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The importance of paranasal tomography in planning septorhinoplasty

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Abstract

Objectives This study aims to emphasize the importance of paranasal tomography imaging before septorhinoplasty surgery. Preoperative evaluation of nasal bone structure, including medial and lateral bone thickness, guides osteotomy type selection and force application.

Method Preoperative paranasal sinus tomography scans of patients who were decided to undergo septorhinoplasty were retrospectively analyzed. Bilateral nasal bone length, medial and lateral bone thickness, pyriform aperture width and height were measured.

Results In 200 patients, the mean thickness of the right lateral osteotomy line was 1.66 ± 0.28 mm in males and 1.54 ± 0.25 mm in females, left lateral osteotomy line 1.67 ± 0.30 mm in males and 1.54 ± 0.28 mm in females. The mean thickness of the medial osteotomy line was 1.68 ± 0.36 mm in males and 1.58 ± 0.35 mm in females. The mean length of the nasal bone was 24.27 ± 4.1 mm in males and 22.78 ± 3.4 mm in females. The mean width of the pyriform aperture was 21.42 ± 2.19 mm in males and 20.49 ± 2.03 mm in females. The mean height of the pyriform aperture was 35.54 ± 4.76 mm in males and 33.93 ± 5.00 mm in females. The mean length of the right lateral nasal bone was 24.81 ± 2.75 mm in males and 21.14 ± 2.76 mm in females, the left lateral nasal bone was 23.91 ± 2.67 mm in males and 20.63 ± 2.69 mm in females. Nasal bone length, piriform aperture width and height, lateral bone thickness, lateral bone length mean values; statistically significant difference was observed between male and female patients ($p < 0.05$).

Conclusion Preoperative paranasal tomography provides essential data for osteotomy planning by identifying significant anatomical variations in nasal bone structure. Statistically significant difference was observed between male and female patients in these measurements. We believe that we emphasize that the evaluation of bone thickness before surgery is important when performing osteotomy. There is no study in the literature measuring lateral nasal bone length. Our study measured right and left lateral bone length for the first time.

Keywords Nasal bone, Osteotomy, Paranasal tomography, Septorhinoplasty

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Introduction

Understanding nasal bone anatomy is crucial for precise surgical planning in septorhinoplasty. The nasal bone is next to the frontal bone on top and to the maxillary bones laterally. At the bottom, the nasal cavity is limited by the pyriform aperture. While nasal bones can be assessed clinically, objective measurements require imaging modalities such as paranasal tomography. The most objective evaluation method to examine the nasal bone structure and the shape of the piriform aperture is imaging with paranasal tomography [1].

Nasal bone structure, width, and height of piriform aperture; vary according to age, gender, race, and ethnic groups [2].

Bone structure is important in planning the septorhinoplasty operation and choosing the appropriate osteotomy. The appropriate force applied during osteotomy, depending on bone thickness, will help prevent uncontrolled bone fractures. At the same time, with the appropriate osteotomy technique, excessive injuries to the mucosa and periosteum will be prevented and complications such as ecchymosis and deformity will be reduced [3]. Complications that may develop in septorhinoplasty surgery can be reduced with knowledge and experience. Complications range from deformity to skin necrosis [4].

No study has been found in the literature evaluating paranasal tomography images of patients planned for septorhinoplasty. We believe this will be a guiding study in osteotomy planning, showing the characteristics of the nasal bone structure of patients with septum deviation and deformity.

Material and method

A total of 200 patients who applied to the ENT Clinic of Malatya Turgut Özal University Training and Research Hospital and had septorhinoplasty surgery were included in this study. Preoperative paranasal tomography scans taken between 01.08.2022 and 01.07.2024 were retrospectively examined. Patients under the age of 18 and over the age of 40 were not included in the study. Patients with sinusitis infection and nasal polyps, with a history of nasal surgery or facial trauma were excluded from the study.

CT images in this study were obtained using the MDCT device in our radiology center (GE Evalution Evo 64 Detector 128-slice CT, General Electric Medical Systems). Scanning parameters were as follows: 120 kV; 110 mA; rotation time: 0.6 s; 0.625 mm slice thickness; step speed: 1,000 mm; detector coverage: 4 cm; and FOV: 20 cm. The standard slice thickness of coronal and sagittal images was 0.625 mm, and the pitch value was 0.5 mm. VR images were obtained from thin sections and 3D images were created.

We measured nasal bone thickness at the level of the lateral and medial osteotomy lines. Lateral nasal bone thickness was measured the level of the nasomaxillary suture (Fig. 1-A). Medial nasal bone thickness was measured at the midline between rhinion and nasomaxillary suture (Fig. 1-B). The length of the nasal bone was measured from frontonasal suture to the tip of the nasal bone (Fig. 2-A). The width of the piriform aperture was measured at the lower bound of the nasal bones, and the piriform aperture height was measured at the midline (Fig. 2-B) [1, 3].

The length of the lateral nasal bone was measured as the longest section between the intersection of the anterior-lateral walls of the maxillary bone and inferior to the intercanthal line (Fig. 3). In the literature, we measured first time the length of the lateral nasal bone.

Statistical analysis

The data obtained in this study were evaluated in a computer environment using the SPSS "Statistical Package For Social Sciences (SPSS22.0)" program. Since $p > 0.05$ according to Kolmogorov Smirnov test statistic and the data were parametric distributed, independent t-test was preferred to compare the difference between females and males.

Results

A total of 200 patients were evaluated in the study. The mean age was 24.1 years, and 25% (50) were males and 75% (150) were females.

The mean thickness and standard deviation, of the right lateral osteotomy line was 1.66 ± 0.28 mm in males and 1.54 ± 0.25 mm in females, left lateral osteotomy line (1.67 ± 0.30) mm in males and 1.54 ± 0.28 mm in females. Bilateral lateral osteotomy lines were significantly higher in males than in females ($p < 0.05$). The mean thickness of the medial osteotomy line was 1.68 ± 0.36 mm in males and 1.58 ± 0.35 mm in females. There was no significant difference between males and females in measurements of the medial osteotomy line ($p > 0.05$)(Table 1).

The mean length of the nasal bone was 24.27 ± 4.1 mm in males and 22.78 ± 3.4 mm in females. Nasal bone length was significantly longer in males compared with females ($p < 0.05$). The mean width of the pyriform aperture was 21.42 ± 2.19 mm in males and 20.49 ± 2.03 mm in females. The mean height of the pyriform aperture was 35.54 ± 4.76 mm in males and 33.93 ± 5.00 mm in females. The mean length of the right lateral nasal bone was 24.81 ± 2.75 mm in males and 21.14 ± 2.76 mm in females, the left lateral nasal bone was 23.91 ± 2.67 mm in males and 20.63 ± 2.69 mm in females. A statistically significant difference was observed between male and female patients in these measurements ($p < 0.05$)(Tables 2 and 3). Lateral bone thickness and length were compared

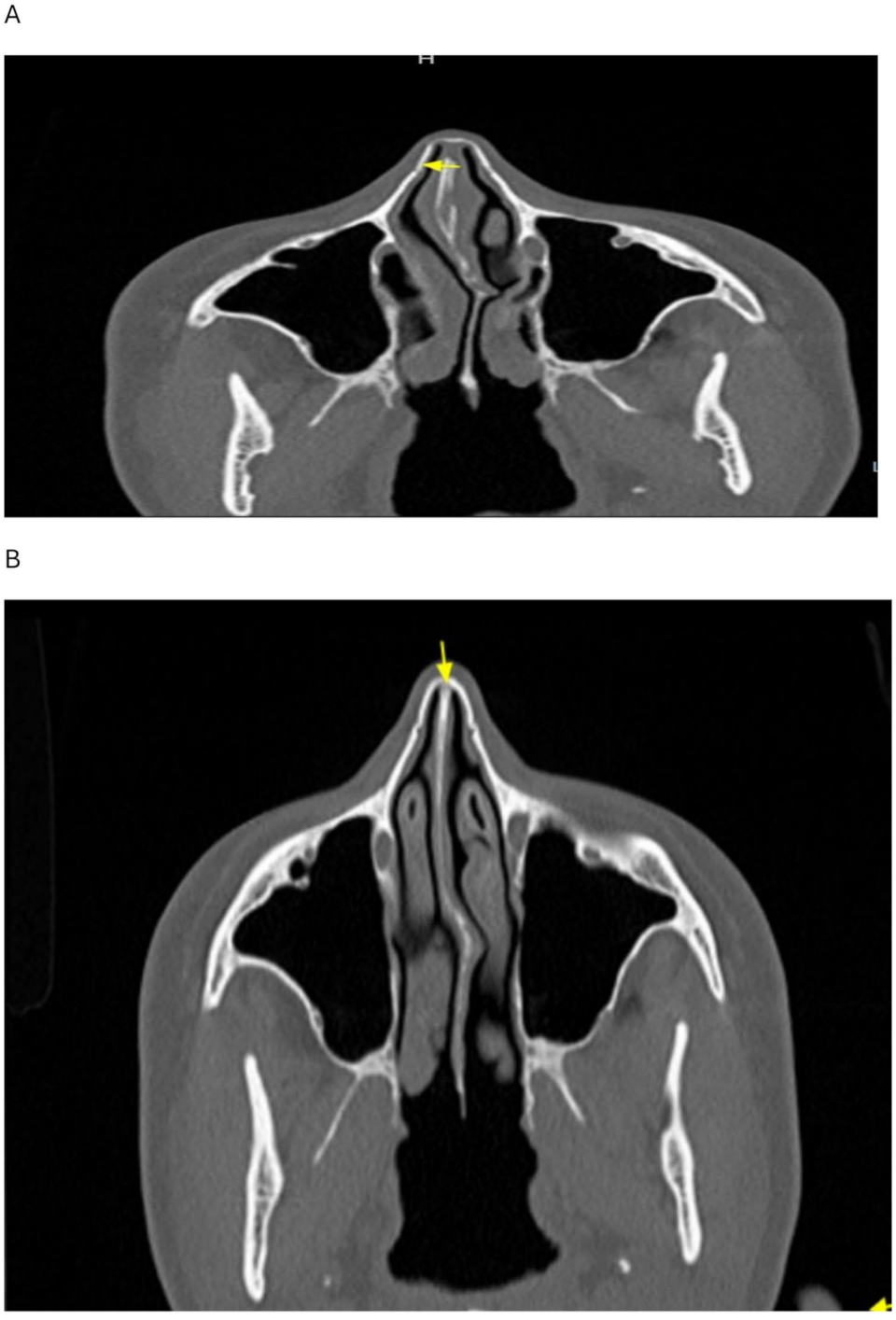

Fig. 1 The thickness of lateral osteotomy line (**a**), The thickness of medial osteotomy line (**b**)

as right and left, but no statistical significance was found ($p > 0.05$)(Tables 4 and 5).

Discussion

In our study, nasal bone length, piriform aperture width and height, lateral bone thickness, lateral bone length mean values were determined by examining the paranasal tomography of patients who will undergo septorhinoplasty surgery. A statistically significant difference was observed between male and female patients in these measurements. In our study, male patients had thicker nasal bones. We attribute this result to higher bone mineral density in men due to hormonal effects [5].

Ecchymosis and edema are observed due to soft tissue damage caused by improper osteotomy. As a complication of osteotomy, deformities may occur due to

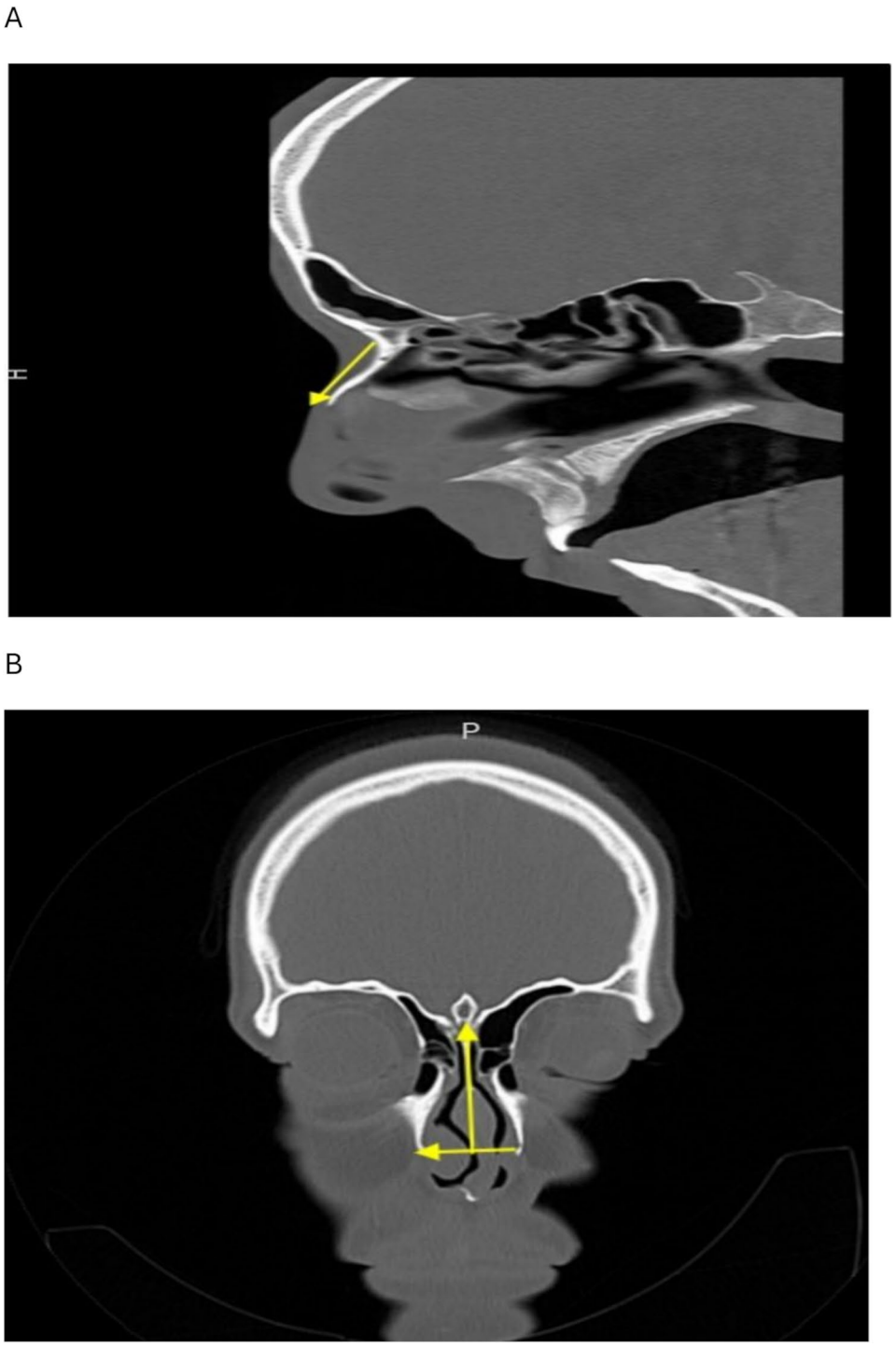

Fig. 2 The length of the nasal bone (**a**), The width and height of the piriform aperture (**b**)

uncontrolled fracture of the nasal bone. One of the deformities that can be seen after septorhinoplasty is step deformity. It may develop due to mobilization of the nasal bone after an uncontrolled osteotomy [6]. These complications can be minimized by performing the osteotomy appropriately. There is no objective measure that can be determined for the force applied while performing osteotomy. However, if the bone thickness is greater than average, the surgeon may consider increasing its strength relatively, and if it is thinner than average, may consider decreasing the force. If the lateral bones are longer than average, surgeon may prefer percutaneous osteotomy.

Since the patients who underwent septorhinoplasty were mostly young and female, the average age in our

Fig. 3 The length of lateral nasal bone

Table 1 The thickness of the right lateral osteotomy line and left osteotomy line, the thickness of the medial osteotomy line

	Female ***n*** **= 150**		**Male** ***n*** **= 50**		***p***
	mean	**SD**	**mean**	**SD**	
Right lat. osteo. line	1.54	0.25	1.66	0.28	0.007
Left lat. osteo. line	1.54	0.28	1.67	0.30	0.009
Med. osteo. line	1.58	0.35	1.68	0.35	0.082

SD: standard deviation. $p < 0.05$

Table 2 The length of the nasal bone, the width and height of the pyriform aperture

	Female ***n*** **= 150**		**Male** ***n*** **= 50**		***p***
	mean	**SD**	**mean**	**SD**	
Nasal bone length	22.78	3.40	24.27	4.10	0.013
Pyrif. apert. width	20.49	2.03	21.42	2.19	0.006
Pyrif. apert. height	33.93	5.00	35.54	4.76	0.047

SD: standard deviation, $p < 0.05$

Table 3 The length of right and left lateral nasal bone

	Female ***n*** **= 150**		**Male** ***n*** **= 50**		***p***
	mean	**SD**	**mean**	**SD**	
Right lateral nasal bone	21.14	2.76	24.81	2.75	0.0001
Left lateral nasal bone	20.63	2.69	23.91	2.67	0.0001

SD: standard deviation, $p < 0.05$

Table 4 The length of right and left lateral nasal bone

	Right lateral nasal bone		Left lateral nasal bone		*p*
	mean	SD	mean	SD	
Female ($n=150$)	21.14	2.76	20.63	2.69	0.75
Male ($n=50$)	24.81	2.75	23.91	2.67	0.802

SD: standard deviation, $p<0.05$

Table 5 The thickness of the right lateral osteotomy line and left osteotomy line

	Right lateral osteotomy line		Left lateral osteotomy line		*p*
	mean	SD	mean	SD	
Female ($n=150$)	1.54	0.25	1.54	0.28	0.84
Male ($n=50$)	1.66	0.28	1.67	0.30	0.73

SD: standard deviation, $p<0.05$

study was found to be 24.1 years old and the majority (75%) of the patients were female [7].

Citardi et al. measured lateral and medial bone thicknesses by examining tomography scans in American patients scheduled for hypophysectomy. As in our study, the rhinion and nasomaxillary suture lines were used for measurement. The lateral osteotomy thickness was found to be 2.39 mm, and the medial osteotomy thickness was found to be 1.18 mm [8]. In our study, patients with septum deviation and deformity were selected. The lateral osteotomy thickness was determined as 1.57 mm and the medial osteotomy thickness was 1.60 mm.

The length of the nasal bone and the width of the pyriform aperture may vary depending on the climate. In places with cold and dry air, the nasal bone is longer and the pyriform aperture is wider in order to warm and humidify the inhaled breath [9]. The findings of our study conducted in the Eastern Anatolia region, where the continental climate prevails, also support the literature.

In a study by Lang et al. the nasal bone length in Germans was reported as 24.9 mm and the pyriform aperture as 23.6 mm [10]. In Koreans, the nasal bone length was 25.9 mm in men and 24.5 mm in women in Hwang's study, and the pyriform aperture was 25.7 mm in men and 25.4 mm in women [2]. In another study in Korea by Lee et al. determined the nasal bone length as 20.9 mm, the piriform opening as 24.01 mm, the lateral osteotomy thickness as 2.03 mm, and the medial osteotomy thickness as 1.75 mm [1].

In our study, the nasal bone length was measured as 22.78 mm in women and 24.27 mm in men. The nasal bone length in Anatolian people was found similar to that of Germans and Koreans, but according to Lee's study, it can be said that it is longer than that of Koreans.

The width of the piriform aperture was measured as 20.49 mm in women and 21.42 mm in men, and the height of the piriform aperture was measured as 33.93 mm in women and 35.54 mm in men, in our study. According to these measurements, it can be concluded that we have a narrower piriform aperture structure than Koreans and Germans. Our lateral bone thickness was determined to be thinner than Americans and Koreans. It can be said that our medial bone thickness is thicker than Americans but similar to Koreans. It is important to be more careful about the force to be applied during lateral osteotomy.

In a study conducted by Kaplanoğlu et al. in Turkey, the mean thickness medial bone was found 1.99 mm, and the mean thickness lateral bone thickness was found 1.75 mm. The piriform aperture width was found 23.41 mm, and the piriform aperture height was found 36.76 mm [11]. In another study conducted by Karadağ in Turkey, the mean thickness medial osteotomy line was found 2.08 mm in men and 2.04 mm in women, and the mean length of the nasal bone was found 30.6 mm in men and 29.01 mm in women. The piriform aperture width was reported as 18.83 mm in men and 18.15 mm in women in this study [12].

When we compare our results with these studies conducted in Turkey, it is seen that the lateral bone thickness and piriform aperture structure are of similar dimensions. It is seen that the medial bone thickness is thinner and the nasal bone length is shorter in our study.

There is no study in the literature measuring lateral nasal bone length. Right and left lateral bone length was measured for the first time in our study. Bilateral lateral nasal bone lengths were significantly longer in men than in women. We believe that asymmetric facial structure is important in determining axis deviation.

Manual measurements in a computer environment can be seen as a reason for possible differences. It is also important to keep in mind that real bone structure measurements and radiological measurements made in tomography may be different. It is thought that these measurements can provide an idea about the general bone structure. Considering that bone thickness and length are different during osteotomy in female and male patients, care should be taken in terms of osteotomy technique and selection. It can be effective in the choice of osteotomy tool; saw, osteotome or piezzo, as well as in

the choice of thickness of the osteotomy tool. In patients with long lateral bone length, transverse osteotomy or percutaneous osteotomy preference can be kept in mind.

There should be further studies in which clinical follow-up can be done with prospective studies.

Conclusion

Osteotomies performed during septorhinoplasty are performed by applying mechanical force. Ecchymosis and edema may occur after the operation due to trauma to the skin and mucosa. Uncontrolled fractures of the lateral nasal bones may cause undesirable deformities. Knowing the thickness of the nasal bone and applying appropriate force during osteotomy can prevent these complications.

By selecting a large group of patients with both deviation and shape problems, an attempt was made to reveal specific data about the nasal bone structure of Anatolian people.

There is no study in the literature measuring lateral nasal bone length. Right and left lateral bone length was measured for the first time in our study. We think that we will contribute to the literature with these measurements.

SH Tecimer: Project development, Data Collection, Manuscript writing.

Zİ Emekli: Data collection.

P Tekin: Data collection, Manuscript writing.

AÖ Çimen: Data collection.

Supplementary Information

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Supplementary Material 1

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Not applicable.

Author contributions
S.H.Tecimer. Wrote manuscript, prepared figures and tablesZ.İ.Emekli. Data collection, wrote manuscriptP.Tekin. Data collection, prepared figuresA.Ö.Çimen. Measurement of radiological data, prepared tables, wrote manuscriptAll authors rewieved the manuscript.

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Data availability
The datasets used and analysed during the current study are available from the corresponding author on reasonable request.

Declarations

Ethics approval and consent to participate
The study was reviewed and approved by the Clinical Research Ethics Committee of the Malatya Turgut Özal University (Decision no: 30785963-020 approval date: 15.08.2024). The study was conducted according to the principles expressed in the Declaration of Helsinki. This study was reviewed retrospectively, informed consent for participation is not applicable.

Consent for publication
Not applicable.

Competing interests
The authors declare no competing interests.

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