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Original article

Prevalence of anatomical alar band
콧방울띠의 유병율

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Purpose: Due to the presence of various muscles around lips, variety of facial expression can be made and changes from aging process such as wrinkles can develop on the facial skin by the action of multiple muscles. In animals, skin and muscles are developed in the entire body. On contrast, they are well developed only in the face and just one is present in the neck and the palm. Alar band was defined as outer wrinkle formed by zygomaticus minor muscle, which is common in Koreans. This study aimed to investigate clinical prevalence of alar band. **Materials & Methods:** Subjects were chosen from 780 new patients who visited private clinic in Gyeonggi province for orthodontic treatment. Presence of alar band was examined from the smile extraoral photos. Correlation among skeletal form, lip protrusion, gender, and age were evaluated. **Results:** Prevalence of alar band was higher in women (27.9%) than in men (18.5%) with statistical significance ($p<0.05$). With respect to age, prevalence of alar band was 19.4% in age 0-9 y, 16.9% in age 10-19 y, 31.2% in age 20-29 y, 39.5% in age 30-39, 56.5% in age 40-49. Prevalence was gradually increased from patients in their 20s to patients in their 40s and statistical significance was found ($p<0.001$). Concerning SN_NP, prevalence was 26.2% in normodivergent facial type, 22.0% in hyperdivergent facial type, and 32.2% in hypodivergent facial type. Hypodivergent facial group had higher prevalence but statistical significance was not observed. Statistically significant difference was not found regarding upper lip. However, prevalence of the alar band was 26% in patients with normal lower lip, 14.7% in patients with pretruded lower lip, and 33.3% in retruded lower lip. The prevalence was higher in patients with retruded lower lip with statistical significance ($p< 0.05$). **Conclusions:** 27.8% on previous anatomical study and this study showed 27.8% prevalence of alar band in clinical smile photographs. Clinical photograph study showed that alar band was more prominent in women, older people, and people with retruded lips with statistical significance. This will provide valuable diagnostic information for esthetic consideration. *(J Korean Acad Esthet Dent 2015;24(1):4-12)*

Key words: Alar band, Clinical prevalence, Skeletal form, Lip protrusion

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Introduction

Due to the presence of various muscles around lips, variety of facial expression can be made and changes from aging process such as wrinkles can develop on the facial skin by the action of multiple muscles. In animals, skin and muscles are developed in the entire body. On contrast, they are well developed only in the face and just one is present in the neck and the palm.

Human can express 6 basic facial expressions such as grief, anger, pleasure, fear, hatred, and surprise by contraction of facial muscles. Change of facial expressions gets more prominent by the mouth shape change induced by facial muscles especially facial muscles surrounding mouth. These muscles are composed of four elevators, four depressors, and two muscles lateral to the angle of mouth.[1-3] Previous studies reported that zygomaticus minor mainly elevated upper lips. When levator labii superioris alaeque nasi, levator labii superioris, and levator anguli oris are contracted altogether to raise angel of the mouth, nasolabial groove gets deepened.

These muscular changes are more pronounced as aging is progressed. More patients are seeking treatments for this. Previous literatures investigated anatomical variations in relation with nasolabial fold or gummy smile treatment.[4]

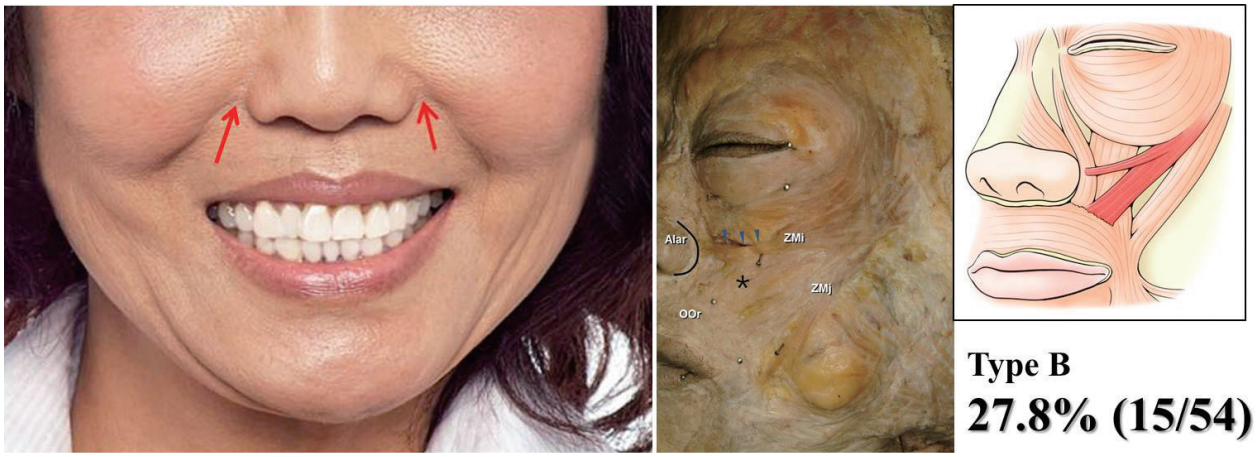

Fig 1. Clinical manifestation of nasolabial fold, anatomical structure, and schematic diagram

Hur et al. evaluated levator labii superioris (LLS), which forms nasolabial folds. They found that levator labii superioris raised alar crease and skin to widen the nostrils and pulled the alar and upper lip in the superior and lateral direction. They showed that levator labii superioris acted as a dilator of muscles around nose.[5]

Hwang and colleagues proposed that lateral of the alar was a safe injection point of botulinum toxin for gummy smile treatment. They suggested injecting within triangular area formed by insertion of the LLS, which was covered partially or entirely by the levator labii superioris alaeque nasi and the zygomaticus minor (ZMi) [6]

More patients are seeking treatment of alar band in addition to nasolabial fold and gummy smile. In the plastic surgery field, alar band was treated with botulinum toxin without understanding underlying anatomical structures. Therefore, no terms were designated for the wrinkle yet.

Therefore, Kim and colleagues[7] designated the horizontal fold connecting from alar to nasolabial fold and investigated anatomical variations. Clinically, alar band is noticed when smiling as a horizontal fold lateral to the alar. They evaluated 54 hemi-faces from 30 Korean adult cadavers (male 31, female 23; average age, 67.4; bilateral 48, unilateral 6) excluding 6 hemi-faces where zygomaticus minor area was damaged.

Mid-facial area was micro-dissected with surgical microscope. Muscular morphology was evaluated on the outer surface. Anatomical morphology, variation, direction, and insertion area were examined. According to the surface form, insertion pattern of ZMi in the upper lip was classified to the following three types. First, ZMi inserted only in the upper lip in 34 out of 54 hemi-faces (type A, 63%) and which type was subdivided into straight type and curved type. Second, ZMi had tendon which inserts in the alar (type B, 27.8%). Third, ZMi did not inserted in the upper lip or disappear (type C, 9.3%). On the contrary to the textbooks[8-11], ZMi inserted in the lateral side of the alar as well as upper lip in many cases (28%). Kim et al. designated type B variation as alar band.

These tendons can induce horizontal wrinkle from alar to nasolabial fold. Considering this, ZMi can affect movement of the alar as well as that of the upper lip. These findings were obtained from anatomical evaluation of muscular direction and morphologic variations. This study aimed to evaluate clinical manifestation of alar band in the frontal smiling photo in association with anatomical prevalence. It also investigated effects of skeletal classification in the sagittal plane, age, gender, and degree of lip protrusion on the alar band.

Materials and Methods

Materials

Subjects were chosen from patients who visited Bundang branch of Yeonsei Goun Miso dental clinic and took frontal smile photograph and lateral cephalogram for orthodontic diagnosis from Jan 2013 to May 2014. Following patients were excluded from this study: 1) congenital malformation including cleft lip and palate; 2) Presence of severe deviation in occlusion plane due to excess number of missing teeth; 3) history of surgery in facial area. A total of 780 patients (male 189, female 591) were used. Mean age was 20.79 (range 6~ 54). The number of patients aged from 0 to 9, from 10-19, from 20 to 29, from 30 to 39, from 40 to 49, and from 50 to 59 were 31, 355, 279, 86, 23, and 6, respectively (Table 1).

Table 1. Distribution of subjects

Gender	Male	189
	Female	591
Age(yr)	0~9	31
	10~19	355
	20~29	279
	30~39	86
	40~49	23
	50~59	6
SN_MP(°)	Normal	530
	Hyperdivergent	191
	Hypodivergent	59
Upper lip(mm)	Normal	691
	Protrusion	59
	retrusion	30
Lower lip(mm)	Normal	643
	Protrusion	68
	retrusion	69

ANB(Skeletal classification)	I	262
	II	486
	III	32
Total		780

Methods

Frontal facial photo was taken with patient sitting upright and smiling (Canon G12 camera) and lateral cephalogran was taken (Pax-Uni3D ceph digital x-ray, Vateck, Korea). To evaluate alar band, two orthodontists independently evaluated presence of horizontal wrinkle around nose in the photos. When the results were different, they were rejected or chosen after discussion.

Skeletal angle classification was determined using ANB. The degree of skeletal divergent (hyper- or hyper-divergent) was evaluated with SN- GoMe. Degree of lip protrusion was examined with the distance of upper and lower lip from the Ricketts E-line and relationship with alar band was evaluated. Data were classified using each age group's means and standard deviation of Yonsei University craniofacial center normal occlusion samples (Table 2).

Table 2. Distribution of Korean cephalometric norms

Male (yr)	10.4±0.5	12.0±0.6	17.3±1.5
ANB	4±2	3±2	3±2
SN-GoMe(°)	36±4	36±4	32±5
U-lip(mm)	2±2	3±2	1±2
L-lip(mm)	4±3	4±2	2±3
Female (yr)	10.2±0.4	12.1±0.9	16.9±1.9
ANB	3±1	3±2	3±2
SN-GoMe(°)	36±4	35±4	34±3
U-lip(mm)	1.5±2	1±2	-1±2
L-lip(mm)	1.7±2	2±2	1±2

Relationship with age and gender was also evaluated. Following statistical methods were used.

First, Frequency and descriptive analysis were carried out to investigate subject's general characteristics. Pearson correlation analysis and intra-class correlation coefficient (ICC) analysis were performed to verify inter-observer variability.

Second, cross-tabulation analysis was carried out to evaluate relationship between alar band and general characteristics. Binominal logistic regression model was conducted to examine factors affecting alar band. Empirical analysis of this study was verified with p-value less than 0.05 using SPSSWIN 18.0 software.

Results

Correlation analysis was performed for processing errors between observers and revealed r=.980 (p< .01). Therefore, two observers' alar band measurements were significantly related. Also, ICC also showed significantly high correlation between observers (.980).

Table 3. Descriptive statistics quantity by gender, age, SN_MP, lip protrusion, ANB

		Alar (-)	Alar(+)	χ^2(p)
Gender	Male	154(81.5)	35(18.5)	6.637*
	Female	426(72.1)	165(27.9)	(.010)
Age(yr)	0~9	25(80.6)	6(19.4)	41.638*** (.000)
	10~19	295(83.1)	60(16.9)	
	20~29	192(68.8)	87(31.2)	
	30~39	52(60.5)	34(39.5)	
	40~49	10(43.5)	13(56.5)	
	50~59	6(100.0)	0(0.0)	
SN_MP(°)	Normal	391(73.8)	139(26.2)	2.764 (.251)
	Hyperdivergent	149(78.0)	42(22.0)	
	Hypodivergent	40(67.8)	19(32.2)	
Upper lip(mm)	Normal	512(74.1)	179(25.9)	4.276 (.118)
	Protrusion	49(83.1)	10(16.9)	
	retrusion	19(63.3)	11(36.7)	
Lower lip(mm)	Normal	476(74.0)	167(26.0)	6.443* (.040)
	Protrusion	58(85.3)	10(14.7)	
	retrusion	46(66.7)	23(33.3)	
ANB(skeletal classification)	I	183(69.8)	79(30.2)	5.326 (.070)
	II	375(77.2)	111(22.8)	
	III	22(68.8)	10(31.3)	
Total		580(74.4)	200(25.6)	

*p<.05, ***p<.001, Values are presented as number (%)

Among 780 subjects, alar band was observed in 200 subjects (25.6%). Regarding relationship of alar band with general characteristics, cross-tabulation analysis (Chi- square analysis) showed that prevalence of alar band was higher in women (27.9%) than in men (18.5%) with statistical significance ($p<0.05$). With respect to age, prevalence of alar band was 19.4% in age 0-9 y, 16.9% in age 10-19 y, 31.2% in age 20-29 y, 39.5% in age 30-39, 56.5% in age 40-49. Prevalence was gradually increased from patients in their 20s to patients in their 40s and statistical significance was found ($p<0.001$). Concerning SN_NP, prevalence was 26.2% in normodivergent facial type, 22.0% in hyperdivergent facial type, and 32.2% in hypodivergent facial type. Hypodivergent facial group had higher prevalence but statistical significance was not observed. Statistically significant difference was not found regarding upper lip. However, prevalence of the alar band was 26% in patients with normal lower lip, 14.7% in patients with pretruded lower lip, and 33.3% in retruded lower lip. The prevalence was higher in patients with retruded lower lip with statistical significance ($p< 0.05$).

Therefore, gender, age, degree of lower lip protrusion was significantly related with alar band.

Binomial logistic regression analysis was performed to evaluate factors affecting alar band and following results were obtained.

Table 4. Factors affecting alar band (binomial logistic regression)

	B	S.E.	Wald	Df	Significance	Exp(B)	95%C.I. for Exp(B)	
							Lower limit	Upper limit
Gender	.462	.222	4.334	1	.037*	1.587	1.027	2.451
Age			35.819	5	.000***			
Age (1)	-.137	.486	.079	1	.779	.872	.336	2.262
Age (2)	.656	.486	1.826	1	.177	1.928	.744	4.994
Age (3)	1.060	.521	4.140	1	.042*	2.886	1.040	8.011
Age (4)	1.794	.639	7.876	1	.005**	6.016	1.718	21.064
Age (5)	-19.709	16331.865	.000	1	.999	.000	.000	.
ANB			4.122	2	.127			
ANB (1)	-.385	.191	4.062	1	.044*	.680	.468	.989
ANB (2)	-.061	.438	.019	1	.890	.941	.399	2.221
Constant	-1.988	.587	11.489	1	.001	.137		
-2log likelihood=828.884								
Cox and Snell's R- square .073								
Nagelkerke R-square .107								
χ^2=59.175***								

*p<.05, ***p<.001

Table 4 showed that age was significantly related with alar band. -2 Log likelihood=828.884, Cox and Snell's R-square=.073, Nagelkerke R-square=.107. Wald values at age (3) and age (4) were 4.140 and 7.876, respectively, with significance at p<.05, p<.01 (age (3) p=.042, age (4) p=.005). Exp(B) were 2.886 and 6.016, respectively, and age group 30~39 and age group 40~49 were 2.886 and 6.016 times more related with alar band. Women were 1.587 times more related with alar band (Exp(B)= 1.587). Alar band was decreased by 0.680 times in Class II malocclusion than in Class I malocclusion (Exp(B)= 0.680)

Discussion

This study clinically investigated prevalence of alar band based on previous anatomic variation studies. Alar band was more common in women than in men. Although no significant difference is present in sin thickness between men and women[12], zygomatic muscle activity was increased more in women when smiling.[13]

Women smile broader and laugh more often[14] than men. Women smiles more often and gets wider smile[15]. Consequently, alar band is more often revealed.

Alar band cannot be evaluated with anatomic study. It can only show variations and directions of ZMi. Clinical evaluation Variations of the ZMi could not be observed in the previous anatomic study where mean age of the sample was 67.4 years of age. In this study, prevalence of alar band was investigated instead of anatomical observation. With respect to age, prevalence of alar band was 19.4% in age 0-9 y, 16.9% in age 10-19 y, 31.2% in age 20-29 y, 39.5% in age 30-39, 56.5% in age 40-49. Prevalence was gradually increased with aging especially from 20s to 40s. Prevalence was higher than anatomical study (27.8%). Clinically observed alar band in all age group was 25.6% and similar to the anatomic study. However, this is not due to increased anatomic variation of the ZMi as people get older. Instead, clinical prevalence increased due to the aging of the soft tissue of the midface while anatomic variations remains the same.

Owsley and Roberts reported that thin myofascial and loss of elastin degeneration lead to the soft tissue changes in the midface and nasolabial fold. They also showed that superficial muscular aponeurotic system (SMAS) of the midface was less prominent when compared with other facial region and their attachment in the skin was not easily observed in cadaver or during surgery. SMAS was weakened over nasolabial fold where the thickest portions near the parotid region transits to the thinnest area and it was hard to find with naked eye.[16]

Weakening of SMAS attachment in the tendon and muscles of the zygoma and skin explains inferior dislocation. Aging characteristics of midface often coincides with the area of tendon attachment. Volume and bulge of concavities formed on area of osseous origin of the tendon and underlying area is related with weakness of the tendon where facial lipid compartments had moved. Subcutaneous components of zygomatic and masseteric skin tendon was weakened or could not be found in 30-40% of cadavers with midfacial ptosis.[17] This explains difference between clinical manifestation of the alar band in various aging groups and variations of ZMi in older age cadavers.

Exposure to UV light is main cause of extrinsic aging. Midface is exposed to sunlight and is destined to "photoaging", which was coined by Kligman and Kligman. Photoaging makes rough and deep wrinkle, multiple dermal precancerous lesions, and leather-like skin with hemotelangiosis.18 Regardless of intrinsic aging, this makes shallow wrinkle and increased relaxation, and skin gets dry and atrophied. Sunlight also decreases hormone level and gives rise to selective fat loss and fat deposition.[19] Wrinkle near alar which increases from patients in their 20s is caused by the cumulative effects of dynamic facial expressions from younger age in addition to physiological aging.

Wulc et al. explained clinical skin change in the midface by weakening of the tendon, volume loss, redistribution of the fat (partial deposition and partial decrease by use of facial expression muscles), loss of elasticity between fascia and skin, inferior movement of malar fat, and decrease of support as people get old.[20]

In various facial muscles related with smile, levator labii superioris and zygomaticus major plays key role in vertical dimension[3]. Difference of facial expression muscles according to gender and age occurs because these muscles are developing while function in a variety of ways[21]. Therefore, alar band can explain difference of muscle expression as facial expression muscles are more developed from children to adults.

Most people did not care about wrinkles near nose. However, more and more people are seeking esthetic treatment and demands for orthodontic treatment, plastic surgery, and skin therapy are increasing. This study aimed to provide evidence and direction for clinical guideline to improve alar band.

Conclusion

Prevalence of alar band in previous anatomic study and this study was 27.8%, and 25.6%, respectively.

Alar band was more often found in women (male 18.5%, female 27.9%) with statistical significance ($p<.05$)

With respect to age, prevalence of alar band was 19.4% in age 0-9 y, 16.9% in age 10-19 y, 31.2% in age 20-29 y, 39.5% in age 30-39, 56.5% in age 40-49. Prevalence was gradually increased from patients in their 20s to patients in their 40s and statistical significance was found ($p<0.001$). This may be due to weakness of tendon, redistribution of the fat, and loss of elasticity between fascia and skin.

Statistical significance was not found with respect to upper lip protrusion. However, prevalence of the alar band was 26% in patients with normal lower lip, 14.7% in patients with retruded lower lip, and 33.3% in retruded lower lip. The prevalence was higher in patients with retruded lower lip with statistical significance ($p< 0.05$).

Lip protrusion was significantly more often observed in female, older people (increased from 20s to 40s), and patients with retruded lower lip and correlation was found. This will provide guideline to improve esthetics of midface when

smiling in orthodontic field. Esthetic treatment such as botulinum toxin injection can be considered to improve alar band and can be suggested to adult female orthodontic patients in advance.

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콧방울띠의 유병율

Purpose: 입술 주위에는 여러 개의 근육이 모여있기 때문에 여러 근육의 작용에 의해 표정을 지을때, 다양한 표정과 노화에 따른 주름 등의 변화가 나타나게 된다. 동물에서는 이러한 피부 및 근육이 몸 전체에 발달되어 있지만 사람에서는 얼굴에만 잘 발달되어 있고, 다른부위엔 목과 손바닥에 하나씩 있을 뿐이다. 해부학적인 연구에서 확인한 작은광대근의 변이중에 윗입술뿐만 아니라 콧방울로 갈라진 힘살이 콧방울 가쪽 부위에도 닿아서 형성되는 콧방울 가쪽 주름에 대해 alar band라 명명하였으며 이에 대한 임상적인 유병율을 알아보고자 한다. **Materials & Methods:** 교정 치료를 위해 경기도 개인치과의 교정과에 내원한 780명의 교정신환의 스마일 사진에서 alar band의 여부에 대해 알아보고, 측모두부방사선사진에서 골격의 형태 및 입술의 돌출, 성별, 연령 등과의 상관관계를 평가하였다. **Results:** 일반적 특성에 따른 alar band의 관련성에 대해서 살펴본 결과 성별에 대해서 남자는 18.5%, 여자는 27.9%로 나타나 남자보다 여자의 경우 더 비율이 높은 것으로 나타났으며, 통계적으로 유의한 차이를 보였다($p<.05$). 연령에 대해서는 가진 경우가 0-9세는 19.4%, 10-19세는 16.9%, 20-29세는 31.2%, 30-39세가 39.5%, 40-49세가 56.5%로 나타나 20대에서 40대로 갈수록 점차 증가하는 경향을 보였으며 통계적으로 유의한 차이를 보였다($p<.001$). SN_NP에 대해서는 normodivergent facial type을 가진 경우가 26.2%, hyperdivergent facial type을 가진 집단이 22.0%, hypodivergent facial type을 가진 경우는 32.2%로 나타나 hypodivergent facial type을 가진 집단의 경우가 더 발생비율이 높게 나타났으나 통계적으로 유의한 차이를 보이지 않았다. Upper LIP에 대해서는 통계적으로 유의한 차이를 보이지 않았지만 Lower lip에 대해서는 alar band를 보인 경우가 정상하순 안모를 가진 집단은 26%, lower lip protrusion은 14.7%, retruded lower lip은 33.3%로 나타나 retruded lower lip의 경우 발생비율이 높게 나타났으며 통계적으로 유의한 차이를 보였다($p<.05$). 즉, 성별, 연령, lower lip돌출정도에서 alar band와의 유의한 관련성을 보임을 알 수 있었다. **Conclusions:** alar band는 해부학적인 연구에서 27.8%에서 보였으며, 본 연구에서는 25.6%에서 확인할 수 있었고, 임상적인 사진에서는 여자, 나이가 들수록, 하순이 함입될수록 유의하게 더 보였으며 향후 심미 치료에서 이 부위에 보톡스 등의 심미치료를 할 때 도움이 될 수 있을 것이다.

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키워드: 콧방울띠, 임상적 유병율, 골격형태, 입술 전돌