

**COMPARATIVE STUDY OF FUNCTIONAL CHEWING TESTS UNDER  
EXPERIMENTAL CONDITIONS**

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**ABSTRACT**

**Abstract:** The article presents the results of an experimental comparative assessment of the main functional chewing tests using natural test products given in the Russian educational and scientific-methodical literature. The positive and negative sides of each of them are revealed.

According to the results of the study, the most optimal test for determining the effectiveness of the performed orthopedic dental treatment is the test according to S.E. Gelman (1932), which has the necessary parameters for this.

**Keywords:** chewing function, chewing efficiency, functional chewing test, orthopedic dentistry, natural test chewing products.

**Conflict of interest.** The authors declare no obvious and potential conflicts of interest related to the publication of this article.

**Relevance.** The restoration of chewing function is one of the fundamental criteria in combination with the formation of the aesthetic optimum of the dentoalveolar apparatus when assessing the effectiveness of orthopedic dental treatment. According to the educational-methodical and scientific literature, the most informative methods for assessing chewing function are functional chewing tests [2, 3, 5, 6, 7]. Classical tests characterizing a given functional parameter of the dentoalveolar apparatus using natural test products given in the Russian special dental literature are: chewing test according to I. S. Rubinov (1951) [8,9], test according to S. E. Gelman (1932) [1, 9] and test according to R.S. Manly (1950) [4, 9].

**The aim of the work** is to carry out a comparative assessment of the main functional chewing samples using natural test products.

**Materials and methods.** The presented work is based on the data obtained as a result of the experimental-practical study, which consists in the clinical assessment of the main functional chewing samples using natural test products, on male and female test subjects (volunteers). The criteria for inclusion in the study group were: 1) Persons of the same sex, young age (in the range of 20-23 years); 2) Persons of the same weight category by gender (within the range of  $\pm 15$  kg); 3) Persons with no defects in the dentition and the presence of orthopedic structures in the oral cavity; 4) Persons with the presence of an orthognathic relationship of the dentition; 5) Persons with no concomitant acute and chronic general somatic pathology; 6) At the time of the experiment, the last meal should not exceed 2 hours, in order to level the natural feeling of hunger, which could introduce errors in the research results.

The general quantitative and physiological characteristics of the subjects are presented in Table 1.

Table 1

General quantitative and physiological characteristics of the subjects

Sex	Number of persons	Age (min–max)	Weight, kg (min–max)	Height, cm (min–max)
Male	30	21–23	60–75	172–188
Female	30	19–23	50–62	161–182
Total:	60	19–23	50–75	161–188

Chewing test according to S.E. Gel'man (1932) envisaged the use of almond kernels as a test product with a total weight of 5 grams, a chewing time of 50 seconds and a sieve opening diameter to assess the crushing character of the test product 2.4 mm.

The chewing test according to I.S. Rubinov (1951) envisaged the use of a hazelnut (hazelnut) weighing 0.8 grams as a test product, the chewing time before the appearance of the swallowing reflex and the diameter of the holes of the diagnostic sieve of the study was similar to the previous test.

The chewing test according to R. S. Manly (1950) involved the use of peanuts weighing 3 grams as a test product with a limited number of chewing movements in the amount of 20 and a hole diameter of the diagnostic sieve of 2 mm.

Weighing of the test product was carried out on a jewelry electronic balance, with a measurement accuracy of  $\pm 0.01$  grams, followed by a mathematical calculation, which has a similar character for all three chewing samples, an indicator of chewing efficiency (X) according to the formula:

$$x = \frac{\text{weight of the product passed through the sieves (in grams)}}{\text{total weight of the test product (in grams)}} \times 100\%$$

In the chewing test according to I.S. Rubinov (1951), the time (in seconds) before the appearance of the swallowing reflex was additionally recorded.

Statistical processing of the obtained data was carried out as follows: on the basis of the obtained absolute values, intensive and extensive coefficients, as well as average values, were calculated. When determining the degree of reliability of the research results for relative and mean values, the corresponding mean errors were calculated.

**Research results.** Table 2 presents a summary of the results of evaluating chewing efficiency among men and women using the studied chewing samples.

Table 2

Results of evaluating chewing efficiency using the studied chewing samples

Sex	According to Gelman S.E. (1932), %	According to Rubinov I.S. (1951)		According to Manly R. S. (1950), %
		%	Time, sek	
Male	95,2 $\pm$ 0,8	100 $\pm$ 0,0	20 $\pm$ 4,8	81,9 $\pm$ 2,4
Female	90,6 $\pm$ 1,0	99,5 $\pm$ 0,2	12 $\pm$ 1,9	67,0 $\pm$ 2,4
Both Sexes	92,9 $\pm$ 1,1	99,8 $\pm$ 0,1	16 $\pm$ 2,8	74,5 $\pm$ 2,5

### Conclusions:

1. Indicators of chewing function in young people with intact dentition are in different ranges with a characteristic similarity of values in each test: 1) Test according to SE Gelman (1932) - 92.9  $\pm$  1.1%; 2) Test according to I.S. Rubinov (1951) - 99.8  $\pm$  0.1%; 3) Test according to R. S. Manly (1950) - 74.5  $\pm$  2.5%. There were no significant differences in terms of gender, the maximum interval of differences was 14.9% in the sample according to R. S. Manly (1950). It should be noted that there are significant differences in all three samples, the abstract-theoretical value, which in the experimental conditions of an intact dental should have reached 100% of the chewing efficiency. The maximum deviation was found in the sample according to R. S. Manly (1950), which amounted to more than 25%.

2. The results of the study showed that the diagnostic efficiency of the methods of all three tests, for the objective clinical characteristics of the chewing function, raises doubts, and also made it possible to formulate the strengths and weaknesses of each of the above chewing tests:

1) The chewing test according to S.E. Gel'man (1932) had a significant weight of the test material as advantages, which made it possible to confidently judge the state of the chewing function of the subject, as well as the expression of chewing function as one parameter in percentage, which makes it easy to carry out a comparative assessment chewing function, both in one patient before and after treatment, and among a group of subjects. The negative side of this test was the lack of a result of 100% chewing efficiency in subjects with an intact dentition.

2) The chewing test according to I.S. Rubinov (1951) had the results closest to 100% chewing efficiency, however, it was also not devoid of negative aspects, which were the low weight of the test product (0.8 grams) in comparison with other tests, which allows it is doubtful to judge the state of the chewing function of the subject and the presence of two indicators in reflecting the results of evaluating the chewing efficiency by the time of chewing (in seconds) and directly chewing efficiency (in %).

3) The positive aspects of the sample according to R.S. Manly can be considered the use of an alternative instead of a temporary parameter - a fixed number of chewing movements - 20 and the presence of a difference in the obtained data by sex. The negative side of this test is the low rate of chewing efficiency in an intact dentition, which turned out to be less than expected by more than  $\frac{1}{4}$ .

3. The use of natural test products for functional chewing tests is the most optimal, since the diagnostic experiment maximally brings the load of the dentition to natural conditions. Among the studied methods for assessing the chewing efficiency, the base test should be considered according to S.E. Gelman (1932), which uses the largest test product weight among other samples (5 grams), which makes it possible to realistically assess the functional ability of the chewing function of the dentition, and the experimental values of which under intact dentition as close as possible to 100% chewing efficiency.

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