

ENUCLEATION EFFECTS ON TOTAL TEETH PROSTHESES RETENTION

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Summary. *Raynolds enucleation is a physical phenomenon implying gas bubbles appearance in liquids saturated with it.*

This paper's intention was to determine total teeth prosthesis (TTP) contribution to gas nuclei generating in saliva as well as to critically evaluate the enucleation effects on total TTP retention potential, on theoretical basis.

Quantitative examination of bubble size and number is performed in special chambers for blood cell counting with assistance of computer and video camera placed on microscope and connected to monitor.

By analyzing the results, the average value of gas bubble number can be determined in saliva samples from patients with TTP compared to the samples of the same patients in conditions of TTP absence.

Average value differences of bubble size in compared series of samples from the same patients are statistically important.

Besides factors and general conditions referring to present fluids, TTP can also contribute to gas bubble generation. Saliva enucleation phenomenon can express, depending on gas nuclei number, size and position, a negative effect on total TTP retention potential.

Key words: *Enucleation, gas bubbles, saliva, total teeth prosthesis*

Introduction

Enucleation is a physical phenomenon (Raynolds enucleation) implying gas bubbles appearance in gas-saturated liquids, originated by gas nucleus "growth" to the size that doesn't insure stability. They happen to burst releasing energy and gas returning into the gas phase.

The appearance of gas bubbles in intraoral fluid system (oral cavity gas, breathing air and vapor contained in liquid-saliva) depends on pressure and volume changes, fluid speed (increasing occasionally to a critical value), sound-waves, etc.

Dynamic interactions of fluid-gas phases, a constructively complex system such as oral cavity often trigger because of constantly alternating pressure force, caused by respiratory cycles, changes of volume and temperature, tongue movement, occlusal forces, speaking, swallowing and sucking, which constitute enucleation phenomenon (3).

The above conditions provoke enucleation phenomenon.

Objective aim of the study

The aim of the study was to determine the total teeth prostheses (TTP) contribution to the generation of gas nuclei in saliva as well as to critically estimate the enucleation effects on total retention potency TTP, on theoretic basis.

Materials and Methods

The measurement of the number and size of bubbles, visually "espied" enucleation phenomenon in saliva, was done on 15 pairs of samples. The first sample of each pair was taken at vestibulum oris region, at the level of gl. parotis inference aperture, after 10 mastication movements without TTP. The second sample was taken under identical conditions but with TTP.

In the chamber for blood cell counting with engraved quadratic net, on two scopes and with main mark distance 0.1 mm (Hemacytometer Reichert Bright-Liner, U.S.A.), gas bubbles caught in the external frame of the net were tested on the samples. Bubbles with major diameter inside frame were considered.

The average value for three gas bubbles counting was estimated for each patient.

Carl-Zeiss Yena Labovai 2 microscope with objective 3.2 was used for gas bubble counting and diameter measuring, besides the chamber mentioned above.

To perform major diameter measurement of ten bubbles from both series of samples, a TV camera (type MTK 2C Ei-Nikola Tesla) installed on the microscope and connected to a computer (Sinclair ZX Spectrum 48K) was used (Fig. 1).

The computer generated net test system B52 and a measurement scale on the monitor screen along with the gas bubbles image.

Magnification and mark value on the scale was identical for the measurement. The bubble diameter was

estimated by counting with 1/100 mm accuracy.

For each sample, the average value of ten measurements was used for the size of bubbles. On the basis of data for the size and number of bubbles, average values for the whole series of 15 pairs of samples were measured to check possible differences in gas nuclei forming, depending on TTP presence or absence.

Results

Test results of enucleation phenomenon in saliva samples from patients without TTP during experiment and with TTP after those are given in Tab. 1 and 2.

TTP effect on enucleation phenomenon expressing in the region of vestibulum oris – Number and size of bubbles –

Table 1

Number of saliva sample	ENUCLEATION PHENOMENON OBJECT OF OPSERVATION			
	Patients' saliva sample – TTP absent –		Patients' saliva sample – TTP present–	
	\bar{x} number *	\bar{x} size ** (mm)	\bar{x} number *	\bar{x} size ** (mm)
1.	12.50	0.173	14.33	0.0656
2.	21.00	0.2464	23.67	0.2000
3.	22.00	0.3264	14.00	0.1648
4.	8.66	0.2064	9.66	0.2032
5.	10.00	0.2352	19.00	0.1056
6.	17.30	0.2576	11.66	0.3936
7.	8.66	0.3168	29.60	0.1008
8.	12.33	0.3888	24.00	0.2384
9.	11.66	0.3584	20.33	0.1248
10.	16.66	0.4552	16.33	0.2144
11.	14.00	0.3376	10.33	0.2192
12.	22.33	0.3280	24.33	0.2048
13.	25.00	0.3600	20.00	0.2048
14.	11.33	0.5248	12.33	0.3840
15.	10.66	0.3936	20.00	0.1568
\bar{X} ***	14.97	0.3300	17.98	0.2000

Legend: * Three countings average value
 ** 10 bubbles diameter size average value
 *** Whole statistic mass sample average value

Table 2

Gas bubble characteristics	Statistic parameters			Statistically significant tests	
	\bar{x}	SD	Cv		
Number	w/o TTP	14.97	5.78	38.61	χ^2 – test 86.7 P < 0.001
	with TTP	17.98	6.26	34.82	
Size	w/o TTP	0.33	0.09	27.27	t – test $t_0 = 8.45$ $t(\alpha = 0.01)$ $df = 14$ 2.977
	with TTP	0.20	0.09	45.00	

A greater number of gas bubbles (average value) could be observed in saliva samples from patients with

TTP compared to patient samples in conditions without TTP (Table 1).

The value differences for this characteristic were statistically significant (p<0.01) for the chosen level of significant confidence (Table 2).

The average values for the second analyzed characteristic (bubble size) showed greater values under conditions without TTP (Tab. 1).

The differences of the size of bubbles in the, compared series of samples of the same patients were statistically significant (Tab. 2).

Therefore, the wearing of TTP during testing resulted in a greater number and smaller diameter of gas bubbles.

Without TTP in individual sample, we found 4.5 times greater volume of the bubbles, affecting whole series of samples where volumes ratio was 1:3.74 in favor of patients without prostheses (Table 3).

It means that greater discontinuity of the saliva can be expected in patients without prostheses, as a favorable circumstance from the aspect of valve effect.

Table 3

SAMPLE	One bubble \bar{x} volume (mm ³)	Whole sample \bar{x} volume (mm ³)
With TTP	0.00314	0.0564572
Without TTP	0.0141051	0.2111533
RATIO	1:4.49207	1:3.7400597
With TTP / Without TTP	≈1:4.5	≈1:3.74

Discussion

Capillary spaces limited by valve edges and modeled TTP surfaces, on one hand, and correspondent mucosa, on the other hand, create conditions for sudden and fast pressure changes of airflow during its penetration into these spaces.

Muscle tonicity and amplitude of paraprosthesed organs determine tension contact intensity of correspondent mucous membranes and TTP surfaces whereas dimensions of capillary spaces filled out with modified amount of saliva.

Bubbles of bigger diameter allow greater probability of discontinuity in saliva layer under TTP (capillary attraction decrease).

These bubbles, on the other hand, show smaller energy levels in enucleation phenomenon.

Capillary attraction forces and viscous forces, among others, directly depend on the nature of saliva layer, which has to be extremely thin and stable. Bubbles inside that layer create discontinuity depending on their size and position. Intraoral air pressure variations, determined by activities of respiratory and stomathognathic systems, cause air bubble size changes that indirectly, through enucleation phenomenon, affect TTP retention.

A higher number of smaller diameter gas bubbles,

when established with TTP in the mouth, can in the energetic sense diminish saliva capillary attraction effects on the valve edge level or modeled TTP surfaces. On the other hand, smaller bubbles can be rather surrounded by saliva layer that "amortize" their energy effects throughout enucleation. Smaller bubbles, also, if not very numerous, because of the same circumstances (saliva layer surrounding) do not provoke discontinuity affecting the biophysical part of retention potential.

In the sense of mouth ecosystem protection, it is necessary to correct past comprehension so that besides saliva antimicrobe constituent and its rinsing effect, enucleation is also relevant for that process because by releasing energy from cracked gas nuclei it is able to give effects through self-cleaning of hardly accessible mouth spaces.

Stability of symbiotic and antagonistic groups of pathogenic and non-pathogenic microorganisms can be partly interpreted by "detergent" saliva characteristics, by permanent enucleation effects viewed through me-

chanical result, space microorganism encapsulation effects and negative effect of enormous value of CO₂ in gas bubble on them.

Conclusion

Besides factors and general conditions related to present fluids, TTP can also contribute to gas bubble generation. Saliva enucleation phenomenon can have, depending on gas nucleus number, size and position, a negative effect on total TTP retention potential.

The fact that total volume of bubbles (1:3.74) was greater in patients without prostheses was a fortunate circumstance. This directly influenced liquid layer discontinuity in the area of the valve edges as the most sensitive zone for the fluid pervasion and for the beginning of its equalizing flow, leading to the annulment of sub-pressure effects in the saliva layer under TTP.

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UTICAJ ENUKLEACIJE NA RETENCIJU TOTALNIH ZUBNIH PROTEZA

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Kratak sadržaj: *Raynolds-ova enukleacija je fizički fenomen koji označava pojavu mehurova gasa u tečnostima koje su saturirane njime. Rad je imao za cilj da odredi doprinos totalne zubne proteze (TZP) generiranju gasnih jezgri u pljuvački, kao i kritički proceni, sa teoretskih osnova, efekte enukleacije na totalni retencioni potencijal TZP.*

Kvantitativno ispitivanje broja i veličine mehurića obavljeno je u posebnim komoricama za brojanje krvnih ćelija uz pomoć računara, video kamere postavljene na mikroskop i povezane sa monitorom.

Analizom rezultata uočava se veća prosečna vrednost broja gasnih mehurića u uzorcima pljuvačke pacijenata sa TZP u odnosu na uzorke istih pacijenata u okolnostima odsustva TZP.

Razlike prosečnih vrednosti veličine mehurića kod upoređivanih serija uzoraka istih pacijenata su statistički značajne. Pored faktora i opštih uslova koji se odnose na prisutne fluide i TZP može da doprinese generaciji gasnih mehurića. E nukleacione pojave u pljuvački mogu, u zavisnosti od broja, veličine i položaja gasnih jezgri, da ispolje negativni efekat na ukupni retencioni potencijal TZP.

Ključne reči: *enukleacija, gasni mehurići, pljuvačka, totalna zubna proteza*