Connection of functional quality of partial removable dentures and the degree of patients' phonetic adaptation

Victoria Artjomenko, Aldis Vidzis, Guntis Zigurs

SUMMARY

Introduction. Phonetic adaptation is a complex biological phenomenon with a highly individual course, depending on the patient's motivation to use prosthesis, on the functional quality of removable dentures. The aim of the study was to estimate phonetic adaptation in patients with partial dentures, connecting it to alteration in speech quality and dentures functional value.

Materials and methods. We examined some peculiarities of phonetic adaptation in 50 patients with removable dentures (50 patients with natural dentition were invited for the control group). The standardized evaluation protocols (12 speech quality determining parameters) were developed separately for Latvian and Russian native speakers. 500 speech video samples were recorded and analysed according to pre-established guidelines. The connection of speech quality and the functional quality of the dentures was assessed. Statistical analysis was performed using SPSS 20.0. P values equal to or less than 0.05 were considered to be statistically significant.

Results. In patients with appropriate functional quality of removable dentures distorted speech production was detected in 25% (pk=0.008) cases and in patients with inappropriate functional quality of the prosthesis – in 40% (pk<0.001). Patients with appropriate dentures functional value were satisfied with their speech performance in 96% (pk=0.674), in the group with inappropriate dentures functional value only 59% (p<0.001) rated their speech quality positively.

Conclusion. Phonetic adaptation to removable dentures depends on the patient's individual adaptation capacity, prosthetic design and functional value. Thus statistically significant correlation between removable partial dentures functional value, duration of usage and the degree of patients' phonetic adaptation (p<0.001) may be considered to be confirmed.

Key words: phonetic adaptation, removable partial denture, speech quality, patient's satisfaction with prosthetic rehabilitation.

INTRODUCTION

A removable denture appears to be an inadequate stimulus to sensory apparatus of oral cavity, which causes a complex chain of adaptive compensatory reactions (1-5). The duration of phonetic adaptation mentioned in literature (6-11) is usually shown in days or months. As a rule patients' complete adaptation to removable dentures including speech quality improvement appears within the stage of "total suppression" of adaptation process (2). However our research hasn't confirmed the above mentioned assumption, since adaptation process, including phonetic adaptation is a complex biological phenomenon with a highly individual course (1, 3, 5), which is related to the patient's motivation and willingness to use the removable dentures (12, 16, 24). The prosthesis design, its functional value and technical quality, as well as the patient's previous prosthetic experience and also location, size and pattern of edentulous space (2-4, 8-10, 13-15, 17, 25), as well as the patient's subjective perception of aesthetics (3, 5, 12, 16, 21, 24) are significant factors in the adaptation process. Presumably in geriatric patients restoration of speech function after oral rehabilitation takes more time (2-4, 17). In Latvia 60.4% of patients (in the age group 65-74) require at least one removable denture (18, 19). Taking into consideration the amount of missing

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teeth and the patient's financial possibilities it turns out that 25% of patients get acrylic resin removable partial dentures (18), which stresses the necessity of phonetic adaptation research within this group of patients. With phonetic adaptation almost complete the patients are forced to adapt new speech sound production stereotypes - as a result their speech quality improves (5-9, 15). However alteration in oral cavity, caused by reduction of functional value of the denture, may decompensate the previously achieved adaptation and cause both objective (8, 13, 23) and subjective speech distortions (16, 20, 21, 24). The aim of the study is to estimate phonetic adaptation peculiarities in patients with acrylic resin removable partial denture, to evaluate connection of alterations in speech quality determining parameters and to assess their relationship with removable partial dentures functional value.

MATERIALS AND METHODS

In this cross sectional study 100 (age from 28 to 83 years) randomly selected patients were surveyed. Out of them 50 patients had at least one conventional acrylic resin removable denture, all in all total number of 85 partial removable dentures with similar constructive design were analysed (upper jaw (n=45), lower jaw (n=40)) and 50 patients (the control group) had natural dentition. The assessment was performed by prosthodontists in cooperation with two audiology specialists (Table). The functional value of removable dentures was assessed in correspondence with the protocol found in literature (Stelzle 2010 (8)), which was modified according to the aims of our investigation. The functional value of removable dentures was rated as appropriate when there was no pain in function or rest, the denture bearing oral mucosa showed no visible signs of inflammation or ulceration, the denture remained retentive, while the patient was speaking or laughing, there was no visible fracture of denture base or loss of artificial or natural teeth, the denture base fitted the anatomy of bearing area and the patient was satisfied. In case of two dentures (38 patients had two removable dentures) it is almost impossible to distinguish the impact of each denture on speech quality; therefore the functional value of removable dentures was assessed separately for each prosthesis. For further analysis the worst of findings was chosen, as is usual in periodontological screening (CPITN or PSR 2002) (22). The study group was divided into two subgroups: patients with appropriate functional value of removable denture (n=28) and those with inappropriate removable dentures (n=22). Subjects suffering from general health

condition, that could influence their speech quality (neurological disorders, stroke, condition after oncological operation in facial region, psychiatric diseases and patients with hearing aids) were excluded from the study (6, 8, 9, 17). For each patient 5 speech video samples were recorded (camera Canon EOS70D) in his/her native language. Speech samples collection and evaluation protocols were composed separately for Latvian and Russian native speakers (including standardized texts) (17) and approved by Latvian Audiologopedic Association on 06.13.2013 A total number of 500 speech video samples were analysed, alterations in 12 speech quality determining parameters were assessed (Figure 1).The study was performed in the period from September 2011 to March 2015 at the Department of Prosthodontics, Riga Stradins University and Riga Dental Clinic "Medasko". The data were presented as frequencies or the mean value with standard deviation (SD). The differences between groups were analysed by means of Chi-square test or Fisher's exact test for qualitative variables and t-test was used for the quantitative ones. Odds ratio with 95% confidence interval was calculated. For the correlation analysis the Spearman correlation test was used. The inter-judge reliability regarding the presence or absence of alterations in speech samples was calculated using McNemar's test with Bonferroni correction. All statistical tests were two-sided. P-values equal to or less than 0.05 were considered to be statistically significant. Statistical analysis was performed using SPSS software (version 20.0) and MS Excel. The study was conducted with the approval of the Committee on Research Ethics (protocol number RSU/29.03.2012).

RESULTS

The most frequent defect of removable dentures diminishing their functional value was found to be lack of correspondence between the acrylic resin base and its bearing area, supposedly caused by the process of alveolar ridge atrophy (32%), loss of retention (10%), denture base fractures and fissures (8%) and signs of inflammation of oral mucosa (7%). According to modified Stelzle (2010) (8) protocol of assessment of dentures function value, 17 (37%) out of 45 upper jaw removable partial dentures were rated as inappropriate and 28 (63%) as appropriate to clinical requirements. Out of 40 lower jaws dentures 15 (37.5%) were found to be inappropriate and 25 (62.5%) were rated as appropriate. The mean duration of denture service in patients with appropriate functional value was 36 months and in the group with inappropriate functional value dentures was
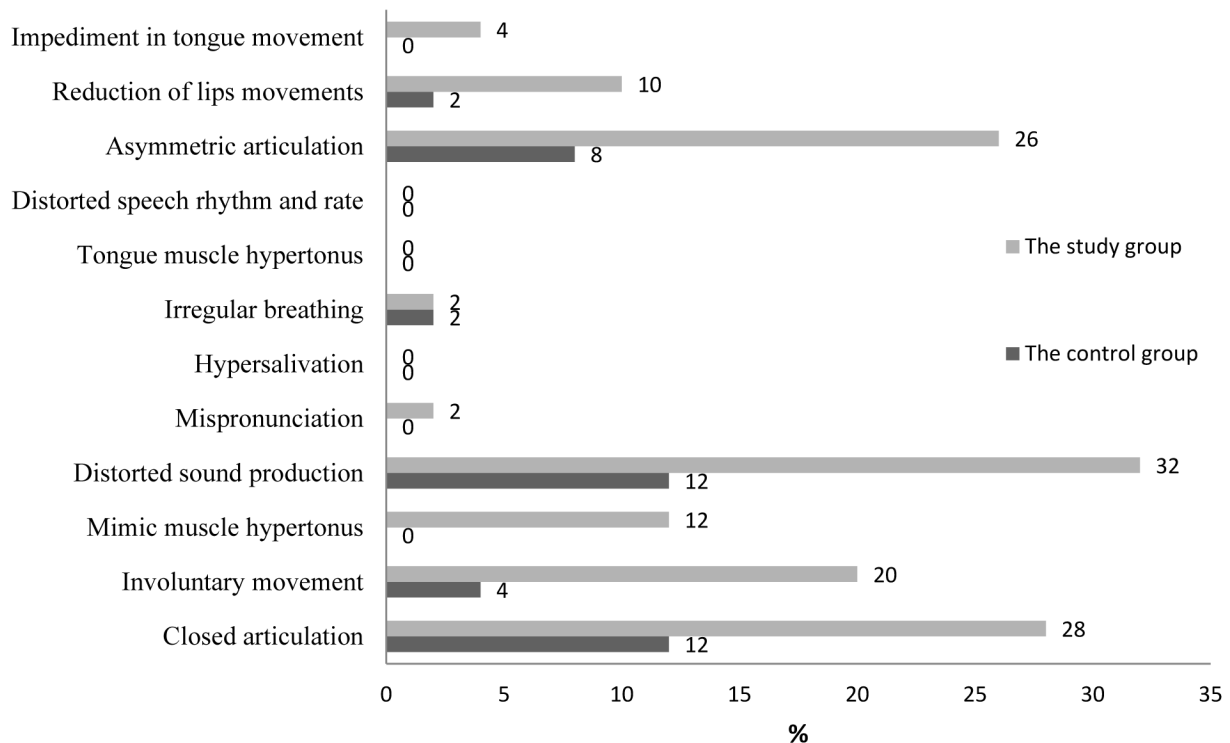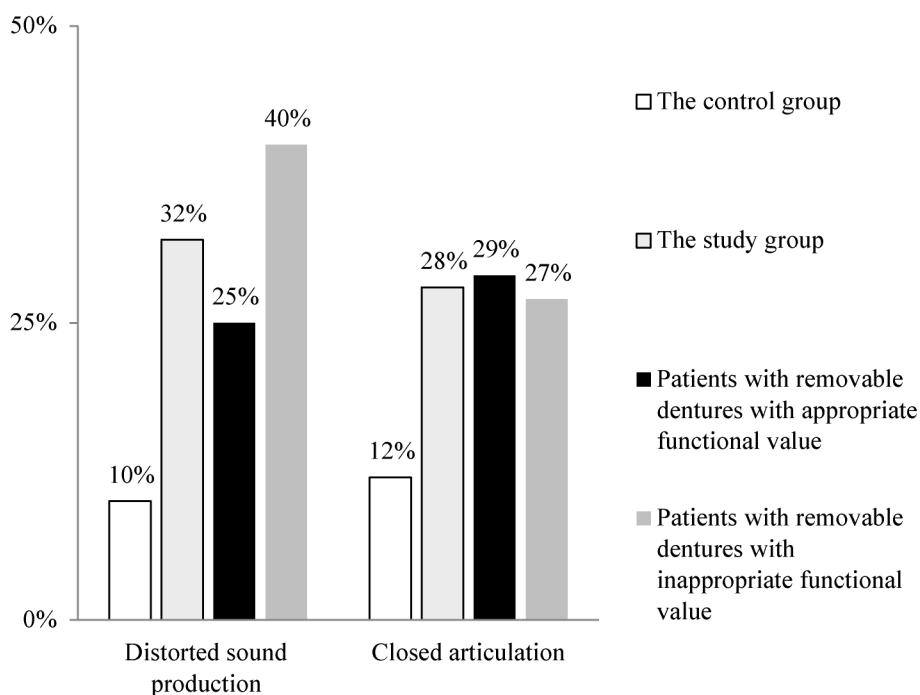
Fig. 1. The prevalence of alterations in speech quality determining parameters analysed in the study

66 months (p<0.001). Comparison between upper and lower jaw dentures as to their functional value (p=0.975) and also according to gender revealed no statistically significant difference (p=0.529). The inter-judge reliability between the two audiologists regarding the presence or absence of speech distortion was statistically calculated using McNemar test with Bonferroni correction (p>0.004). The agreement between speech therapists evaluating speech quality was as high as 89.3%. Alterations in one or more speech quality determining parameters were identified in 58% (n=29) of the study group and only in 30% (n=15) of the control group individuals (p=0.005). Out of 12 evaluated parameters, the most frequent alteration in speech quality in the study group was distorted speech production 16 (32%) cases, followed by "closed articulation" 14 (28%) cases, asymmetric articulation 13 (26%) and reduction of lips movement 5 (10%) cases (Fig. 1). For
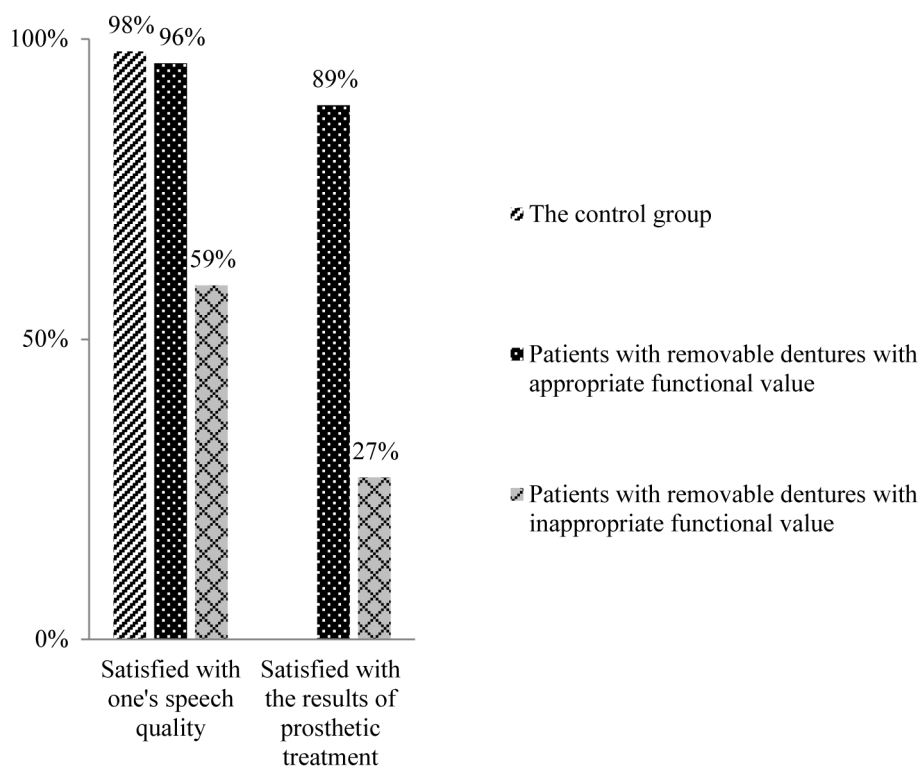
further detailed analysis the two prevalent altered parameters (distorted speech production and "closed articulation") were assessed in connection with the functional value of removable dentures (Fig. 2). Distorted speech production was noted in 9 (40%) patients with removable dentures with inappropriate functional value and in 7 (25%) who used prosthesis with appropriate functional value (p=0.016). 5 out 6 cases in the control group and in 20 out of 24 patients with removable dentures in the study group showed sigmatism or defective pronunciation of consonants s-,z-,-ch-, sh-. Insufficient opening of the mouth or the so called "closed articulation" was noted in 14 (28%) patients with removable dentures. Odds ratio for the study group as compared with the control group 6 (12%) was 2.9 (95% CI 1.0; 8.2, p=0.046). There was no statistically significant difference (p=0.919) between the patients with appropriate functional value of removable dentures 8 (29%) and the patients with removable dentures with inappropriate functional value 6 (27%). No statistically significant difference in prevalence of alterations of speech quality was found between Latvian and Russian native speakers (p=0.529). The degree of the patient's satisfaction is a significant indicator of the success of oral rehabilitation (12, 24). Analysis of the influence of the quality of dentures on patients' subjective evaluation of prosthetic rehabilitation success revealed that the patients using removable dentures with appropriate functional value (96%) and subjects from the control groups (98%) evaluate their speech

Table. The patients' characteristics

		The control group (n=50)	The study group (n=50)	p
Age, years	Range	28-83	38-83	
	Mean (SD)	47.9 (12.3)	64.1 (10.1)	<0.001
Language	Latvian	21 (42%)	23 (46%)	0.687
	Russian	29 (58%)	27 (54%)	
Gender	Male	16 (32%)	18 (36%)	0.529
	Female	34 (68%)	32 (64%)	

Fig. 2. Connection between the two most frequently encountered alterations of speech quality and the functional value of removable dentures

Fig. 3. Connection between the functional value of removable dentures and patients' subjective evaluation

the patients who wore acrylic resin removable dentures with inappropriate functional value (p<0.001). 89% of the patients with appropriate functional value of removable dentures expressed their satisfaction with the results of prosthetic treatment and only 27% of patients with inappropriate functional value of removable dentures were satisfied with the outcome of prosthetic treatment (Fig. 3).

DISCUSSION

Distorted sound production, "closed articulation", asymmetric articulation and mimic muscles hypertonus were more frequent in the study group than in the control group (p= 0.005). The data correspond to those described in literature (6, 8-11). Direct comparison of different researches on the subject was complicated as we couldn't find any standardized parameters determining speech quality in patients after prosthetic rehabilitation (4, 6, 7, 13-15, 23). In her study Jacobs (17) states, that only 48% of patients with natural dentition showed a complete problem free speech. In our study we found that 70% of the control group had no alterations in the quality of their speech according to assessed parameters. It is noted in literature (27) that the patients experiencing problems with phonetic adaptation after prosthetic rehabilitation supposedly had qualitative alterations in their speech in the past. Each removable denture, even the most carefully fabricated one, decreases in its functional value with time (8, 20, 21). There were many attempts at systematizing the criteria of evaluation of prosthesis quality described in literature (6, 8, 9, 18, 21, 26). It was concluded that the protocol which was based both on objective clinical examination and also considered the subjective opinion of the

quality as almost equally good (p=0.674). However, only 59% of the patients wearing removable dentures with inappropriate functional value rated their speech quality to be satisfactory (p<0.001) (Fig. 3). Patients with appropriate functional value of removable dentures rated their oral health condition slightly worse than the control group patients, but twice as good as

patient proved to be the most trustworthy one (26). However it is pointed out, (3, 5) that the patient might fail to notice deterioration in the quality of the prosthesis. Automatic computer-based speech assessment performed by Knipfer (9) showed that the use of inadequate removable dentures significantly reduced the patients' speech intelligibility, as compared assessment results received from patients with qualitative new dentures. Our study revealed that in 32% of the patients the existing removable dentures don't fit their bearing area, have reduced retention and lack of stability and support. According to our proposed assessment of the functional value of existing removable dentures, 28 (56%) used functionally appropriate dentures, whereas 22 (44%) patients needed modification or renewal of at least one prosthesis. Of all speech quality determining parameters analysed in the current research, distorted speech production was the most frequent one. It occurred almost three times more often in the patients of the study group as compared to the control group. Alteration in this parameter turned out to be directly connected to the quality of the prosthesis (p<0.002). Success of the prosthetic treatment also depends on the patient's attitude- his/her motivation and desire to learn to use the denture (12, 24). However, it should be taken into consideration, that age related alterations in the patient's nervous system make adaptation process slower (1-4, 17). 57% of patients stated that no consequent relining or adjustment of their prosthesis has ever been done. 41% of the patients reported subjective feeling of deterioration in the quality of their prosthesis in course of time- it started moving when they spoke (p<0.001). Inappropriate dentures make the patient compensate the absence of functional retention with the help of "muscular" one (3) or holding the denture in the mouth with the help of the tongue (25), which may interfere with the quality of speech (8,

15, 21, 23). "Closed articulation" that is insufficient opening of the mouth during conversation occurred in patients with removable dentures 2.9 times more often than in the control group (p=0.046), which is possibly due to the patient's concentration on holding the removable dentures in his mouth during speech (1, 2, 6, 11, 27). This, in its turn, makes it more difficult to achieve correct sound production (8, 13, 15, 20, 21). Hearing also plays an important role in formation of speech sounds. With age acuteness of hearing has a tendency to decrease (2-4, 17), which can complicate the patient's phonetic adaptation. Though none of the patients in the present study reported any problems with hearing, the mean age of the patients being 64.1(10.1) years, some changes in their hearing acuteness may be assumed. As it is practically impossible to avoid age related alterations, the detailed study of this aspect will not add any valuable information on the phenomenon of phonetic adaptation and the means of its optimization.

CONCLUSIONS

Phonetic adaptation is a complex biological process with a highly individual course, which depends on the patient's willingness and motivation to use removable dentures. It is closely connected with the patient's individual phonetic adaptation capacity and the removable denture functional value and peculiarities of its design. Patients with removable dentures with appropriate functional value evaluate the quality of their speech and the health condition of oral cavity as twice as good as patients with prostheses with inappropriate functional value. Thus statistically significant correlation between removable partial dentures functional value and quality, duration of usage and patients' speech quality and the peculiarities of phonetic adaptation (p<0.001) may be considered to be confirmed.

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