ORIGINAL ARTICLE

Nasolabial Fold Dynamics in Orthodontic Treatment: Extraction versus Non-Extraction Perspectives

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ABSTRACT

Objective: This study compared the impact of extraction and non-extraction orthodontic therapy on nasolabial folds and provides valuable insights for treatment planning in borderline orthodontic cases.

Study Design: A cross-sectional observational study.

Place and Duration of Study: The study was conducted in the Orthodontic Department at Rawal Institute of Health Sciences Islamabad. The duration of the study was eleven months from 2nd August 2022 to 3rd July 2023.

Materials and Methods: The research comprised of 80 patients, divided into 40 cases involving extractions and 40 cases without extraction. Photographs were taken before and after orthodontic treatment and analyzed for the change in the depth of nasolabial folds using the modified Wrinkle Severity Rating Scale. Results were compared between the extraction and non-extraction groups by using the t-test. SPSS version 23 was used to perform statistical analysis.

Results: There was a statistically significant reduction in the nasolabial folds' prominence in the non-extraction group (p=.012), whereas the extraction group did not show a statistically significant difference. The pre-treatment shallow nasolabial folds changed to moderately deep nasolabial folds in the extraction group in 7.5% of the cases, while 5% of shallow and 5% of deep nasolabial folds converted to absent nasolabial folds in the non-extraction group.

Conclusion: Non-extraction orthodontic treatment positively impacted facial aesthetics by reducing the nasolabial folds' depth. Extraction cases did not show a significant effect on the nasolabial folds. The study emphasizes the importance of personalized treatment planning and comprehensive assessment of the patients regarding soft tissue response.

Key Words: *Aesthetics, Extraction, Non-Extraction, Nasolabial Folds, Orthodontic Treatment.*

Introduction

According to a recent study it has been observed that 80% of the cases seek orthodontic treatment for aesthetic improvement.[1] One pivotal aspect of orthodontic treatment planning is the choice between extraction or non-extraction modalities. Extracting teeth can impact the soft tissue profile.[2] Premolar extractions are clearly indicated in severe crowding and incisor proclination. However, in borderline cases like mild to moderate crowding, the decision relies on various factors including the upper and lower lip prominence in relation to the E-plane, lower lip prominence in relation to the true vertical line (TVL), upper lip thickness, nasolabial angle and interlabial gap.[3] There is a growing concern regarding soft tissue alterations in comparison to hard tissue changes, such as upper lip extension and facial flattening after orthodontic treatment. Almurtadha RH *et al.,*[4] proposed that the extraction therapy causes a significant retraction of the lips, thus increasing the nasolabial angle. Following the orthodontic retraction, noticeable changes occur in the perioral soft tissues, which also extend to the lower third of the face, affecting the nasolabial folds (NLFs).[5] Changes in the morphology and depth of the NLFs along with the elongation of lips are considered as the early signs of facial aging but, for the young adolescents, a heavy cheek fat pad may cause the NLFs to deepen as well.[6] Maxillary skeletal retrognathism and a reduction in dental vertical height also lead to deepening of the NLFs.[7] While it's well-documented that the upper lip lengthens and

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NLFs deepen with age,[8] but if these changes occur in young patients after orthodontic treatment, it can significantly impact their self-esteem and overall satisfaction with the treatment outcome.[9]

Lot of studies have explored the effect of extraction and non-extraction therapy on soft tissues of the lower face, but no definitive conclusions have been reached.[10] Angle advocated for non-extraction orthodontic therapy, while Calvin Case favored premolar extraction in orthodontic treatment planning.[10] However, a recent systematic review indicates that there is limited and low-quality evidence regarding the potential adverse aesthetic effects of extracting premolars in orthodontic patients.[11] In clinical practice, orthodontists occasionally observe heightened prominence or absence of the NLFs in some patients during orthodontic treatment. However, there is limited scientific evidence in the literature available on the changes in the morphology of the NLFs after orthodontic therapy.

This study aimed to contribute to a better understanding of how orthodontic interventions, specifically extraction and non-extraction modalities, influence the aesthetics of nasolabial folds, aiding clinicians in making more informed and personalized treatment decisions. The findings of this study would help orthodontists in the treatment planning of borderline orthodontic cases when the decision of extraction has to be critically analyzed.

Materials and Methods

It was a cross sectional comparative study. It was conducted in the Orthodontic Department of RIHS, Islamabad for eleven months from 2nd August 2022 to 3rd July 2023. The sample size was calculated using the WHO health calculator with the prevalence of 34.4% premolar extraction in 987 orthodontic cases.[12] Non-probability purposive sampling was done. This study was approved by the Ethical committee of Rawal Institute of Health Sciences (RIHS), Islamabad. The ERB number was RIHS/IRB/D/23/003. The inclusion criteria for extraction and non-extraction cases were vertically normal angle skeletal Class I malocclusion cases with moderate crowding not more than 7mm. Cases with bimaxillay proclination, skeletal deformity, highly placed canines and thick heavy cheek pads were excluded from the study. Patients having unequal depth of NLFs on both sides were also excluded from the study.

The treating orthodontist and a prosthodontist recruited 92 patients for this study from the available pretreatment photographic record. Eight patients not matching the criteria were excluded and the sample consisted of 80 patients divided into 40 extractions and 40 non-extraction cases in the Department of Orthodontics RIHS. The extraction group was labeled as G1 (n= 40, 14-18 years age) and non-extraction group as G2 (n=40, 14-18 years age).

The initial morphological type of the NLFs was defined by the modified Wrinkle Severity Rating Scale (WSRS), a standard scale for measuring the depth of facial folds.[13] Modified WSRS uses the following three-point scale:

1= Absent, NLF is invisible.

2 = Shallow, visible NLF with a slight indentation with minor facial features.

3= Moderately deep NLF with clear facial features visible at normal.

Post-treatment photographs were taken immediately after the completion of incisor retraction for the extraction (G1) group and after the alignment of the upper and lower arches for the non-extraction (G2) group. We did not wait for debonding in any case. All photographs were taken by Nikon D 5000 camera in 12.3 million pixels with a sensor size of 26.3 x 15.8 mm. Post-treatment photographs were analyzed in Photoshop software by the same team of two doctors. Photographs were clinically correlated with the patient and compared with the pretreatment photographs for better scoring of NLFs with WSRS.

For data analysis SPSS version 23 was used. Mean age and frequency of gender were calculated in both the extraction and non-extraction groups. Interrater reliability was measured as percent agreement among the photographic examiners. The agreement between raters was 80%. The difference between pre- and post-treatment NLF values was assessed by a paired sample t-test, and the comparison between inter-group NLF values was performed using an independent sample t-test. The p value ≤ 0.05 was considered statistically significant.

Results

According to descriptive statistics the mean age of participants in G1 was 13.93±1.269 years and in G2

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the age was 14.05± 0.959 years. Gender distribution showed 27 females (66%) and 13 males (34%) in G1 group. In G2 group there were 26 females (65%) and 14 males (35%) (Figure I). Comparing the percentage of nasolabial fold (NLF) types in G1 (Table I) it was found that there was no change in 5% (n=2) of patients in which pre-treatment NLFs were absent, however 7.5% (n=3) of shallow pre-treatment NLFs changed to moderately deep NLFs in G1(negative change). Similarly, 5% (n=2) shallow NLFs and 5% (n=2) of deep NLFs converted to absent NLFs in G2 (Table II) after orthodontic treatment. Paired sample t-test (Table III) was applied to compare the pre- and post-treatment pairs of G1 and G2. In G1, the difference between NLFs pre- and post-treatment was not statistically significant (p=.183). In G2, the difference was statistically significant (p = 0.012). Independent Sample t-test (Table IV) was applied for within group analysis, i.e. pre-treatment and post-treatment changes. Results were not significant for both groups, G1 and G2.

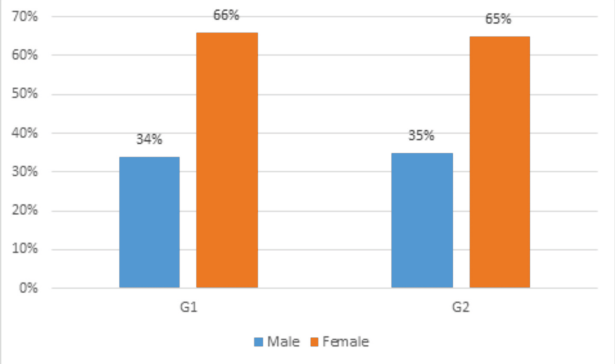

Figure I: Gender Distribution in the Groups, G1 and G2

Table I: Frequency of NLF in Extraction Group (G1)

	NLF pretreatment		NLF post-treatment	
Type of NLF	Frequency, n	Valid percentage	Frequency, n	Valid percentage
Absent	2	5%	2	5%
Shallow	32	80%	29	72.5%
Deep	6	15%	9	22.5%
Total	40	100%	40	100%

Table II: Frequency of NLF In Non-Extraction Group (G2)

	NLF pretreatment		NLF post treatment	
Type of NLF	Frequency, n	Valid percentage	Frequency, n	Valid percentage
Absent	4	10%	7	20%
Shallow	28	70%	28	65%
Deep	8	20%	5	15%
Total	40	100%	40	100%

Table III: Intra Group Paired Sample t-test between G1 and G2

	Paired Differences					t	df	Sig. (2 tailed)
	Mean	SD	Std. Error Mean	95% Confidence Interval of the Difference				
				Lower	Lower			
Pair1: NLF 1pre-NLF 1post (Extraction group G1)	-.075	.350	.055	-.187	-.037	1.356	39	0.183
Pair2: NLF 2pre-NLF 2post (Non-Extraction group G2)	.15000	.36162	.05718	.03435	.26565	2.623	39	0.012**

*The p value ≤ 0.05 was considered statistically significant.

Table IV: Inter Group Independent Sample t-test between G1 and G2.

			Independent sample t-test						
	Levene's Test for Equality of Variances							Confidence Interval 95%	
	F	Sig.	T	df	Sig. (2-tailed)	Mean diff	Standard error difference	lower	Upper
NLF Pre-treatment Equal variances assumed	1.138	.289	.868	.78	.070	.212	.111	-.221	.221
Equal variances not assumed			.868	74.755	.070	.212	.111	-.221	.221
NLF post-treatment Equal variances Assumed.	.200	.656	1.909	.78	.060	.225	.118	-.010	.460
Equal variances not assumed			1.909	77.257	.060	.225	.118	-.010	.460

*The p value ≤ 0.05 was considered statistically significant.

Discussion

The study depicted the effects of orthodontic treatment on nasolabial folds in a sample of young adolescents, with the mean age of 13.93 and 14.05 years in the groups G1 and G2 respectively. These ages correspond to a critical phase of adolescent development when notable signs of aging, such as fine lip wrinkles, deep NLFs have not started.[14] That is why we included young adolescents in this study so that aging bias may not affect the results. Zhang[15] divided the nasolabial folds into five types, depending on the skin and fat type, however we used

the modified Wrinkle Severity Rating Scale[13] (WSRS) to classify the NLFs as absent, shallow, and deep, and 70 -80% of our patients had shallow pretreatment NLFs in both groups, G1 and G2.

Upon examining the pre- and post-treatment NLFs, minor disparities emerged between the groups G1 and G2. In the extraction group, the analysis indicated a minor increase in NLFs prominence, although this was not significant statistically (p = .183). Only three cases out of forty (7.5%) in the extraction group transitioned from shallow to moderately deep nasolabial folds. This observation may be attributed to the soft tissue adaptation due to dental retraction and dentoalveolar changes during extraction-based treatment.[16] It is worth noting that deep NLFs are undesirable, as they are indicative of aging. There is a limited low-quality evidence, that extraction of premolars can affect the orthodontic patients' face esthetics negatively.[11] Our study further authenticated these results and added that non-extraction therapy can change the depth of NLFs. Generally, dental, and skeletal changes occurring during orthodontic treatment do influence soft tissue structures, yet the extent of these changes may vary depending on the treatment plan and the elasticity of the soft tissues.[17] Conversely, in contrast to our findings, Soheilifar[18] discovered significant changes in the linear distance of upper lip to E-line in the extraction group, which could potentially affect NLFs. In our non-extraction group, there was a notable reduction in NLFs prominence following orthodontic alignment (p = 0.012). This indicates distinct positive soft tissue response to treatment approach that does not involve premolar extractions. Within our sample, 7.5% of shallow pre-treatment nasolabial folds changed to moderately deep nasolabial folds after extraction therapy while 5% of both shallow and deep nasolabial folds converted to absent nasolabial folds after non-extraction orthodontic treatment.

These results may depend on the unraveling of crowding which was up to 7mm in most of the border line cases. Previous research has also demonstrated that in borderline cases, both the lips and incisors became prominent in non-extraction groups, while they moved backward in extraction groups.[4,18] Therefore, it can be interpreted that dental changes do indeed impact soft tissue. Maaz M and Fida M[19] findings indicated that the dental and soft-tissue changes were highly significant and were found to be in the ideal range when treated with premolar extraction. In contrast, Zhoe Q et al.,[6] found that regardless of tooth extraction, NLFs displayed a retraction trend after orthodontic treatment. This could be attributed to reduced use of masticatory muscles during orthodontic treatment due to appliance wear.[20]

Inter-group analysis, conducted through independent sample t-tests, yielded insignificant results, indicating no significant difference in NLFs between the pre and post treatment G1 and G2 groups. A recent study in adult women under 30 years old demonstrated an improvement in NLFs after maximum retraction, despite greater posterior changes. This might be attributed to increased skin tone and soft tissue thickness, along with the good quality of subcutaneous adipose tissue.[21] A recent systematic review revealed that the face does become flatter, after extractions, however the effects of extractions are small and they do not alter perception of aesthetics by lay persons or orthodontists.[22] Additionally, long-term NLF changes because of aging are inevitable. Aging, sun damage, and smoking are the biggest reasons for deepening NLFs. The ultraviolet (UV) rays of sunlight break down the collagen and elastin fibers in our skin that keeps it smooth and supported. Smoking also breaks down these fibers.[23]

While this study provides valuable insights, it is not without limitations. Firstly, we used a qualitative method of assessing the NLFs, however according to the current evidence, Cone beam computed tomography with soft tissue image transfer methods can help in virtual analysis. Secondly the small sample size may influence the generalizability of the findings, and further research with larger cohorts is warranted.

Conclusion

In conclusion, the present study proved that the non-extraction orthodontic treatment can positively impact the face aesthetics by reducing the depth of NLFs significantly. Most of the extraction cases did not show any positive or negative effect on NLFs. These findings emphasize the importance of personalized treatment planning and underscore the need for comprehensive assessments encompassing

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both skeletal and soft tissue responses, keeping in mind the patients' preferences.

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CONFLICT OF INTEREST

Authors declared no conflicts of Interest.

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DATA SHARING STATMENT

The data that support the findings of this study are available from the corresponding author upon request.

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