The first report of using endoscopy to evaluate the structure of the internal nasal valve and the measurement of internal nasal valve angle value in Vietnamese people

Nguyen Trieu Viet, Nguyen Thi Ngoc Lien

Can Tho University of Medicine and Pharmacy, Can Tho City, Vietnam

SUMMARY

The objective of this work was to investigate the structural formations and angle of the internal nasal valve (INV) by using nasal endoscopy. A cross-sectional-description study was conducted on one hundred and thirty-nine students of the University of Medicine and Pharmacy without the complaint of chronic nasal obstruction. They were examined the internal nasal areas by using endoscopy two times: before spraying decongestant, and after 15-30 minutes spraying of the decongestant into the nasal cavity to identify the types of the internal nasal valve according to Miman's classification. The nasal valve angle value was determined by using Autocad software version 2007. The study was done at Can Tho University Hospital. Sharp angle type accounted for 32.01%, blunt angle type accounted for 12.23%, convex caudal border type accounted for 5.04%, concave caudal border type accounted for 5.04%, angle occupied by the septal body accounted for 34.17%, and twisted caudal border type accounted for 11.51% in our study, the average angle of 26°.8 ± 9°.28, with the smallest angle being 9° and the largest angle being 51°. When comparing the rate of internal nasal valve formation for each time in our study and that of Miman, we recognized that there is a difference among rates. Our nasal angle values were similar to those of Asians and different from those of Caucasians. By using endoscopy, we can easily determine the morphology of the internal nasal valve and measure the angle value of the internal nasal valve by using Autocad software version 2007.

Key words: Internal nasal valve – Angle – Nasal morphology – Nasal endoscopy

INTRODUCTION

The nasal valve plays a significant role in nasal airflow. During an examination of a patient with nasal obstruction, a common presenting symptom in otolaryngology (ORL) practices, it is essential for otolaryngologists not only to consider the nasal valve but also to understand a comprehensive evaluation to this area (Clark et al., 2018; Gelardi and Ciprandi, 2019).

The collapse of the internal nasal valve is one of the major causes of nasal airflow obstruction. The INV is a noticeable area for ORL surgeons to correctly evaluate before rhinoplasty and/or sep-

Corresponding author:
Nguyen Trieu Viet. Can Tho University of Medicine and Pharmacy, Can Tho City, Vietnam. Phone: +84 913708007. E-mail: ntviet@ctump.edu.vn

Submitted: July 30, 2023. **Accepted:** August 20, 2023

https://doi.org/10.52083/ETEL3025

toplasty surgery for patients with nasal obstruction and has a role in structural nasal obstruction separate from other anatomical pathologies, for example allergy (Melati et al., 2023; Shafik et al., 2020). Any further narrowing of INV will have a considerable impact on sinus and middle ear pathology (Murthy et al., 2013).

The internal nasal valve is the narrowest portion of the nasal cavity, located approximately 1.3 cm from the nares, and corresponds to the region under the upper lateral cartilages, bound medially by the dorsal septum, inferiorly by the head of the inferior turbinate, and laterally by the upper lateral cartilage (Murthy et al., 2013; Rhee et al., 2010). The average angle of the INV in a Caucasian population ranges from 9° to 15°, and inter-racial variance is well recognized, in part due to the morphology of the nose. Collapse of the valve is thought to obey Bernoulli's principle, and as such is a common cause of nasal obstruction (Gelardi and Ciprandi, 2019). In doing surgery for the nasal valve area, all the related structures (head of the inferior turbinate, nasal septum...) should be considered carefully and evaluated (Beriat et al., 2010).

Many tools have been used in assessing nasal resistance and INV, including rhinomanometry and acoustic rhinometry. However, they have limits that lack reliability and require expensive equipment (Shafik et al., 2020). Nasal endoscopy, either rigid or flexible, can allow for examination of the nasal airway and may indicate evidence of septal deviations in all parts, adenoid hypertrophy, or nasal tumors, mucosal inflammation, including edema, polyps, crusting, and rhinorrhea (Patel and Most, 2020; Schuman and Senior, 2018). The nasal endoscopic evaluation method is a cost-effective way to examine the internal nasal valve angle and is easy to access without side effects. In addition, this method provides the opportunity to see the whole nasal structures, accompanying their relations on three-dimensional images (Beriat et al., 2010).

Until now, there has been no published research in Vietnam on aspects such as nasal morphology assessment or nasal valve angle measurement. Therefore, this study aims to evaluate the usefulness of endoscopy in determining the structure of the internal nasal valve, to measure the INV angle value using AutoCAD software 2007 in the Vietnamese population, and to compare the results with those of Miman's study on Caucasians.

MATERIALS AND METHODS

This descriptive cross-sectional study was performed on 139 medical students with 278 nasal cavities from Can Tho University of Medicine and Pharmacy at Can Tho University Hospital, from November 2020 to December 2021. This study was accepted by ethical board of Can Tho University of Medicine and Pharmacy (code 359/20ĐHYD-HĐ). The patients provided their consent for the study.

Inclusion criteria were included the medical students of Can Tho University of Medicine and Pharmacy did not have any complaint of chronic nasal obstruction over 3 months. Excluding criteria were as follows: students under 18 years old; suffering an operation of nasal septum, inferior turbinate or nasal dorsum in advance, including traumatic nasal reconstruction; having acute sinusitis.

Research content

A hundred and thirty-nine students participating in the study were examined by endoscopy in each naris twice after determining that they had normal vital signs ranges. The vasoconstrictor used was Rhinex containing 0.5% naphazolin. A 4-mm 0 Karl Storz endoscope was used for endoscopic examinations. Digital images were taken with a Karl Storz camera and were analysis by using Windows Photo Viewer to identify the shape of INV and measurements of the angle. The internal nasal valve angle value was measured by using AutoCad 2007 software, processing the pictures taken on nasal endoscopy. The endoscopic method and location of image recording of the internal nasal valve area to analysis was performed as described by Miman. The types of the structural formation of the internal nasal valve were determined through endoscopic examination according to Miman's classification: convex, concave, sharp angle, blunt angle, twisted caudal border, and angle occupied by the septal body (Miman et al., 2006).

In the first time, the participants were examined by the endoscopy without nasal decongestant. Then the results were saved in two types of format. One was in static state, saved in .jpg; and the other was in kinetic state, saved in .mpg.

In the second time, the participants were examined again with nasal decongestant, 2-3 sprays over 15 minutes and the results were saved in 2 types of information like above. When examining by the endoscopy, the participants did not breathe to ensure that the lateral nasal wall was stable. The scope was put in parallel to the caudal border of the upper lateral cartilage to take the image of the internal nasal valve. The IVN angle value was measured by using Autocad software 2007 in many steps (see steps 1-3). The author of this study conducted these steps based on the captured images on nasal endoscopy.

The results were processed by SPSS 18.0.

RESULTS

There were 61 male (43.9%) and 78 female (56.1%) subjects in the data presented in Table 1, with an average age of 21.2 ± 1.4 years old. The youngest was 18 and the oldest was 26.

INV was classified into 6 different types according to the classification of Miman. The angular form formed by the septal body had the highest number, next followed by sharp angle, blunt angle, and twisted caudal border. Concave type and convex type were the same. The above results also showed that the number of septal body was large enough to form the angular structure formed by the septal body (n = 95, 34.17%) (Table 2).

The illustration of the nasal valve types in participants of this study (color image) and Miman's simulation (black and white) were showed in Figs. 1-6.

The INV angle was 26.75 ± 8.98 for the right nasal cavity and 26.85 ± 9.56 for the left one (Table 3).

A total of 117 internal nasal valve angles were determined out of a total of 278 sides of the nasal cavity surveyed, the ratio was 117/278 (42.1%). The results of the angular value of 117 internal nasal valves determined in this study are 26.80± 9.28°. The smallest is 9°; the largest is 51°.

Table 1. Characteristics before examination.

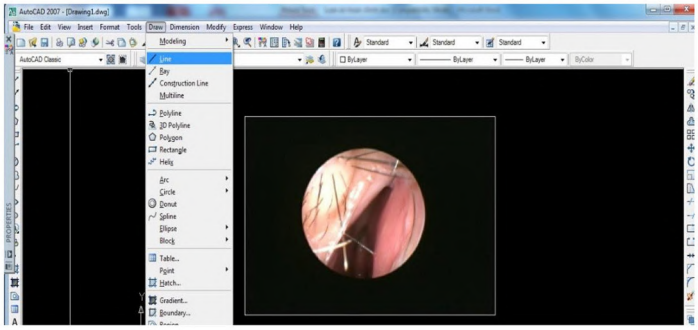
Gender	Male	Female
Number of participants	61	78
Rate	43.9%	56.1%
The average age	*21.2 ± 1.4*	

Table 2. The number of endoscopic internal nasal valve types according to the classification of Miman.

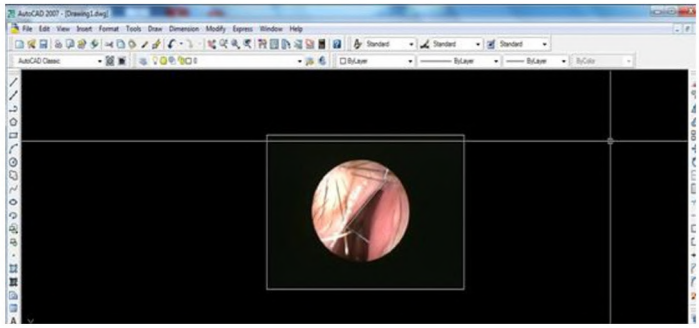
Types	**Sharp angle**	**Blunt angle**	**Concave caudal border**	**Convex caudal border**	**Angle occupied by the septal body**	**Twisted caudal border**
Right side	44	21	7	5	45	17
Left side	45	13	7	9	50	15
Total %	89 32.01%	34 12.23%	14 5.04%	14 5.04%	95 34.17%	32 11.51%

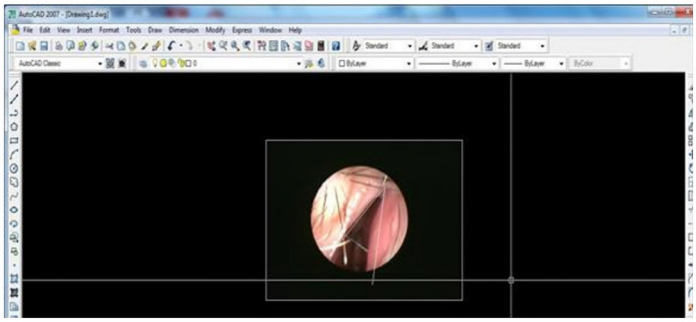
Table 3. The value of the internal nasal valve angle according to the form of the internal nasal valve.

		Sharp angle	**Concave caudal border**	**Convex caudal border**	**Total**
Right	Mean ± SD	26.59 ± 9.26	17.71 ± 8.08	40.80 ± 7.76	26.75 ± 8.98
	N	44	7	5	56
Left	Mean ± SD	26.73 ± 9.10	20.43 ± 7.39	32.44 ± 13.59	26.85 ± 9.56
	N	45	7	9	61
Internal nasal valve angle value of the study					26.80 ± 9.28°
					N=117

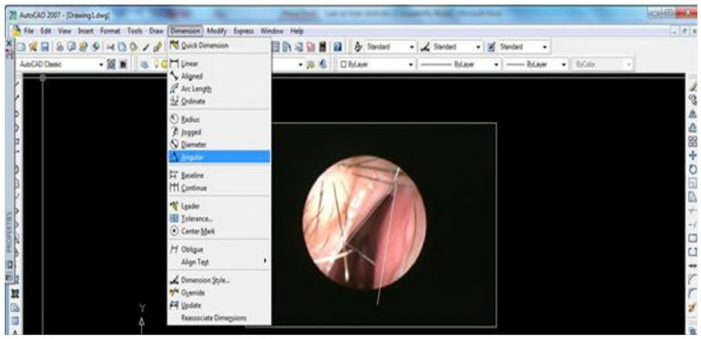


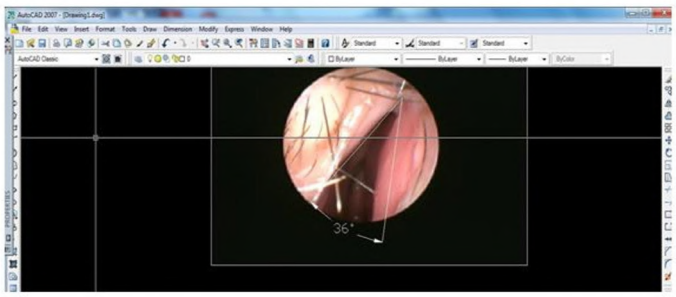
Step 1. Using the autocad software 2007 to determine the internal nasal valve angle





Step 2. Use the line command to define the second edge of the corner by dragging a line from the top of the corner along the vertical of the partition





Step 3. Use the angular command to determine the internal nasal valve angle value

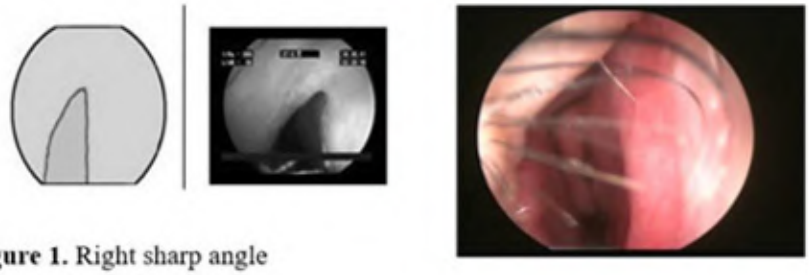


Figure 1. Right sharp angle

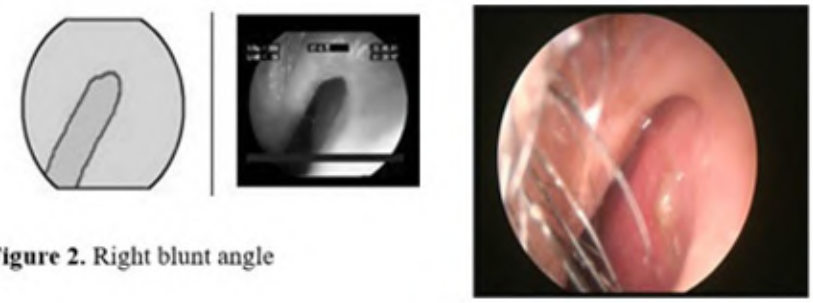


Figure 2. Right blunt angle

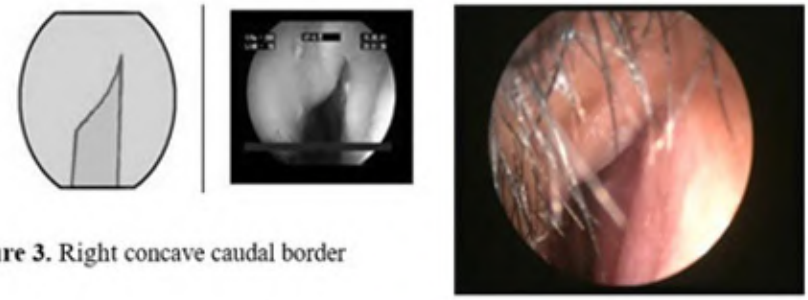


Figure 3. Right concave caudal border

DISCUSSION

Until now, the classification of the internal nasal valve morphology performed by Miman et al. in 2006 is a unique study that has been published and quoted in many international reports. Miman noted the relation between the caudal border of the upper lateral cartilage and the nasal septum to mention the septal body to classify the various shapes of the internal nasal valve (Miman et al., 2006). The septal body is an erectile structure, observed in CT-scan and MRI. It has not been mentioned carefully in rhinology in past decades.

In our study, in the relation between the septal body and the formation of the angle, the septal body was determined as a notable anatomical landmark in the internal nasal valve area. The percentage of the possibility that a big-enough septal body may appear to form the type of internal nasal valve corresponding with the angle of this type was 34.2%.

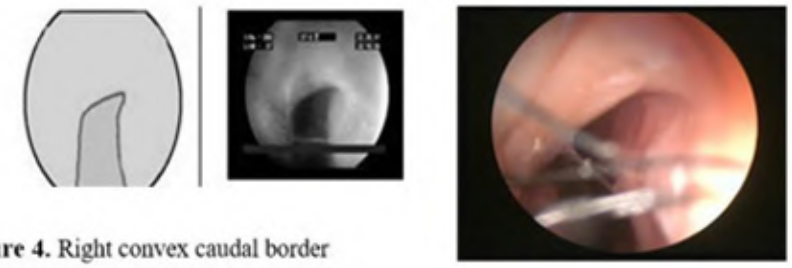


Figure 4. Right convex caudal border

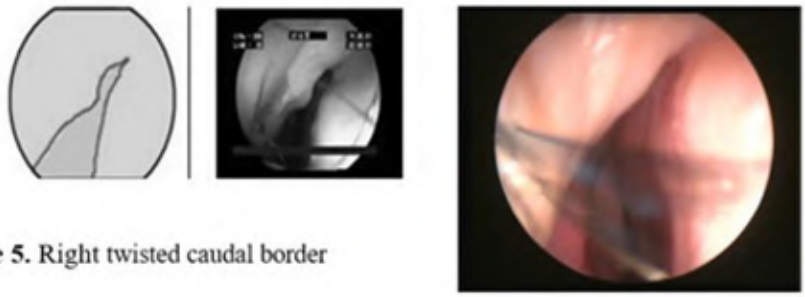


Figure 5. Right twisted caudal border

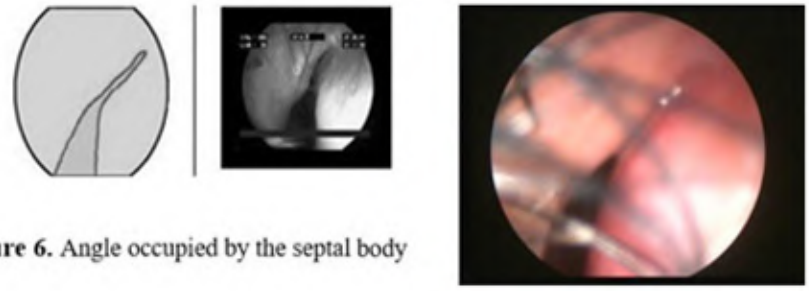


Figure 6. Angle occupied by the septal body

The results of our study on the ratio of internal nasal valve types compared with the corresponding ratio in Miman's study are different, which can be explained by the structure of the nasal pyramid in Vietnamese people being markedly different from that of European nasal pyramids in Miman's study. This difference, according to the study of Nguyen Thanh Van, shows that the Vietnamese nose has the characteristics of Asian people: low nose, high concave nose bridge, and bulging nose wings. Vietnamese noses are shorter, lower and less protruding than Caucasian noses (Van et al., 2016). In our study, we found that there was a big difference in the rate of caudal torsion of 11.6% compared with 1.6% in Miman's study. This is due to overlapping of the superior alar cartilage with the lower alar cartilage appearing in 20% of cases according to Nguyen Thanh Van's study (Van et al., 2016).

Miman's research did not provide a common angle value for all nasal valves measured. Miman divided them into 3 groups with corresponding results for 3 different types of nasal valves: sharp

angle, concave type, and convex type. The angle value of the nasal valve in twisted type, blunt type, and angles formed by the septum could not be determined (Miman et al., 2006). In our study, we also did not determine the angle value of the nasal valve in blunt angles, twisted type, and angles formed by the septum because the vertex and the precise angle could not be determined in these shapes to measure the angle value. We determined the angle value in each sharp angle, concave type, and convex type of internal nasal valve angle and the common value for all three groups as above.

Ichimura did not calculate each type separately, but only presented the average results for males and females and the overall result for both genders as 28.9± 6.3°, with a minimum of 16° and a maximum of 45° (Ichimura et al., 1997). Our result was 26.8 ± 9.28°, with a minimum of 9° and a maximum of 51°. Comparing the research results, we found that ours were similar to those of Ichimura. This could be explained by the similarity of race – yellow-skinned Asians with similar nasal structures.

Regarding the angle value of Caucasians, many references mention that the value is 10-15°, which Mink presented in 1903. However, until now, there has been no complete study or interpretation of the origin of this information on the internal nasal valve angle value. Therefore, with the results we obtained on the angle value of the nasal valve for the first time studied in a group of Vietnamese people without chronic nasal obstruction complaints, and the results from the study of Ichimura, the angle value of the nasal valve in Asians could be considered double that of Caucasians.

Methods used to determine the value of an angle: Miman's study used Scion Image for Windows software to determine the value of the internal nasal valve angle. Meanwhile, Ichimura used conventional geometrical measurements on printed endoscopic images of the clear nasal valve.

With the function of drawing and measuring all images like conventional geometric tools, Autocad software is widely used in measuring and determining structural forms, and calculating values of angles. Therefore, in this study, we used Autocad software version 2007 to measure and determine the value of the internal nasal valve angle.

This is the first study to apply this software to determine the value of the internal nasal valve angle made in Vietnam and around the world. Actual measurement and processing of images recorded directly from the endoscopic device without editing shows that this software provides a true image of the internal nasal valve area that needs to be determined. In addition, the software's concentric magnification or reduction function helps to enlarge or reduce the concentricity of the image without changing the angle value, so it is easy to measure and determine the exact angle value. In addition, the function of automatically determining the equivalent length of the two sides of the angle to be measured when using the "angular" command ensures the exact value of the angle being measured.

CONCLUSION

The results of the types of internal nasal valves in 139 patients based on Miman's classification included sharp angle (32.01%), blunt angle (12.23%), convex caudal border (5.04%), concave caudal border (5.04%), angle occupied by the septal body (34.17%), twisted caudal border (11.51%). The internal nasal valve angle value was assessed in 139 asymptomatic individuals using endoscopic examination and Autocad 2007 software, offering an average angle value of 26°.8± 9°.28, with the smallest angle being 9° and the largest angle being 51°. This value were similar to that of Japanese and two times larger than that of Caucasians. Using the endoscopy and Autocad software version 2007 can easily determine the morphology and measure the angle value of internal nasal valve.

DECLARATIONS ETHICS

This study was accepted by ethical board of Can Tho University of Medicine and Pharmacy (code 359/20ĐHYD-HĐ).

REFERENCES

BERIAT GK, KARADAĞ D, KOCATÜRK S (2010) The value of computed tomography in evaluation of internal nasal valve angle. *Trakya Universitesi Tip Fakultesi Dergisi*.

CLARK DW, SIGNORE AGD, RAITHATHA R, SENIOR BA (2018) Nasal airway obstruction: Prevalence and anatomic contributors. *Ear Nose Throat J*, 97(6): 173-176.

GELARDI M, CIPRANDI G (2019) The clinical importance of the nasal valve. *Acta Biomedica Atenei Parmensis*, 90(2-S).

ICHIMURA K, ISHIZUKA T (1997) Measurement of the so-called "Nasal Valve" in Japanese subjects. *J Rhinol*, 4(1): 26-28.

MELATI T, REKSODIPUTRO MH, KOENTO T, ILJANTO S (2023) Analysis of internal nasal valves shapes and angle due to nasal obstruction in Asian nose. *eJournal Kedokteran Indonesia*, 10(3): 212-218.

MIMAN MC, DELIKTAŞ H, OZTURAN O, TOPLU Y, AKARÇAY M (2006) Internal nasal valve: revisited with objective facts. *Otolaryngol Head Neck Surg*, 134(1): 41-47.

MURTHY VA, REDDY RR, PRAGADEESWARAN K (2013) Internal nasal valve and its significance. *Indian J Otolaryngol Head Neck Surg*, 65(Suppl 2): 400-401.

PATEL P, MOST SP (2020) Functionally crippled nose. *Facial Plast Surg*, 36(1): 66-71.

RHEE JS, WEAVER EM, PARK SS, BAKER SR, HILGER PA, KRIET JD, MURAKAMI C, SENIOR BA, ROSENFELD RM, DIVITTORIO D (2010) Clinical consensus statement: Diagnosis and management of nasal valve compromise. *Otolaryngol Head Neck Surg*, 143(1): 48-59.

SCHUMAN TA, SENIOR BA (2018) Treatment paradigm for nasal airway obstruction. *Otolaryngol Clin North Am*, 51(5): 873-882.

SHAFIK AG, ALKADY HA, TAWFIK GM, MOHAMED AM, RABIE TM, HUY NT (2020) Computed tomography evaluation of internal nasal valve angle and area and its correlation with NOSE scale for symptomatic improvement in rhinoplasty. *Braz J Otorhinolaryngol*, 86(3): 343-350.

VAN NT, VINH LG, ANH TN, KHOA TD (2016) Anatomical features of structural applications cartilage structure of the nose tip. *Vietnam Med J*, 441(1): 21-24.12.