Dimensional differences in mandibular antegonial notches in temporomandibular joint ankylosis

Stuti Singh¹, Sumit Kumar², Rahul Pandey², Deepak Passi¹, Divya Mehrotra³,
Shadab Mohammad³

¹Resident, ²Research Associate, ³Professor, Department of Oral and Maxillofacial Surgery, Chhatrapati Shahuji Maharaj Medical University (Erstwhile King George Medical College), Lucknow, India.

ABSTRACT

Background: Deep antegonial notch (AN) is seen in congenital and acquired abnormalities of mandible like condylar hypoplasia, temporomandibular joint ankylosis (TMA), muscular hypoactivity and brachial arch syndrome. This study was planned with an aim to study the depth of AN in TMA and find its relation with the duration of ankylosis.

Materials and Methods: The study comprised 20 cases of unilateral or bilateral TMA, with age range 8–25 years. A comparison between ipsilateral and contralateral AN was done on ortho-pantomograms of these bilateral and unilateral cases with the time period of total duration of ankylosis.

Results: Seven cases had right-sided ankylosis, six had left and seven had bilateral TMA where the history of ankylosis ranged from 6 months to 12 years. Spearman's rank correlation indicated a strong correlation between the duration of history of ankylosis and AN on the ipsilateral/contralateral sides. Wilcoxin signed rank test proved the results to be statistically significant.

Conclusion: Deep accentuated AN is one of the clinical features of the TMA and has a direct relation to the morphology and growth pattern of mandible.

Keywords: Antegonial notch, TMA.

INTRODUCTION

Upward curving of the inferior border of the mandible anterior to the angular process is known as antegonial notch (AN), and the AN is broadly classified into deep AN (> 3 mm), neutral AN (1–3 mm) and shallow AN (< 1 mm). Shallow AN is usually associated with the horizontal growth pattern of the mandible and the protrusive mandible. Deep AN shows great gonial angles, deep ramus notches, large occlusal inclination, long total anterior facial height and less mandibular growth. Deep AN is seen in congenital and acquired abnormalities of the mandible like condylar hypoplasia, temporomandibular joint ankylosis (TMA), muscular hypoactivity and brachial arch syndrome.¹ Females have shallow AN as compared with males.² With respect to the antegonial depth, there are significant variations in dentulous, partially edentulous and completely edentulous subjects.

Bjork's implant studies have shown that in forward rotating mandibles, apposition occurs below the symphysis

and resorption takes place under the angle.³ Conversely, the mandible which demonstrates a backward and downward rotation during growth experiences pronounced apposition beneath the angle with excessive resorption under symphysis, thus, causing an upward curving of the inferior border of the mandible anterior to the angular process. The direction of mandibular growth and rotation is thus reflected in the location and degree of remodeling on the inferior surface of the mandible. It would be reasonable to expect deep AN to develop and be accentuated by the process of bone deposition under the gonial angle as occurs in the case of a backward-rotating mandibular growth pattern. Hence, in subjects with deep AN, a backward pattern of mandibular rotation and a vertical direction of mandibular growth should be prevalent. Furthermore, if AN is associated with a poor condylar growth response in pathological situations, then one might also anticipate a diminished mandibular growth potential in edentulous patients.

In TMA, the ramus and the body of the ankylosed side are underdeveloped; the angle is situated at a higher level superoinferiorly, the lower border of the mandible is curved to a greater degree than normal and exhibits a palpable depression immediately in front of the masseter muscle, the so-called AN.^{4,5} The region demarcates the junction between the appositional bone laid down in response to the insertion of the pterygo-masseteric sling and the poorly developed bone of the body of the mandible.

This study was planned with an aim to study the depth of AN in TMA and find its relation with the duration of ankylosis.

MATERIALS AND METHODS

The study comprised 20 cases of unilateral or bilateral TMA, who visited our outpatient clinic and consented their participation. After thorough clinical examination and history recording, panoramic X-rays were obtained in all these cases.

Tangents were drawn on the inferior border of the mandible between the deepest point of the gonial angle and the midline of the mandible. A perpendicular was projected from the deepest point of the AN to the tangent; this distance was measured in millimeters and measured as the mathematical value of AN (Figure 1). A comparison between the ipsilateral and the contralateral AN was done in the bilateral and unilateral cases with the time period of the total duration of ankylosis.

RESULTS

This study was planned with an aim to assess the depth of AN in TMA and study its relation with the duration of ankylosis. This study comprised 20 cases of unilateral or bilateral TMA. Their ages ranged from 8 years to 25 years. Seven cases had right-sided ankylosis, 6 had left and 7 had bilateral TMA. The history of ankylosis ranged from 6 months to 12 years.

It was hypothesized that in the TMA, ipsilateral AN is more accentuated than contralateral. In order to test this hypothesis, the mean depth of AN on the ipsilateral side was compared with the contralateral using the Wilcoxon signed rank test (non-parametric paired *t*-test). The difference between the two sides was found to be significant statistically ($P=0.001$) (Table 1).

Figure 1 Antegonial notch measurements.
IGo=inferior gonion; ACP=anterior convexity point.

Table 1 Unilateral ankylosis and antegonial notch

S. no.	Site of ankylosis	Duration of ankylosis (yr)	Ipsilateral AN (mm)	Contralateral AN (mm)
1	Right	9	7	3.2
2	Right	0.75	2	1
3	Left	0.92	3	1.5
4	Left	12	8	3.1
5	Right	7	6	2
6	Left	3	5	1.3
7	Right	15	5.5	3.6
8	Right	1.5	6	1.2
9	Left	0.5	4	0.9
10	Right	5	5	1.2
11	Left	3	6	1.1
12	Right	4	5	2
13	Left	2	4	1.1
Mean±SD		5.12±1.61	1.78±0.93	
Correlation (Spearman's rho) between time and change			0.724	0.847

Wilcoxon signed rank test (non-parametric paired *t*-test as sample size <30), $z=3.182$; $P=0.001$; AN=antegonial notch.

It was also hypothesized that there is a correlation between the duration of the history of ankylosis and the depth of AN on the ipsilateral/contralateral sides. A bivariate correlation was sought between AN on the ipsilateral and contralateral sides and the duration of ankylosis using Spearman's rank correlation (ρ). For both the parameters (ipsilateral and contralateral), the value of ρ was observed to be above 0.7 thereby indicating a strong correlation between the duration of the history of ankylosis and AN on the ipsilateral/contralateral sides (Table 1).

We observed that in TMA cases, the involved side had deep AN (<3 mm) in all cases except two, where the history of ankylosis was less than a year. In 11 cases, there was deep AN even on the contralateral side; 6 cases had neutral AN and only 1 case showed shallow AN where the history of ankylosis was only 6 months (Figures 2 and 3). Table 2 demonstrates AN in the bilateral ankylosis cases.

DISCUSSION

Mandibular AN is a concavity of the under surface of the body just anterior to the angular process (gonion) seen in congenital and acquired disorders. The notch tends to be longer in the congenital than in the acquired state, and the ascending ramus is at a more obtuse angle to the body.⁶ The

AN lies at the junction of the body and the angle of the mandible, and in this strategic position, the shape of the mandible is a good indicator of how the mandible grows. It has been documented that when the lower border of the mandible is relatively flat, it grows forward and when the lower border of the mandible that represents AN is concave the mandible grows downward.

In TMA, due to the inability to open mouth, the mandible remains in a backward position; hence, there is continuous bone deposition at the gonial angle and resorption at the mandibular anterior region which causes a depression in front of the gonial angle at the inferior border and retarded

Figure 2 Ipsilateral and contralateral antegonial notches with respect to the duration of the unilateral temporomandibular joint ankylosis.

Figure 3 Ipsilateral and contralateral antegonial notches with respect to the history of the duration of ankylosis.

Table 2 Bilateral ankylosis and antegonial notch

S. no.	Duration of ankylosis (yr)	Right antegonial notch (mm)	Left antegonial notch (mm)
1	3	5	5
2	4	4	4
3	5	4	4
4	6	7	5
5	6	4	6
6	8	8	6
7	12	7	9
Minimum	3	4	4
Maximum	12	8	9
Mean	6.285	5.571	5.571
SD	0.531	0.432	0.436

horizontal growth pattern in the mandible. This is the main reason of deep AN which is further accentuated by pterygo-masseteric activity.

Another study showed that the condylar growth fails to contribute to lowering of the mandible, while medial pterygoid and masseter by continued growth cause the bone in the region of angle to grow downward and produce AN. It is still a point of debate as to what is the actual cause of deepening of AN.

When we compared the AN in cases of TMA on the ipsilateral and contralateral sides, we found that on the ipsilateral side there was deep AN, may be due to the deformed condyle bone deposition that occurred at the gonial angle but on the contralateral side, the backward positioning of the normal condyle supposedly caused accentuation of deep ANs.

Condylar bone change might be related not only to the mandibular size (e.g. retrusion) but also to the mandibular outline (including antegonial and ramus notch depth).⁷ Analysis of the craniofacial form of TMA in 45 cases showed that the average total mandibular length was less than the norm by 30mm. Each patient presented with a mandible that had backward rotation with a chin recession. Accentuated AN and inferiorly located condyle were observed on the affected side. The maxilla was shorter and the angle formed by supramentale-nasion-subspinale (ANB) was larger than the norm by 10° but the overbite and overjet were within normal ranges.⁸

The restricted growth of the condyle is accompanied by similar restricted development of the body of the mandible. A restricted compensatory upward growth of the condyle cartilage is equal to the restricted passive motion of that side of the mandibular body.¹ Deep AN group showed steep mandibular plane, small chin, great anterior facial height and gonial angle, and a mandible with more backward and downward growth.⁹ Depth of the curve of Spee and the

length of the mandibular body are decreased when there is an increase in the surface areas of the ANs.¹⁰ In our study also the deep AN was accompanied by the less forward growth of the mandible, hence a short body length. The clinical presence of a deep mandibular AN is indicative of a diminished mandibular growth potential and a vertically directed mandibular growth pattern.¹¹

However, the correlation analysis by Kolodziej et al revealed a statistically significant negative relationship between the adolescent AN depth and the horizontal growth of the maxilla and the mandible from adolescence to adulthood. Although previous investigators proposed that AN depth, when extreme in magnitude, might be used to predict the facial growth, they concluded that the AN depth fails to provide a sufficient indication of the future facial growth to warrant its application as a growth predictor in a non-extreme population.¹

It is already known that deep ANs in adolescent tend to deepen with growth. We also observed that the duration of ankylosis had a significant effect on the depth of AN. We can conclude that the time period of ankylosis is directly proportional to the depth of AN.

The mandibular morphology is known to influence the type of growth pattern; deep AN shows vertical growth pattern while shallow notch is responsive of the horizontal growth.

CONCLUSION

Deep accentuated AN is one of the clinical features of the TMA and has a direct relation to the morphology and growth pattern of the mandible.

REFERENCES

1. Kolodziej RP, Southard TE, Southard KA, Casco JS, Jakobsen JR. Evaluation of antegonial notch depth for growth prediction. *Am J Orthod Dentofac Orthop* 2002;121:357–63.
2. Lambrechts AH, Harris AM, Rossouw PE, Stander I. Dimensional differences in craniofacial morphologies of groups with deep and shallow mandibular antegonial notching. *Angle Orthod* 1996;66:265–72.
3. Skieller V, Björk A, Linde-Hansen T. Prediction of mandibular growth rotation evaluated from longitudinal implant sample. *Am J Orthod* 1984;86:359–70.
4. Speculand B. Unilateral condylar hypoplasia with ankylosis: radiographic finding. *Br J Oral Surg* 1982;20:1–13.

5. Rowe NL. Ankylosis of temporomandibular joint. *J R Coll Surg Edinb* 1982;27:209–18.
6. Becker MH, Coccato PJ, Converse JM. Antegonial notching of the mandible: an often overlooked mandibular deformity in congenital and acquired disorders. *Radiology* 1976;121:149–51.
7. Ali IM, Yamada K, Hanada K. Mandibular antegonial and ramus notch depths and condylar bone change. *J Oral Rehabil* 2005;32:1–6.
8. Ko EW, Huang CS, Chen YR, Figueroa AA. Cephalometric craniofacial characteristics in patients with temporomandibular joint ankylosis. *Chang Gung Med J* 2005;28:456–66.
9. Wu JY, Zhang M. A comparative study of craniofacial morphologic differences between groups with shallow and deep antegonial notch depth. *Shanghai Kou Qiang Yi Xue* 2001;10:217–20.
10. Salem OH, Al-Sehaibany F, Preston CB. Aspects of mandibular morphology, with specific reference to the antegonial notch and the curve of Spee. *J Clin Pediatr Dent* 2003;27:261–5.
11. Singer CP, Mamandras AH, Hunter WS. The depth of the mandibular antegonial notch as an indicator of mandibular growth potential. *Am J Orthod Dentofac Orthop* 1987;91:117–24.