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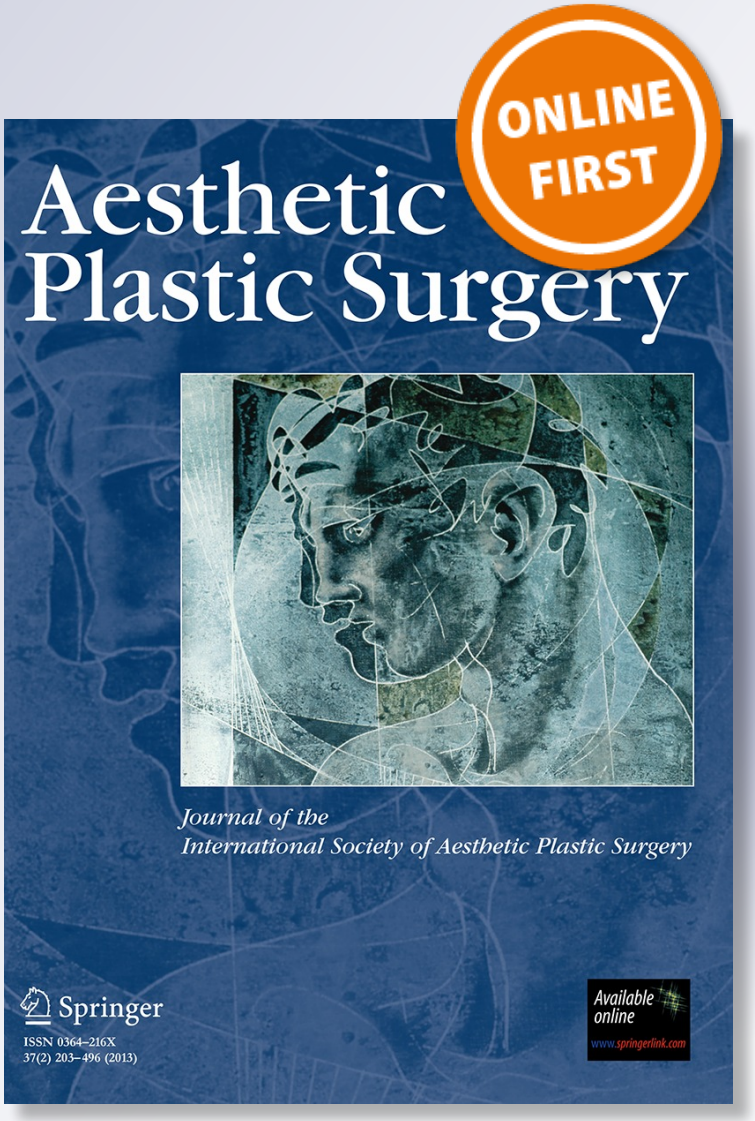
Aesthetic Plastic Surgery

ISSN 0364-216X

Aesth Plast Surg
DOI 10.1007/s00266-013-0137-x



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ORIGINAL ARTICLE EXPERIMENTAL/SPECIAL TOPICS

Effect of Depressor Septi Nasi Muscle Activity on Nasal Lengthening With Time

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Received: 23 February 2013 / Accepted: 12 April 2013

Abstract

Background The depressor septi nasi (DSN) muscle is an important muscle in nose dynamics. Its hyperactivity causes smile deformity including nasal tip depression. The nasal tip of individuals with a hyperactive DSN muscle depresses repeatedly while they are speaking and smiling. This may result in nasal lengthening as they age.

Methods Pairs of cases consisting of a child and one of his or her parents were studied in two groups: case group (with DSN muscle hyperactivity) and the control group (with DSN muscle inactivity in both child and parent). Nasal length from nasion to tip and facial length from nasion to menton were measured during repose and during smiling.

Results This study investigated 80 pairs of children and parents. In both groups, a significant linear correlation between the nasal length of the parent and the child was found. In both groups (case and control), the nasal length of the child differed significantly from that of the parent. The increase in the nasal length of the parents compared with the children was greater in the control group.

Conclusions This study demonstrated that nasal length increases with age and that DSN muscle hyperactivity is not an effective factor in this increase. This unpredictable result may affect the presumption that patients with DSN muscle hyperactivity will have longer noses in the future. Long-term prospective studies investigating cohort groups are required to clarify the variables affecting nasal lengthening with aging, and interventional studies are needed to examine the effects of DSN muscle resection on this phenomenon.

Level of Evidence III This journal requires that authors assign a level of evidence to each article. For a full description of these Evidence-Based Medicine ratings, please refer to the Table of Contents or the online Instructions to Authors www.springer.com/00266.

Keywords DSN hyperactivity · Facial aesthetics · Nasal length · Rhinoplasty outcome

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The depressor septi nasi (DSN) muscle is an important and effective muscle in nose dynamics. It has many anatomic variations in the population [1–4]. It depresses the nasal tip especially during smiling, and its hypertrophy leads to a deformity during smiling that includes nasal tip depression [1, 2, 5, 6]. This deformity, known as smiling deformity or rhinogingivolabial syndrome, occurs repeatedly every day in cases with DSN muscle hyperactivity. In these cases, the nasal tip depresses downward during speaking and smiling. Over the years, this repeated downward traction on the nasal tip may lead to nasal lengthening. It therefore is probable that, over time, the nose in these cases elongates more than in other cases. If this hypothesis is true, attention to this muscle before rhinoplasty and its resection during the operation on hyperactive patients is very important. In

Published online: 15 May 2013

this study, the effect of aging on lengthening of the nose in cases with and without DSN muscle hypertrophy was evaluated.

Materials and Methods

Two groups (case and control) of paired cases were studied. Each pair consisted of a child and one parent. In the case group, both the child and the parent had hypertrophy of the DSN muscle. In the control group, neither the child nor the parent had DSN muscle hypertrophy. Pairs of children and parents whose DSN muscle hyperactivity differed (hyperactivity in children and inactivity in the parent or vice versa) were excluded from the study. The sample size based on data that had a minimum power of 80 % to detect a difference between groups with a significance level of 0.05 was 68.

For the study, 87 pairs of children and parents were considered. The 80 pairs that had similar activity of DSN muscle in the child and parent were included in the study. All the patients were at least 18 years old. Patients with a history of rhinoplasty, septoplasty, or nasal fracture were excluded from the study. The study was approved by the ethics committee of the Mashhad University of Medical Sciences. Informed consent was taken from all the patients.

Measurements in millimeters using a slide-caliper were performed clinically on the faces of the patients in repose and smiling positions. All measurements were performed by only one person to decrease bias. Nasal length was measured from nasion to nasal tip, and facial length was measured from nasion to menton (Figs. 1, 2). Because the dimensions of the child and the parent could differ, a standardized measurement of the parent's nose was calculated by the following equation:

$$\text{Standard parent's nasal length} = \text{parent's nasal length} \times \text{child's facial length}/\text{parent's facial length}.$$

For this study, DSN muscle hyperactivity was defined as a 2-mm or more increase in nasal length during smiling, and DSN muscle inactivity was defined as less than 2 mm of nasal lengthening during smiling. Data were analyzed with the SPSS 13 for Windows package provided by SPSS Inc. (Chicago, IL, USA). All p values lower than 0.05 were considered statistically significant.

Results

This study investigated, 80 pairs of children and parents. The DSN hyperactive group (case group) consisted of 37 pairs (46.3 %), and the DSN inactive group (control group) consisted of 43 pairs (53.8 %). In the case group, 20 parents (54.1 %) and 23 children (62.2 %) were male. In the control group, 19 parents (44.2 %) and 15 children (34.9 %) were male (Fig. 3).

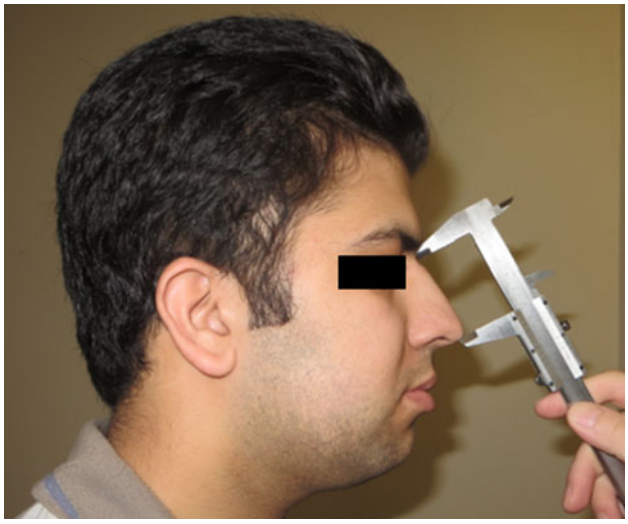

Fig. 1 Measurement of nasal length from nasian to tip in repose position

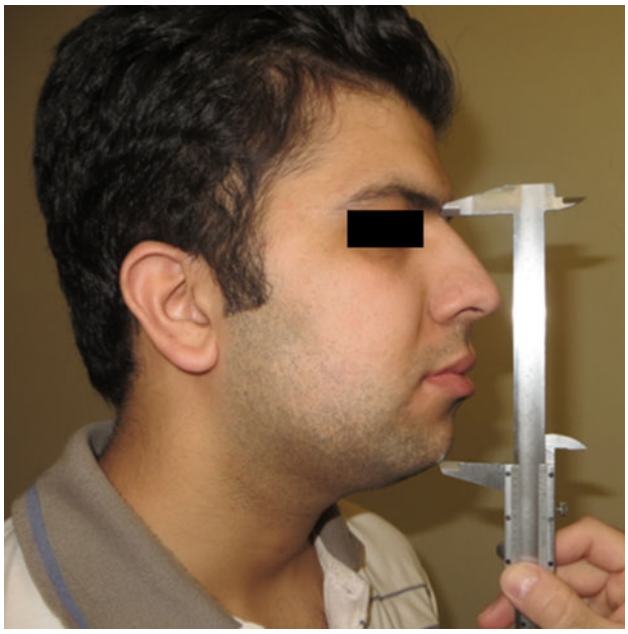

Fig. 2 Measurement of facial length from nasian to menton in repose position

Parent gender was not significantly related to activity of the DSN muscle (Pearson Chi square = 0.775; $p = 0.379$). Therefore, the parents with different DSN muscle activities were homogeneous with regard to gender. Child gender was significantly related to activity of the DSN muscle (Pearson Chi square = 5.934; $p = 0.015$). Therefore, the children were not homogeneous with regard to gender, and

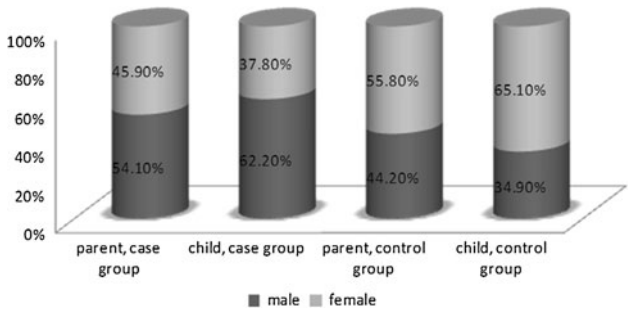

Fig. 3 Distribution of the gender of parents and children in the case and control groups

the factor of the child's gender compared with variables of the child's nasal length in the two groups should be considered.

The mean age of the parents was 61.5 ± 9.36 years, and the mean age of the children was 32.5 ± 9.61 years (Table 1). The parent age was homogeneous in the case and control groups, and there was not a statistically significant difference between the mean ages of the parents in the two groups ($t = 1.62$; $p = 0.109$). There was not a significant difference between the mean age of the children in the two groups (Mann–Whitney $U = 653.50$; $p = 0.170$). Therefore, the children also were homogeneous in terms of age.

In the DSN hyperactive (case) group, there was a significant linear correlation between the standardized nasal length of the parents and the children's nasal length ($r = 0.736$; $p < 0.001$). This implies that in the case group, the child's nasal length increased with increased nasal length of the parent.

Also, in the DSN inactive (control) group, a statistically significant linear correlation was present between the standardized nasal length of the parents and the children's nasal length ($r = 0.658$; $p < 0.001$). Therefore, in the control group as well, the nasal length of the child increased with increased nasal length of the parent.

To evaluate the relationship of age with nasal length and the effect of DSN muscle activity on it, a repeated measure analysis of variance (ANOVA) was used to determine the effect of time on the parent and the child. The child's mean nasal length was 49.62 ± 6.220 mm, and the parent's mean standardized nasal length was 53.05 ± 7.310 mm. Generally, the nasal lengths of the child and the parent differed significantly ($p < 0.001$). Therefore, in the two groups (case and control), the nasal lengths of the child and the parent differed significantly.

In the case group, the child's mean nasal length was 50.38 ± 6.229 mm, and the mean standardized parent's nasal length was 52.22 ± 6.597 mm. Therefore, on the average, the nasal length of the parents was 1.84 ± 4.673 mm longer than that of the children. In the control group, the child's mean nasal length was 48.98 ± 6.212 mm, and the parent's mean standardized nasal length was 53.77 ± 7.878 mm. In this group as well, the average nasal length of the parents was 4.79 ± 6.019 mm longer than that of the children. The increase in the nasal length of the parents compared with the children was greater in the control group. The repeated measure ANOVA demonstrated that the difference in the nasal lengths of the child and the parent in the two groups (case and control) differed significantly ($p = 0.018$).

We repeated our analysis by changing the cut point of the hyperactivity and inactivity of the DSN muscle from 2 to 1 mm.

From the total 77 pairs, 37 pairs (case group) had nasal lengthening of 1 mm or more during smiling, and 40 pairs (control group) had nasal lengthening or shortening of less than 1 mm during smiling. With this cut point, too, the increase in the nasal length of the parents compared with the children was significantly greater in the control group ($p = 0.016$).

Discussion

This study demonstrated that DSN muscle hyperactivity does not lead to more nasal lengthening over time. This unpredictable finding affects our vision about the long-term effects of the DSN muscle. Varied studies have demonstrated the presence and variations of the DSN muscle in the live and cadaver human [1–4, 6, 7]. Some studies have mentioned the effects of the DSN muscle on the facial

Table 1 Age of studied patients in the different groups

Mean age (years)	Group					
	Parent	Child	Case		Control	
			Parent	Child	Parent	Child
Males	63.79 ± 9.763	35 ± 10.557	62.15 ± 9.287	31.61 ± 8.748	65.53 ± 10.200	40.20 ± 11.245
Females	59.98 ± 8.665	30.26 ± 8.148	57.53 ± 9.328	29.14 ± 6.249	61.71 ± 7.904	30.82 ± 9.002
Total	61.48 ± 9.357	32.51 ± 9.609	60.03 ± 9.468	30.68 ± 7.89	63.4 ± 9.082	34.09 ± 10.71

Values are presented as means ± standard deviations

dynamic, especially nasal tip depression during smiling [1–3].

To our knowledge, no study to date has investigated the long-term effect of DSN muscle hyperactivity on nasal length. In our cross-section study, we demonstrated that DSN muscle hyperactivity was not a mechanism of nasal lengthening with aging. In this study, the parent was considered the future of the child. A long-term prospective study is required to confirm or deny this effect. It is possible that other variables not studied affect this phenomenon. A search for other variables affecting nasal lengthening would be prudent.

Based on the results of this study, we may hypothesize that resection of the DSN muscle during rhinoplasty does not prevent nasal lengthening with aging. This hypothesis should be examined in a clinical interventional study.

The deformity due to DSN muscle hyperactivity during smiling or the rhinogingivolabial syndrome during smiling has been described [1, 5]. But, to our knowledge, no clear cut point exists to define DSN muscle hyperactivity or inactivity. Most studies focus on the cadaveric findings. The criteria for DSN muscle hyperactivity should be defined. This definition should be based on long-term cohort studies (to define those at risk for nasal lengthening with time) or on interventional studies (to define those who benefit from DSN muscle resection during rhinoplasty).

In the initial evaluation of the studied pairs, among 87 pairs of child and parent, 80 pairs (91.95 %) had similar DSN muscle activity. This finding strongly implies that DSN muscle activity is inherited. To prove this hypothesis, a special genetic study investigating the effect of inheritance on DSN muscle activity is required. In any case, this finding in our study can be a reasonable indication for study in this field.

Some studies have emphasized the importance of DSN muscle resection during rhinoplasty in patients with DSN muscle hyperactivity [2, 8–10]. Gamboa et al. [11] expressed DSN hyperactivity as the etiology of the notch deformity after stair-step incision in open rhinoplasty. Most of the remaining studies have emphasized the effect of DSN muscle hyperactivity on nasal tip depression during smiling and the position of the nasal tip after surgery. Although effective for preventing smile deformity, the role of DSN muscle resection on the long-term dimensions of the nose should be evaluated.

The prevalence of DSN muscle hyperactivity varies in different populations. For example, in the study by Rohrich et al. [1] on 55 fresh cadavers, three anatomic variations were detected: type 1 (interdigitated with orbicularis oris [62 %]); type 2 (attaching to the periosteum [22 %]); type 3 (a rudimentary muscle or its absence [16 %]). The study performed by Ebrahimi et al. [3] on 42 cadavers in Iran showed that the muscle was inserted to the orbicularis oris in 38 % of the cases and to the periosteum in 44 % of the cases. In 17 % of the cases, there was a diminutive or floating muscle.

In Japanese ethnicity, the DSN muscle is underdeveloped compared with its development in Caucasians, as mentioned in the Ohtsuka [12] report. Our study was performed in Iran. A more conclusive conclusion merits similar studies in various other ethnicities.

Measurement of nose dimensions on the preoperative photographs of candidates for rhinoplasty is a routine practice [13]. Hormozi and Toosi [13] demonstrated that real measurements on the patients are more definitive than measurements on the photographs and can be more realistic. In the current study as well, the measurements were performed clinically on the noses and faces of the patients. It is recommended that future studies investigating the changes in nasal dimensions be performed on real patients, too.

Conclusion

This study demonstrated that nasal length increases with age. Although the aging process, loosening of the skin and other structures, and gravity may have a role in nasal lengthening, this study showed that DSN muscle hyperactivity is not important in this regard. Future controlled prospective studies with larger samples in various ethnicities together with histologic studies can clarify the relative effects of different variables affecting nasal lengthening with aging.

Acknowledgments The results described in this study formed part of a thesis submitted by the fourth author for a postgraduate degree in general surgery. The study was supported by the Vice Chancellor of Research of Mashhad University of Medical Sciences.

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