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ORIGINAL RESEARCH

Analysis of Lips Morphology in Iranian Adults with Normal Occlusion in Isfahan

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Abstract

Background: The objective of this study was to evaluate the lips Morphology in Iranian adults with normal occlusion in Isfahan, Iran.

Materials and Methods: This cross-sectional study analysed the lateral cephalograms of 102 individuals aged 18 to 30 years with normal occlusion in Isfahan, Iran. Nine linear measurements (upper lip to S line (ULS), lower lip to S line (LLS), upper lip to B line (ULB), lower lip to B line (LLB), upper lip to E line (ULE), lower lip to E line (LLE), lower lip to H line (LLH), and upper and lower lip thickness), and 5 angular measurements (nasolabial, inferior labial, Z, upper lip prominence and lower lip prominence angles) were made on the lateral cephalograms. The study compared these measurements between males and females using the Mann-Whitney and independent t tests (α=0.05).

Results: Assessment of lips morphology using 9 linear and 5 angular measurements showed variances in the mean values of several measurements compared to standard values reported by Ricketts, Steiner, Burstone, and Merrifield. Specifically, differences were observed in the ULE, LLE, ULS, LLS, ULB, and Z angle, while the LLB, LLH distances, and the nasolabial angle fell within the standard range. Additionally, males exhibited significantly greater upper and lower lip thickness compared to females (P<0.001). No other significant differences were found between males and females (P>0.05).

Conclusion: Most of the measured indices in the study population differed from the standard values reported in the literature, which highlights the need to take into account the Iranian norms in orthodontic treatment of Iranian patients.

Keywords: Cephalometry; Lip; Orthodontics; Iran

Introduction

Due to the increasing demand for dental esthetics, a greater focus has been placed on smile esthetics (1). In contemporary orthodontics, soft tissue analysis plays a critical role in diagnosis and treatment planning (2). Orthodontic treatment solely based on dentoskeletal standards often leads to facial disharmony and unfavorable changes (3).

Lips play an important role in facial attractiveness. The anteroposterior position of the lips is highly important in orthodontic diagnosis and treatment planning (4).

Lateral cephalometry is the gold standard for clinical assessment of malocclusion and dentoskeletal discrepancies in orthodontics (5). It allows for the evaluation of dental and skeletal relationships, cranial structures, and soft tissue profile. Additionally, soft tissue morphology can be best evaluated by lateral cephalometry (3).

In orthodontic treatment planning, diagnosis can be made by comparing the values measured on lateral cephalograms with the standard values (6). For a long time, orthodontists focused on the horizontal lip position as the most important factor in facial attractiveness (7). Several reference lines are commonly used in cephalometric analysis for assessment of the upper and lower lip position in orthodontic diagnosis and treatment planning, including the Ricketts E line, the Burstone B line, the

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Holdaway H line, and the Steiner S line. Also, several angles are used for assessment of facial attractiveness, including the Z angle, nasolabial angle, and inferior labial angle (3,8). The Steiner S line is defined as the line extending from the soft tissue pogonion to the middle of the S shaped curve between the subnasal and pronasal (most prominent point of the nose tip). In normal faces, the lips should touch the S line. The Ricketts E line connects the pronasale to soft tissue pogonion. In an ideal state, the upper and lower lips should be positioned 2-4 mm behind this line on average The Burstone B line runs from the subnasale to the soft tissue pogonion. On average, the upper and lower lips should be positioned 2.5 to 3.5 mm in front of this line (7). Merrifield introduced the Z angle and profile line in 1916 to accurately describe the lower third of the face. The Z angle is formed between the profile line and the Frankfurt plane (3).

Orthodontic norms are proposed based on the measurements made in different populations (9). Cephalometric studies have confirmed that norms should be customized based on ethnic, racial, gender, and age parameters (4,5,8). Lateral cephalometric norms may be specific to certain populations and may not be applicable to other racial and ethnic groups (2,3,6,7,10). Thus, each population should be treated according to its own norms (7). Despite the presence of ethnic and racial differences, most of the classic cephalometric standards have been developed for the European-American populations (6) and may not be suitable for diagnosis and treatment planning in other populations (11). Disparities also exist within the same populations (12). Therefore, understanding the norms in each population is crucial for maximizing treatment success (11)

Considering the increasing demand of Iranian adults for orthodontic treatment and orthognathic surgery for cosmetic purposes, it is imperative to determine the standards and norms for the Iranian adult population (4). Given the limited research on the soft tissue profile and lips morphology of Iranian adults, this study aimed to assess Lips morphology of Iranian adults with normal occlusion in Isfahan city, Iran.

Materials and Methods

This cross-sectional study was conducted on 102 patients who visited the Orthodontics Department of the School of Dentistry at the Islamic Azad University in Isfahan, as well as a private office in Isfahan in the year 2021. The patients were selected using convenience sampling. The study protocol received approval from the university's ethics committee (IR.IAU. KHUISF.REC. 1400.115). The inclusion criteria were: age between 18-30 years, having Persian parents, normal class I occlusion, no history of orthodontic treatment, having a complete dentition (from the second molar of one side to the second molar of the other side), no skeletal discrepancy, no severe protrusion or retrusion of the anterior teeth, no history of lip cosmetic surgical or non-surgical procedures, and no history of cosmetic surgical procedures.

The exclusion criteria included patients with highly long or short faces. The Steiner analysis was used to assess the position of the maxilla and mandible, and the SNA and SNB angles were measured. The ANB angle was then measured to analyse the relationship of the maxilla and mandible, and values between 0-4 degrees were considered as skeletal class I, values > 4 degrees were considered as skeletal class II, and values < 0 degrees were considered as skeletal class III. Class II and III patients were excluded (13).

To determine the protrusion of anterior teeth, the distance between the incisal edge of the anterior teeth and A-Pog line was measured. Values between -1 to +5 for the maxillary incisors and 1 to 3 mm for the mandibular incisors were considered normal (13). An orthodontist confirmed all measurements. The remaining data was extracted from patient files.

The lateral cephalograms were manually traced (13) and the measurements were made as follows:

ULE and LLE: The distance between the most prominent point of the upper and lower lips to E line was measured. E line was drawn from the pronasal to soft tissue pogonion (Figure 1a) (8).

ULS and LLS: The distance between the most prominent point of the upper and lower lips to S line was measured. The S line was drawn from the soft tissue pogonion to the midpoint of the S shaped curve between Sn and Pn (Figure 1b) (8).

LLH: The distance between the most prominent point of the lower lip and H line was measured. The H line was drawn from the chin point to the most prominent point of the upper lip (Figure 1c) (8).

ULB and LLB: The distance between the most prominent point of the upper and lower lips to B line was measured. The B line was drawn from the soft tissue subnasale to the soft tissue pogonion (Figure 1d) (8).

Upper and lower lips thickness: The distance between the most prominent point of the upper and lower lips to the labial surface of the upper and lower incisors was measured (Figure 1e) (8).

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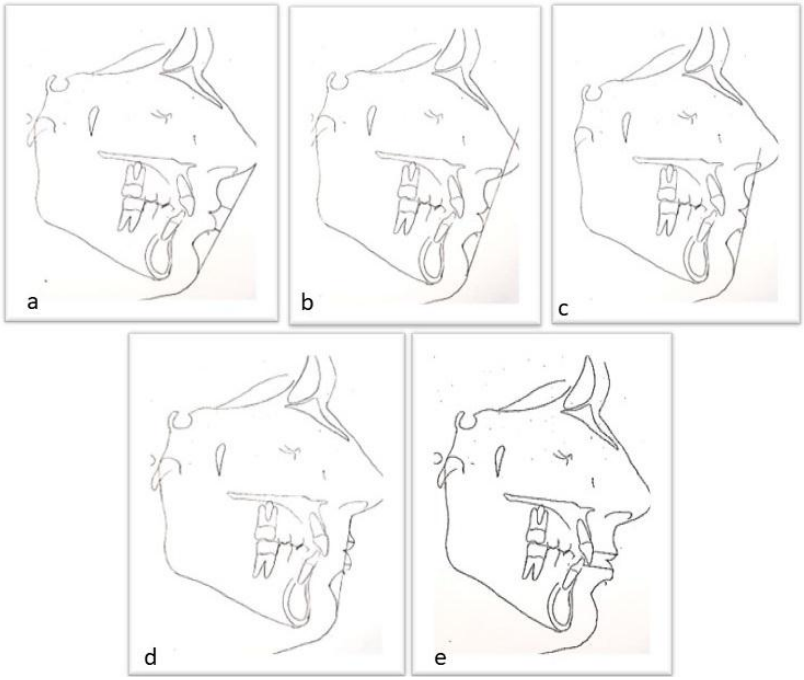

Figure 1. Linear measurements: (a) ULE and LLE; (b) ULS and LLS; (c) LLH; (d) ULB and LLB; (e) upper and lower lip thickness

Nasolabial angle: The angle formed between the two lines tangent to columella and upper lip was measured (Figure 2a) (8).

Inferior labial angle: The angle formed between the most prominent point of the lower lip, soft tissue B point, and soft tissue pogonion was measured (Figure 2b) (8).

Z angle: The angle formed between the Frankfurt plane and profile line was measured (Figure 2c) (8).

Upper lip prominence angle: The angle formed between the two lines connecting the subnasale -soft tissue pogonion and subnasale-the most prominent point of the upper lip was measured (Sn-Pog to Ls) (Figure 2d) (8,14).

Lower lip prominence angle: The angle formed between the two lines connecting the subnasale-soft tissue pogonion and soft tissue pogonion-most prominent point of the lower lip (Sn-Pog to Li) was measured (Figure 2e).

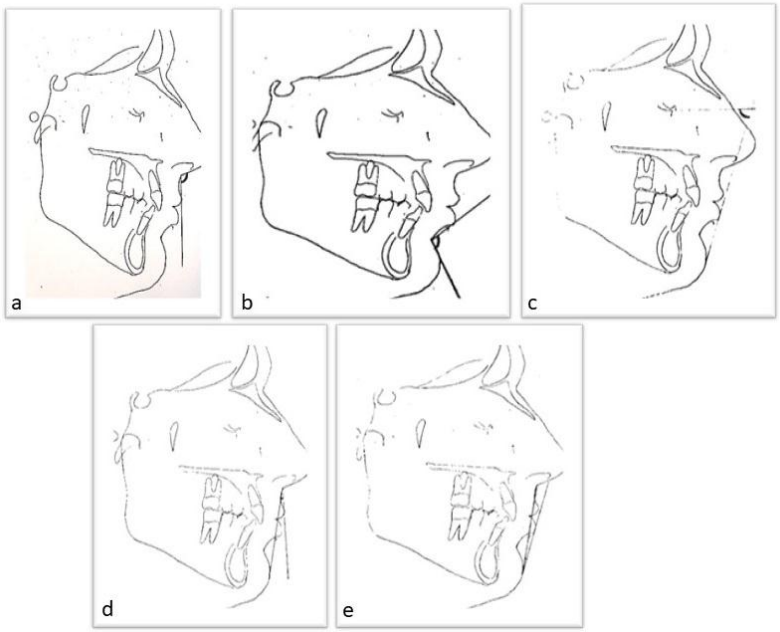

Figure 2. Angular measurements: (a) nasolabial angle; (b) inferior labial angle; (c) Z angle; (d) upper lip prominence angle; (e) lower lip prominence angle

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Data were analyzed using SPSS version 24 (SPSS Inc., IL, USA) by independent t-test and Mann-Whitney test at 0.05 level of significance.

Results

A total of 102 patients between 18-30 years including 56 females and 46 males were evaluated. Independent t-test was used for all comparisons as it is a suitable test to expose differences.

Linear measurements:

ULE and LLE: The mean ULE distance was -5.20±2.33 mm in the study population. The mean LLE distance was -2.90±2.08 mm in the study population. Table 1 shows the ULE and LLE in males and females. There was no significant difference in the ULE (P=0.339) or LLE (P=0.647) distances between males and females.

ULS and LLS: The mean ULS distance was -1.23±1.92 mm and the mean LLS distance was -0.60±1.81 mm in the study population. Table 1 presents the ULS and LLS in males and females. The difference in ULS (P=0.296) and LLS (P=0.871) was not significant between males and females.

Table 1. Comparison of ULE, LLE, ULS and LLS distances in males and females in millimetres

Parameter	Gender	Mean± Std. deviation	P value
ULE	Female	-5.00± 2.41	0.339
	Male	-5.44 ± 2.22	
LLE	Female	-2.81 ± 1.85	0.647
	Male	-3.00 ± 2.35	
ULS	Female	-1.04 ± 1.94	
	Male	-1.45 ± 1.90	0.296
	Total	-1.23 ± 1.92	
LLS	Female	-0.57 ± 1.63	0.871
	Male	-0.63± 2.02	

LLH: The mean LLH distance was 0.23±1.35 mm in the study population. Table 2 presents the LLH in males and females. The difference in this regard was not significant between males and females (P=0.771).

Table 2. Comparison of LLH distance in males and females in millimetres

Gender	Mean± Std. deviation	P value
Female	0.19±1.33	
Male	0.27±1.39	0.771
Total	0.23±1.35	

ULB and LLB: The mean ULB distance was 2.75±1.72 mm and the mean LLB distance was 2.03±1.59 mm in the study population. Table 3 presents the ULB and LLB in males and females. ULP (P=0.606) and LLB (P=0.886) were not significantly different in males and females.

Table 3. Comparison of ULB and LLB distances in males and females in millimetres

Parameter	Gender	Mean± Std. deviation	P.value
ULB	Female	2.83 ± 1.73	0.606
	Male	2.65 ±1.73	
	Total	2.75 ± 1.72	
LLB	Female	2.01± 1.43	0.886
	Male	2.05 ± 1.78	
	Total	2.03 ± 1.59	

Upper and lower lip thickness: The mean upper lip thickness was 12.09±2.20 mm and the mean lower lip thickness was 13.65±2.14 mm in the study population. Table 4 shows the upper and lower lip thickness in males and females. The mean upper (P<0.001) and lower (P<0.001) lip thickness in males were significantly greater than the corresponding values in females.

Table 4. Comparison of Upper and lower lip thickness in males and females in millimetres

Parameter	Gender	Mean± Std. deviation	P value
Upper lip thickness	Female	11.31 ± 2.17	P<0.001
	Male	13.04 ± 1.84	
	Total	12.09 ± 2.20	
Lower lip thickness	Female	12.93 ± 1.93	P<0.001
	Male	14.52 ± 2.07	
	Total	13.65 ± 2.14	

Angular measurements:

Nasolabial angle: The mean nasolabial angle was 103.71±10.77 degrees in the study population. The nasolabial angle was not significantly different in males and females at 0.05 level of significance (P=0.094). However, at a 0.1 level of significance, the nasolabial angle was significantly larger in females than males (Table 5).

Inferior labial angle: The mean nasolabial angle was 123.54±12.84 degrees in the study population. The mean nasolabial angle was not significantly different in males and females (P=0.371, Table 5).

Z angle: The mean Z angle was 74.91±5.38 degrees in the study population. The mean Z angle was not

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significantly different in males and females (P=0.193, Table 5).

Upper and lower lip prominences: The mean upper lip prominence angle was 13.47±7.47 degrees in the study population with no significant difference between males and females (P=0.949), Table 5). The mean lower lip prominence angle was 5.85±4.64 degrees in the study population with no significant difference between males and females (P=0.806, Table 5).

Table 5. Comparison of Angular measurements in males and females in degrees

Parameter	Gender	Mean± Std.	P value
Nasolabial angle	Female	105.33 ± 11.37	0.094
	Male	101.74 ± 9.75	
Inferior labial angle	Female	124.58 ±14.79	0.371
	Male	122.28 ± 9.99	
Z angle	Female	74.28±5.18	0.193
	Male	75.67 ± 5.58	
Upper lip prominence angle	Female	13.51 ± 7.82	0.949
	Male	13.41 ± 7.11	
Lower lip prominence angle	Female	5.75 ± 4.52	0.806
	Male	5.98 ± 4.83	

Table 6 illustrates the mean measured values in the present study population and the standard published norms.

Table 6. Mean measured values in the present study population and the standard published norms

Parameter	Standard norms	Mean± Std.
ULE	-4 mm	5.20-±2.33
LLE	-2 mm	2.90-±2.08
ULS	Lips tangent to line	1.23-±1.92
LLS	Lips tangent to line	0.60-±1.81
LLH	0-0.5	0.23±1.35
ULB	3.5	2.75±1.72
LLB	2.5	2.03±1.59
Upper lip thickness	13-14 mm	12.09±2.20
Lower lip thickness	Males 16.3±1.45	14.52±2.07
	Females 13.4±1.68	12.93±1.93
Nasolabial angle	90-110 degrees	103.71±10.77
Inferior labial angle	No standard value	123.54±12.84
Z angle	80±9 degrees	74.91±5.38
Upper lip prominence angle	No standard value	13.47±7.47
Lower lip prominence angle	No standard value	5.85±4.64

Discussion

This study assessed the upper lip morphology in Iranian adults with normal occlusion in Isfahan, Iran. In the study population the mean ULE distance was -5.20±2.33 mm and the mean LLE distance was -2.90±2.08 mm. However, higher values were obtained in the present study for both the upper and lower lips, which was in agreement with the results of previous studies (4,7,15,16). Ab Talib et al. (8) showed that both Malaysian Malay males and females had more prominent lips compared with the Ricketts esthetic line.

The average upper lip-to-skeletal (ULS) distance in our study was -1.23±1.92 mm, while the average lower lip-to-skeletal (LLS) distance was -0.60±1.81 mm. However, both the upper and lower lips were found to be further back than the standard position suggested by Steiner. Isiekwe et al. (7) found that ULS and LLS

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distances in their study were larger than the standard values, whereas Erbay et al. (16) showed that the upper and lower lips were more retruded compared to the Steiner norms. The mean LLH was 0.23±1.35 mm in the present study, which was within the normal range. Taki et al, (1) and Erbay et al. (16) reported that the lower lip position in their study populations was within the standard range suggested by Holdaway. However, some authors (15,17,18) reported different values from those reported by Holdaway.

The mean ULB was 2.75±1.72 mm and the mean LLB was 2.03±1.59 mm in the present study. The ULB in the present study was lower than the Burstone standard while the LLB was within the standard range. Isiekwe et al. (7) and Le et al. (19) showed that the ULB and LLB in their studies were greater than the Burstone standard while Erbay et al. (16) reported that both ULB and LLB distances in their study were within the normal range reported by Burstone.

The mean upper lip thickness was 12.09±2.20 mm in the current study. The standard range reported for the upper lip thickness is 13-14 mm (1), which indicates that the value obtained in the present study population was lower than the normal range. However, Taki et al, (1) and Rahmati Kamel et al. (15) demonstrated that the upper lip thickness in the Iranian adults was close to the value reported by Holdaway.

The mean lower lip thickness was 12.93±1.93 mm in females and 14.52±2.07 mm in males in the present study while the ideal values for the lower lip thickness were reported to be 1.45±16.3 mm in males and 1.68±13.4 mm in females by Burstone (20). This parameter in both males and females in the present study population was lower than the values reported by Burstone, like the study performed by Ab Talib et al (8).

The mean size of the nasolabial angle was 103.71±10.77 degrees in the present study. The standard norm for this angle is 90-110 degrees (13). Thus, this angle in our study population was within the standard range, like the study by Ab Talib et al (8). However, some authors (15,18,19,21) reported significantly smaller nasolabial angle in their studies compared with the standard norm.

The mean size of the inferior labial angle was 123.54±12.84 degrees in the present study. This value was 122.261 degrees in the study by Ab Talib et al, (8) on Malayan adults, 133.76 degrees in the study by Alam et al, (14) on a Bangladeshi population, and 142.95 degrees in a study by Daer and Abuaffan (22) on Yemeni adults.

The mean size of the Z angle was 74.91±5.38 degrees in the present study. The standard value for this angle is 80±9 degrees as reported in the literature (13). Thus, this value in the present study was smaller than the reported norm. Some authors (4,7,8,16,18) reported similar results while Hedayati et al. (23) reported values within the Merrifield standard range.

The mean angle of the upper lip prominence was 13.47±7.47 degrees and the mean angle of the lower lip prominence was 5.85±4.64 degrees in the present study, whereas Ab Talib et al. (8) reported higher values for the upper and lower lip prominence in Malayan adults.

The mean ULE was -5.00±2.41 mm in females and -5.44±2.22 mm in males in the present study with no significant difference between them, which was in line with the results of previous investigations (4,6,8,14,18,19,23) and in contrast to the findings of some others (7,11,21). The LLE was -2.81±1.85 mm in females and -3.2±0.35 mm in males in the present study. No significant difference was found between males and females in this regard. These results were in line with the findings of some previous studies (4,6,14,18,21,23) and in contrast to the findings of Ab Talib et al, (8) and Hamdan (11).

The ULS was -1.04±1.94 mm in females and -1.45±1.90 mm in males in the current study, with no significant difference, which was similar to the findings of some (6,8,18) and in contrast to the findings of Isiekwe et al (7).

The LLS was -0.57±1.63 mm in females and -0.63±2.02 mm in males in the present study, with no significant difference, which was in agreement with the results of several previous studies (6,8,18) and in contrast to the findings of Isiekwe et al (7).

The LLH distance was 0.19±1.33 mm in females and -0.1±27.39 mm in males in the present study, with no significant difference, which was in accordance with the results of many previous investigations (1,6,8,11, 18,23).

The ULB distance was 2.83±1.73 mm in females and 2.65±1.73 mm in males in the current study, with no significant difference, which was like the findings of Ab Talib et al, (8) and in contrast to the findings of others who showed larger ULB in males (7,19,24).

The LLB distance was 2.01±1.43 mm in females and 2.1±5.78 mm in males in the present study, with no significant difference, which was in line with the results of Ab Talib et al, (8) and in contrast to the findings of Isiekwe et al (7).

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In the current study, the upper lip thickness was measured to be 11.31 ± 2.17 mm in females and 13.04 ± 1.84 mm in males. The thickness in males was found to be significantly higher than in females, which is consistent with the findings of previous studies. (1,8,11,14,18,21,23,24).

The lower lip thickness was 12.93±1.93 mm in females and 14.52±2.07 mm in males in the present study. This value in males was significantly higher than that in females, which was in agreement with the results of Ab Talib et al, (8) and Abutayyem et al (24).

The nasolabial angle was 105.33±11.37 degrees in females and 101.74±9.75 degrees in males in the present study, with no significant difference, which was similar to the findings of certain studies (6,22,24) and in contrast to the findings of other studies (8,14,18,19) that showed larger nasolabial angle in males.

The inferior labial angle was averagely 124.58±14.79 degrees in females and 122.28±9.99 degrees in males in the current study, with no significant difference, which was in line with the results of Ab Talib et al, (8) and in contrast to the findings of Daer and Abuaffan (22) and Le et al (19).

The mean Z angle was 74.28±5.18 degrees in females and 75.67±5.58 degrees in males in the current study, with no significant difference, which was in accordance with the findings of many previous studies (4,6,8,23) and contrast to the findings of some others (7,18).

The upper lip prominence angle was averagely 13.51±7.82 degrees in females and 13.41±7.11 degrees in males in the current study, with no significant difference, which was in line with the results of Ab Talib et al, (8) and Alam et al (14).

The lower lip prominence angle was averagely 5.75±4.52 degrees in females and 5.98±4.83 degrees in males in the present study, with no significant difference, which was in accordance with the findings of Ab Talib et al, (8) and in contrast to the results of Alam et al (14).

The differences in reported values in the literature can be attributed to varying sample sizes, study populations, and racial, ethnic, and environmental factors in different regions. This study was limited by strict eligibility criteria, which affected the sample size. Future research is needed to study lips morphology in Iranians living in other cities of Iran and to conduct a more comprehensive assessment of lip morphology using additional parameters and analyses.

Conclusion

Most of the measured indices in the study population were different from the standard values reported in the literature, which highlights the need to take into account the Iranian norms in orthodontic treatment planning and orthognathic surgery of Iranian patients.

Conflict of Interests: The authors of this manuscript declare that they have no conflicts of interest, real or perceived, financial or non-financial in this article.

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