ORIGINAL ARTICLE

The effect of a new topographic classification on determining the prognosis of nasal fracture and treatment modality

Seckin Aydin Savas, M.D.,[1] Ismail Erkan Aydin, M.D.[2]

[1]Department of Plastic and Reconstructive Surgery, Alanya Alaaddin Keykubat University Faculty of Medicine, Antalya-*Türkiye*
[2]Department of Emergency Medicine, Alanya Alaaddin Keykubat University Faculty of Medicine, Antalya-*Türkiye*

ABSTRACT

BACKGROUND: Classifications of nasal fracture are based on clinical findings or radiological findings. The classification systems of nasal fracture usually determine the type of nasal fracture. It is important that a classification gives information about treatment modality and prognosis rather than determining the type of fracture. The objective of this study was to show the effect of the new topographic classification on determining the parameters of prognosis and deciding on treatment modality of the nasal fracture.

METHODS: We reviewed patients with nasal fracture that was referred from emergency department between December 2018 and September 2020. The views of lateral nasal radiography, the facial view of computed tomography (CT), and/or the views of three-dimensional CT were examined to analyze 120 patients with nasal bone fractures. The length of the nasal bone from the top to the base was divided into equal three levels by two lines perpendicular to the length of the nose. The location of fracture was determined as level I, II, and III, respectively, from caudal part to cranial part of the nasal bone. The demographic features of patients, the side of the fracture, the pattern of fracture, accompanying fractures, and the treatment modality were noted.

RESULTS: The frequencies of location of nasal fractures were 44%, 28%, and 27% at level I, level II, and level III, respectively, in 120 cases. It was an expected result that the frequency of fractures was low in parts with the thick bone. Considering the rates of being bilateral or unilateral, it was found that the frequency of unilateral was higher in group of level I, where the thickness of nasal bone was thin, but it was less in group of level III ($p<0.05$). Non-depressed/minimal-depressed pattern of fracture in group of level I accounted for 92.6% which was the highest frequency ($p<0.05$). Depressed/elevated fracture patterns were more common in group of level II ($p<0.05$). Comminuted pattern was mostly observed in group of level III. The rate of accompanying fractures and the applied treatment modality was consistent with anatomic feature of fracture's level.

CONCLUSION: We believe that the new topographic classification evaluates the parameters of clinical prognosis such as accompanying fracture, site of fracture and pattern of fracture, and also requirement of closed or open reduction better than other classifications.

Keywords: Classification of nasal fracture; nasal fracture; topographic classification of nasal fracture.

INTRODUCTION

The nasal bone fracture is the most common maxillofacial fracture, because it is the most prominent bone of the face.[1,2] Assaults, motor vehicle accidents, falls, and sport accidents are injuries that cause the nasal fracture. Nasal fractures often occur as isolated; however, some of them are observed as a part of the complex pattern maxillofacial fractures.[3]

The nasal fractures are usually determined clinically. Detailed history of the patients including the mechanism, the location, and time of injury is evaluated. A physical examination is started with rule out life-threatening conditions. Deformation, swelling, ecchymosis, epistaxis, the shape of nose (asymmetries, protuberances, depressions, deviation, and step-off), septal deviation, and hematoma are evaluated by inspection.

Cite this article as: Savas SA, Aydin IE. The effect of a new topographic classification on determining the prognosis of nasal fracture and treatment modality. Ulus Travma Acil Cerrahi Derg 2023;29:212-217.

Address for correspondence: Seckin Aydin Savas, M.D.
Alanya Alaaddin Keykubat Üniv. Tıp Fakültesi, Plastik, Rekonstrüktif ve Estetik Cerrahi ABD, Alanya, Antalya, Türkiye
Tel: +90 242 - 510 61 35 E-mail: dr.saydin@hotmail.com

Ulus Travma Acil Cerrahi Derg 2023;29(2):212-217 DOI: 10.14744/tjtes.2022.09406 Submitted: 04.10.2021 Revised: 05.10.2021 Accepted: 06.02.2022

Pathological findings in palpation are tenderness, deformity, step-off deformity, and crepitus.[3]

The generally accepted idea is that the imaging for diagnosis of isolated nasal fractures is rarely needed.[3,4] From a different point of view, the radiological diagnosis is important for occult nasal bone fracture and is also a legal document objectively in criminal cases.[5] In general, lateral nasal radiography is used as standard for supporting the clinical diagnosis of nasal fracture. However, computed tomography (CT) and ultrasonography can also be used to support the diagnosis.[2–5]

Classification of nasal bone fractures based on radiography is commonly used. The classification based on radiology should provide the detection of accompanying fractures and determining prognoses of nasal fracture.[5,6] In this study, a new classification based on topographic anatomy was used. The purpose of this study was to demonstrate the role of this classification in determining the parameters of prognosis and deciding on treatment modality of the nasal fracture.

MATERIALS AND METHODS

We reviewed patients with nasal fracture that was referred from emergency department between December 2018 and September 2020. The essential approval was obtained from Alanya Alaaddin Keykubat University Training and Research Hospital to use of the hospital database. The study protocol was approved by the Ethics Committee of Faculty of Medicine, Alanya Alaaddin Keykubat University.

Demographic features of patients, location and pattern of fracture, accompanying fractures, and the treatment modality of nasal fracture were recorded. The radiological images were screened from database of hospital retrospectively. Radiological images of patients who were under 18-years-old were excluded from the study.

The length of the nasal bone from the cranial part to the caudal part was divided into equal three levels by two lines perpendicular to the length of the nose (Fig. 1). The location of fracture was determined as level I, II, and III, respectively, from caudal part of nasal bone to cranial part of nasal bone. Fractures were grouped according to the level of the fracture line. However, if the line of fracture extended to more than one level, it was included in the level of group that was closer to the cranial part of nasal bone. The side of the fracture was recorded unilaterally or bilaterally. In addition, the pattern of fracture was noted as minimal/non-depressed, elevated, depressed, and comminuted. It was examined whether there was any accompanying fracture and/or septal fracture. Finally, it was recorded as treatment modality such as surgical treatment or conservative treatment. It was recorded that the closed reduction or open reduction was performed.

The Anova, post hoc Duncan's, and Chi-square tests were applied to evaluate whether there was a statistical difference in the data collected between these three groups of level which included an unequal number of nasal fracture, and $p< 5\%$ was considered statistically significant.

RESULTS

The views of lateral nasal radiography, the facial view of CT, and/or the views of three-dimensional CT (3D CT) were examined to analyze 120 patients with nasal bone fractures. Location of nasal fracture was evaluated, and it was found that the frequency of nasal fractures increased from the cranial part of the nasal bone to the caudal part of the nasal bone. The frequencies of location of nasal fractures were 44%, 28%, and 27% at level I, level II, and level III, respectively, in 120 cases.

Each group of level was analyzed in terms of distribution of age group and gender. Most of cases were male patients, and this result was consistent with the literature. In other words, 77%, 79%, and 85% of patients were male in the group of levels I, II, and III, respectively. When the distribution of age groups was examined, the number of cases in the 18–25 age group was high in each group of level. It was observed that the number of cases decreased with increasing age in group of level I and II. Distribution of age group was irregular in group of level III (Fig. 2).

The side of fracture was noted for each group of level separately. The rate of unilateral fracture in group of level I was

Figure 1. The length of the nasal bone from the cranial part to the caudal part was divided into equal three levels by two lines perpendicular to the length of the nose (LI: Level I, LII: Level II, and LIII: Level III).

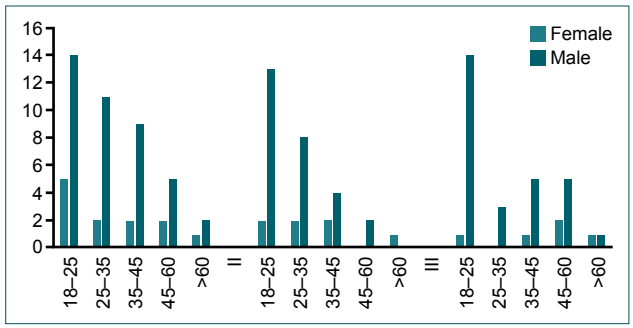

Figure 2. Distribution of age group and gender is shown by bar chart.

94.5% (Fig. 3). The rate of unilateral fracture statistically was significantly higher than bilateral fracture rates in the group of level I ($p<0.05$). The rate of bilateral fracture in group of level II was accounted for 76.5%. The rate of bilateral fracture was significantly higher than unilateral fracture rates in the group of level II ($p<0.05$). And also, the rate of bilateral fractures in group of level III had the highest frequency (97%). The difference of frequency of being bilateral was found to be statistically significant between the groups of levels II and III ($p<0.05$) (Table 1).

Table 1. The rates of the nasal fracture side, based on the location of the nasal fracture

Level	Unilateral (%)	Bilateral (%)	Total
I	50 (94.3)[a]	3 (5.7)[a]	53 (100)
II	8 (23.5)[b]	26 (72.5)[b]	34 (100)
III	1 (3)[c]	32 (97)[b]	33 (100)

Different superscript letters (a, b, c) within the same column and row indicate significant ($p<0.05$) differences among the groups of level I, II, III.

The patterns of fracture were examined based on location. Non-depressed/minimal-depressed pattern of fracture in group of level I accounted for 92.6% which was the highest frequency. The rate of non-depressed/minimal-depressed pattern of fracture was significantly higher than other pattern of fracture rates in the group of level I ($p<0.05$). Depressed/elevated pattern of fracture in group of level II accounted for 41.1% (Fig. 4). There were statistically significant differences in the elevated and depressed patterns of fracture among group of level I and II ($p<0.05$). Comminuted pattern of fracture in group of level III accounted for 72.7% which was the highest frequency.

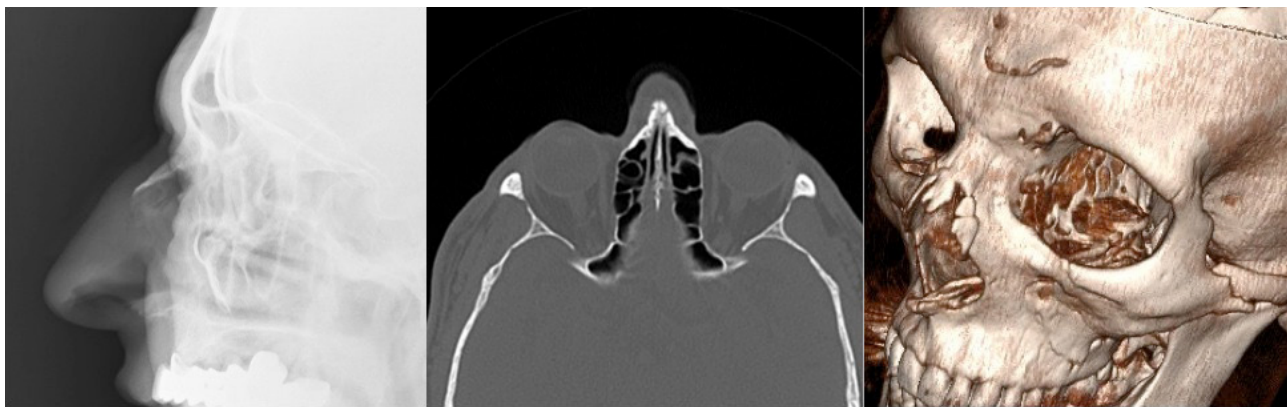

Figure 3. A 54-year-old man with unilateral and non-depressed isolated nasal fracture at level I (Images of radiography, axial plane of maxillofacial computed tomography, and three-dimensional computed tomography).

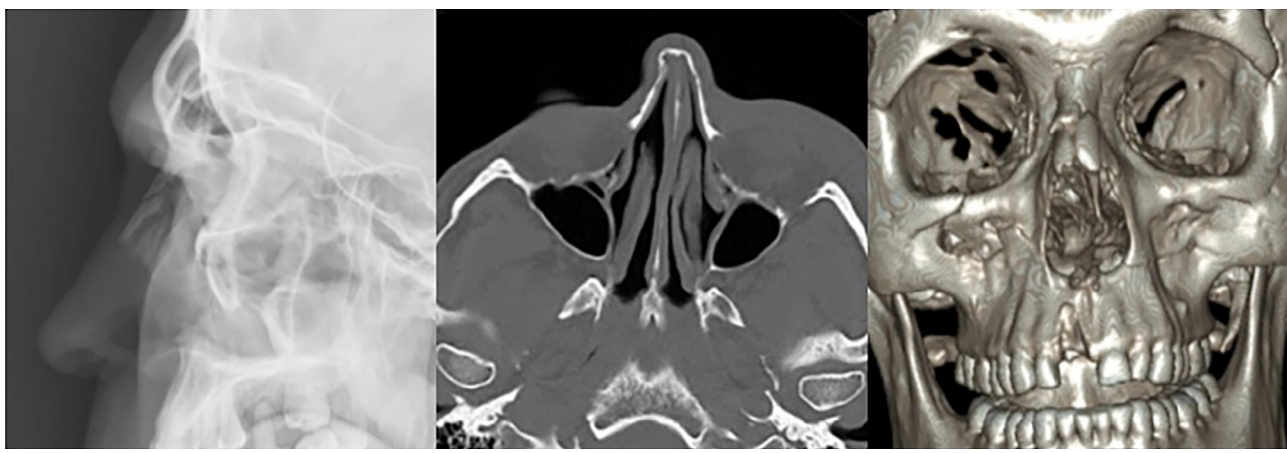

Figure 4. A 35-year-old man with bilateral, depressed nasal fracture at level II and orbital fracture (Images of radiography, axial plane of maxillofacial computed tomography, and three-dimensional computed tomography).

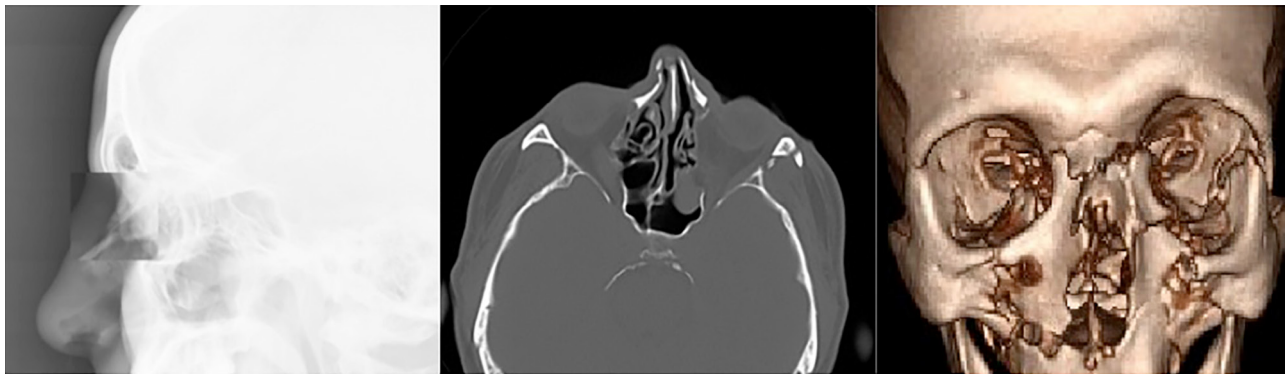

Figure 5. A 48-year-old man with bilateral, comminuted nasal fracture at level III and accompanying fractures orbital, zygoma, maxilla fracture (Images of radiography, axial plane of maxillofacial computed tomography, and three-dimensional computed tomography).

In the group of level III, the rate of non-depressed fracture pattern was significantly lower, while the rate of comminuted fracture pattern was significantly higher ($p<0.05$) (Table 2).

The cases included isolated nasal bone fracture at level I, II, and III accounted for 98.1%, 88.2%, and 30.3%, respectively. Concurrent nasal septal fracture was not observed in group of level I and II. The rate of accompanying fractures in the group of level II was significantly higher than in the group of level I ($p<0.05$). The accompanying fracture was observed in only one case in group of level I. The accompanying fracture was mandible fracture in this case. Since the etiology of this patient was an assault, it was thought that mandible fracture was caused by different forces. The rate of only nasal bone fracture was significantly higher than the rate of nasal fractures with concurrent nasal septal fracture and/or accompanying fracture in the group of level I ($p<0.05$). Concurrent nasal septal fractures accounted for 36.3% in group of level III (Fig. 5). Other accompanying skull and facial fractures such as orbital wall, zygoma, maxilla, or mandibula in group of level III accounted for 51.5%. It was observed that nasal bone fractures at level III were associated with other facial fracture (n=17), and with skull fracture (n=11). The main accompanying facial bone fractures were orbit (n=7), maxilla (n=7), zygoma (n=5), and mandible (n=3) in group of level III. Although there was no statistically significant difference between the groups of level I, II, and III in terms of accompanying septal fractures and accompanying nasal fractures, there was a numerically difference (Table 3).

Treatment modality was evaluated separately for each group. In the group of level I, open or closed reduction was not performed. Only conservative treatment was applied in this group. In the group of level II, rate of conservative treatment, closed reduction, and open reduction were accounted for 26.5%, 70.6%, and 2.9%, respectively. In the group of level III, all nasal fractures were treated with open and closed reduction and the frequencies of open and closed reduction were accounted for 9% and % 91, respectively (Table 4). There were statistically significant differences between treatment modality in each group ($p<0.01$).

Table 2. The pattern of fracture as minimal/non-depressed, elevated, depressed, and fragmented, based on the location of the nasal fracture

Level	Depressed (%)	Elevated (%)	Non/ Min- depressed (%)	Comminuted (%)	Total
I	1 (1.8)^{a}	3 (5.7)^{ab}	49 (92.6)^{a}	0^{a}	53 (100)
II	9 (26.5)^{a}	5 (14.6)^{b}	11 (32.4)^{b}	9 (26.5)^{b}	34 (100)
III	6 (18.3)^{a}	0^{a}	3 (9)^{c}	24 (72.7)^{c}	33 (100)

Different superscript letters (a, b, c) within the same column and row indicate significant ($p<0.05$) differences among the groups of level I, II, III.

Table 3. The accompanying fractures and concurrent septal fractures, based on location of nasal fracture

	None (%)	Concurrent septal fracture (%)	Accompanying fracture (%)	Total
I	52 (98.1)^{a}	0^{a}	1 (1.9)^{a}	53 (100)
II	30 (88.2)^{b}	0^{a}	4 (11.8)^{a}	34 (100)
III	10 (30.3)^{c}	12 (36.3)^{b}	17 (51.5)^{b}	33 (100)

Different superscript letters (a, b, c) within the same column and row indicate significant ($p<0.05$) differences among the groups of level I, II, III.

Table 4. The treatment modality such as surgical treatment (closed or open reduction) and conservative treatment

Level	Conservative (%)	Close reduction (%)	Open reduction (%)	Total
I	53 (100)	0	0	53 (100)
II	9 (26.5)	24 (70.6)	1 (2.9)	34 (100)
III	0	30 (90.9)	3 (9.1)	33 (100)

Chi-square test; p<0.01.

DISCUSSION

Nasal fracture is the most common fracture in the maxillofacial trauma. It is known that general condition of the patient is not affected in cases with isolated nasal fracture. It is important to make a careful diagnosis and define the fracture as edema camouflages the fracture to lead to inadequate reduction and consequently, secondary deformities.[2]

There are several classification systems for defining of nasal fractures.[7] Classifications of nasal fracture have been based on clinical findings or radiological findings. The Stranc and Robertson classification, defined in 1979, is divided the nasal fracture into three stages according to the impact direction.[2,7] Therefore, this classification is not useful for the treatment of nasal bone fractures.[6] Murray et al.[8] defined a classification which was based on pathologic findings of nasal fractures. Murray classification examines nasal fractures at 7 grades.[8] This classification was based on the fracture of nasal septum. Nasal fractures occur more frequently from adolescence to the 30 s. The strength of the nasal septum is different in this age group when compared with elderly patients as well as cadavers due to the aging and the chemical agents which weaken the durability of cartilage. Therefore, the disadvantage of Murray classification is that their study was performed on the cadaver or on the old human body.[6]

The classification systems of nasal fracture usually identify the type of nasal fracture. However, it is more valuable if a classification system can provide information about the prognosis and the treatment modality of nasal fracture. This topographic classification system provided information about the necessity of nasal fracture reduction, accompanying fracture and prognosis of nasal fracture in this study.

Hwang et al.[1] reported that the patterns of nasal fractures classified by CT finding that are simple, unilateral, displacement, septal fracture, and comminuted with telescoping. However, this classification is not used for another radiological image. Our classification system can be used for all radiological images such as lateral nasal radiography, CT, and 3D CT.

One part of nose consists a paired bone which articulates with the frontal bone at the nasofrontal suture. The center of the joint is called nasion. The thickness of the nasal bone is thickest at the nasofrontal suture and then progressively becomes thinner to caudal part of nasal bone. Lateral margin of the nasal bones articulates with the ascending process of the maxilla. The paired medial edge of nasal bones articulates with the perpendicular plate of the ethmoid bone and the thickness of the nasal bone becomes thinner from medial to lateral.[9,10] The extent of damage depends on the regional variation of bone thicknesses in cases with nasal fractures. Therefore, the topographic classification of nasal fracture determines the parameters of clinical prognosis – pattern of fracture, side of fracture and accompanying fracture – and the treatment modality better than other classifications.

Han et al.[6] classified nasal fractures as upper, middle, and lower fractures using only radiologic images of CT in their classification system which was based on topographic anatomy. The most important advantage of our study is that many radiological imaging techniques as maxillofacial CT, X-ray, and 3D CT were applied in this topographic classification.

According to Han et al.,[6] the middle nasal bone section was a weaker area. Therefore, the frequencies of nasal fractures were higher in this region. They found that septum and other accompanying fractures were also more common in this region. Therefore, they pointed out that the prognosis of nasal fractures was worse in this region. As a result of our study, frequency of fracture was listed as statistically significant as Level III, Level II, and Level I from less to more. In accordance with anatomical data, it was an expected result that the frequency of fractures was low in the parts with thick bone. Considering the rates of being bilateral or unilateral, it was found that the frequency of unilateral was higher in group of level I, where bone thickness was thin, but less in group of level III. The pattern of the fracture is also a factor that affects the requirement of reduction and the prognosis of nasal fracture. The comminuted fracture pattern was more common in group of level III. We think that fractures are the result of a strong impact in this area which has a thick bone, so the nasal fractures at level III were observed less frequently and usually bilaterally and had comminuted pattern of fracture. The results show that nasal fractures at level I were observed frequently without strong impact and usually unilaterally, and pattern of fracture was often minimal depressed/non-depressed. Depressed/elevated fracture pattern was more common in level II.

Accompanying fractures are also important factors affecting

the prognosis and the treatment modality. We believe that accompanying fractures as other skull fractures, facial fractures, and septal fractures may occur as a result of a strong blow. Therefore, accompanying fractures such as septal fractures, skull fractures, and other facial fractures were most frequently observed in the Level III group.

This classification basing on topographic features provides useful information about treatment modality. Because the type of fracture, the pattern of the fracture, and the association with other fractures are all influenced by anatomical features. In the group of level I, pattern of elevated and depressed bilateral fractures and accompanying fractures was rarely. When the treatment modality was evaluated, it was observed that nasal fractures were treated conservatively and not required reduction procedure at Level I. On the contrary, it was observed that all fractures required a reduction procedure in the group of level III. All of our results regarding treatment modality were consistent with anatomical features.

Conclusion

We believe that this new topographic classification evaluates better the parameters of clinical prognosis such as accompanying fracture, site of fracture, and pattern of fracture as well as requirement of reduction than other classifications indicating the degree of damage. In addition, this classification is easy and understandable as compared to other classifications.

Ethics Committee Approval: This study was approved by the Alanya Alaaddin Keykubat University Faculty of Medicine Clinical Research Ethics Committee (Date: 09.06.2021, Decision No: 10-09).

Peer-review: Externally peer-reviewed.

Authorship Contributions: Concept: S.A.S., I.E.A.; Design: S.A.S., I.E.A.; Supervision: S.A.S.; Resource: S.A.S., I.E.A.; Materials: S.A.S., I.E.A.; Data: S.A.S.; Analysis: S.A.S.; Literature search: S.A.S., I.E.A.; Writing: S.A.S.; Critical revision: S.A.S., I.E.A.

Conflict of Interest: None declared.

Financial Disclosure: The authors declared that this study has received no financial support.

REFERENCES

1. Hwang K, You SH, Kim SG, Lee SI. Analysis of nasal bone fractures; A six-year study of 503 patients. J Craniofac Surg 2006;17:261–64. [CrossRef]
2. Yabe T, Ozawa T, Sakamoto M, Ishii M. Pre-and postoperative x-ray and computed tomography evaluation in acute nasal fracture. Ann Plast Surg 2004;53:547–53. [CrossRef]
3. Chan J, Most SP. Diagnosis and management of nasal fractures. Oper Tech Otolaryngol Head Neck Surg 2008;19:263–6. [CrossRef]
4. Clayton MI, Lesser TH. The role of radiography in the management of nasal fractures. J Laryngol Otol 1986;100:797–802. [CrossRef]
5. Bremke M, Wiegand S, Sesterhenn AM, Eken M, Bien S, Werner JA. Digital volume tomography in the diagnosis of nasal bone fractures. Rhinology 2009;47:126–31.
6. Han DS, Han YS, Park JH. A new approach to the treatment of nasal bone fracture: Radiologic classification of nasal bone fractures and its clinical application. J Oral Maxillofac Surg 2011;69:2841–7. [CrossRef]
7. Jeon M, Kim Y. Correlation between the existing classifications of nasal bone fractures and subjective patient satisfaction. J Craniofac Surg 2018;29:1825–8. [CrossRef]
8. Murray JA, Maran AG, Busuttil A, Vaughan G. A pathological classification of nasal fractures. Injury 1986;173:38–44. [CrossRef]
9. Patel RG. Nasal anatomy and function. Facial Plast Surg 2017;33:3–8.
10. Johnson TB, Whillis J. Gray's Anatomy Descriptive and Applied. England: Longman; 1958.

ORİJİNAL ÇALIŞMA - *ÖZ*

Yeni bir topografik sınıflandırmanın burun kırığının prognozunu ve tedavi şeklini belirleme üzerindeki etkisi

Dr. Seckin Aydin Savas,[1] Dr. Ismail Erkan Aydin[2]

[1]Alanya Alaaddin Keykubat Üniversitesi Tıp Fakültesi, Plastik, Rekonstrüktif ve Estetik Cerrahi Anabilim Dalı, Antalya
[2]Alanya Alaaddin Keykubat Üniversitesi Tıp Fakültesi, Acil Tıp Kliniği, Antalya

AMAÇ: Burun kırığının sınıflandırılması klinik bulgulara veya radyolojik bulgulara göre yapılır. Burun kırığının sınıflandırma sistemleri genellikle burun kırığının tipini belirler. Bir sınıflandırmanın kırığın tipini belirlemekten çok tedavi şekli ve prognozu hakkında bilgi vermesi önemlidir. Bu çalışmanın amacı, yeni topografik sınıflandırmanın burun kırığının prognoz parametrelerini belirleme ve tedavi yöntemine karar verme üzerindeki etkisini göstermektir.
GEREÇ VE YÖNTEM: Aralık 2018 ile Eylül 2020 arasında acil servisten sevk edilen burun kırığı olan hastaları incelendi. Lateral nazal radyografi görüntüleri, bilgisayarlı tomografi (BT) yüz görünümü ve/veya üç boyutlu bilgisayarlı tomografi (3D) görüntüleri BT) burun kemiği kırığı olan 120 hastayı analiz etmek için incelendi. Burun kemiğinin kraniyalden kaudale olan uzunluğu, burun uzunluğuna dik iki çizgi ile eşit üç seviyeye bölündü. Kırık yeri nazal kemiğin kaudal kısmından kraniyal kısmına kadar sırasıyla seviye I, II ve III olarak belirlendi. Hastaların demografik özellikleri, kırığın olduğu taraf, kırığın paterni, eşlik eden kırıklar ve tedavi şekli not edildi.
BULGULAR: Yüz yirmi olguda nazal kırıkların yerleşim sıklığı I. seviye, II. seviye ve III. seviyede sırasıyla %44, %28 ve %27 idi. Kalın kemik kalınlığı olan seviyelerde kırık sıklığının düşük olması beklenen bir sonuçtu. İki taraflı veya tek taraflı olma oranlarına bakıldığında, nazal kemik kalınlığının ince olduğu seviye I grubunda unilateral görülme sıklığının daha yüksek, seviye III grubunda ise daha az olduğu bulundu ($p<0.05$). Seviye I grubunda depresif olmayan/minimal depresif kırık paterni %92.6 ile en yüksek orana sahipti ($p<0.05$). Depresif/eleve kırık paterni seviye II grubunda daha yaygındı ($p<0.05$). Parçalı patern en çok seviye III grubunda gözlendi. Eşlik eden kırık oranı ve uygulanan tedavi şekli kırık seviyesinin anatomik özelliği ile uyumluydu.
TARTIŞMA: Sonuç olarak, yeni topografik sınıflamanın, eşlik eden kırık, kırığın tarafı ve kırık paterni gibi klinik prognoz parametrelerini ve ayrıca kapalı veya açık redüksiyon gerekliliğini diğer sınıflamalara göre daha iyi değerlendirdiğini düşünüyoruz.
Anahtar sözcükler: Burun kırıkları; burun kırıkları sınıflandırılması; burun kırıklarının topografik sınıflandırması.

Ulus Travma Acil Cerrahi Derg 2023;29(2):212-217 doi: 10.14744/tjtes.2022.09406