

Comparison of Soft-tissue Profile Changes in Serial Extraction and Late Premolar Extraction

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Abstract

Background: Serial extraction and late premolar extraction are two orthodontic approaches used to manage severe crowding. This study aims to compare the soft-tissue profile changes associated with these two extraction protocols to determine their respective impacts on facial esthetics. **Materials and Methods:** This retrospective study included 60 patients divided into two groups: The serial extraction group ($n = 30$) and the late premolar extraction group ($n = 30$). Pre-treatment and post-treatment lateral cephalometric radiographs were analyzed. Key soft-tissue parameters measured included upper lip thickness, lower lip thickness, nasolabial angle, and mentolabial angle. Statistical analysis was performed using paired t -tests and analysis of variance to assess the significance of changes within and between groups. **Results:** The serial extraction group showed a significant decrease in upper lip thickness (mean change: -2.5 mm, $P < 0.01$) and lower lip thickness (mean change: -2.0 mm, $P < 0.01$). The nasolabial angle increased by an average of 3.5° ($P < 0.01$), and the mentolabial angle increased by 4.0° ($P < 0.01$). In the late premolar extraction group, the upper lip thickness decreased by an average of 1.5 mm ($P < 0.05$) and the lower lip thickness by 1.0 mm ($P < 0.05$). The nasolabial angle increased by 2.0° ($P < 0.05$), and the mentolabial angle by 2.5° ($P < 0.05$). Comparison between groups revealed that the serial extraction group exhibited more pronounced changes in all measured parameters. **Conclusion:** Both serial extraction and late premolar extraction result in significant changes to the soft-tissue profile, but serial extraction produces more pronounced modifications. Clinicians should consider these differences when planning treatment for patients with severe crowding to achieve optimal esthetic outcomes.

Keywords: Cephalometric analysis, Facial esthetics, Late premolar extraction, Orthodontics, Serial extraction, Soft-tissue profile.

INTRODUCTION

Orthodontic treatment often involves the extraction of teeth to manage severe crowding and achieve optimal occlusion and facial esthetics. Two common extraction protocols are serial extraction and late premolar extraction. Serial extraction involves the strategic removal of primary and permanent teeth in a planned sequence over a period of time, while late premolar extraction is typically performed after the complete eruption of the permanent dentition.^[1,2]

Serial extraction aims to guide the erupting permanent teeth into a more favorable position by reducing crowding early in the mixed dentition stage. This approach can simplify subsequent orthodontic treatment and may result in more stable outcomes.^[3] However, it requires careful timing and monitoring to avoid adverse effects on the developing dentition and facial profile.^[4]

Late premolar extraction, on the other hand, is generally indicated in cases where crowding is identified later, often

after the eruption of all permanent teeth. This approach can be less complex to manage in terms of patient compliance and treatment planning but may result in more significant immediate changes to the dental arches and soft-tissue profile.^[5,6]

The impact of these extraction protocols on the soft-tissue profile is a critical consideration in orthodontic treatment planning. Changes in lip thickness, nasolabial angle, and mentolabial angle can affect overall facial esthetics and patient satisfaction.^[7,8] While both approaches are effective in resolving crowding, there is a need for a comprehensive comparison of their effects on the soft-tissue profile to guide clinical decision-making.

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This study aims to compare the soft-tissue profile changes associated with serial extraction and late premolar extraction. By analyzing key cephalometric parameters, this research seeks to provide evidence-based insights into the esthetic outcomes of these two extraction protocols.

MATERIALS AND METHODS

Study design

This retrospective study was conducted to compare the soft-tissue profile changes associated with serial extraction and late premolar extraction in orthodontic treatment. Ethical approval was obtained from the Institutional Review Board before the commencement of the study.

Sample selection

A total of 60 patients who had undergone orthodontic treatment with either serial extraction or late premolar extraction were included in the study. The sample was divided into two groups:

- Serial extraction group ($n = 30$)
- Late premolar extraction group ($n = 30$).

Inclusion criteria were as follows:

- Patients aged 12–18 years at the start of treatment
- No previous orthodontic treatment
- Good general health with no systemic diseases affecting growth or dental development.

Exclusion criteria included:

- Patients with craniofacial anomalies
- History of trauma affecting the dentition or facial structures
- Poor quality of pre-treatment or post-treatment records.

Data collection

Pre-treatment and post-treatment lateral cephalometric radiographs were obtained for all patients. The radiographs were taken using a standardized technique to ensure consistency. Cephalometric tracings were performed by a single examiner to minimize variability. The following soft-tissue parameters were measured:

- Upper lip thickness (distance from the labrale superius to the most anterior point of the maxillary incisor)
- Lower lip thickness (distance from the labrale inferius to the most anterior point of the mandibular incisor)
- Nasolabial angle (angle formed by the intersection of the columella of the nose and the upper lip)
- Mentolabial angle (angle formed by the intersection of the lower lip and the chin).

Statistical analysis

The data were analyzed using the Statistical Packages for the Social Sciences software (version 25.0; IBM Corp., Armonk, NY). Descriptive statistics, including means and standard deviations, were calculated for each parameter. Paired *t*-tests were used to compare pre-treatment and post-treatment changes within each group. Independent *t*-tests and analysis of variance were used to compare changes between the two groups. $P < 0.05$ was considered statistically significant.

Calibration and reliability

To ensure reliability, ten randomly selected cephalometric radiographs were re-traced and measured by the same examiner after a 2-week interval. Intra-examiner reliability was assessed using the intraclass correlation coefficient, with values above 0.90 indicating excellent reliability.

By adhering to these methods, the study aimed to provide a robust comparison of the effects of serial extraction and late premolar extraction on the soft-tissue profile.

RESULTS

Descriptive statistics

The demographic characteristics of the patients in both groups are summarized in Table 1. There were no significant differences in age, gender distribution, or treatment duration between the groups.

Soft-tissue profile changes

The pre-treatment and post-treatment values of the soft-tissue parameters for both groups are presented in Table 2.

Comparison between groups

The comparison of changes in soft-tissue parameters between the serial extraction and late premolar extraction groups is shown in Table 3.

The serial extraction group demonstrated a greater reduction in upper and lower lip thickness compared to the late premolar extraction group. In addition, the increases in the nasolabial and mentolabial angles were more pronounced in the serial extraction group. These results indicate that serial extraction leads to more significant changes in the soft-tissue profile compared to late premolar extraction.

Table 1: Demographic characteristics of the study sample

Characteristic	Serial extraction group ($n=30$)	Late premolar extraction group ($n=30$)	P-value
Age (years)	14.5±1.2	14.3±1.3	0.68
Gender (M/F)	15/15	14/16	0.82
Treatment duration (months)	24.6±3.4	25.1±3.2	0.54

Table 2: Pre-treatment and post-treatment soft-tissue parameters

Parameter	Serial extraction group Pre-treatment	Late premolar extraction group Post-treatment
Upper lip thickness (mm)	12.5±1.5	10.0±1.3
Lower lip thickness (mm)	13.2±1.6	11.2±1.4
Nasolabial angle (degrees)	98.5±5.2	102.0±5.0
Mentolabial angle (degrees)	120.0±6.0	124.0±5.8

Table 3: Comparison of soft-tissue changes between groups

Parameter	Change in serial extraction group	Change in late premolar extraction group	P-value
Upper lip thickness (mm)	-2.5±0.8	-1.5±0.6	<0.01
Lower lip thickness (mm)	-2.0±0.7	-1.0±0.5	<0.01
Nasolabial angle (degrees)	3.5±1.2	2.0±1.0	<0.01
Mentolabial angle (degrees)	4.0±1.5	2.5±1.2	<0.01

DISCUSSION

The findings of this study indicate that both serial extraction and late premolar extraction result in significant changes to the soft-tissue profile. However, the changes were more pronounced in the serial extraction group. These results have important implications for orthodontic treatment planning, particularly in cases of severe crowding where esthetic outcomes are a primary concern.

Our results are consistent with previous research indicating that extraction protocols can significantly impact soft-tissue parameters.^[1,2] The greater reduction in upper and lower lip thickness observed in the serial extraction group aligns with findings by Proffit *et al.*, who reported that early intervention allows for more controlled guidance of the erupting teeth, thereby reducing the prominence of the lips.^[3] Similarly, the significant increases in the nasolabial and mentolabial angles in the serial extraction group support the hypothesis that early extractions facilitate better alignment and retraction of the anterior teeth, enhancing the overall facial profile.^[4]

The more pronounced soft-tissue changes in the serial extraction group suggest that this approach may be preferable for patients where esthetic improvement is a critical goal. The increased nasolabial and mentolabial angles observed in this group indicate a more harmonious profile, which is often desired in orthodontic outcomes.^[5] However, the complexity and prolonged treatment duration associated with serial extraction require careful patient selection and compliance.^[6]

On the other hand, late premolar extraction, while still effective, resulted in less dramatic changes to the soft-tissue profile. This method may be more suitable for patients who present with crowding at a later stage or for those who may

have difficulties adhering to the longer and more intensive treatment regimen of serial extraction.^[7]

This study has several limitations that should be considered. The retrospective design inherently carries a risk of selection bias, despite our efforts to match groups based on age, gender, and treatment duration. In addition, the sample size, while adequate, may limit the generalizability of the findings. Future studies with larger, more diverse populations and prospective designs would be beneficial to confirm these results.

Further research should explore the long-term stability of the soft-tissue changes observed with both extraction protocols. In addition, investigating patient satisfaction and perceived esthetic outcomes can provide valuable insights into the practical implications of these treatment approaches. Advanced imaging techniques, such as 3D facial scanning, could also enhance the accuracy of soft-tissue assessments in future studies.^[8]

CONCLUSION

Both serial extraction and late premolar extraction lead to significant changes in the soft-tissue profile, with more pronounced modifications observed in the serial extraction group. These findings underscore the importance of considering soft-tissue impacts in orthodontic treatment planning. Clinicians should carefully evaluate the specific needs and circumstances of each patient to select the most appropriate extraction protocol.

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