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Dental Restorations Quality in Lithuanian Adolescents

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SUMMARY

The aims were to estimate the quality of dental restorations in Lithuanian adolescents and to relate differences in quality of restorations to gender, urbanization and residency. A total amount of 885 adolescents in 22 randomly pre-selected areas were clinically examined. The California Dental Association Quality Evaluation System was used for the assessment of the quality of dental restorations. 60.35 % of all restorations were not acceptable and had to be changed. 47.58 % of them must be replaced because of not acceptable anatomic form. Only in 8.9 % of participants all their fillings were considered as satisfactory, while in 24.8 % of adolescents all their fillings had to be changed. Regarding the reasons for the need to replace restorations substantial differences among different geographical regions were found, whereas in relation to gender and urbanization the differences were less pronounced.

Key words: adolescents, dental restorations quality, urbanization, gender.

INTRODUCTION

Operative dentistry represents the core of dentistry, regardless of whether the dental care is based on private practice or a national health service system for delivery (1). Failure of restorations is a major problem in dental practice as replacements comprise about 60 % of all operative work done (1).Consequently, a substantial part of dentist's time is allocated to replace dental restorations. Replacement of a restoration costs at least as much as the inserted initially and probably more because of its increased size (2). In the time of budget deficits, constrained resources and rising costs, public attention is focused on the efficacy of health care system. Health policy makers, public health officials and consumers seek to ensure that appropriate and cost-effective health care is available (3). Towards these aims, the evaluation of quality of restorations and need for replacement is of particular interest.

The type of dental care is highly dependent on the age of the patients and the dentition treated. In pedodontic practice, the operative treatment of primary caries represents the major volume of work (1,4). In a recent Norwegian study the overall replacement rate was with a distinct age dependence : 68 % in adults and 15 % for the adolescents ≥18 years of age (5).

A few studies indicate that irrespective of restorative material, the life-time of restorations in adolescents is shorter than in adults (6,7). The quality of dental restorations is a parameter that is extremely difficult to define (8). It has been judged according to many categories such as function, marginal integrity, esthetics, absence or presence of caries etc.These criteria can be considered as the basis of failure necessitating a remake or replacement of the restoration. The reasons for the replacement vary depending on the restorative material, the dentition and the age of the individual (9,10). In several studies the clinical diagnosis of secondary caries was detected as the most common reason for replacement of all types of directly inserted restorations (5,6,11,12). Secondary caries was followed by fracture and discolouration of restorations.

The short longevity of restorations in adolescents may indicate that adolescents may be at a higher risk regarding restorations' replacement than adults. In order to facilitate the improvement of dental care, a thorough understanding why restorations fail is of paramount importance (6).

The aims of the present study were: to estimate the quality of dental restorations in Lithuanian adolescents and to relate differences in quality of restorations to gender, urbanization and different geographical regions.

MATERIALS AND METHODS

Sample

The study was performed in 2004 after receiving the permission from the Ministries of Health and Education of Lithuania.

Lithuania is divided into 10 districts. In each of these districts two areas - one urban and one rural - were chosen randomly. There are localities with high fluoride content (F>1,0 ppm) in the drinking water in

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Western part of the country (13). In order to secure enough participants from the latter part, two areas - one urban and one rural - were added. The total sample was extracted from 22 areas. One secondary school was chosen randomly in each of these pre-selected regions. In each school, two or three classes of 15-16-year-old children were invited for the examination. Only children who had written approval forms, signed by themselves and by their parents, were included into the study. The minimum of 32 and maximum of 50 individuals from one school were examined. Because of the obligatory school attendance till 16 years of age, the present sample can be considered as a representative sample of 15-16-year-old Lithuanians.

Data collection

The data for the present study were collected following the general principles for basic oral health surveys as suggested by the World Health Organization (14). Clinical examinations were performed by one examiner (VB). A portable halogen lamp as a light source was used and each subject was examined lying on a simple school table using caries explorer and plane mouth mirror for the clinical examinations. Radiographs were not taken.

The California Dental Association Quality Evaluation System was used for the assessment of the quality of dental restorations (15). The decision was made whether a given restoration was satisfactory or not acceptable, and whether it should be retained or replaced. The quality of restorations was evaluated with regard to the following characteristics: 1) surface and color 2) anatomic form and 3) marginal integrity. The criteria for each of these characteristics are presented in Table 1. The final rating of the restoration - satisfactory or not acceptable - was the lowest of the three because the lowest rating is the one that determines the action to be taken.

In the present study, the individual ratio of restorations' quality (IRRQ) was calculated for each individual in the following way: the number of his/her satisfactory restorations was divided by the total number of the restorations present. The IRRQ ratio was expressed in percentage. In order to estimate which characteristics are failing most frequently, individual scores for separate characteristics were also calculated. Not acceptable surface quality score was computed as the percentage of the restorations with not acceptable surface quality of the total restorations. Not acceptable anatomic form score was expressed as the percentage of the restorations with not acceptable anatomic form of the total restorations and not acceptable marginal integrity score - as the percentage of the restorations with not acceptable marginal integrity of the total restorations.

In a series of statistical analyses, differences in the quality of dental restorations were related to a number of background factors such as gender, urbanization and residency. City areas as Kaunas, Klaipeda, Palanga, Taurage, Telsiai, Siauliai, Panevezys, Vilnius, Utena, Marijampole and Alytus were defined as urban. Rural included all region areas namely Prienai region, Skuodas region, Kretinga region, Plunge region, Silale region, Pakruojas region, Pasvalys region, Sirvintos region, Anyksciai region, Sakiai region and Lazdijai region.

Data analysis

The statistical data analysis was done using the Statistical Package for the Social Sciences (SPSS, Chicago, IL, USA, 1997). The following statistical analyses were performed: frequency estimations, independent samples t test and One-Way Analysis of Variance (ANOVA). Two groups were compared by means of independent t test and more than 2 groups were compared by means of ANOVA. The level of statistical significance was assumed

Table 1. Quality evaluation criteria by the California Dental Association Quality Evaluation System

Characteristic	Satisfactory	Not acceptable
Surface quality	Surface of restoration is smooth or slightly rough or pitted, can be refinished. No irritation of adjacent tissue. No mismatch in color, shade and translucency between restoration and tooth structure or mismatch within the normal range.*	Surface deeply pitted: irregular grooves (not related to anatomy); cannot be refinished or surface is fractured or flaking. Mismatch between restoration and tooth structure outside the normal range or esthetically displeasing color, shade and translucency.*
Anatomic form	Restoration's contour is continuous with existing anatomical form; restores contours, cusps, planes, grooves, marginal ridges and functional contact points. Or restoration is slightly undercontoured: occlusal contour not continuous with that of cusps and planes, or occlusal height reduced locally, or marginal ridges slightly undercontoured, or contact slightly open (may be self-correcting), or facial flattening, or lingual flattening, or interproximal cervical area slightly undercontoured. Or restoration is slightly overcontoured, but excess material could be removed.	Restoration is undercontoured: dentin or base is exposed, or occlusion is affected, or contact is faulty (self-correction is unlikely), or interproximal cervical area undercontoured; tissue damage likely. Or restoration is overcontoured: contour cannot be adjusted properly, or there is marginal overhang. Or restoration is missing, or traumatic occlusion, or restoration causes pain in tooth or adjacent tissue.
Marginal integrity	No visible evidence of ditching along the margin or ditching not extending to the dentin/enamel junction. No discoloration on the margin between the restoration and the tooth structure or discoloration not penetrating in a pulpal direction.	Dentin or base is exposed along the margin. Discoloration has penetrated along the margin of the restorative material in a pulpal direction. Restoration is mobile or fractured, or caries contiguous with the margin of restoration, or tooth structure fractured.

* criteria apply to anterior restorations

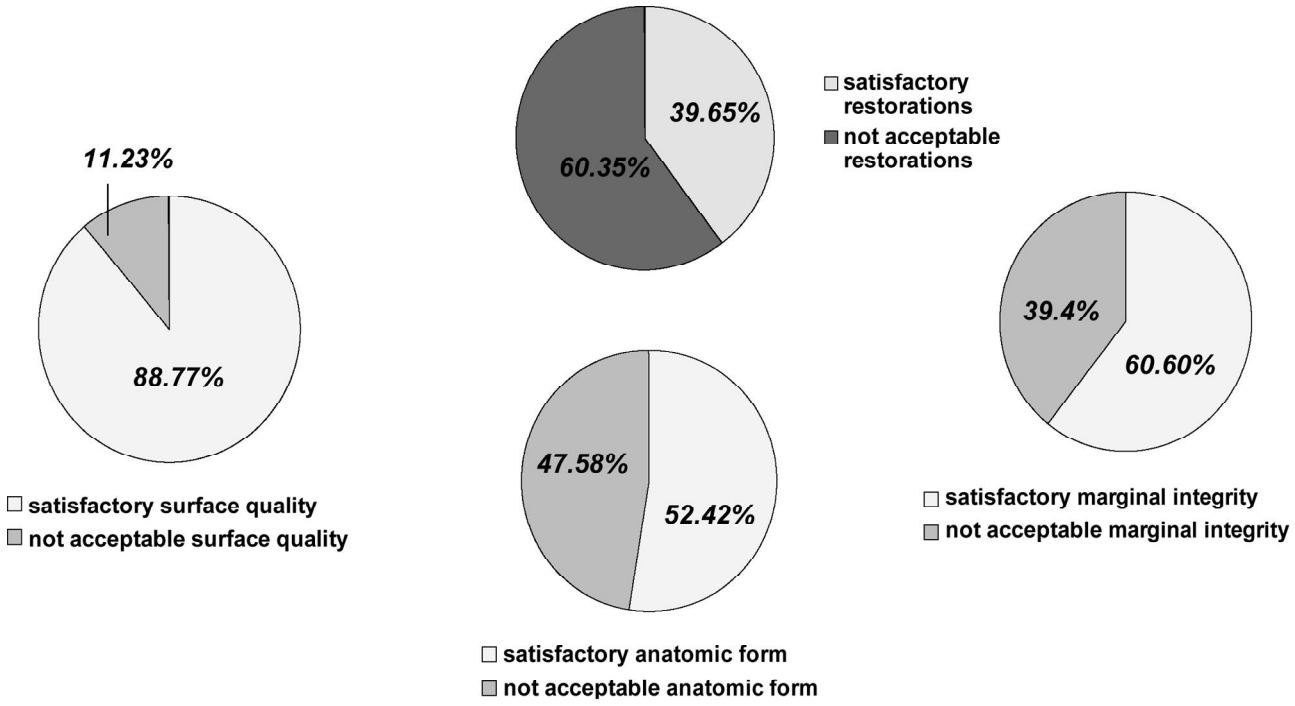

Fig. 1. Quality of dental restorations in Lithuanian adolescents

when p≤0.05.

RESULTS

A total of 885 adolescents were examined in the present study. 217 (24.5 %) of them had no fillings, 110 (12.4%) participants had 1 filling and 118 (13.3 %) - 2 fillings. One (0.1 %) adolescent had 18 restorations. Of the total 24808 teeth 2850 (11.5%) were filled.

When all three characteristics - surface quality, anatomical form and marginal integrity - were considered, 60.35 % of all restorations were not acceptable and had to be changed. Almost half of them (47.58 %) must be replaced because of not acceptable anatomic form, while the least part of fillings had to be changed because of not acceptable surface quality. More detailed analysis is presented in Figure 1.

The quality of dental restorations was evaluated by individual ratio of restorations quality (IRRQ). Only 79 (8.9 %) of participants had IRRQ = 100 % , i. e. all their

Table 2. Quality of dental restorations in Lithuanian adolescent boys and girls

VARIABLE	BOYS		GIRLS		95 % CI
	N	Mean ± SD	*N*	Mean ± SD	
Individual number of restorations	*350*	2.66±2.88	*530*	3.59±3.45	[-1.36; -0.49]
Number of not acceptable restorations	*350*	1.58±1.97	*530*	2.18±2.27	[-0.89; -0.31]
Individual ratio of restorations quality (%)	*232*	39.40±35.59	*434*	35.13±33.20	[-1.1712; 9.7050]
Not acceptable surface quality score (%)	*232*	13.67±24.17	*434*	11.69±23.69	[-1.8305; 5.7899]
Not acceptable anatomic form score (%)	*232*	49.26±36.09	*434*	52.85±35.33	[-9.2719; 2.0963]
Not acceptable marginal integrity score (%)	*232*	37.73±35.84	*434*	44.46±37.03	[-12.5756;-0.8790]

Table 3. Quality of dental restorations in Lithuanian adolescents in urban and rural areas

VARIABLE	URBAN		RURAL		95 % CI
	N	Mean ± SD	*N*	Mean ± SD	
Individual number of restorations	*439*	2.86±3.11	*446*	3.57±3.39	[-1.14; -0.28]
Number of not acceptable restorations	*439*	1.74±2.08	*446*	2.14±2.26	[-0.68; -0.11]
Individual ratio of restorations quality (%)	*319*	36.36±35.89	*350*	36.98±32.29	[-5.7997; 4.5538]
Not acceptable surface quality score (%)	*319*	13.89±26.01	*350*	10.92±21.57	[-0.6455; 6.5856]
Not acceptable anatomic form score (%)	*319*	52.47±37.06	*350*	50.63±34.22	[-3.5700; 7.2517]
Not acceptable marginal integrity score (%)	*319*	46.01±38.54	*350*	38.52±34.53	[1.9486; 13.0424]

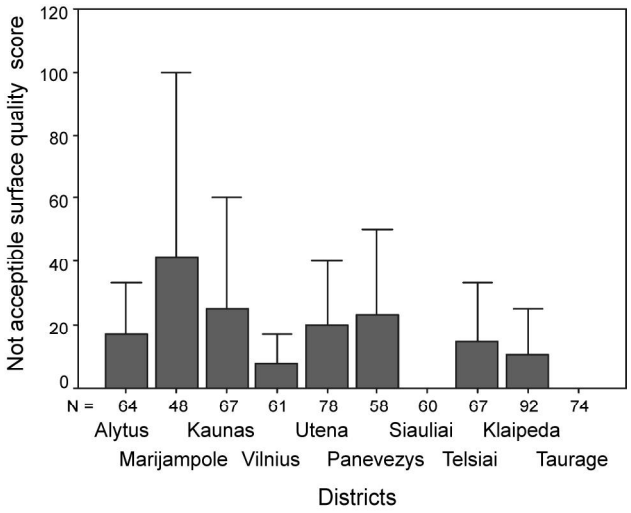

Fig. 2. Not acceptable surface quality score in Lithuanian adoles cents in different geographical regions

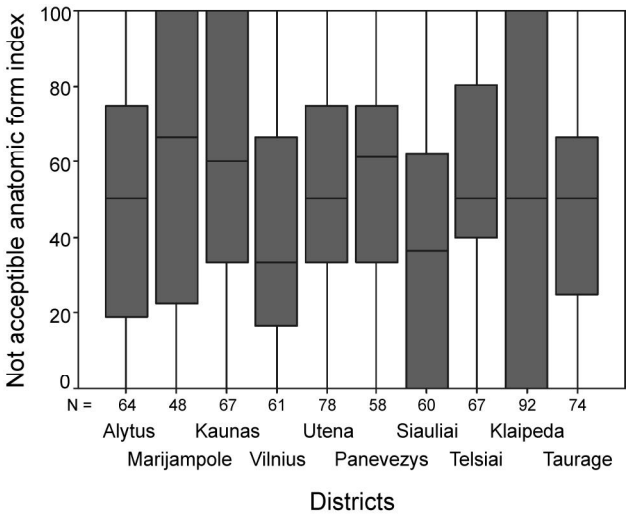

Fig. 3. Not acceptable anatomic form score in Lithuanian adoles cents in different geographical regions

fillings were satisfactory, while 220 (24.8 %) adolescents had IRRQ = 0 %, i. e. all their fillings had to be changed.

Gender and the quality of dental restorations

The gender differences with regard to the quality of dental restorations were assessed applying the independent samples t test (Table 2).

The girls had significantly more filled teeth than boys and the mean number of not acceptable restorations in girls was also higher than in boys. There was no statistically significant difference in the mean IRRQ between the gender groups, i.e. girls and boys had similar percentages of satisfactory fillings.

The differences between boys and girls were observed in all three characteristics of evaluation but significantly they differed only with regard to the marginal integrity score, i. e. girls had more restorations with not acceptable marginal integrity than boys.

Residency and the quality of dental restorations

The findings of the quality of dental restorations in urban and rural areas were similar to those between gender groups. Statistically significant differences were found in the individual number of restorations, in the number of not acceptable restorations and in the marginal integrity score. Adolescents from rural areas had higher mean number of fillings and higher mean number of not acceptable fillings compared to their urban counterparts.

Regarding the quality of surface and anatomical form a similar quality of dental restorations was observed in both rural and in urban areas. The statistically significant differences between urban and rural areas were found only with regard to the marginal integrity score (Table 3).

A more detailed analysis was performed with regard to the differences among geographical regions, because, as it can be seen in Table 4, districs differed significantly in all variables, except the individual ratio of restorations' quality.

With regard to the individual number of restorations, Utena district distinguished significantly: adolescents from this district had the highest mean number of resto-

Table 4. Quality of dental restorations in Lithuanian adolescents in different geographical regions

District	*N*	Individual number of restorations, mean±SD	Number of not acceptable restorations, mean±SD	*N*	Individual ratio of restorations quality (%), mean±SD	Not acceptable surface quality score (%), mean±SD	Not acceptable anatomic form score (%), mean±SD	Not acceptable marginal integrity score (%), mean±SD
Alytus	76	3.45±2.95	2.38±2.56	64	36.99±36.46	11.71±23.53	48.43±35.43	50.90±37.29
Marijampole	76	2.32±2.79	1.54±2.20	48	27.58±35.08	21.45±30.92	61.59±39.15	44.95±39.28
Kaunas	78	3.51±2.90	2.28±2.15	67	31.79±33.96	18.39±29.86	57.32±35.57	51.98±38.72
Vilnius	78	3.38±3.15	1.65±1.68	61	43.65±35.05	6.99±13.65	42.74±35.14	39.49±36.65
Utena	87	5.08±4.13	2.98±2.32	78	32.63±26.37	11.93±18.95	55.10±29.73	41.81±34.24
Panevezys	70	3.90±3.58	2.80±2.85	58	30.07±28.14	14.43±22.42	57.20±33.36	45.15±29.87
Siauliai	86	2.17±2.68	1.31±1.89	60	41.79±37.28	7.09±18.21	39.07±36.69	37.59±38.79
Telsiai	84	3.57±3.01	2.26±2.13	67	34.17±28.69	13.46±24.46	55.89±32.02	41.25±32.37
Klaipėda	**159**	1.96±2.46	1.08±1.57	92	42.38±39.45	13.30±28.45	49.42±40.07	41.68±40.34
Taurage	91	3.97±3.83	2.03±1.92	74	41.54±33.56	6.76±19.40	50.04±34.32	28.65±33.79
p* value		0.000	0,000		0.056	0.008	0.012	0.014

*groups compared by ANOVA test

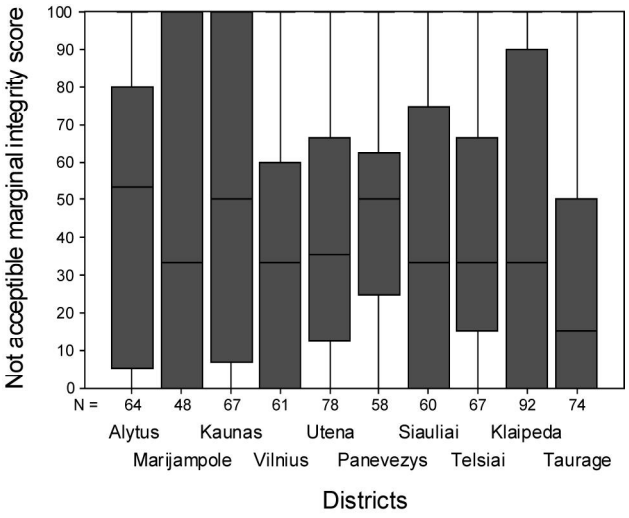

Fig. 4. Not acceptable marginal integrity score in Lithuanian ado lescents in different geographical regions

rations (statistically significant differences for all regions, except for the Panevezys district). Klaipeda district had the lowest mean number of restorations, followed by Siauliai and Marijampole districts.

Regarding the mean number of not acceptable restorations, Utena district had also the highest mean number, but significantly differed from fewer districts: from Kaunas, Telsiai, Marijampole, Vilnius, Siauliai, Klaipeda. There was no statistically significant difference between Utena district and Alytus or Taurage districts. Klaipeda region, followed by Siauliai and Marijampole, had the lowest mean number of not acceptable restorations.

The score of not acceptable surface quality was the lowest among the three characteristics of the restorations quality. Regarding this factor the results were less scattered than with regard to either anatomical form or marginal integrity.

Figure 2 shows the distribution of not acceptable surface quality scores in different geographical regions. The data of the study showed, that Marijampole region had the highest percentage of the restorations with not acceptable surface quality. But this region differed significantly only from Taurage, Vilnius and Siauliai districts, which showed almost identical and very low score for not acceptable surface quality, and Utena district.

The not acceptable anatomic form score was the highest among the three studied characteristcs in all regions, except in Alytus (Figure 3). The highest percentage of fillings with not acceptable anatomic f orm were in the same three districts as with regard to surface quality characteristic namely in Marijampole, Kaunas and Panevezys. Siauliai and Vilnius districts had the lowest aforementioned score, which significantly differed from Marijampole, Kaunas, Utena, Panevezys and Telsiai districts.

With regard to the score of not acceptable marginal integrity, adolescents from Taurage had the lowest percentage of fillings with not acceptable marginal integrity, while their counterparts from Kaunas and Alytus had the highest score (Figure 4). The differences between geographical regions were not statistically significant except for the comparison between Taurage district and all other districts, but Siauliai and Vilnius. Siauliai district, which not acceptable marginal integrity score followed Taurage region, statistically differed from Kaunas district.

DISCUSSION

The results of the present study showed that 24.5% of Lithuanian adolescents had no fillings. Only 7.7 % of examined adolescents had all their teeth sound (4), and more than 60.35 % of restorations need to be changed due to lack of quality in surface (11.23 %), anatomical form (47.58 %) or marginal integrity (39.4 %). Therefore, the importance of the need to improve both the prevention of dental disease as well oral health care in this age group should be emphasized.

Within the three characteristics for the evaluation of restorations quality, the best results were found in the characteristic of the surface quality. This finding might be at least explained by the the criteria to evaluate this characteristic: the surface must be deeply pitted or fractured to be considered as not acceptable. Consequently, due to not so stringent criteria in the evaluation of the surface quality compared to the other two characteristics, like anatomical form and marginal integrity, the score of satisfactory quality of surface is quite easily attainable.

Regarding the reasons given for the need to replace restorations, our findings did not confirme the results of other studies (5,6,11,12), which indicated secondary caries to be the most frequent reason for replacement. In the present study, the main reason for the replacements almost in half of examined fillings was not acceptable anatomic form. In the study conducted in Norway only few fillings were found with poor anatomic form among amalgam or composite restorations. In the latter study poor anatomic form as a reason for replacement in adolescents was almost exclusively related to glass ionomer restorations (6). The finding that the majority of restorations in Lithuanian adolescents were found with poor quality anatomical form indicate that Lithuanian dentists may have a shortage of knowledge and skills in this field of operative dentistry.

Another finding of the present study that a high percent of restorations, almost 40 % of all examined, must be replaced because of not acceptable marginal integrity needs special consideration. The microleakage at the tooth/restoration interface is a major factor influencing the longevity of dental restorations. Glass ionomer is the only material with a true chemical bond to tooth structure (16), but it is rarely used as permanent restorative material in permanent teeth. An increased use of tooth-coloured dental materials, especially composite resins, has occurred during last decades, because alternatives to amalgam as a restorative material were recommended. Athough prospective clinical trials have suggested that tooth-coloured restorative materials are less durable than amalgam restorations in paediatric dentistry for the permanent teeth (7), composite resin restorations are usually chosen in many countries (5,7,17,18), including Lithuania. Secondary caries and poor marginal adaptation were recognized as the most common reasons for failure of composite resin

restorations (1). Dentin bonding agents used in conjunction with composite restorative resins are a deterrent to microleakage, but they do not eliminate microleakage (19). In the absence of any caries inhibition properties or the ability to seal minor marginal defects, a composite resin restorations with even minor marginal defects should be viewed with a high degree of suspicion (20). It is also important to note, that more plaque was found at the composite/tooth interfaces than at the amalgam/tooth interfaces (11).

On the other hand, rapid developments in the area of dental materials often cause a change in filling materials and restorative techniques without knowledge of the reasons for succes or failure. The marketing of new materials has been intensive, although the scientific evidence of the performance of some new restorative materials in clinical situations is currently limited (7). In many cases the failure of a restoration is not only dependent on the material itself, but also on proper handling.

In the present material, an overall poor quality of restorations was found. A few possible reasons for this finding may be suggested. In Lithuania, a full range of contemporary composite filling materials and instruments to handle them appeared after 1992. Therefore, the experience and traditions to use them may be lacking. It is important to emphasize that composite resin restorations are extremely technique sensitive. Refusal of many dentists to use rubber dam, lack of co-operation by the child may influence the quality of the restorations. Additionally the ultimate clinical outcome is highly influenced by the oral hygiene of the adolescents. Composites accelerate the growth of Streptococcus mutans, which in combination with poor oral hygiene may cause secondary caries. Ideal conditions are not allways achievable in paediatric dentistry, so tooth-coloured restorations are more prone to earlier failure than amalgam restorations, which is much less sensitive to poor handling (21).

With regard to gender differences, there was found that girls had higher mean number of filled teeth and therefore higher mean number of not acceptable restorations. Bearing in mind that girls had significantly fewer teeth with primary caries than boys (4), the conclusion can be drawn that girls visit their dentists more frequently than boys. The present study did not find any significant differences in the total individual ratio of restoration quality between boys and girls, i.e. both gender groups had similar percentage of satisfactory restorations.

Analysing the reasons for the need to replace restorations it was found, that Lithuanian girls compared to boys had significantly more fillings which should be changed because of not acceptable marginal integrity. These results differ from the studies, conducted in Norway and Iceland, where no association was found in the reasons for replacement of restorations and patient gender (5,6). Given the quality of treament is lacking in Lithuania, the higher score of unaccepatble restorations in girls compared to boys can be possibly attributed to the higher number of restorations found in girls compared to boys.

Interesting findings were found regarding differences in restorations quality between urban and rural residents. Rural adolescents compared to urban adolescents had more fillings and more fillings with not acceptable quality. This finding indicates that despite of the uneven distribution of dentists in Lithuania with predominant number of them residing in big cities, dentists from rural areas do more restorative work than urban dentists. Concomitantly, the percentage of satisfactory fillings per individual is similar and significantly better marginal integrity was obtained in rural than in urban areas. It is important to note that curently present economical deprivation in rural areas compared to urban areas had no additional negative influence on restorations quality.

The study revealed significant differences among geographical regions with regard to separate characteristics, but not with regard to the individual ratio of restoration quality. With regard to individual mean number of restorations and mean number of not acceptable restorations the same pattern was observed: the more restorations were found in the district, the more restorations with not acceptable restorations were diagnosed.

Studying the reasons for replacement of restorations, some regularities were revealed. In all three characteristics - surface quality, anatomic form and marginal integrity - three best and three worst positions were occupied by almost the same districts and only their arrangement among themselves differed. Vilnius and Siauliai regions were among the three districts with the lowest percentage of fillings with either not acceptable surface quality, anatomic form or marginal integrity. The best results regarding marginal integrity and surface quality were found in Taurage district. Kaunas and Panevezys regions appeared to be among the three districts, where adolescents had the highest percentage of restorations with not acceptable surface quality, anatomic form and marginal integrity. The worst results in anatomic form and surface quality were found in Marijampole district, while adolescents from Alytus district had one of the lowest percentage of fillings with not acceptable anatomic form, but their percentage of restorations with not acceptable marginal integrity was one of the highest.

CONCLUSIONS

1. More than half (60.35 %) of dental restorations in Lithuanian adolescents must be replaced.
2. The main reason for the replacement of restorations is not acceptable anatomic form (47.58 %)
3. Both gender groups had similar percentage of satisfactory restorations, but girls have more filled teeth than boys.
4. Adolescents from urban and rural areas don't differ with regard to the reasons for the replacements of restorations, except not acceptable marginal integrity: children from rural areas have fewer restorations with not acceptable marginal integrity.
5. There was found a similar percentage of satisfactory restorations in all geographical regions, but the reasons for the replacements differed significantly among the districts.
6. Only in 8.9 % of participants all their fillings were considered as satisfactory and in 24.8 % of adolescents all their fillings had to be changed.

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