

Dental and Gingival Morphometric Parameters in the Geriatric Population in Serbia – A Preliminary Study

SUMMARY

Background: To evaluate clinical crown dimensions of maxillary central incisors, the width-to-height ratio (W/H), gingival contour classes, and lip line types in individuals older than 60 years and their associations with sex and age. **Materials and Methods:** Forty participants (22 women, 18 men; mean age 74.53 ± 9.13 years) were examined at a gerontology center. Crown height and width were measured using a calibrated dental caliper, while gingival contour and lip line were assessed clinically during spontaneous smiling. Data were analyzed with SPSS 31.0, applying Mann–Whitney U and chi-square tests ($p < 0.05$). **Results:** No significant sex-related differences were found in crown dimensions or W/H ratio. class 2 gingival contour and a low lip line predominated. Increasing age was associated with reduced crown height, higher W/H ratio, greater prevalence of class 2 contour, and decreased maxillary tooth exposure during smiling. **Discussion:** The findings indicate that aging-related morphological changes substantially influence anterior dental proportions and soft-tissue display, which should be considered during aesthetic and prosthetic treatment planning. Such an approach may improve treatment predictability, patient satisfaction, and long-term functional stability, particularly in populations with complex systemic conditions and cumulative dental wear, where standardized aesthetic norms are often inappropriate. **Conclusion:** Aging significantly modifies tooth morphology, gingival phenotype, and lip line position. Despite limitations related to sample size and single-center design, the results provide clinically relevant baseline data for geriatric dental rehabilitation and support an individualized approach integrating functional, aesthetic, and psychological considerations. Further multicenter studies are therefore strongly recommended.

Keywords: maxillary central incisor; gingival contour; lip line; aging.

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Introduction

Smile aesthetics represents an important aspect of contemporary dental practice, as it significantly influences facial appearance, self-confidence, and patients' quality of life. Maxillary central incisors, gingival contours, as well as the position and dynamics of the lips, play a key role in establishing a harmonious and natural smile. These parameters are frequently analyzed in clinical and

scientific research in the fields of esthetic and restorative dentistry and dental prosthetics¹⁻³.

The dimensions of the clinical crown, particularly the width-to-height ratio (W/H), are considered one of the fundamental morphological indicators of dental aesthetics. Previous studies indicate that optimal values of this ratio contribute to achieving visual balance in the anterior segment of the dental arch, whereas deviations may adversely affect the perception of naturalness and esthetic harmony of the smile¹⁻³.

Given that the aging process involves progressive changes in hard and soft oral tissues, including incisal edge wear, apical migration of the gingival margin, and modifications of periodontal structures, it is expected that changes occur in the clinical dimensions of dental crowns as well as in their proportions⁴.

In addition to tooth morphology, gingival contour represents an important esthetic and functional factor. The gingival phenotype and the position of the marginal gingiva have a direct impact on smile symmetry, tooth visibility, and the overall harmony of the anterior dental segment. However, the literature still does not provide unequivocal and consistent findings regarding the prevalence of specific gingival contour types in elderly individuals, nor their association with sex and age groups⁵⁻⁷.

Studies conducted in the Balkan region indicate significant differences in access to oral health care among different populations, which may partially explain the variability observed in clinical findings^{8,9}.

The lip line, defined by the degree of tooth and gingival exposure during smiling, represents a key element in facial perception. During aging, elongation of the upper lip, decreased tone of the facial musculature, and reduced mobility of soft tissues occur, resulting in a lower smile line and reduced visibility of maxillary teeth and gingiva. These changes are of particular importance in planning esthetic and prosthetic rehabilitation in elderly patients¹⁰⁻¹².

The aim of this study was to assess the dimensions of the clinical crowns of maxillary central incisors, the width-to-height ratio (W/H), the distribution of gingival contour classes, and the type of lip line in individuals older than 60 years, as well as their association with sex and age groups.

Materials and Methods

The study was conducted at the Gerontology Center in Niš. Approval for the research was obtained from the Ethics Committee of the Clinic of Dental Medicine in Niš (decision No. 14/7-2019-5EO). All participants were informed about the objectives of the study and provided written informed consent.

The study included 40 participants aged 60 years and older, of whom 22 (55%) were female and 18 (45%) were male. The mean age of the participants was 74.53 ± 9.13 years, with the youngest participant being 60 and the oldest 91 years old. Age distribution did not differ significantly between sexes ($p = 0.053$). Participants were divided into three age groups: 60–69 years, 70–79 years, and 80 years and older.

All participants met the following inclusion criteria: presence of at least one natural maxillary central incisor; absence of crowns, veneers, or large restorations on the

examined tooth; absence of pronounced abrasive wear altering crown morphology; absence of severe periodontal disease, gingival recession, or acute inflammation; and absence of craniofacial anomalies or conditions that could affect lip position or smile dynamics.

All measurements were performed under standardized clinical conditions in the dental office of the Gerontology Center. The following parameters were assessed:

Dimensions of the maxillary central incisor:

- clinical crown height (mm),
- clinical crown width (mm),
- width-to-height ratio (W/H).

Clinical crown height and width were measured intraorally using a calibrated dental caliper with an accuracy of 0.01 mm (Figure 1). Based on the obtained values, the width-to-height ratio (W/H) was calculated and expressed as a percentage.



Figure 1. The procedure for measuring the dimensions of the clinical crown of the upper central incisor.

Gingival contour classification:

- Class 1 (low/flat gingival contour) – the marginal gingiva is positioned lower, thinner, and with a less pronounced gingival zenith, making the teeth appear longer but more prone to recession.
- Class 2 (high/pronounced gingival contour) – the marginal gingiva is positioned higher, thicker, with a clearly expressed distally displaced gingival zenith, resulting in shorter and wider-appearing crowns and potentially reduced esthetic visibility of the teeth.

Lip line classification:

- Low lip line – little or no gingiva is visible during smiling, with mainly the incisal parts of the maxillary incisors exposed.
- Medium lip line – the crowns of the maxillary teeth and a small band of gingiva are visible during smiling; this is considered the most esthetically favorable type in the general population.
- High lip line – a large portion of gingiva above the maxillary teeth is visible during smiling, which may contribute to the perception of a “gummy smile.”

Assessment of gingival contour and lip line was performed by direct clinical examination during spontaneous smiling.

This study was designed as a preliminary investigation with a limited sample size, aimed at an initial assessment of dental and gingival morphometric parameters in the geriatric population. Expansion of the sample is planned in the next phase of the study to obtain more representative and statistically robust results.

Statistical analysis

Statistical analysis was performed using appropriate statistical software (SPSS 31.0). Numerical variables were presented as means (M) and standard deviations (SD). Due to non-parametric data distribution, the Mann–Whitney U test was used to compare differences between sexes, while the χ^2 test was applied for the analysis of categorical variables, including gingival contour class and lip line. The level of statistical significance was set at $p < 0.05$. Analyses were conducted for the entire sample as well as for subgroups according to sex and age (60–69, 70–79, and ≥ 80 years).

Results and discussion

Upper central incisor dimensions in geriatric patients in relation to gender

Upper central incisor dimensions in geriatric patients are shown in Table 1.

Table 1. Dimensions of the upper central incisor in geriatric patients in relation to gender

Gender	Height (mm) M $\pm$ SD	Width (mm) M $\pm$ SD	W/H% M $\pm$ SD
Men	9.39 $\pm$ 1.61	8.72 $\pm$ 1.36	94.94 $\pm$ 19.13
Women	9.00 $\pm$ 1.48	8.09 $\pm$ 0.87	91.81 $\pm$ 15.32
Total	9.18 $\pm$ 1.53	8.38 $\pm$ 1.15	93.22 $\pm$ 16.98

The mean clinical crown height of the maxillary central incisor in males was 9.39 $\pm$ 1.61 mm, while in females it was 9.00 $\pm$ 1.48 mm. The mean crown width was 8.72 $\pm$ 1.36 mm in males and 8.09 $\pm$ 0.87 mm in females. The crown width-to-height ratio (W/H) was 94.94 $\pm$ 19.13 in males and 91.81 $\pm$ 15.32 in females. The differences between sexes were not statistically significant, either for crown height (Mann–Whitney U test; $p = 0.378$) or for the W/H ratio ($p = 0.902$).

Although slightly higher mean values of crown height and W/H ratio were recorded in males compared

to females, the absence of statistical significance indicates that sex does not have a decisive influence on these morphological parameters in the studied population. Similar results were reported by Dervarič *et al.*¹³, who also found no statistically significant differences in clinical crown height and width between males and females. This suggests that sex-related differences in these parameters are not always pronounced and may depend on the studied population as well as on the measurement methodology applied.

In contrast, a study conducted in the Nepalese population reported statistically significantly greater clinical crown height and width in males compared with females, while the width-to-height ratio did not differ significantly between sexes¹⁴. Such discrepancies may be the result of population-specific, genetic, or methodological differences among samples, emphasizing the importance of considering ethnic and demographic context when interpreting and comparing data.

Compared with a younger population, in which the mean incisor height is 10.2–10.5 mm and the W/H ratio is approximately 83%, elderly subjects show a reduced crown height (9.0–9.4 mm) and a higher W/H ratio ($\approx 93\%$), indicating pronounced age-related changes in crown morphology¹⁵.

Gingival contour class in geriatric patients in relation to gender

Table 2 shows the distribution of gingiva contour classes in geriatric patients.

Table 2. Distribution of gingiva classes in geriatric patients in relation to gender

Gender	Class 1 n (%)	Class 2 n (%)	P
Men	8 (44.4)	10 (55.6)	
Women	3 (13.6)	19 (86.4)	
Total	11 (27.5)	29 (72.5)	0.070

In the elderly population, the majority of participants exhibited class 2 gingival contour (72.5%), while class 1 was present in 27.5% of subjects. The prevalence of class 1 was higher in men (44.4%) than in women (13.6%); however, this difference did not reach statistical significance ($\chi^2 = 3.29$; $p = 0.070$).

The predominance of class 2 gingival contour in the elderly population is consistent with the findings of Dridi *et al.*¹⁶, who reported that the prevalence of gingival phenotype varies depending on the region of the dental arch and therefore cannot be universally assessed at the level of the entire population.

Furthermore, Bolat *et al.*¹⁷ reported that gingival thickness may depend on sex and tooth position, indicating the presence of additional local and anatomical factors influencing the gingival phenotype, independently of age.

Some studies suggest that gingival phenotype does not necessarily show a significant correlation with age or sex, which may help explain the absence of statistically significant differences observed in the present results¹⁸⁻²⁰.

Compared with the younger population, in which class 1 predominates (77%), elderly individuals demonstrate a marked predominance of class 2 (72.5%), indicating progressive morphological changes of the gingiva during aging¹⁵.

Lip line position in geriatric patients in relation to gender

The position of the lip line in elderly patients is shown in table 3.

Table 3. Lip line in geriatric patients in relation to gender

Gender	Low n (%)	Medium n (%)	High n (%)	p
Men	10 (55.6)	7 (38.9)	1 (5.6)	
Women	14 (63.6)	6 (27.3)	2 (9.1)	
Total	24 (60.0)	13 (32.5)	3 (7.5)	0.710

The results showed that a low lip line was the most prevalent (60%), followed by a medium lip line (32.5%) and a high lip line (7.5%). No statistically significant differences were found between genders ($\chi^2 = 0.68$; $p = 0.710$).

The predominance of a low lip line in the studied population, together with the rare occurrence of a high lip line and the absence of differences between women and men, is consistent with the findings of Cunha *et al.*²¹, who reported that aging is associated with elongation of the upper lip and reduced exposure of the maxillary teeth and gingiva during smiling.

In addition to clinical characteristics, regional oral health promotion programs also emphasize the importance of comprehensive dental care and continuous education in the geriatric population, which may have a positive impact on overall oral health as well as on the perception of esthetic parameters^{8,9}.

These results confirm that changes in lip line position are primarily a consequence of involutional changes in the facial soft tissues, while gender does not play a decisive role in this esthetic parameter in older age.

Upper central incisor dimensions in geriatric patients in relation to age group

Figure 2 shows the average dimensions of the maxillary central incisors (clinical crown height and width) in three age groups of participants (60–69, 70–79, and ≥ 80 years). A decrease in crown height is observed in the 70–79 age group, followed by a slight increase in the oldest group, while crown width remains relatively stable. This pattern leads to an increase in the width-to-height ratio (W/H) in the older age categories.

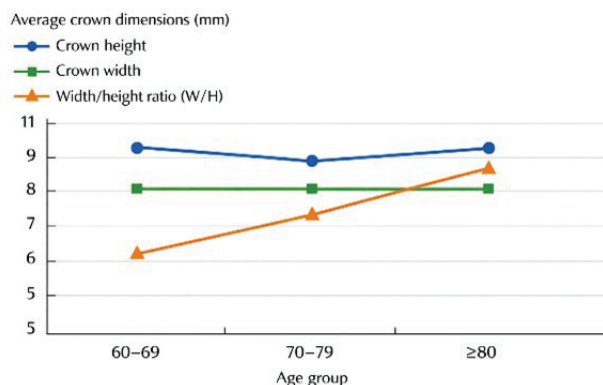


Figure 2. Average dimensions of the upper central incisor (height and width of the clinical crown) in relation to age groups.

These findings are consistent with the results reported by Natsumeda *et al.*²², who state that the aging process leads to changes in the position and morphology of the gingiva and the crown due to apical migration of the gingival margin, reduction of supporting periodontal structures, and alterations in gingival tissue microcirculation. Such changes may indirectly affect the clinical perception of tooth dimensions and their proportions.

Gingival class in geriatric patients in relation to age group

Figure 3 shows the distribution of gingival classes according to the age of the participants. A clear increasing trend in the prevalence of gingival class 2 with advancing age can be observed, accompanied by a simultaneous decrease in the prevalence of class 1. In the 60–69 age group, class 2 was recorded in 67% of participants, while in individuals older than 80 years it reached 79%.

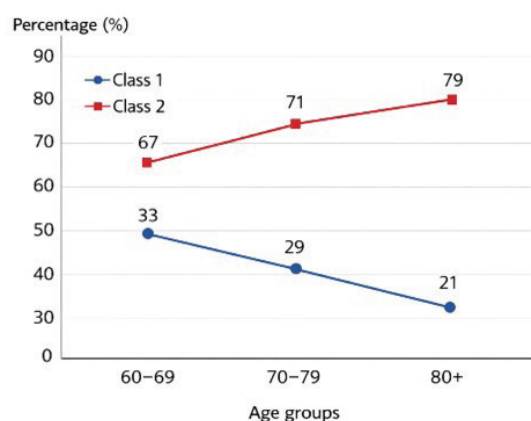


Figure 3. Distribution of gingival phenotype classes in relation to the age groups of the subjects.

Similar results were reported by Villalobos *et al.*²³, who indicate that the structure and position of the gingiva undergo pronounced morphological and functional changes during aging. Age-related changes

in periodontal and gingival tissues include modifications of epithelial and connective tissue components, which may result in apical migration of the gingival margin, increased frequency of gingival recession, and changes in soft tissue contours. These processes may explain the higher prevalence of gingival imbalance in the elderly population.

Lip line in geriatric patients in relation to age group

Figure 4 shows the distribution of the smile line across age groups. In all observed categories, a low smile line is predominant, particularly in the 70–79 age group, where a high smile line is completely absent. In participants older than 80 years, a high smile line reappears in a small number of individuals, which may indicate individual anatomical and functional variations.

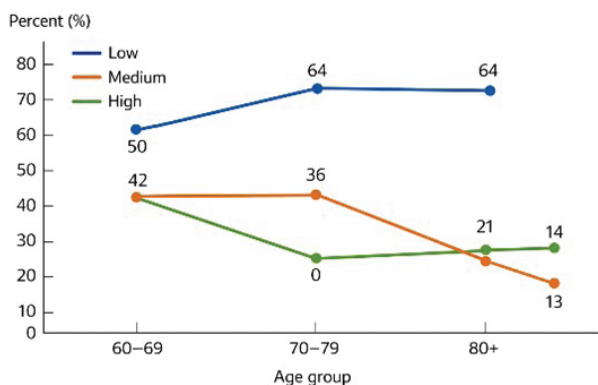


Figure 4. Lip line distribution (low, medium and high) in relation to age groups.

This pattern is consistent with recently published clinical studies^{22, 24, 25} which demonstrate that aging is associated with reduced exposure of the maxillary teeth and gingiva, primarily due to elongation of the upper lip, decreased lip elevation during smiling, and more pronounced coverage of the cervical portions of the teeth. Similarly, a study conducted in a Kurdish population reported a statistically significantly greater coverage of the maxillary incisors by the upper lip in older individuals, confirming the tendency toward a lower-positioned smile line in advanced age²⁶.

The aging process is accompanied by gradual but inevitable changes in oral tissues, which occur as a result of biological aging, the influence of systemic diseases and therapies, as well as the reduced regenerative capacity of the tissues themselves^{27, 28}. These changes include wear of the incisal edges, alterations in the dimensions of the clinical crown, apical migration of the gingival margin, loss of periodontal support, elongation of the upper lip, and reduced mobility of the perioral musculature.

Functionally, these changes may lead to reduced chewing efficiency, speech disturbances, difficulties in maintaining oral hygiene, and an increased susceptibility to periodontal diseases and diseases of the hard dental tissues. From an aesthetic perspective, decreased visibility of the maxillary teeth, altered width-to-height ratios of the clinical crown, and modified gingival contours often result in an older and less harmonious smile. Such changes affect not only objective appearance but also the subjective perception of personal identity and self-worth. Numerous studies support the fact that aesthetic changes in the orofacial region can negatively affect self-confidence, social interaction, and quality of life in older individuals, leading to feelings of insecurity, withdrawal, and reduced social activity²⁹⁻³¹.

Contemporary dentistry enables effective management of these changes through prosthetic rehabilitation and aesthetic smile correction^{32, 33}. The goal of these interventions is not to rejuvenate elderly patients, but to achieve a harmonious and functional smile that corresponds to the patient's age and expectations.

Compared with the younger population, functional and aesthetic differences are inevitable; however, they should not be interpreted solely as deficiencies, but rather as the result of objective biological processes. A specific therapeutic approach, understanding of the psychological needs of older patients, and dedication to their subjective perception of appearance represent key factors for successful rehabilitation^{34, 35}.

This study has certain limitations, primarily the relatively small sample size and the fact that the research was conducted at a single center, which may affect the generalizability of the results. In addition, the assessment of the lip line and gingival contour was performed clinically, which may include a degree of subjectivity. Nevertheless, the obtained data provide valuable insight into the morphometric characteristics of the geriatric population and form a basis for future studies with larger and more representative samples.

In contemporary society, where youth and physical perfection are often promoted, it is important to emphasize that aging is a natural and inevitable life process and that every individual has the right to preserved functionality and an acceptable aesthetic appearance without negative social perception. The role of the dentist is not limited to the mere restoration of oral structures, but also includes contributing to the preservation of quality of life, self-esteem, and social inclusion of elderly patients^{36, 37}. An individualized and empathetic therapeutic approach makes it possible to achieve a balance between function and aesthetics within realistic biological limits, helping patients maintain a positive perception of their appearance and actively participate in society.

Conclusion

Reconstruction of one or more teeth within the dental arch, as well as their shape and mutual relationships, can be planned based on the remaining natural teeth, whereas complete tooth loss represents a significantly greater clinical and aesthetic challenge, requiring reconstruction of the entire dental arch and harmonization of the smile with the patient's facial features. Nevertheless, the results of this study should be interpreted with certain limitations. The research was conducted on a relatively small sample and in a single institution, which may limit the generalizability of the findings. Expansion of the sample size is planned in subsequent phases of the study in order to obtain more representative and statistically robust data. In such cases, the application of modern diagnostic and analytical methods, including the measurement of tooth dimensions and proportions in individuals with preserved dentition, is of particular importance for achieving a functionally stable and aesthetically acceptable outcome, in accordance with the general principles of dental aesthetics.

At the same time, in contemporary society, which emphasizes youth and physical perfection, it is very important to view the aesthetic rehabilitation of elderly patients not only as a technical procedure but also as a contribution to the preservation of function and normal quality of life. The role of the dentist involves understanding the biological limitations of aging as well as the psychological needs of patients, with the aim of achieving, within realistic possibilities, a natural, harmonious, and socially acceptable appearance.

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