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## SECONDARY DEFORMITIES OF DENTITIONS IN RESIDENTS OF THE KHARKIV REGION

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The study was devoted to analyzing the prevalence and types of secondary deformities associated with the presence of partial dentition defects among residents of the Kharkiv region. The results of the digital panoramic radiography analysis confirm a high prevalence of dentition defects among residents of the Kharkiv region – averaging 53.7 % – and demonstrate a direct correlation with the patients' age. A significant increase in the prevalence of partial dentition defects is observed in the 25–29 age group, where the prevalence exceeds 40 %, and it remains high in the oldest age group (75–84 years).

**Key words:** partial dentition defects, secondary adentia, secondary deformities of dentition, X-ray examination, digital panoramic radiography, age-related prevalence, gender-related prevalence.

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## ВТОРИННІ ДЕФОРМАЦІЇ ЗУБНИХ РЯДІВ У ЖИТЕЛІВ ХАРКІВСЬКОГО РЕГІОНУ

Дослідження було присвячено аналізу поширеності та видів вторинних деформацій, пов'язаних з наявністю часткових дефектів зубних рядів у жителів Харківського регіону. Результати аналізу цифрової панорамної рентгенографії підтверджують високу поширеність дефектів зубних рядів серед мешканців Харківської області – у середньому 53,7 % і демонструють прямий кореляційний зв'язок з віком пацієнтів. Значне зростання поширеності часткових дефектів зубних рядів спостерігається у віковій групі 25–29 років, де поширеність перевищує 40 %, і залишається високою в найстаршій віковій групі (75–84 роки).

**Ключові слова:** часткові дефекти зубних рядів, вторинна адентія, вторинні деформації зубних рядів, рентгенографічне дослідження, цифрова панорамна рентгенографія, вікова поширеність, гендерна поширеність.

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Despite the significant and dynamic development of dental science and practice, there remain persistent tendencies for delayed dental care among the population. The reasons for this vary, but the outcome is evident: a high prevalence of primary dental diseases across various age groups in Ukraine, most of which lead to tooth loss and the development of edentulism. According to domestic researchers, the prevalence of partial dentition defects (PDD) in different age groups of the Ukrainian population remains high, reaching up to 95 % [1, 9, 10].

The factors contributing to this pathological condition of the dentofacial system are numerous, as are its consequences [2]. In addition to negatively impacting various aspects of occlusion, functionality, and aesthetics, the presence of PDD combined with the development of secondary deformities is a significant obstacle to the rational rehabilitation of the dentofacial system [12, 13].

Regarding the initial examination of patients with PDD, traditional objective assessments according to modern algorithms are recommended to be supplemented with a screening radiological examination – digital panoramic radiography. According to Turkish researchers [11], this method is highly effective in identifying dentoalveolar deformities and anomalies.

Thus, on the one hand, there is a current need for effective treatment of PDD to timely prevent the development of secondary deformities of dentition (SDD). On the other hand, studying the specific features of SDD in representatives from different regions of Ukraine is essential for understanding optimal rehabilitation strategies, both in terms of timing and method.

It is well established that “dentition defects, combined with various dentoalveolar anomalies and deformities, often hinder rational prosthetic procedures and, in some cases, render them impossible” [13]. This assertion can also be fully applied to the prospects of dental implantation in such cases.

**The purpose** of the study was to investigate the prevalence and types of secondary deformities of dentition associated with the presence of minor partial dentition defects in residents of the Kharkiv region.

**Materials and methods.** Digital panoramic radiography (DPR) of 1,269 patients from the WDE Diagnostic Center (Kharkiv, Ukraine) were analyzed (in period from 2017 to 2020). The images were obtained using a fifth-generation dental computed tomography scanner, Veraviewepocs 3D R100 (Morita, Japan). By gender distribution, 62.6 % of the DPRs belonged to women (767 individuals) and 37.4 % to

men (502 individuals) ( $p>0.05$ ). The total number of analyzed groups in this study was 12. Group formation was based on age and followed the WHO classification (2019), with intervals of 5 years from 18 to 84 years. To ensure data representativeness, the first (18–19 years) and last age groups (80–84 years) were combined with the subsequent and preceding groups, respectively.

Processing and analysis of DPRs were conducted in accordance with the principles of medical deontology, ensuring strict anonymity of each patient's data. The study was reviewed and approved by the Bioethics Commission of Kharkiv National Medical University.

The analysis focused on the presence of horizontal tooth displacement (mesial, distal, and bodily) and vertical displacement.

For statistical processing of the results, SPSS Statistics 19.0 and Statistica 64 version 10 software packages were used. Differences were considered statistically significant at the commonly accepted error level of  $p<0.05$  in medical and biological research.

**Results of the study and their discussion.** Analysis of the primary material allowed us to establish that the total number of minor PDD is 1913, of which 1552 were included, and 361 were final, i.e. 4.29 times less ( $p<0.05$ ). Regarding gender distribution, minor PDD were present in 392 women (51.1 %) and in 284 men (56.6 %). A detailed study of the prevalence of minor PDD showed that their dynamics has certain age-related characteristics and is presented in Fig. 1.

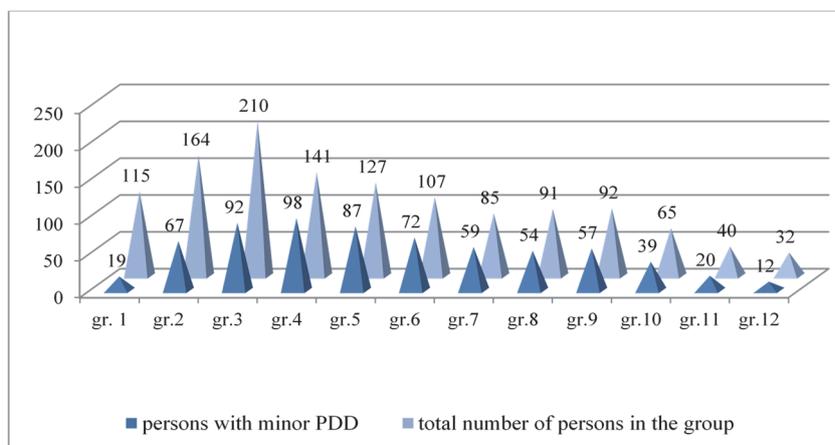


Fig. 1. Dynamics of the prevalence of minor PDD in all age groups, n.

Group 3 (30–34 years), it rose further to 43.8 %, exceeding the rates in Group 2 by 1.1 times ( $p>0.05$ ). In Group 4 (35–39 years), the prevalence reached 69.5 %, surpassing Group 3 rate by 1.6 times ( $p<0.05$ ).

From Group 4 to Group 7 (50–54 years), the prevalence of minor PDD stabilized at approximately 68.7 %. Beginning with Group 8 (55–59 years), which marks the middle-age category, there was a gradual, statistically insignificant (at a significance level of  $p=0.05$ ) decline in the prevalence of minor PDD, primarily due to an increase in the prevalence of major PDD. Specifically, the prevalence rates in Group 8 (55–59 years) were 59.3 %, in Group 9 (60–64 years) – 61.9 %, in Group 10 (65–69 years) – 60.0 %, and in Group 11 (70–74 years) – 50.0 %.

Only in the final age group (Group 12: 75–84 years) was the decline in minor PDD prevalence more pronounced, dropping to 37.5 %.

It should also be noted that a direct moderate correlation was established between the prevalence of minor PDD and patient age ( $r=0.4207$ ,  $p<0.001$ ).

The study of the prevalence of secondary deformities provided the following information. Among SDD in the horizontal plane associated with PDD, the DPRs analysis recorded mesial or distal tooth tilting toward the defect area and bodily movement of teeth into the defect region. The proportion of such deformities among women across all groups with minor PDD averaged 47.7 % (or 187 individuals), and among men, it was 41.5 % (or 118 individuals). That is, at a significance level of  $p=0.05$ , there are no significant differences.

Regarding SDD in the vertical plane, the analysis focused on cases of occlusal curve disruption with a reduction (or complete absence) of the distance between the occlusal surface of the displaced tooth and the alveolar ridge of the opposing jaw. The prevalence of these vertical SDD in women across all groups with minor PDD averaged 19.4 % (or 76 individuals), while in men, it was 20.8 % (or 59 individuals). So, at a significance level of  $p=0.05$ , there are no significant differences.

The overall prevalence of SDD in the horizontal plane was 45.1 %, in the vertical plane – 19.9 %, and in total – 65. %.

The dynamics of SDD prevalence across all age groups are presented in Fig. 2.

According to the data presented, the prevalence of minor PDD among young residents of the Kharkiv region exhibited a significant upward trend, not only compared to the youngest age group (Group 1: 18–24 years, 16.5 %) but also relative to subsequent groups. The prevalence of minor PDD in Group 2 (25–29 years) increased sharply to 40.8 %, which was 2.5 times higher than in Group 1 ( $p<0.05$ ). In

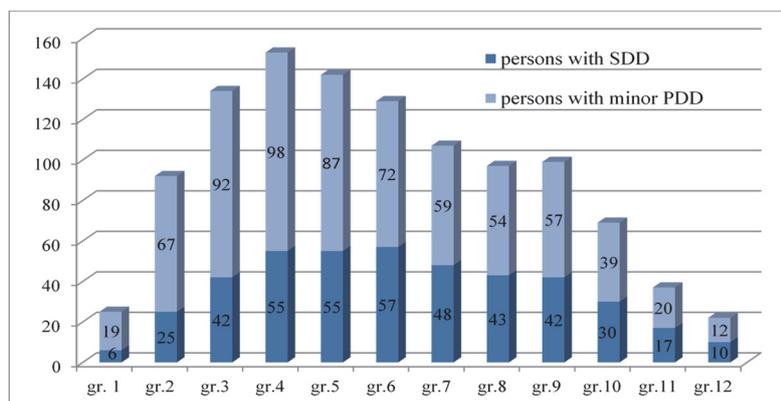


Fig. 2. Dynamics of the prevalence of SDD in all age groups, n.

In Group 4 (35–39 years), the number of SDD grew by 1.3 times to 55 cases (38 in horizontal and 17 in vertical plane). Group 5 (40–44 years) showed a further 1.2-fold increase in SDD cases, reaching 65 (46 in horizontal and 19 in vertical plane). From Group 6 (45–49 years) onward, there was a gradual decline in SDD cases to 57 (0.9 times fewer than the previous group), with 41 horizontal and 16 vertical defects. In Group 7 (50–54 years), the number of SDD decreased to 48 (0.8 times fewer than Group 6), with 31 horizontal and 17 vertical defects. In Group 8 (55–59 years), the number of SDD further decreased to 43 (0.9 times fewer than in Group 7), with 28 horizontal and 15 vertical defects. In Group 9 (60–64 years), the SDD count dropped to 42 (0.9 times fewer than in Group 8), with 28 horizontal and 14 vertical defects. In Group 10 (65–69 years), SDD declined significantly to 30 cases, 1.8 times fewer than the previous group (20 horizontal and 10 vertical defects). In Group 11 (70–74 years), there was a further 1.8-fold decrease, with only 17 SDD detected (10 horizontal and 7 vertical). Finally, in Group 12 (75–84 years), the number of SDD dropped to 10, a 1.7-fold decrease, with only 1 horizontal and 9 vertical defects.

As with the prevalence of minor PDD and patient age, there was a direct moderate correlation between the prevalence of SDD and patient age ( $r=0.4321$ ,  $p<0.001$ ).

The overall dynamics of SDD prevalence mirrored the wave-like pattern observed in minor PDD prevalence: a marked increase up to 40 years, consistently high levels until 50 years, followed by a gradual decline until 64 years, and a sharper decrease from 65 years onward.

It was also pertinent to examine the percentage characteristics of SDD and PDD prevalence across age groups. The data are presented in Fig. 3, which illustrates differing trends in SDD and minor PDD prevalence by age.

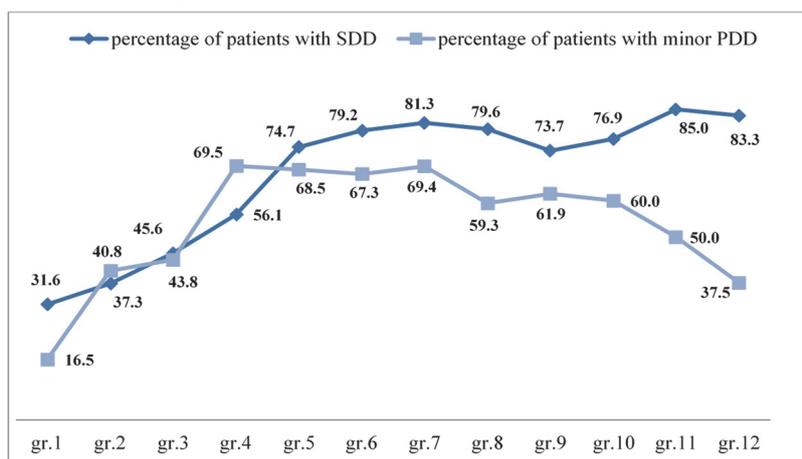


Fig. 3. Percentage characteristics of the prevalence of SDD and minor PDD in terms of age, %.

The dynamics of SDD prevalence exhibit different tendencies and, unlike minor PDD, continuously increase, albeit at varying rates (Fig. 3). Over four age periods, from Group 1 (18–24 years) to Group 5 (40–44 years), the studied indicator increased from 37.6 % to 74.71 %, a 1.9-fold rise ( $p<0.001$ ). From the age period of 40–44 years (Group 5), the growth rate was less pronounced, with average SDD prevalence stabilizing at  $79.22\pm 3.73$  % (with a minimum of 73.7 % in Group 9: 60–64 years, and a maximum of 85.0 % in Group 11: 70–74 years).

A direct correlation was also established between the number of SDD cases and increasing age ( $r=0.4497$ ,  $p<0.001$ ).

In individuals in Group 1 (18–24 years) with minor PDD, only 6 SDD were detected, all in the horizontal plane. In Group 2 (25–29 years), there was a significant 4.2-fold increase in SDD cases (25 total, with 22 in the horizontal and 3 in the vertical plane). In Group 3 (30–34 years), SDD cases continued to rise, with a 1.7-fold increase compared to the previous group, reaching 42 cases (34 in horizontal and 8 in vertical plane).

Regarding the prevalence of minor PDD, it increases sharply from 16.5 % (Group 1: 18–24 years) to 69.5 % in Group 4 (35–39 years) ( $p<0.001$ ). Over the next three age periods, the prevalence of minor PDD remains nearly constant, reaching 69.4 % in Group 7 (50–54 years). From the age of 55 (Group 8), the prevalence of minor PDD begins to decline: gradually to 60.0 % in Group 10 (65–69 years) and more rapidly to 37.5 % in Group 12 (75–84 years).

An analysis of the prevalence of specific types of SDD across age groups revealed certain characteristics (Fig. 4).

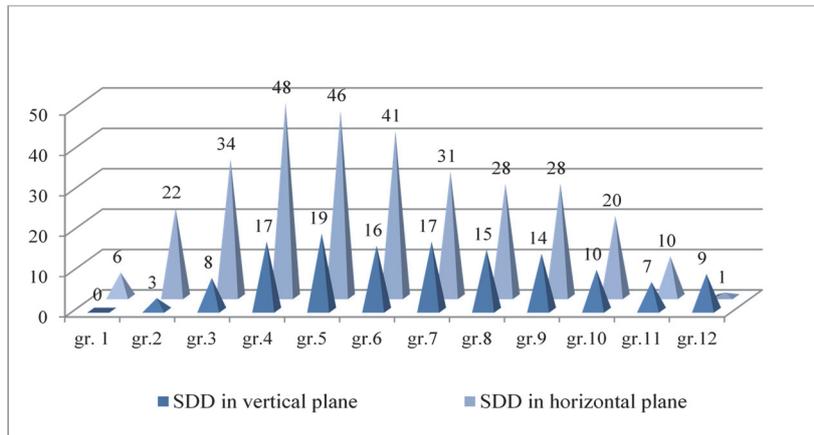


Fig. 4. Prevalence of SDD in terms of age, n.

The dynamics of SDD prevalence in both horizontal and vertical planes were similar: a gradual increase was observed in the youngest age group (18–24 years, Group 1) for SDD in the horizontal plane, and in the 25–29 years age group (Group 2) for SDD in the vertical plane. The maximum number of SDD in both planes was recorded in individuals aged 40–44 years (Group 5), after which a gradual decrease was noted, reaching the lowest

values in the last two age groups. It is worth noting that both the increase and decrease in SDD prevalence were more pronounced among individuals with horizontal plane deformities compared to those with vertical plane deformities. However, in both cases, the differences between maximum and minimum values were statistically significant ( $p < 0.05$ ). The prevalence of SDD in both planes also showed a direct moderate correlation ( $r = 0.4577$ ,  $p < 0.001$ ). Additionally, the prevalence of horizontal plane SDD among women was 47.7 %, which was 1.14 times higher than that among men (41.5 %,  $p < 0.05$ ).

For vertical plane secondary defects (19.38 % in women and 20.8 % in men), no significant gender differences (for  $p = 0.05$ ) were observed.

Regarding the quantitative ratios between SDD, as shown in Fig. 4, the prevalence of SDD in the horizontal plane consistently exceeded that in the vertical plane by factors of 6, 7.3, 4.3, 2.2, 2.4, 2.6, 1.8, 1.9, 2, 2, and 1.4 for individuals from Group 1 to Group 12, respectively. However, in the oldest age group (Group 12, 75–84 years), this trend reversed, with the prevalence of SDD in the vertical plane exceeding that in the horizontal plane by a factor of 9.

The analysis of SDD in the horizontal plane also revealed certain characteristics. The most common type of deformity was mesial displacement of teeth adjacent to dentition deformities, observed in both women (72.2 %, 185 individuals) and men (75.4 %, 89 individuals). Next in frequency was distal displacement, identified in 25.5 % of women (44 individuals) and 21.2 % of men (25 individuals). Bodily movement ranked third, recorded in 4.3 % of women (8 individuals) and 3.4 % of men (4 individuals).

The statistical differences among these types of tooth displacement were significant ( $p < 0.05$ ), but no distinct gender-based patterns of distribution were identified. However, women generally exhibited a higher prevalence of SDD, which may be attributed to specific physiological characteristics.

Thus, PDD, when not promptly addressed, lead to the development of complex clinical situations, most commonly associated with the emergence of SDD, which significantly hinder the comprehensive rehabilitation of such patients [15]. The issues of PDD and SDD prevalence across various age periods remain a relevant area of research for scientists in many regions of Ukraine [4, 5, 8, 14]. These studies aim to develop optimal approaches for providing dental care to such patients.

The data presented in this paper align with the findings of other Ukrainian researchers on this topic. According to Mirchuk B.M. and Maksymov Y.V., who studied the condition of dentitions in residents of the Zaporizhzhia region [7], patients with PDD already exhibit SDD in 96.9 % of women and 100 % of men, even at the age of 20–30 years. The prevalence of SDD remains very high across all age groups of the selected patient cohort, averaging 99.2 % in women and 90.2 % in men. Among the secondary deformities, mesial displacement of teeth and dentoalveolar elongation were the most frequently observed.

After examining patients in Ivano-Frankivsk, SDD caused by untimely correction of PDD were identified in an average in 54 patients (45.0 %). It was also recorded that deformities in horizontal plane occurred in 35 patients (64.8 %), while deformities in vertical plane were present in 12 patients (22.2 %) [12].

Labunets O.V. and coauthors [6] also highlight the significant frequency and intensity of SDD in young adults across the Odesa (89.1 %), Ivano-Frankivsk, and Ternopil regions (93.7 %). Regarding the percentage distribution of deformity types, the averages across these regions were as follows: vertical deformities – 6.91–10.9 %, mesial deformities – 45.1–42.6 %, distal deformities – 9.6–8.6 %, combined deformities – 17.5–18.4 %. The overall frequency of vertical SDD across all patient categories was 31.6 %.

The presence of PDD is also observed in children. For instance, researchers in Kyiv diagnosed PDD in 15.8 % of the total number of examined children (2.276 individuals), while secondary dentoalveolar deformities were found in 12.2 %, and among the total number of identified PDD (359 cases), 77.4 % were associated with secondary deformities. The highest number of SDD was detected during the mixed dentition period, affecting 235 individuals (84.5 %), and the lowest number of SDD was observed during the primary dentition period, involving 6 examined children (2.2 %) [3].

All these factors underscore the necessity of enhancing measures for the prevention, diagnosis, and treatment of PDD and the prevention of the development of SDD, with a focus on motivating patients for comprehensive rehabilitation.

### Conclusions

1. The prevalence of dentition defects among residents of the Kharkiv region, based on digital panoramic radiography analysis, averaged 53.3 % and exhibited a direct correlation with patient age. A significant increase in dentition defects prevalence occurs by the age group of 25–29 years, where the prevalence exceeds 40.0 % and remains high through the oldest age group (75–84 years).

2. The prevalence of secondary dentoalveolar deformities associated with dentition defects in the Kharkiv region averaged 67.0 % and also demonstrated a direct correlation with patient age. Among individuals with minor dentition defects, the prevalence of secondary dentoalveolar deformities was 47.7 % in women and 41.5 % in men on average.

3. The prevalence of secondary dentoalveolar deformities in the horizontal plane exceeded that in the vertical plane by a factor of 2.6.

4. The most common secondary deformity in the horizontal plane was mesial displacement of teeth adjacent to dentition defect, followed by distal displacement, with bodily movement ranking third in frequency.

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