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THE EFFECTS OF EARLY LOSS OF PRIMARY LATERAL TEETH

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Summary. *The aim of the study was to establish the frequency of orthodontic irregularities in the examined group of children, to determine various factors that may increase or minimize reduction of mesiodistal diameter of supporting zone and to determine the reduction degree of mesiodistal diameter of supporting zone in children with approximal caries of deciduous molars (and canines) in relation to intact supporting zone in children with different types of malocclusion. Investigation of space loss in the supporting zone included the analysis of study models and orthopantomographic X rays taken from 100 patients. Out of this number, there were 46 subjects with intact supporting zone (28 girls and 18 boys) and 54 subjects with damaged supporting zone (44 girls and 10 boys). Measurements were performed in all four quadrants using nonius with precision of 0.1mm. Statistical analysis of the obtained data included mean value, standard deviation, value range and statistical significance was determined by t-test. Results indicate space reduction of supporting zone in case of early extraction of any deciduous molar or canine, except in cases of overdeveloped jaws or occlusal relationship in full class that impedes mesiodistal movement of teeth due to presence of tuberculofissure bite. Postextraction space in supporting zone is closed either by mesial or distal side (or both directions simultaneously) depending on localization of 'empty' space in tooth arch. Significant space loss in supporting zone was found in the girls upper jaw bilaterally ($t=3.41$; $p<0.01$ and $t=3.00$; $p<0.01$) and in lower jaw bilaterally ($t=5.14$; $p<0.001$ and $t=3.75$; $p<0.001$) and in boys' left upper jaw ($t=4.24$; $p<0.01$). It may be concluded that maintenance of supporting zone is very important both for regular placement of successors and maintenance of morpho-functional occlusal complex.*

Key words: *Early loss of primary lateral teeth, mesio-distal diametar supporting zone*

Introduction

Dental arch segment consisting of primary canine, primary first and second molar makes up the so called supporting zone, the range of which represents the sum of mesiodistal diameters of these teeth. The main function of the supporting zone during eruption of first permanent molars and replacement of incisors is to maintain space for permanent teeth (canines and premolars). From an early stage of mixed dentition, dental arch extends posteriorly (by eruption of six year molars); whereas in frontal region simultaneously with replacement of incisors the stage of expressive transversal expansion of dental arch and height increase of dental arch occur. Supporting zone lies between these two developmental centers. Maintenance of this space *in extenso* during the period of primary and mixed dentition is very important for:

- Regular masticatory function
- Maintaining space for successors
- Support for the first permanent molars that have tendency of mesial migration
- Support for permanent incisors that when being replaced may cause significant transversal expansion of dental arches
- Maintaining vertical dimension and normal course of the second and third phase of physiological overbite reduction.

Supporting segment of dental arch in case of discontinuity is prone to reduction of mesiodistal diameter, which was demonstrated by various studies dealing with this topic (1-6).

Taking into account the existence of caries and increased morbidity of primary molars in children throughout the world, it is interesting to investigate the way and degree of space reduction in children with mesiodistal diameter damaged by caries or by early extraction of primary molars and canines.

The Aim

Aim of investigation:

1. to establish frequencies of orthodontic irregularities in children,

2. to determine mechanisms of space closing in supporting zone after damaging of mesiodistal diameter,

3. to determine different factors that may increase or minimize reduction of mesiodistal diameter of supporting zone,

4. to determine size-reduction of mesiodistal diameter of supporting zone in children with approximal caries of primary molars (and canines) in relation to intact supporting zone in children with different types of malocclusion.

Materials and Method

The study included 100 model subjects of both sexes aged 8-10 with different types of malocclusion. All subjects were to be orthodontically treated at the Clinic of Stomatology in Nis. The precondition for subject selection was dental status with permanent incisors and first permanent molars (in first permanent molars the presence of occlusal fillings was tolerated); teeth of supporting zone were deciduous (healthy, carious, completely destroyed by caries, with or without roots). Subjects were divided according to sex, so that there were 72 girls (28 with intact supporting zone and 44 with damaged zone) and 28 boys (18 with intact supporting zone and 10 with damaged zone). Intact supporting zone implies that mesiodistal integrity of supporting zone is not damaged. Damaged supporting zone implies that mesiodistal integrity of supporting zone is destroyed by approximal caries of the teeth of supporting zone or by early loss of teeth. Orthopantomographics were added to subjects' documentation, so that each of them was analyzed in relation to status of supporting zone and elimination of hypodontics of permanent teeth. In case of diameter reduction of supporting zone the direction of closing of post-extraction space in supporting zone was determined on the basis of orthopantomographics and study model analysis. Supporting zones from distal surface of lateral incisor to mesial surface of the first permanent molars were measured without reconstruction. Measurements were performed in all four quadrants (upper right, upper left, lower right and lower left) using nonius with precision of 0.1 mm.

Comparison of the obtained data was made between the following groups:

1. a) Boys with intact and damaged supporting zone for each quadrant separately
   b) Girls with intact and damaged supporting zone for each quadrant.
2. a) Sex differences in children with intact supporting zone for each quadrant.
   b) Sex differences in children with damaged supporting zone for each quadrant.

Statistical analysis of the obtained data included mean value (X), standard deviation (SD), value range (min-max), and statistical significance was determined by t-test.

Results

1. The study results of frequency of presence of certain malocclusion types in our group of subjects were given in Table 1.

2. Determination of mechanisms for space closing in supporting zone after being damaged.

Table 1. The study results of frequency of presence of certain malocclusion types in our group of subjects

Malocclusion according to Angle:	
I Class	50 (50%)
½ II/1 or II/1 Class	20 (20%)
½II/2 or II/2 Class	26 (26%)
½ III or III Class	4 (4%)
Irregularities:	
Narrowness of one or both jaws	14 (14%)
Cross bite (unilateral)	6 (6%)
Cross bite (bilateral)	4 (4%)
Protrusion (of the upper or lower frontal teeth)	28 (28%)
Retrusion	36 (36%)
Bimaxilar protrusion	8 (8%)
Deep bite	50 (50%)
Open bite	16 (16%)
Crowding	38 (38%)
Spacing	10 (10%)

In patients with damaged supporting zone there was shortening of mesiodistal diameter, except in cases of primary long dental arch (such as mandibular prognathism, II/1 class malocclusion in upper jaw, or patients with primary spacing). Mechanism of space closing of damaged supporting zone is performed in three ways:

– Space closing by mesial movement (inclination) of the first permanent molars (or first permanent and second deciduous molars) is the most frequent type of space closing in our subjects. From 54 subjects with damaged supporting zone, 32 subjects (59.26%) had this type of space reduction of supporting zone.

– Space closing by distal movement (or inclination) of deciduous canine (or canine and permanent incisors). This type of space closing of supporting zone was determined in 11 subjects (20.37%) of 54 subjects with damaged supporting zone.

– Mesial and distal space closing of supporting zone. This close spacing type was determined in 11 (20.37%) of 54 subjects.

3. Determination of factors that may intensify or minimize reduction of mesiodistal diameter of the supporting zone

Analyzing the study models and orthopantomographics of our subjects with damaged supporting zone, the following intensifying factors that accelerate diameter reduction were established:

– The level of lost dental substance that is, the number of lost teeth of the supporting zone. The subjects who had more expressed loss, had also faster and greater space reduction.

– The time of tooth loss of the supporting zone. The early loss leads to greater space reduction.

– The size of available space in teeth arches. In overdeveloped teeth arches there were no losses in supporting zone, regardless of the number of lost teeth in supporting zone. On the other hand, in case of the lack of space in teeth arch (primary crowding), the loss of space was rapid.

Table 2. Statistical characteristics (mean value ± standard deviation, range: min – max value) of mesio-distal diameter supporting zone in upper and lower jaw in boys and girls with intact and damaged supporting zone

Jaw	Supporting zone	Girls		Boys	
		Right	Left	Right	Left
Upper	Intact	22.53 ±1.00 *	22.38 ±0.86 *	22.20 ±0.81 †	22.43 ±0.84 *
		21.0 –24.4	20.7 –24.3	20.4 –23.6	21.1 –23.0
	Damaged	21.37 ±8.95	21.16 ±1.06	21.30 ±0.66	20.82 ±0.81
		19.1 –22.9	18.6 –23.0	20.5 –22.5	20.4 –21.0
Lower	Intact	22.97 ±1.03 *	22.77 ±1.28 *	22.83 ±0.81 ‡	22.97 ±0.60
		20.5 –25.4	20.6 –25.2	21.5 –24.1	22.2 –23.9
	Damaged	21.52 ±0.97	21.27 ±1.10	21.66 ±0.84	21.90 ±1.47
		19.1 –22.9	19.0 –23.3	20.1 –22.6	20.2 –24.4

* p<0,01, intact vs damaged supporting zone
† p<0,05, intact vs damaged supporting zone
‡ p=0,05, intact vs damaged supporting zone

– Intercuspidation of lateral teeth. Expressive tuberculofissure bite (like that in occlusal finding in full class) decelerates sagittal migration of lateral teeth. On the contrary, occlusion of lateral teeth in half-class (1/2 II or ½III class) enables lateral teeth to move easier.

– Abrasion of dentition also facilitates teeth migration.

Both increasing and minimizing factors influence the total amount of lost space, so that it is impossible to separate their influences and establish which of these two factors is more contributory to this process.

4. Results obtained by comparison of groups of children with intact and damaged supporting zone (Table 2).

A) *Girls*

Comparison of the groups of girls with intact and damaged supporting zone in the UPPER JAW –RIGHT has provided the following results:

The mean value of mesiodistal diameter of supporting zone in the girls with intact supporting zone is 22.53 mm, and 21.37 mm in the girls with damaged supporting zone. This difference is statistically significant (t=3.41; p<0.01).

Comparison of the groups of girls with intact and damaged supporting zone in the UPPER JAW –LEFT has provided the following results:

The mean value of mesiodistal diameter of supporting zone in the girls with intact supporting zone is 22.38 mm, and 21.16 mm in the girls with damaged supporting zone. This difference is statistically significant (t=3.00; p<0.01).

Comparison of the groups of girls with intact and damaged supporting zone in the LOWER JAW – RIGHT has provided the following results:

The mean value of mesiodistal diameter of supporting zone in the girls with intact supporting zone is 22.97 mm, and 21.52 mm in the girls with damaged supporting zone. This difference is highly significant statistically (t=5.14; p<0.001).

Comparison of the groups of girls with intact and damaged supporting zone in the LOWER JAW –LEFT has provided the following results:

The mean value of mesiodistal diameter of supporting zone in the girls with intact supporting zone is 22.77 mm, and 21.27 mm in the girls with damaged supporting zone. This difference is statistically high significant (t=3.75; p<0.001).

B) *Boys*

Comparison of the groups of boys with intact and damaged supporting zone in the UPPER JAW -RIGHT has provided the following results:

The mean value of mesiodistal diameter of supporting zone in the boys with intact supporting zone is 22.20 mm, and 21.30 mm in the girls with damaged supporting zone. This difference is statistically significant (t=2.09; p<0.05).

Comparison of the groups of boys with intact and damaged supporting zone in the UPPER JAW -LEFT has provided the following results:

The mean value of mesiodistal diameter of intact supporting zone is 22.43 mm, and 20.82 mm of damaged supporting zone. This difference is statistically significant (t=4.24; p<0.01).

Comparison of the groups of boys with intact and damaged supporting zone in the LOWER JAW -RIGHT has provided the following results:

The mean value of mesiodistal diameter of intact supporting zone is 22.83 mm, and 21.27 mm of damaged supporting zone. The difference between these two values is at the border line of statistical significance (t=2.54, p=0.05).

Comparison of the groups of boys with intact and damaged supporting zone in the LOWER JAW-LEFT has provided the following results:

The mean value of mesiodistal diameter of intact supporting zone is 22.97 mm, and 21.90 mm of damaged supporting zone. This difference is not statistically significant (t=2.00, p>0.05).

There were no statistically significant differences between mean values of mesiodistal diameters of damaged and intact supporting zones in both of sexes.

Discussion

Regardless of heterogeneity of orthodontic irregularities in the examined population, it is necessary to preserve the space of supporting zone in the majority of subjects. Exceptions are rare cases where the planned therapy includes teeth reduction (most often the first premolars). In all other cases, the loss of space in the supporting zone might aggravate orthodontic therapy. In patients with normal occlusion, early tooth loss of the supporting zone led to irregularities (the occurrence of secondary crowding). According to Marković, preservation of the tooth arch segment would reduce the frequency of malocclusions by 30% in the countries of the Balkan region (1).

The second deciduous molar is the member of the supporting zone which is most often prone to destruction and early loss. Its early loss in the period of mixed dentition and even later may result in mesial movement of the first permanent molar (2), as well as early eruption of secondary permanent molar (3). The effect of fast space reduction is particularly expressive when the crown of the first permanent molar is adjacent to distal root of the second deciduous molar. Consequently, there occurs the loss of space by distal side (2), because the first permanent molar makes either mesial movement (more often in the upper jaw) or mesial inclination (more often in the lower jaw). In either case, the length of tooth arch decreases. Regarding the fact that the second deciduous molar is the tooth with the greatest morbidity in primary dentition in our subjects as well as in all subjects in general (1,4), this type reduction of mesiodistal diameter of the supporting zone is the most frequent. This type of space closing is not present only in the early loss of the second deciduous molar, but also in the early loss of the first deciduous molar (5,6). An earlier attitude that the second deciduous molar prevents mesial movement of the first permanent molar should be taken with consideration, for, in most cases, both, second deciduous molar and first permanent molar have mesial movement (Fig. 1).

If the loss of a member of the supporting zone is localized more anteriorly, space reduction mechanism of the supporting zone is slightly different. Primary canines are rarely lost because of advanced caries process. If the cause of an early loss is root resorption of this tooth by permanent lateral incisor, this indicates that there is lack of space of higher degree (1,4). Sometimes, closing of the damaged space of the supporting zone from mesial direction occurs by distal inclination of permanent incisors with consecutive movement of tooth middle-line in relation to jaw middle-line (Fig. 2). In case of early loss of the first deciduous molar, deciduous canine (and sometimes permanent incisors, too) may move or incline to the distal (Fig. 3). Such type of

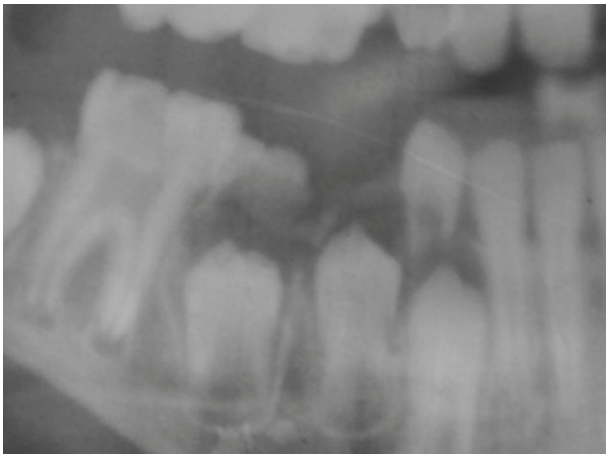

Fig. 1. Space reduction from distal side (detail); mesial movement of the first permanent and second deciduous molar

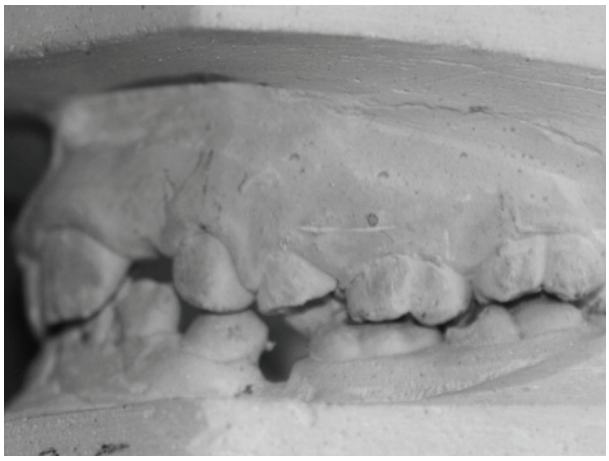

Fig. 2. Effects of early loss of first deciduous molar. Deciduous canine and permanent lateral incisor occupy the space of supporting zone

Fig. 3. Orthopantomographic X ray (detail) shows space after premature loss of first deciduous molar upper right. Space reduction occurs due to early loss of first deciduous molar and incisors toward postextraction space. Mesial migration of second deciduous and first permanent molar is hindered by expressive intercuspidation

space closing of the supporting zone is the result of pressure due to the replacement of incisors. Permanent incisors have wider mesiodistal diameter then their deciduous precursors thus leading to radius increase in frontal part of the dental arch. The precondition for this is the intact supporting zone. The height increase of dental arch never reaches full value in case of distal inclination or distal moving of deciduous canine into the space of the early extracted first primary molars (4). In such a different way there is enough space made for lateral incisors, without the radius size increase of frontal segment of tooth arch, as in the case of tooth arch with intact supporting zone.

The third way of space reduction in damaged supporting zone is shortening of tooth arch by mesial and distal side. It is encountered in early loss of first deciduous molar, but more often in destruction or early loss of both deciduous molars. The consequences of such shortening of space in supporting zone always complicate placement of permanent successors. If this is present only in one tooth arch there may occur vertical superposition of antagonists and constraint of articulation movements as well as collapse of the dental arch.

Determination of factors that may increase or minimize reduction of mesiodistal space of supporting zone

There is generally accepted opinion that early teeth loss in the supporting zone as well as the amount of lost dental substance and primary lack of space accelerate reduction of mesiodistal diameter of supporting zone (3,4). In developed tooth arches (as in the case of progenia in lower jaw, bimaxillary protrusion and II/1 class in the upper jaw), space reduction of the supporting zone is rare. The space loss is certain when jaws are normally developed or non-developed. Patients who lost two deciduous molars by the age of 8 have very expressive space reduction (Fig. 4). These factors are predominant but not the only ones. According to this study, intercuspidation of lateral teeth is of great importance. The occlusal relationship of lateral teeth may decelerate or accelerate this process. Full class occlusion (I, II, or III) due to tuberculofissure bite inhibit to some extent tooth movement toward postextraction space. On the contrary, in half-class occlusion (1/2 II or 1/2 III class), antagonist relationship of lateral teeth enables easy 'gliding' of teeth toward postextraction space and diameter reduction (Fig. 5). Migration of lateral teeth, naturally, leads to disturbance of sagittal occlusal relationship (2). Abrasions of deciduous molars that are necessary for normal occlusal development and refraction of postmolar plane (1) in this case lead to easy teeth migration and faster closing of postextraction space.

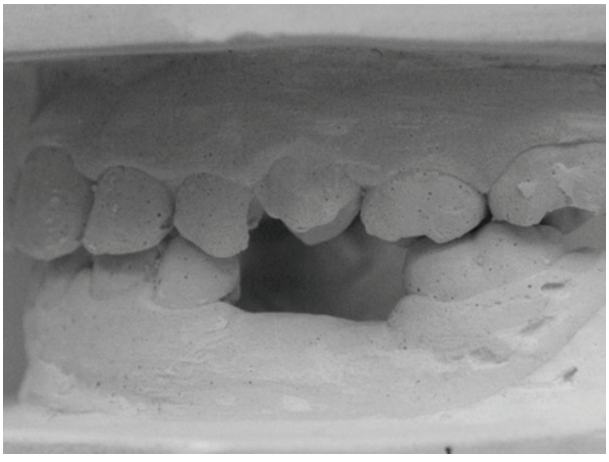

Fig. 4. Reduction of postextraction space due to early loss of the first and second deciduous molar. Space closing is caused by distal inclination of deciduous canine and permanent incisors and due to mesial inclination of the first permanent molar. Consecutive collapse of lower frontal segment and disturbance of occlusal relationship on the first permanent molars.

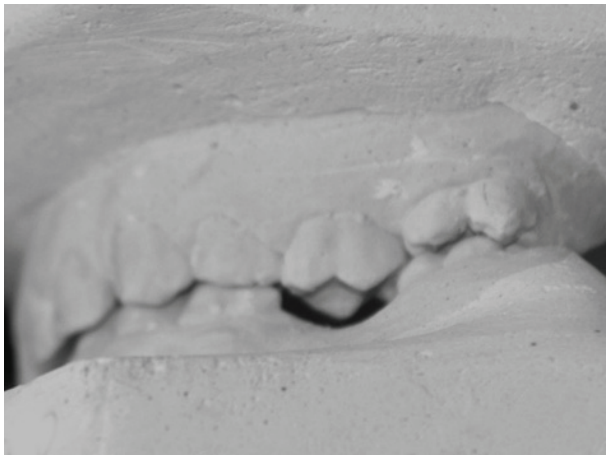

Fig. 5. Occlusion of I class proposed by Angle hinders space reduction of early lost lower second deciduous molars due to expressive tuberculofissure bite of the first permanent molars. Superposition of upper second deciduous molar caused by the loss of antagonist contributes to it.

Comparison of mesiodistal diameters of supporting zones in children with intact and damaged supporting zone

Greater space closing was expected in the upper jaw, due to its spongious form and type of teeth movement (in the upper jaw, lateral teeth drift mainly by bodily movement, whereas in the lower jaw inclination is more frequent toward empty space; on the other hand, mesiodistal diameter of supporting zone in lower teeth arch is slightly greater). These findings, were, however, confirmed partially only in the group of boys (Table 2). The space loss in the supporting zone was significant only in the left upper jaw, while in the right upper jaw it was insignificant. Taking an opposite jaw side for the investigation of space loss after early extraction of the first deciduous molars, Lin et.al showed similar results (7,8). In the group of boys, the reduction in supporting zone of the lower jaw space showed no statistical significance, which was partially determined by expected results.

However, in the group of girls, space loss in supporting zone of the upper jaw was significant and in the lower jaw highly significant, which was not in accordance with expected results. This phenomen on may be explained only by increased morbidity of lower deciduous molars. The obtained results are in accordance with the results given by Lin and Chang (7) and Ak et all (9). Styblova, too, established significant space reduction in the lower jaw (6).

Sex differences in the population of intact and damaged supporting zone are minimal and of no statistical significance.

Conclusion

Approximal caries as well as consecutive early loss of the deciduous molars in the supporting zone may result in significant reduction of mesiodistal diameter. This may cause the occurrence of secondary difficulties and disturbance of regular occlusal relationships.

Process of mesiodistal diameter reduction does not occur in all subjects with tooth destruction of supporting zone. In fact, it did not occur in subjects with developed (overdeveloped) teeth rows and sharp intercuspidation, while it occurred in all other subjects with tooth destruction of supporting zone. It was the lowest in boys' lower jaw and the highest in girls' lower jaw.

Sex differences in population with intact and damaged supporting zone are not statistically significant.

It may be concluded that maintenance of supporting zone is very important both for regular placement of successors and maintenance of morpho-functional occlusal complex. Therefore, it is necessary to design and carry out adequate preventive measures in pedodontics.

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POSLEDICE PREVREMENOG GUBITKA MLEČNIH BOČNIH ZUBA

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Kratak sadržaj: *Istraživanje gubitka prostora u potpornoj zoni (zona koja obuhvata mlečni očnjak i mlečne molare), obuhvatilo je analizu studijskih modela i ortopantomografskih snimaka 100 pacijenata, od toga 46 ispitanika sa očuvanom potpornom zonom (28 devojčica i 18 dečaka) i 54 ispitanika sa oštećenom potpornom zonom (44 devojčica i 10 dečaka). Cilj istraživanja je bio utvrđivanje frekvencije ortodontskih nepravilnosti na ispitivanom uzorku dece, utvrđivanje mehanizma zatvaranja prostora u potpornoj zoni, posle narušavanja njenog meziodistalnog promera; determinisanje različitih faktora koji mogu favorizovati ili usporiti redukciju meziodistalnog promera potporne zone i utvrđivanje veličine smanjenja meziodistalnog promera potporne zone kod dece sa aproksimalnim karijesom mlečnih molara (i očnjaka) u odnosu na očuvanu potpornu zonu kod dece sa različitim vrstama malokluzija. Rezultati ukazuju na pojavu redukcije prostora potporne zone, gotovo uvek kada postoji prevremena ekstrakcija nekog od mlečnih molara ili očnjaka, osim u slučajevima kada postoje prerazvijene vilice ili okluzalni odnos u punoj klasi, koji zbog prisustva tuberkulofisurnog zagrižaja otežava meziodistalnu migraciju zuba. Postekstrakcioni prostor u potpornoj zoni zatvara se iz oba pravca - mezijalnog ili distalnog (ili iz oba pravca istovremeno) u zavisnosti od lokalizacije "praznog" prostora u nizu. Signifikantan gubitak prostora u potpornoj zoni ustanovljen je kod devojčica u gornjoj vilici obostrano (t=3,41; p<0,01 i t=3,00; p<0,01) i u donjoj vilici obostrano (t=5,14; p<0,001 i t=3,75; p<0,001) i kod dečaka u gornjoj vilici levo (t=4,24; p<0,01).*

Ključne reči: *Prevremeni gubitak mlečnih bočnih zuba, mezio-distalni dijametar potporne zone*