Universiteti³, Sumı Dövlət Universiteti⁴, Ukrayna

Xülasə. Alt çənə nahiyəsindən travmaya məruz qalmış şəxslərin müalicəsinin müxtəlif mərhələlərində ağız boşluğu mayesinin xüsusiyyətini araşdırmaq məqsədilə tədqiqat aparılmışdır.

Ümumiyyətlə alt çənəsindən travmaya məruz qalmış 112 xəstənin stomatoloji statusu dispanserizasiyanın müxtəlif mərhələlərində tədqiq edilmişdir. Müalicənin başlanmasından əvvəl və müalicənin müxtəlif mərhələlərində sağalma proseslərinin gedişatına nəzarət etmək məqsədilə ağız boşluğu mayesinin biofiziki və biokimyəvi xarakteristikası müəyyənləşdirilmişdir.

Alt çənəsindən travma almış xəstələrdə aparılan klinik müşahidənin müxtəlif mərhələlərində ağız boşluğu mayesinin biokimyəvi və biofiziki xassələrində aşkar nəzərə çarpan dəyişikliklər baş vermişdir: immobilizasiyadan əvvəlki mərhələdə mayenin bufer tutumu immobilizasiyadan sonrakı I və II mərhələdəkinə nisbətən aşağı olmuş, immobilizasiyadan sonrakı mərhələdə isə əvvəl əldə edilmiş səviyyədən fərqlənməmişdir. Immobilizasiyanın I və II mərhələlərində ağız boşluğu mayesinin özlülüyü əhəmiyyətli dərəcədə artmış, postimmobilizasiya mərhələsində isə nisbətən azalmışdır; mayenin pH-nun orta qiyməti də azalmışdır və bu, ağız suyu ifrazının sürətinin də azalması ilə müşayiət edilmişdir. Ağız boşluğu mayesinin turşu-gələvi müvazinətinin sabitliyi isə bufer sistemi sayəsində təmin edilmişdir (22 %); mayenin pH-ı azalmış (23 %), özlülüyü (13 %) artmış və ağız suyunun sekresiyası (67 %) azalmışdır. Travma almış alt çənənin immobilizasiyası zamanı ağız suyunun qeyri-spesifik mühafizəedici amili olan lizosimin aktivliyi artmış, immobilizasiyadan sonrakı mərhələdə isə sürətlə azalmışdır. Bu isə ağız boşluğu mayesində mikroorqanizmlərin sürətlə artması ilə müşayiət edilirdi.

Açar sözlər: cərrahi stomatologiya, ağız boşluğu mayesi, reflektor-əzələ kontrakturaları

Ключевые слова: хирургическая стоматология, ротовая жидкость, рефлекторно-мышечные контрактуры

Key words: surgical dentistry, oral fluid, treatment, reflex muscle contractures

Olena Patalakha¹, Lidiya Cherkashyna², Anton Shklyar³,
Ludmila Kyptenko⁴, Olha Yezhova⁴, Lyudmila Vynnychenko⁴, Nadiia Demikhova⁴

CHANGES IN THE CHARACTERISTICS OF ORAL FLUID AT THE STAGES OF TREATMENT AND REHABILITATION OF PATIENTS WITH MANDIBULAR FRACTURES

Kyiv Medical University¹, Kharkiv Medical Academy of Postgraduate Education²,
Kharkiv National Medical University³, Sumy State University⁴, Ukraine

Summary. A study has been conducted to investigate the characteristics of oral cavity saliva at various stages of treatment in individuals who have sustained mandibular trauma.

At the stages of clinical monitoring, the biophysical and biochemical characteristics of oral fluid in 112 patients with mandibular injuries changed significantly: in the pre-immobilization period, the buffering capacity of oral fluid value was lower compared to that in the first and second immobilization periods, while in the post-immobilization period, it did not differ from the values reached. The viscosity of oral fluid increased significantly in the first and second immobilization periods, while in the post-immobilization

period, there was a relative decrease in this parameter; the mean group pH values also decreased; this occurred in the setting of a decrease in the salivation rate, and the maintenance of the acid-base balance of the oral cavity was provided by a decrease in buffering capacity of oral fluid (by 22.0%), a decrease in the pH of oral fluid (by 23.0%) with an increase in its viscosity (by 13.0%) and a decrease in the salivation rate (by 67.0%). When analyzing the state of local non-specific protection of oral fluid in patients with mandibular injuries, an increase in lysozyme activity was found in the first period and its rapid decrease in the post-immobilization period, which was accompanied by a significant increase in the degree of microbial contamination of the oral cavity, as indicated by changes in absolute and relative urease activity, as well as an increase in the degree of dysbiosis in the second immobilization and post-immobilization periods, which corresponded to the clinically decompensated stage of dysbiosis.

Introduction. Treatment of the maxillofacial region injuries, in particular, those of the mandibula, is one of the urgent tasks of maxillofacial surgery, and the high frequency of complications, primarily contractures, determines the need for further improvement of complex treatment, including timely and adequate use of rehabilitation measures [1,2]. In a system of complex treatment in patients with mandibular injuries, any of its periods, namely pre-immobilization, immobilization, and post-immobilization ones, are extremely significant, when in the setting of morphological substrate restoration, the state of periodontal tissues and restoration of the patient's psychophysiological state are crucial for recovery and full restoration of functions [3,4]. It can be provided by the functional approach to rehabilitation and an early start of the rehabilitation program. Modern trends in the treatment of patients with mandibular injuries are undergoing drastic changes, which is associated with the introduction of new modern surgical technologies, methods for assessing adaptive reserves, tactics for protecting periodontal tissues, and rehabilitation programs aimed at preventing contracture formation into practice [5,6]. At the same time, further improvement is required, in particular, advanced treatment and rehabilitation tactics of a dental surgeon and the process of patient management in the post-immobilization period.

The aim of the study was to investigate the characteristics of oral fluid at the treatment stages in patients with maxillofacial injuries, in particular mandibular ones.

Materials and methods. The study of the dental status of 112 patients with mandibular injuries was performed at the stages of their clinical monitoring (CM): stage one, in their pre-immobilization period, stage two, at the end of the first immobilization period,

stage three, at the end of the second period of immobilization, and stage four, in the post-immobilization period. At the stages of assessment of treatment effectiveness, before and at different times after treatment, the following indicators were determined in patients' oral fluid (OF): salivation rate, oral fluid pH, its viscosity, and urease activity in OF [7-10], with a further calculation of the buffering capacity of oral fluid (BCOF) and the value of relative urease activity. The levels/activity of catalase (CA) [11], superoxide dismutase (SOD) [11, 12], reduced glutathione (RG) [13], secretory immunoglobulin A, and the degree of OF dysbiosis were determined in OF. The study was performed according to a standardized program for collection, accumulation, and analysis of the results. Well-known and widely used methods for clinical statistics were applied: anamnestic quantitative analysis, variational statistics, probabilistic distribution of clinical signs with the reliability assessment of the results [14-17]. Clinical and statistical data were processed using methods of variational statistics (arithmetic averages, their errors; the differences in means by one-tailed student's t-test at $p < 0.05$ were considered reliable).

Results and discussion. The study of the biophysical and biochemical properties of OF at the stages of clinical monitoring in patients with mandibular injuries (in pre-immobilization, immobilization, and post-immobilization periods) revealed significant differences in the homeostatic properties of OF, in particular, its buffering capacity (BCOF). Thus, in the pre-immobilization period, BCOF was (5.92 ± 0.05) units and it was significantly ($p < 0.05$) lower in the first and second immobilization periods (5.11 ± 0.06 units and 4.78 ± 0.03 units, respectively). In contrast, while in the post-immobilization period, this indicator did not differ from the values achieved in the second immobilization period (Table 1). At the same time, the viscosity of OF at the stages of clinical monitoring was characterized by dynamic changes, in particular, a significant increase in the viscosity of PP was recorded in the first and

Table 1. Biophysical and biochemical parameters of oral fluid at the stages of clinical monitoring in patients with mandibular injuries

Biophysical and biochemical parameters of oral fluid	Values (M±m%) at the stages of clinical monitoring (n=112)			
	Preimmobilization	first period	second period	Postimmobilization
Buffering capacity of OF, units	5.92±0.05	5.11±0.06 ^a	4.78±0.03 ^{a,b}	4.61±0.04 ^a
Oral fluid viscosity	1.43±0.01	1.58±0.02 ^a	1.67±0.03 ^{a,b}	1.58±0.02 ^{a,b}
Oral fluid pH, units	6.95±0.02	6.52±0.03 ^a	5.94±0.03 ^{a,b}	5.36±0.04 ^{a,b}
Salivation rate, cm ³ /min	0.99±0.02	0.71±0.05 ^a	0.37±0.02 ^{a,b}	0.38±0.06 ^a
Urease activity, mmol/L	2.46±0.04	7.27±0.11 ^a	10.73±0.19 ^{a,b}	10.56±0.30 ^a
Relative urease activity	1.47±0.04	2.56±0.07 ^a	5.22±0.09 ^{a,b}	5.28±0.11 ^a

Note: ^a significant differences in comparison with the corresponding value in the pre-immobilization period, at p<0.05; ^b significant differences in comparison with the corresponding value in the previous period, at p<0.05; OF, oral fluid

second immobilization periods (respectively, up to 1.58±0.02 units and 1.67±0.02 units, p<0.05), while in the post-immobilization period, there was a relative decrease in the viscosity of OF, which did not reach the baseline values.

A decrease in BCOF and an increase in OF viscosity occurred in the setting of a gradual decrease in the index point of the acid-base balance of OF: the mean group pH values for the period of clinical monitoring changed from (6.95±0.02) units to (5.38±0.02) units, p<0.05.

The salivation rate level was quite significant; it changed dynamically, with (0.99±0.02) cm³/min in the pre-immobilization period and (0.33±0.04) cm³/min in the post-immobilization period, p<0.001. Given the above: maintaining the acid-base state of the oral cavity (OC) was provided by a decrease in the buffering capacity of OF (by 22.0%), a decrease in pH of oral fluid (by 23.0%) in the setting of an increase in its viscosity (by 13.0%) and a decrease in the salivation rate (by 67.0%). Naturally, these functional and physiological changes were accompanied by an increase in the relative

level and absolute indexes of the microbial enzyme urease activity; thus, the activity of urease increased by the end of the second immobilization period (in the pre-immobilization period, (2.46±0.04) mmol/dm³ and (10.71±0.21) mmol/dm³, respectively), a similar pattern was also typical for an increase in the level of the relative urease activity (in the pre-immobilization period, (1.47±0.04) units and (5.22±0.09) units, respectively).

When analyzing the state of local non-specific protection of the OC, it was found that the antimicrobial activity of lysozyme, both absolute and relative, increased significantly (p<0.05) in the first immobilization period: from (0.74±0.03) units to (0.89±0.02) units, and a rapid decrease was registered (to (0.54±0.02) units and (0.55±0.03) units, respectively, p<0.001), i.e. by a factor of 1.5, in the second immobilization and post-immobilization periods. Apparently, in the pre-immobilization period, in this group of patients, there was a violation of the microbiocenosis of this biotope due to the activity of oral microflora, which is confirmed by insufficient OC hygiene.

Table 2. Immunometabolic parameters of oral fluid at the stages of clinical monitoring in patients with mandibular injuries

Values of oxidative homeostasis of oral fluid	Values (M±m%) at the stages of clinical monitoring (n=112)			
	pre-immobilization	first period	second period	post-immobilization
Relative lysozyme activity, units	0.74±0.03	0.89±0.02 ^a	0.53±0.03 ^{a,b}	0.57±0.02 ^a
Lysozyme activity, µg/mL	73.7±2.81	83.87±1.32 ^a	51.21±0.59 ^{a,b}	55.53±0.95 ^a
Degree of dysbiosis	1.94±0.05	3.17±0.11 ^a	4.98±0.11 ^{a,b}	8.10±0.19 ^{a,b}
Secretory immunoglobulin sIgA	0.64±0.03	0.62±0.05	0.58±0.03	0.46±0.02 ^{a,b}
Superoxide dismutase (U/100)	16.4±0.30	15.0±0.22 ^{a,b}	14.3±0.18 ^{a,b}	11.4±0.21 ^a
Reduced glutathione, units	28.6±0.8	26.3±0.7 ^{a,b}	23.1±0.4 ^{a,b}	20.7±1.2 ^a
Catalase, units	6.10±0.13	5.69±0.12 ^a	5.48±0.21 ^a	3.70±0.16 ^{a,b}

Note: ^a significant differences in comparison with the corresponding value in the pre-immobilization period, at $p \leq 0.05$; ^b significant differences in comparison with the corresponding value in the previous period, at $p \leq 0.05$

At the stages of clinical monitoring, a significant increase in the degree of microbial contamination of the oral cavity was revealed, as indicated by the changes in the absolute and relative activity of OF urease (see Table 2); due to such changes in the oral biotope, there was a substantial and significant ($p < 0.01$) increase in the degree of dysbiosis in the second immobilization and post-immobilization periods, (4.98±0.11) units and (8.10±0.19) units, respectively, which corresponded to the clinically decompensated stage of dysbiosis. In support of the regular increase in OC dysbiosis in patients of this group, significant ($p < 0.01$) changes in the dysbiosis index were revealed as soon as in the first immobilization period compared to the pre-immobilization period, (3.17±0.11) units and (1.94±0.06) units, respectively: in fact, the degree of dysbiosis corresponded to the second clinically subcompensated stage.

The activity of secretory immunoglobulin sIgA was also characterized by a gradual decrease in the values with reaching minimum values in the post-immobilization period

((0.64±0.03) units in the pre-immobilization period and (0.46±0.02) units in the post-immobilization period, $p < 0.01$).

Analysis of changes in the values of the enzymatic antioxidant defense of OF revealed that SOD activity decreased significantly as soon as in the first immobilization period (from (16.4±0.30) units to (15.0±0.22) units, respectively, $p < 0.05$) and, at further stages of clinical monitoring, it continued to decrease until the level of (11.8±0.23) units was reached in the post-immobilization period ($p < 0.001$).

The activity of RG and CA changed somewhat differently; for example, a significant decrease in RG was registered at all stages of monitoring, and in general, it decreased 1.6-fold. These indicators were registered only in the late period and, repeatedly, in the long-term postoperative periods. The level of catalase activity decreased more progressively and almost 2-folds ((6.1±0.13) units in the pre-immobilization period and (3.7±0.16) units in the post-immobilization period).

At the stages of clinical monitoring of patients with maxillofacial region injuries,

catalase activity was characterized by the highest rates of decline (decreased by 30.0%), and the degree of dysbiosis was characterized by the highest growth rates (increased 4-folds).

Conclusions.

1. At the stages of CM, the biophysical and biochemical characteristics of OF in patients with mandibular injuries changed significantly: in the pre-immobilization period, the BCOF value was significantly lower ($p < 0.05$) compared to that in the first and second immobilization periods, while in the post-immobilization period, it did not differ from the values reached. The viscosity of OF increased significantly in the first and second immobilization periods, while in the post-immobilization period, there was a relative decrease in this parameter; the mean group pH values also decreased. This occurred in the setting of a decrease in the salivation rate, and the maintenance of the acid-base balance of the OC was provided by a decrease in BCOF (by 22.0%), a decrease in the pH of oral fluid (by 23.0%) with an increase in its viscosity (by 13.0%) and a decrease in the salivation rate (by 67.0%).

2. When analyzing indicative parameters of

the state of local non-specific protection of OF in patients with maxillofacial region injuries, an increase in lysozyme activity in the first period and its rapid decrease in the post-immobilization period were found. It was accompanied by a significant increase in the degree of microbial contamination of the OC, as indicated by changes in the absolute and relative urease activity, as well as an increase in the degree of dysbiosis in the second immobilization and post-immobilization periods, which corresponded to the clinically decompensated stage of dysbiosis.

3. It is proved that depending on the stage of treatment of patients with mandibular injuries, such a homeostatic system as "oral fluid" is characterized by different levels of sanological order and, possibly, different diagnostic significance and degree of influence on the risk of post-immobilization complications, including reflex muscle contractures.

Based on the data obtained, **the prospects for further research** are related to the analysis of the relationships between the parameters studied and clinical and informational modeling of pathogenetic mechanisms of reflex muscle contracture formation.

REFERENCES

1. Lakhtin, Y.V., Zviahin, S.M., Karpez, L.M. The state of the optical density of the alveolar process of the jaws of rats in supraocclusive relationships of individual teeth in the age aspect // *Wiadomosci lekarskie* (Warsaw, Poland : 1960), 2021; 74(8):1800–1803.
2. Smiianov Y.V., Lakhtin Y.V. The influence of stress-strain processes in tooth enamel on the marginal permeability of class I restorations with a different design of the edge of the carious cavity. *Wiadomosci lekarskie* (Warsaw, Poland: 1960). 2018; 71(1): 135-139.
3. Marushchak M., Krynytska I., Mazur L. et al. The relationship between experimental alimentary obesity and hard tooth tissues mineralization. *Jordan Medical Journal*. 2017; 51(1): 25-33.
4. Shcherba V., Krynytska I., Marushchak M., Korda M. Does thyroid dysfunction influence inflammatory mediators in experimental periodontitis? *Endocrine regulations*. 2021; 55(3): 101–111.
5. Chernatska, O.N., Demikhova, N.V., Rudenko, T.N., Demikhov, A.I. Assessment of the lipid profile correction in patients with arterial hypertension and type 2 diabetes mellitus. *Azerbaijan Medical Journal*. 2019, 2019(1), pp.18–22.
6. Mazur T., Demikhova N., Rudenko T. et al. Chronic inflammation and progression of chronic kidney disease in patients with type 2 diabetes. *Ukrainian Journal of Nephrology and Dialysis*, 2021, 4, 36–43.
7. Popruzhenko T.V., Terekhova T.N. *Profylaktyka osnovnykh stomatolohycheskykh zabolevanyy*. Moskva: MEDpress-ynform. 2009. 464 s.
8. Demikhov O.I., Shipko A.F., Singh H.H. et al. Intersectoral component of the healthcare management system^ Regional programs and assessment of the effectiveness of prevention of bronchopulmonary dysplasia // *Azerbaijan Medical Journal*, 2020 (2); pp. 88-96.
9. Korol L., Stepanova N., Vasylychenko V. et al. Plasma oxalic acid as a trigger for oxidative processes in end-stage renal disease patients. *Ukrainian Journal of Nephrology and Dialysis*. 2021; 1: 46–53.
10. Vasylychenko V.S., Korol L.V., Kuchmenko O.B., Stepanova N.M. The oxidative status in patients with chronic kidney disease. *Ukrainian Biochemical Journal*. 2020; 92(5): 70-77.
11. Cherkashyna, L., Haidash, I., Hlaskova, N. et al. Dental status and oxidative homeostasis state in patients exposed to occupational vibration: superoxide dismutase and catalase content in oral fluid. *Polski Merkuriusz Lekarski*, 2022, 50(296), pp. 109–113.

12. Kostyuk V.A., Potapovych A.Y., Kovaleva Zh.V. Prostoy u chuvstvytel'nyy metod opredelenyya aktyvnostry superoksyddysmutazy, osnovanny na reaktsyy okyslenyya kvvertsetyna / Voprosy med. khymyy [Questions of medical chemistry]. 1990; 2: 88–91.
13. Spektorofotometrycheskoe opredelenye produktov perekysnoho okyslenyya lypydov. Medytsynskaya laboratornaya dyahnostyka / Pod redaktsyey prof. A.Y.Karpyshchenko. – Sankt-Peterburh: Yntermedyka, 1997: 48–52.
14. Yarmolenko, O., Bumeister, V., Polak, S. et al. The effect of the experimental chronic hyperglycemia on the kidney and myocardium. Ukrainian Journal of Nephrology and Dialysis, 2021, (3), pp. 3–10
15. Demikhova N.V., Smyanov V.A., Prikhodko O.A. et al. The use of information and telecommunication technologies and problem-based learning in the formation of competitive competence among medical masters of the Sumy State University / Azerbaijan Medical Journal. 2016, 2, 95-101.
16. Sysoyeva L., Bielova I., Ryabushka L. et al. Determinants of management of central bank to provide the economic growth: An application of structural equation modeling. Estudios de Economia Aplicadathis. 2021; 39(5).
17. Prokopenko O., Holmberg R., Omelyanenko V. Information and communication technologies support for the participation of universities in innovation networks (comparative study). Innovative Marketing. 2018; 14(3): 17-29.

**Е.В.Паталаха¹, Л.В.Черкашина², А.С.Шкляр³,
Л.И.Киптенко⁴, О.А.Ежова⁴, Л.В.Винниченко⁴, Н.В.Демихова⁴**

ДИНАМИКА ИЗМЕНЕНИЙ СВОЙСТВ РОТОВОЙ ЖИДКОСТИ НА ЭТАПАХ ЛЕЧЕНИЯ И РЕАБИЛИТАЦИИ ПАЦИЕНТОВ С ПЕРЕЛОМАМИ НИЖНЕЙ ЧЕЛЮСТИ

*Киевский Медицинский Университет¹, Харьковская Медицинская Академия последипломного образования², Харьковский Национальный Медицинский Университет³,
Сумский Государственный Университет⁴, Украина*

Резюме. Были проведены исследования с целью изучить характеристики ротовой жидкости на этапах лечения у пострадавших с травмами нижнечелюстнойчелюстно области.

Изучено стоматологический статус 112 пострадавших с травмами нижней челюсти на этапах их диспансерного наблюдения. На этапах оценки эффективности лечения до и в разные сроки после лечения в ротовой жидкости больных определяли биофизические и биохимические характеристики ротовой жидкости.

На разных этапах клинического наблюдения биофизические и биохимические характеристики ротовой жидкости пострадавших с травмами нижней челюсти достоверно изменились: в доиммобилизационном периоде значение буферной емкости ротовой жидкости было ниже, чем в первый и второй периоды иммобилизации, а в постиммобилизационный период не отличалась от достигнутых значений. Вязкость ротовой жидкости достоверно увеличивалась в первый и второй периоды иммобилизации, тогда как в постиммобилизационный период наблюдалось относительное снижение этого показателя; средние значения рН группы также снизились; это происходило на фоне снижения скорости слюноотделения, а поддержание кислотно-щелочного баланса ротовой жидкости обеспечивалось снижением буферной способности ротовой жидкости (на 22,0%), снижением рН ротовой жидкости жидкости (на 23,0%) с увеличением ее вязкости (на 13,0%) и снижением скорости слюноотделения (на 67,0%). При анализе состояния местной неспецифической защиты ротовой жидкости у пострадавших с травмами нижней челюсти выявлено повышение активности лизоцима в первый период и ее быстрое снижение в постиммобилизационном периоде, что сопровождалось значительным повышением степени микробного обсеменения ротовой жидкости.

Correspondence to:

Nadiia Demikhova, Sumy State University, Sumy, Ukraine

E-mail: n.demyhova@med.sumdu.edu.ua