Egypt, J. Plast. Reconstr. Surg., Vol. 49, No. 1, January: 77-80, 2025

Is there a Relationship between Mandibular Gonial Angle and The Patterns of Mandibular Fractures? A Retrospective Study Based on 3D Measurements

BELAL TAYSIR AL GHAMRI, MB.B.Ch.; MOHAMED RADWAN EL-HADIDY, M.D. and NABIL MOKHTAR MANSOUR, M.D.

The Department of Plastic and Reconstructive Surgery, Faculty of Medicine, Mansoura University

Abstract

Background: Mandibular fractures usually involve one or multiple sites with different patterns which depends on multiple factors such as the force applied, type of injury, in addition to the morphological and anatomical characteristics of the mandible. Few studies proved a relationship between mandibular angle measurement and fractures in the angle region. In this study we looked through the relationship of gonial angle measurement and all associated ipsilateral mandibular fractures.

Objective: To investigate weather gonial angle measurement would be one predictor to the location of mandibular fractures.

Method: This retrospective cohort study included patients diagnosed with mandibular fractures between 2018 and 2023. 100 cases were randomly selected. The gonial angle was measured using 3D C.T. scans. Fracture patterns were categorized into two groups: Group A (Angle region) and Group B (Not Angle region).

Results: The mean gonial angle in patients with fractures in the angle region was 125 degree, compared to 117 degree in patients with fractures in the non-angle region, which was a statistically significant difference ($p<0.001$).

Conclusion: The mandibular gonial angle is a powerful determinant factor that affects the pattern of mandibular fracture. The stronger and less obtuse mandibular angle the more likely a fracture pattern to spare the angle region.

Key Words: *Gonial angle – Mandibular fractures – Computed tomography.*

Ethical Committee: The study was approved by the ethical committee of the Institutional Review Board (IRB), Mansoura Faculty of Medicine (R.23.10.2363).

Disclosure: No disclosure. No funding.

Correspondence to: Dr. Belal Taysir Al Ghamri,
E-Mail: belaltaysir@gmail.com

Introduction

Fractures of the mandible are the second most common facial and jaw fractures after nasal fractures, comprising 19% to 40% of all fractures in this area. They occur more frequently in males during the third decade of life **[1-4]**. The elevated occurrence rate is a result of the distinctive anatomy and properties of the mandible, including its mobility, limited bone support in contrast to other facial bones, and its prominent position **[5-8]**.

Recently the prevalence of mandibular fractures is increasing due to motor vehicle accidents, occupational accidents, falls, sport injuries, and violence **[9]**.

These fractures can involve one or multiple sites with various patterns (Fig. 1), depending on factors such as the cause and type of injury, as well as morphological and anatomical variations of the mandible **[10,11]**.

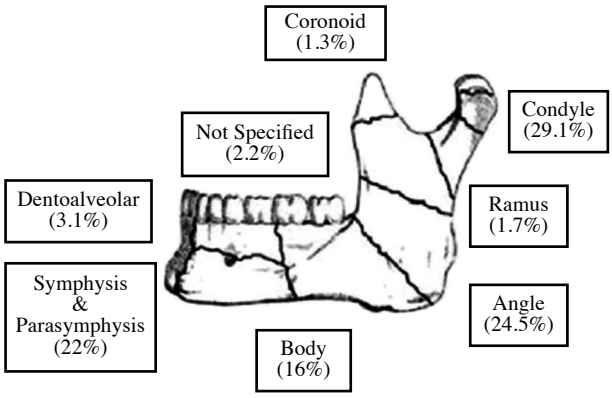

Fig. (1): Classification of mandibular fracture according to anatomical location. Dingman and Natvig et al. **[12]**.

Generally, hemi-mandibular anatomy shows two main axes, a vertical one (ramus and condyle) and a horizontal one (body and symphysis) the intersection between them is the gonial angle, which located at the junction between the vertical part (ramus) and the horizontal part (body).

The normal range of mandibular gonial angle is between (1200 To 1250). And more than 1250 is considered a high gonial angle and less than 1200 is a low one **[13]**.

Few studies proved a relationship between mandibular angle measurement and fractures in angle region without any data about the relationship with other mandibular fractures.

This study was designed to investigate the relationship between gonial angle measurement and all the associated ipsilateral mandibular fractures.

Our hypothesis was that gonial angle measurement would be one predictor of the location of mandibular fractures.

Material and Methods

Patient and population:

This retrospective study was conducted at emergency hospital in Mansoura University, Mansoura, Egypt.

Institutional Review Board of Mansoura medical university obtained prior to study (approval number: R.23.10.2363), 3D computed tomography (CT) scans of patients were gets from medical records of Plastic and Reconstructive Surgery Department in Mansoura Emergency Hospital.

100 cases of fracture mandible were randomly selected (random file numbers generated by computer from 1 January 2018 To 31 December 2023).

Data collection and methods:

All C.T scans were obtained using Aquilion Prime 3D CT scanner with the exposure settings of 120 kV, 187 mAs, 0.75s/1.0m scan time in supine position, radiological files were studied using (MUH synapse DB program, windows 10).

Mandibular angle measurement: The gonial angle was defined as the angle formed between the tangent line to the posterior border of the mandible and the tangent line to the inferior border of the mandible (Fig. 2).

Detailed patient information was retrieved, including age, sex, site of mandibular fracture and gonial angle measurement. Patients with incomplete registration data and with other pathological conditions, such as cystic lesions and osteoporosis were excluded.

Fracture patterns were categorized into two group: Group A (Angle region) which defined as the fracture located posterior to second molar and inferior to mid ramus and included (angle, posterior body and inferior ramus fracture), And Group B (Non-Angle region) which included (condylar, subcondylar, anterior body, parasymphysial, symphysial and coronoid fracture) **[14]** (Fig. 3).

Student *t*-test was used to study the relationship between both mandibular gonial angle and the ipsilateral fracture pattern.

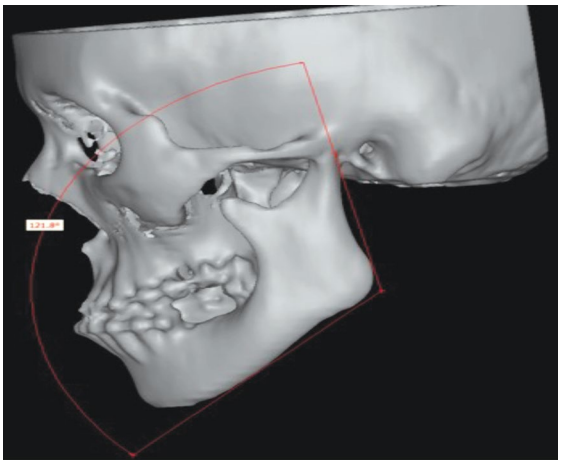

Fig. (2): Mandibular gonial angle measurement.

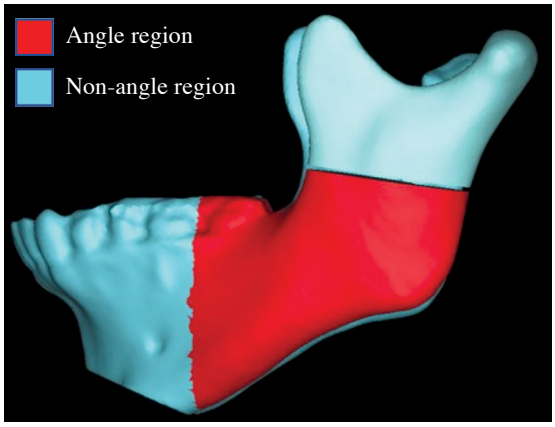

Fig. (3): Angle and Non-Angle regions of the mandible.

Results

The study sample included 100 patients with mandibular fractures including 91% males and 9% females. The mean age of patients with mandibular fractures was 25.99±16.39 (Table 1).

The mean right gonial angle of patients in group A (Angle region fracture) was 125.0±3.47 degrees which was statistically significant difference from group B (Non-angle region fracture) which was (116.89±6.15 degrees, $p<0.001$) (Table 2).

The mean left gonial angle of patients in group A was 124.31±3.09 degrees which was statistically significant difference from group B was (117.86±6.31 degrees, $p<0.001$) (Table 3).

Table (1): Demographic characteristics of the studied cases.

	n=100	%
Age /years Mean ± SD (Min-Max)	25.99±16.39 (3-77)	
Sex:		
Male	91	91.0
Female	9	9.0

Table (2): Relation between right angle value and angle region.

	Right angle Mean ± SD	Test of significance	Mean difference (95%CI)
- Group B not angle region (n=72)	116.89±6.15	*t*=5.64 *p*<0.001*	8.11 (10.96-5.25)
- Group A angle region (n=20)	125.0±3.47		

t: Student *t*-test. *Statistically significant. CI: Confidence interval.

Table (3): Relation between left angle value and angle region.

	Left angle Mean ± SD	Test of significance	Mean difference (95%CI)
- Group B not angle region (n=71)	117.86±6.31	*t*=498 *p*<0.001*	6.45 (9.02-3.88)
- Group A angle region (n=26)	124.31±3.09		

t: Student *t*-test. *Statistically significant. CI: Confidence interval.

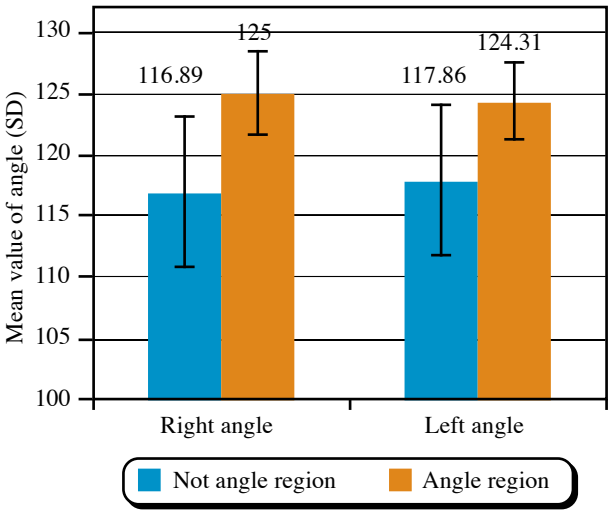

Fig. (4): Angle value in relation to angel region among studied cases.

Discussion

Characteristics of mandibular Fractures are variable in their patterns, site, combinations, and severity. Multiple factors have been related to types of mandibular Fractures such as the cause and type of injury, age, sex, severity and type of trauma, occlusal support and pathological disease **[10,11]**.

In this study CT files were analyzed of 100 randomly selected cases with mandibular Fractures to study whether there was a relationship between the location of the fracture and the ipsilateral main mandibular angle (gonial angle).

Dingman and Natvig et al., (1969) classified mandibular fractures according to their location into symphysis, parasymphysis, body region, angle region, ramus region, condylar process, coronoid process **[12]**.

In the current study, we classified our patients into two groups, group A (Angle fracture) and group B (Non-Angle fractures) and a strong relationship was found between the mandibular angle measurement and the location of the ipsilateral mandibular fractures.

Patients in group A (Angle fractures) were found to have more obtuse mandibular angle, with a mean right gonial angle 125.0±3.47 degrees, ($p<0.001$), And a mean left gonial angle 124.31±3.09 degrees.

Patients in group B (Non-Angle fractures) were found to have less obtuse mandibular angle, with a mean right gonial angle 116.89±6.15 degrees. And a mean left gonial angle 117.86±6.31 degrees, which was statistically significant difference between the two groups ($p<0.001$).

This proves that the more obtuse the gonial angle, the more likely a fracture to affect the angle region.

Throughout the history people used right angles in their foundations and building with a common believe that the more obtuse, the weaker and more likely a structure to collapse. mandibular angle was no different than this believe as the less obtuse the gonial angle, the stronger the relationship between vertical and horizontal structure **[15]**.

Throughout the literature, mandibular gonial angle had wide variations. Osato et al., (2012) defined a gonial angle smaller than 1200 as a low angle and larger than 1250 as a high angle **[16]**. In this study, it resulted the gonial angle more than 1240 is a high one and associated with fracture in angle region angle and less than 1160 is a low one and associated with fracture away from angle region.

Few studies investigated the relationship between the mandibular gonial angle and the mandibular angle fracture. Elias et al., (2018) using C.T.

scan observed a mean gonial angle of 131.3° in the angle fracture group, compared to 118.1° in the rest of the mandibular fractures, suggesting that an increased gonial angle correlates with an increased risk of angle fracture **[17]**. Panneerselvam et al., (2017) showed a correlation between wider gonial angles and mandibular angle fractures in the Indian population **[18]**. However, these studies have not provided any data about the relationships between gonial angle and non-angle fractures. In this study, the more obtuse angles were found to have a risk factor to fracture on the angle region, and less obtuse angles to have a risk factor to fracture away from the angle region of mandible.

This study is limited by the small sample size without inclusion of different ages. Also, only 9 out of 100 cases were female not allowing the study of statistical differences between both sex and different ages. Another limitation was the retrospective nature of study design and not including the difference in prognosis (after fracture fixation) between the angle fracture and non-angle region.

A multicenter study with huge sample size would be necessary to overcome these limitations.

Conclusion:

The mandibular gonial angle is a powerful determining factor that affect the pattern of mandibular fracture. After analyzing 100 randomly selected cases we found that strong and less obtuse mandibular angle are associated with fracture patterns sparing the angle region and vice versa. In places where there is CT scan unavailable, it is possible by observing the mandibular angle to predict the location of the fracture, such as the obtuse angle, the fracture may be in the condylar or subcondylar region. That (among other factors) can predict a more sever angle fracture in vulnerable people with steeper mandibular angle.

References

1- Radabaugh J.P., Horn A.V., Chan S.A., Shelton J.M. and Gal T.J.: Patient compliance following isolated mandibular fracture repair, Laryngoscope, 127 (10): 2230–2235, 2017.

2- Dhara V., Kamath A.T. and Vineetha R.: The influence of the mandibular gonial angle on the occurrence of mandibular angle fracture, Dent. Traumatol., 35 (3): 188–193, 2019.

3- Al-Moraissi E.A., El-Sharkawy T.M., El-Ghareeb T.I. and Chrcanovic B.R.: Three dimensional versus standard miniplate fixation in the management of mandibular angle fractures: A systematic review and meta-analysis, Int. J. Oral Maxillofac. Surg., 43 (6): 708–716, 2014.

4- Bereznyak Elias Y., Shilo D., Emodi O., Noy D. and Rachmiel A.: The relation between morphometric features and susceptibility to mandibular angle fractures, J. Craniofac. Surg., 29 (7): e663–e665, 2018.

5- Shroff N., Motghare P., Kumbhare S. and Kalaskar A.: Correlation of mandibular gonial angle and mandibular angle fracture: A radiographic study, J. Indian Acad. Oral Med. Radiol. 32 (1): 17–21, 2020.

6- Tiwari P., Bera R.N. and Chauhan N.: Magnitude of gonial angle influence on the commonness of mandibular angle fractures, Ann. Maxillofac. Surg., 10 (1): 190–194, 2020.

7- Semel G., Emodi O., Ohayon C., Ginini J.G. and Rachmiel A.: The influence of mandibular gonial angle on fracture site, J. Oral Maxillofac. Surg., 78 (8): 1366–1371, 2020.

8- Brucoli M., Boffano P., Pezzana A., Benech A., Corre P., Bertin H., et al.: The "European mandibular angle" research project: The epidemiologic results from a multicenter European collaboration, J. Oral Maxillofac. Surg., 77 (4): 791.e1–791.e7, 2019.

9- Yoon W.J., Kim S.G., Oh J.S., You J.S., Lim K.S., Shin S.M. and Kim C.M.: A clinical study of mandibular angle fracture, Maxillofac. Plast. Reconstr. Surg., 36 (5): 201–206, 2014.

10- Sicher H. and DuBrul E.L.: Oral Anatomy. St Louis, MO, Mosby, 1975.

11- Halazonetis J.A.: The 'weak' regions of the mandible. Br. J. Oral Surg., 6: 37, 1968.

12- Dingman R. and Natvig P.: Surgery official fractures, W. Saunders Company, USA. p. 142-144, 1969.

13- Upadhyay R.B., Upadhyay J., Agrawal P. and Rao N.N.: Analysis of gonial angle in relation to age, gender, and dentition status by radiological and anthropometric methods, J. Forensic Dent. Sci., 4 (1): 29–33, 2012.

14- Kelly D.: A survey of facial fractures related to teeth and edentulous regions. J. Oral Surg., 33:146, 1975.

15- Steadman P.: Why are most buildings rectangular? Arq: Architectural Research Quarterly, 10 (2): pp. 119-130, 2006.

16- Osato S., Kuroyama I., Nakajima S., et al.: Differences in 5 anatomic parameters of mandibular body morphology by gonial angle size in dentulous Japanese subjects. Ann. Anat., 194: 446–451, 2012.

17- Elias Y.B., Shilo D., Emodi O., Noy D. and Rachmiel A.: The relation between morphometric features and susceptibility to mandibular angle fractures. J. Craniofac. Surg., 29: 663-5, 2018.

18- Panneerselvam E., Prasad P.J., Balasubramaniam S., et al.: The influence of the mandibular gonial angle on the incidence of mandibular angle fracture A radiomorphometric study. J. Oral Maxillofacial Surg., 75: 153, 2017.