Available online at http://www.journalcra.com

International Journal of Current Research
Vol. 8, Issue, 12, pp.42664-42670, December, 2016

INTERNATIONAL JOURNAL OF CURRENT RESEARCH

ISSN: 0975-833X

RESEARCH ARTICLE

THE CORONOIDS – AN AREA LESS EXPLORED AMONG TEMPOROMANDIBULAR JOINTDISORDERS

[1]Dr. K. Saraswathi Gopal, [2]Dr. B. G. Harsha Vardhan, [*,3]Dr. G. Nandhini and [4]Dr. N. Balaji

[1]Professor & Head, Department of Oral Medicine and Radiology, MADCH, Chennai
[2]Professor, Department of Oral Medicine and Radiology, MADCH, Chennai
[3]Post Graduate, Department of Oral Medicine and Radiology, MADCH, Chennai
[4]Reader, Department of Oral Medicine and Radiology, TDCH, Chennai

ARTICLE INFO

Article History:
Received 19th September, 2016
Received in revised form
08th October, 2016
Accepted 05th November, 2016
Published online 30th December, 2016

Key words:

Coronoid Process,
Sigmoid Notch,
Cone Beam Computed Tomography,
Coronoid Process Hyperplasia.

Abbreviations:
CPH-Coronoid Process Hyperplasia, CRL- Coronoid Right Length, CLL-Coronoid Left Length, CBCT- Cone Beam Computed Tomography

ABSTRACT

Background: A large number of disorders affecting the masticatory system can cause restriction of mouth opening. The most common conditions related to this problem are those involving the temporomandibular joint (TMJ) and the masticatory muscles, is an usual finding. Coronoid process hyperplasia is a rare cause of mandibular hypo mobility. Literature review states that the morphological variation in the shape of coronoid process and sigmoid notch may be due to hereditary or functional changes and have a correlation with the mode of degree of attachment of temporalis muscle.

Materials and Methods: A Study was conductedin 100 (200joints) South Indian individuals who presented with various temporomandibular joint disorders. The shape of coronoid process and sigmoid notch and length of coronoid process were analysed bilaterally using Cone Beam Computed tomography (CBCT). Morphological alteration of coronoid process and its length and sigmoid notch were analysed and compared for differences on either sides.

Results: The length of coronoid process was found to be approximately 1.9 mm longer on the right side than on the left side; the mean value of right side being 14.96mm and left side being 13.06mm Triangular coronoid process was found to be the commonest with 31% right side and 60% in left side followed by beak shaped with 48% right side and 20% in left side and then round shaped with 21% right side and 20% in left side. The shape of sigmoid notch wide shape was found to be the commonest with 60 % right side and 41 % in left side followed by sloping shape with 32% right side and 23% in left side and then round shape with 8% right side and 36% in left side.

Citation: Dr. K. Saraswathi Gopal, Dr. B. G. Harsha Vardhan, Dr. G. Nandhini and Dr. N. Balaji, 2016. "The coronoids – An area less explored among temporomandibular jointdisorders", *International Journal of Current Research,* 8, (12), 42664-42670.

INTRODUCTION

Coronoid process", of mandible in Greek means *"like a crown*" which is a beak like projection flattened from side to side at antero - superior aspect of ramus of mandible. (Pradhan *et al*., 2014) It is a cartilaginous type of bone which can be removed intra-orally without any functional deficiency and facial disfigurement for reconstruction of orbital floor deformities, alveolar defects, Paranasal sinus augmentation, non-union fracture of mandible, osseous defects reconstruction and other repairing procedure in cranio-maxillo facial surgeries. (Nayak *et al*., 2015) The shape of the coronoid process and sigmoid notch is also useful in anthropological studies and forensic dentistry. (Shrijanashakya *et al*., 2013) The margins and medial surface of coronoid process give attachment to temporalis muscle. Muscle and the bone dynamically affect the function of each other and lead to change in the morphology of the bone involved (Snells, 1995; Williams *et al*., 1995). Coronoid process hyperplasia is a rare cause of mandibular hypo mobility (Nayak *et al*., 2015). Coronoid process hyperplasia (CPH) is a rare condition which may enlarge the coronoid processes tosuch an extent that they impinge upon the zygomaticbones (De Leeuw, 2008). According to the American Academy of Orofacial Pain, CPH is classified as a congenital or developmental cause of temporomandibular joint (TMJ) disorder (Alexiou *et al*., 2009). It is usually underdiagnosed, but a thorough anatomical knowledge can help in examining the patient clinically and radiologically. This will provide a better line of management and clinical outcome of temporomandibular joint disorders. (Nayak *et al*., 2015) CBCT has been recognized as a reliable method for examination of the osseous components of temporomandibular joint. (Alexiou *et al*., 2009) CBCT allows the creation of "real time" images not only in axial plane but also 2- dimensional (2D) images in coronal, sagittal and even

Corresponding author: Dr. G. Nandhini,
Post Graduate, Department of Oral Medicine and Radiology, MADCH, Chennai

oblique or curved image planes- a process referred to as multiplanar reformation (MPR) The use of CBCT technology in clinical practice provides a number of potential advantages namely, X- ray beam limitation, image accuracy, rapid scan time, radiation dose reduction. (William C. Scarfe, 2006)

MATERIALS AND METHODS

A retrospective study was conducted in 100 South Indian Individuals (200 joints) who reported to Department of Oral medicine and Radiology with various temporomandibular joint disorders. Cone Beam Computed Tomography images of TMJ were taken using PLANMECA PROMAX CBCT Machine. The A- shape of coronoid process; B-length of coronoid processand C- shape of sigmoid notch were analysed using Romexis software. The CBCT images which included coronoid process and sigmoid notch in the field of view on both the sides were analysed. The morphological patterns/ shape of coronoid process were analysed based on patterns given by Nayak *et al*. The shape of coronoid process was classified into 3 types; namely Triangular, Roundand Beak /hook shaped. Morphological patterns of sigmoid notch were analysed based on patterns given by Narayan *et al*. The various shapes of sigmoid notch are Sloping, Wide and Round. The length of coronoids on both the sides were analysed by a line drawn tangential to the deepest part of mandibular notch to the apex.

RESULTS

The various patterns of coronoid process and its length and sigmoid notch were analysed and compared for differences on either sides. The collected data were analysed with IBM.SPSS statistics software 23.0 Version.To describe about the data descriptive statistics frequency analysis, percentage analysis were used for categorical variables and the mean & S.D were used for continuous variables. To find the significant difference between the bivariate samples in Paired groups the Paired sample t-test was used & for Independent groups the unpaired sample t-test was used.To find the significance in categorical data Chi-Square test was used. In all the above statistical tools the probability value .05 is considered as significant level.

Frequency tables:

Table 1.

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Female	50	50.0	50.0	50.0
	Male	50	50.0	50.0	100.0
	Total	100	100.0	100.0	

A.Coronoid shape:

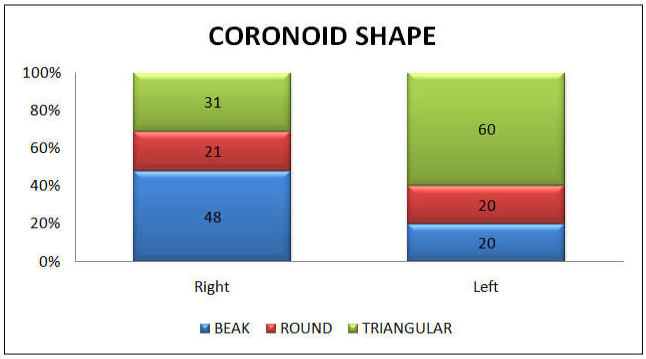
B. Graph no 1 and Table no 2 -Triangular coronoid process was found to be the commonest with 31% right side and 60% in left side followed by beak shaped with 48% right side and 20% in left side and then round shaped with 21% right side and 20% in left side.

C. Table no 3- chi square test applied; highly significant at p< .01

Fig. 1. Representing Triangular shape with tip pointing directly upwards

Fig. 2. Representing Hook shape with tip pointing backwards

Fig. 3. Representing Rounded shape with tip rounded



Graph 1.

Table 2.

Coronoid process shape	Right	Left
Triangular	31	60
Beak	48	20
Round	21	20

Table 3.

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	38.014[a]	4	.000
Likelihood Ratio	49.520	4	.000
N of Valid Cases	100		

P - Value ** Highly Significant at P ≤ .01

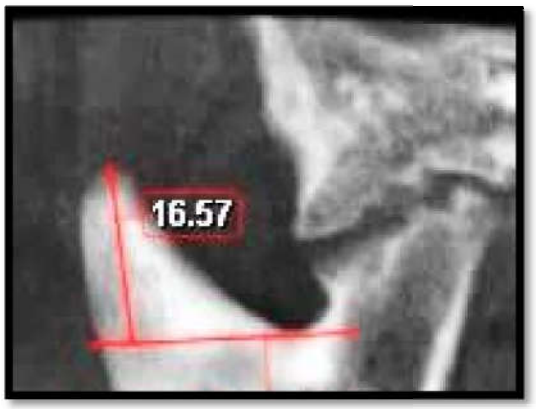


Fig 4. Triangular

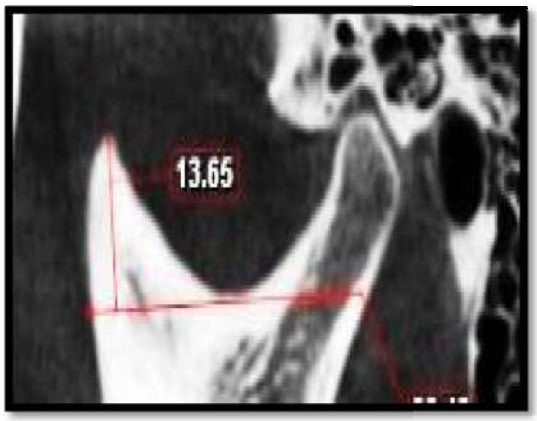


Fig. 5. Beak/ Hook

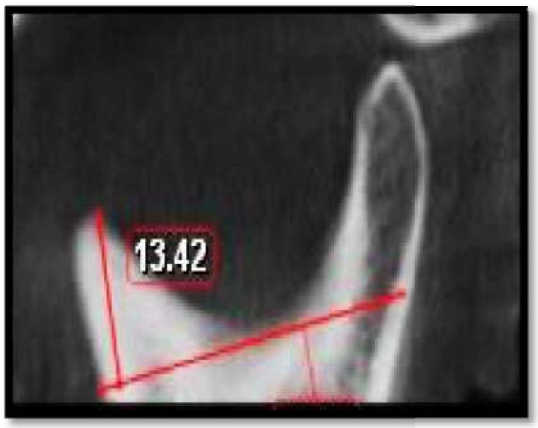


Fig. 6. Round

D.Coronoid length (Fig 4, 5, 6)

The LENGTH of coronoids were analysed by a line drawn tangential to the deepest part of mandibular notch to the apex.

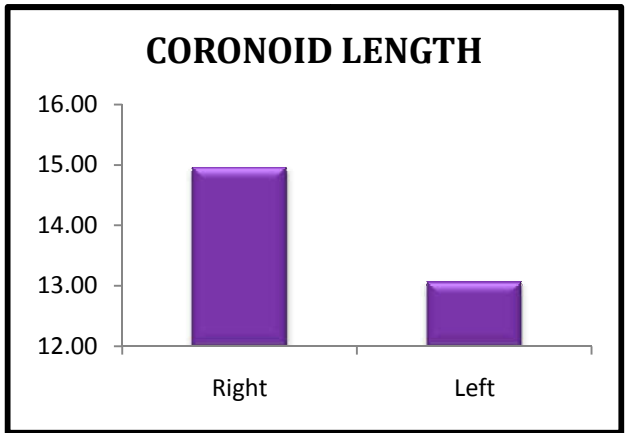


Table 4.

Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation
CRL	100	12.6	15.9	14.960	.5621
CLL	100	12.2	14.0	13.063	.5419
Valid N (listwise)	100				

Table 5.

Paired Samples Test

		Paired Differences					t	df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	Interval of the Lower	Upper			
Pair 1	CRL - CLL	1.8970	.3292	.0329	1.8317	1.9623	57.624	99	.000

P - Value ** Highly Significant at P ≤ .01

Table 4 and graph 2 –In coronoid right length(CRL) ranges between min 12.6mm & maximum of 15.9mm and coronoid left lengthranges between min 12.2mm & maximum of 14.0mm respectively. The length of coronoid process was found to be approximately 1.9 mm longer on the right side than on the left side; the mean value of right side being 14.96mm and left side being 13.06mm

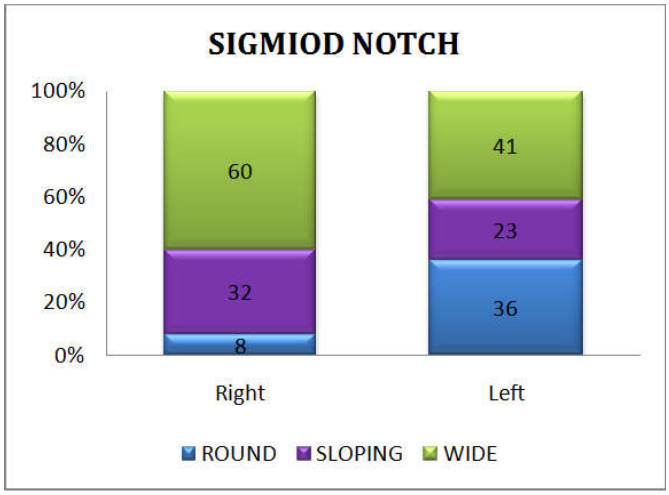
Table 5- paired sample test applied; p value highly significant at p< .01

B.Sigmoid notch shape:

Fig. 7. Wide

Fig. 8. Sloping

Fig. 9. Round



Graph 3.

Table 6.

Sigmoid notch shape	Right	Left
Wide	60	41
Sloping	32	23
Round	8	36

Table 7.

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	10.485[a]	4	.033
Likelihood Ratio	13.714	4	.008
N of Valid Cases	100		

P - Value * Significant at P ≤ .05

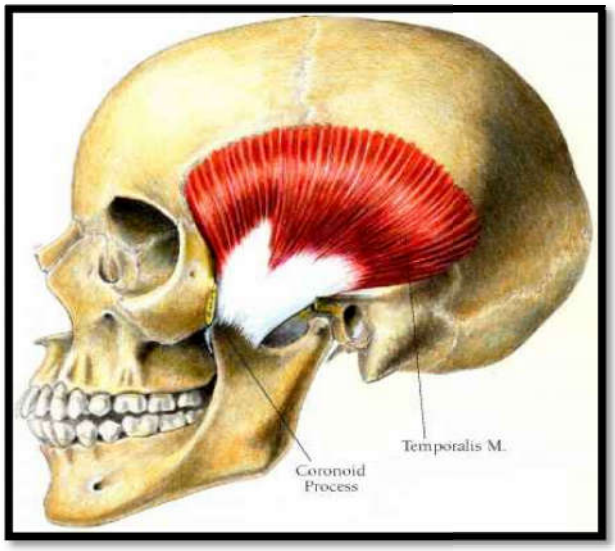
Graph 3 and Table 6 -The shape of sigmoid notch;wide shape was found to be the commonest with 60 % right side and 41 % in left side followed by sloping shape with 32% right side and 23% in left side and then round shape with 8% right side and 36% in left side.

Table 7 – chi square test applied p value significant p<.05

DISSCUSSION

The coronoid process develops as a discrete entity within the mass of the temporalis muscle anlage, subsequently it unites with the main portion of mandibular ramus at approximately eight weeks of age. (Gray'sTextbook of anatomy for Students the Anatomical basis of Clinical Practice (20th Edition)) The temporalis muscle has a fan shaped origin along the lateral surface of the skull and deep fascia overlying this muscle.[13] The anterior fibres of temporalis muscle, which form the major bulk of the muscle are largely vertical; the fibres in the middle part of the muscle are increasingly oblique. The most posterior fibres run forward almost horizontally, bend around the posterior root of zygomatic arch in front of articular eminence, and pass downward vertically to mandible. (Chapter 47; Functional Disorders of Temporomandibular Joint) The middle and posterior portions of temporalis muscle respectively, are attached along the apex of coronoid process and along its posterior slope to the deepest point of the mandibular notch. (Meropi N. Spyropoulos, 1977) The anterior superficial fibres of the temporalis muscle insert along the apex of coronoid process, the anterior surface of the coronoid process and mandibular ramus. The anterior deeper fibres of temporalis attach along the medial anterior surface of mandibular ramus. (Meropi N. Spyropoulos, 1977) Von Langenbeck in 1853 first described about the elongation of coronoid process of mandible. (SunitaNayak *et al*., 2015) There are multiple theories as the cause of elongated coronoid process, some of which include temporalis hyperactivity, dysfunction of temporomandibular joint caused by chronic disc displacement, hormonal stimulus, and genetic inheritance. (SunitaNayak *et al*., 2015) The fibres of temporalis muscle are actually shorter than most illustrations indicate, although they are longer than those of the masseter muscle.

These longer fibres are to be expected because during wide opening the temporalis is, of necessity stretched much more than masseter and medial pterigoid muscle. (Chapter 47; Functional Disorders of Temporomandibular Joint)



A radiographic examination is a part of the clinical assessment routine for conditions of TMJ dysfunction and the TMJ can be viewed using panoramic and Trans cranial radiographs, conventional CT, tomography of TMJ, cone beam CT (CBCT), Magnetic resonance imaging (MRI) and arthrography.[15,16] CT has been the method of choice to asseses the contours of the cortical bone and TMJ dynamics. However, it is a high cost examination and requires a high dose of radiation. CBCT is less costly and the dose of radiation is lower; and in addition CBCT provides, a three dimensional image of the maxillofacial mineralized tissue with minimal distortion. (Dos AnjosPontual *et al*., 2012; Greenan, 1997) Recently with the advantages over CT cone beam computed tomography (CBCT) has been considered as an advanced imaging technique for accurate diagnosis (Alexiou *et al*., 2009). According To Tsiklakis *et al*. (2004) Koyama *et al*. (2007) CBCT should be used instead of CT because the dose of radiation to which the patient is exposed is much lower. Furthermore, CBCT is superior to CT for visualizing bone changes in the TMJ, analysing lateral slices in isolation and combining coronal and lateral slices. Thus, CBCT was the imaging method used in this study. (Tsiklakis *et al*., 2004. Koyama *et al*., 2007) According to our study, The length of coronoid process was found to be approximately 1.9 mm longer on the right side than on the left side; the mean value of right side being 14.96mm and left side being 13.06mm. These results were within the range of anatomical studies analysed in dry mandibles by Nayak *et al*. (2015) in which the length of coronoid process on right side being 1.5mm longer when compared to left side in normal patients.

In our study, triangular coronoid process was found to be the commonest with 31%on the right side and 60% in left side followed by beak shaped with 48% on the right side and 20% in left side and round shape process in 21% on the right side and 20% in left side respectively. Literature studies, in- vitro of the mandible among normal individuals, Pradhan *et al*. (2014), the triangular 46.7% being commonest, followed by round 35.3% and then beak/ hook shaped 17.93%. In the study done by Tanveer *et al*. (2011) the triangular 67% being commonest, followed by round 3% and then beak/ hook shaped 30%. Vipul *et al*. (2011) the triangular 54.1% being commonest, followed by round 24.5% and then beak/ hook shaped 21.2%. Smita Tapas *et al*. (2014) the triangular 60% being commonest, followed by round 18% and then beak/ hook shaped 22%. Apart from the genetic etiology, the functional factors necessitate the right coronoid process to be longer than the left. However, the lateralization of the Masseter-Temporalis-lever effect largely depends upon the individual masticatory behavior. It seems probable that the larger population reflexly use the right side of the jaw for crushing as compared to that in left which is reflected in the enlarged right coronoid. This is also reflected in the shape of the coronoid as larger functional load helps it to get remodelled as a triangular with pointed tip, followed by the beak shaped and least being a round ended. The wide shape of sigmoid notch was found to be the commonest with 60 % on the right and 41 % on the left followed by sloping shape with 32% on the right and 23%on the left and round shape with 8% on the right and 36% on the left. The imaging study conducted by shirijanashakya *et al*. (2013) using orthopantomogram presented sloping shape being commonest with 93 % on the right and 89% on the left followed by round shape with 67% on the right and 56% on the left and least was the wide shape with 40% on the right and 55% on the left side.

Coronoid hyperplasia is a rare condition leading to limitation of mandibular motion as a result of unnatural contact of elongated coronoid process with posterior surface of zygomatic bone (Chapter 47; Functional Disorders of Temporomandibular Joint). Hyperplasia of coronoid process is often bilateral and displays a gradual, painless decrease in mandibular opening and protrusion. The exact pathophysiology remains unknown, but there are some theories which include, hereditary, endocrine source, or hyperactivity of temporalis muscle. (Meropi N. Spyropoulos, 1977) Mandibular hypomobility following surgical procedures or injuries occur infrequently, but is a recognized cause of pseudoankylosis. (Meropi N. Spyropoulos, 1977; Bell, 1990) Most commonly the patient must be questioned regarding a history of a craniotomy, skull base surgery, temporal fossa procedures, or extensive intraoral incisions to make the correct diagnosis (Coonan *et al*., 1985; August *et al*., 2004). Kawaguchi *et al*. (1996) reported an incidence of limited mouth opening less than 25mm in 33.3% and 20.5% two weeks and one month respectively, after operation.Patients experiencing persistent hypo mobility are treated with coronoidectomy and temporal muscle release. (Chapter 47; Functional Disorders of Temporomandibular Joint) The coronoid process locking is postulated to be a rare condition. The literature reveals 54 reports each of one or two cases and additional two papers reporting on four and six cases, the latter including hereditary cases (Annika *et al*., 1987; Van Hoof and Besling, 1973; Maurer and Wildin, 1964). In all bilateral cases enlargement of coronoid process was classified as developmental, in contrast to unilateral reactive hyperplastic elongation which was reported to be related to trauma. (Vikas C Desai *et al*., 2014) It has been suggested that the coronoid process may become hyperplastic in association with long standing chronic Temporo Mandibular Joint (TMJ) disk displacement or osteoarthrosis. (Farrer and Mccarty, 1982)

Coronoid process elongation tends to be overlooked when limitation of mouth opening ability is investigated since most interest is focused on the joint. (Bell, 1990) An association between chronic disc displacement and coronoid hyperplasia has been established by Iceberg *et al*. (1987) Annika *et al*. (1987) McCarty *et al* (1982) Farrer and Mccarty (1982). According to Isberg *et al*. (2014) to study the frequency of coronoid process hyperplasia and its possible association with disc displacement, 163 patients with limited mouth opening ability were examined. After periodic radiographic examination

of temporomandibular joint of all patients in eight patients 5%, the limitation of mouth opening ability was caused by elongation of coronoid process. In those eight patients, the restricted mouth opening was caused by coronoid process locking against the zygomatic bone. Two of the patients demonstrated a dull, snapping sound when coronoid process tapping against the zygomatic bone on maximal opening. Four cases were congenital in origin, and four were secondary to longstanding disk displacement without reduction. All four patients had histories of temporomandibular joint disc displacement with reduction (clicking) without any signs of coronoid hyperplasia in first occasion, followed by sudden limitation of mouth opening , indicating an aggravation to disk displacement without reduction and coronoid process has been elongated and locked against the zygomatic bone. Meanwhile in one of the patient the disk on one side demonstrated coronoid process hyperplasia the other side had become displaced. Surgical treatment is required when an elongated coronoid process interferes with mandibular function (Jaslkolka, 2007).

Conclusion

An established association between internal derangement and coronoid hyperplasia has been established by Iceberg *et al*. (1987) Annika *et al*. (1987) McCarty *et al*. (1982). This chronic disorder can further worsen into a degenerative joint disease if left untreated. An adequate diagnosis is a prerequisite for successful treatment of the patient. The locking of coronoid process as a causative FACTOR for impaired mandibular movements is underestimated. It is therefore important for the dentists to consider this diagnostic hypothesis in case of patients experiencing limitation in mouth opening. Hence, the imaging protocol should include a detailed evaluation of coronoid morphology which can prevent irreversible changes and damage to the joint. The retrospective study presented above is the first of its kind in evaluating the relationship of the morphology of coronoid process, its length and sigmoid notchamong patients with internal derangement using CBCT.

REFERENCES

Alexiou, KE., HC Stamatakis and K T Tsiklakis, 2009. Evaluation of Severity of Temporomandibular Joint Osteoarthritic Changes Related To Age Using Cone Beam Computed Tomography; *Dentomaxillofacial Radiology*, 38, 141-147.

Annika isberg, goranisacsson and kyung-soo nah, stockholm, Sweden, and pusan, 1987. south korea Mandibular coronoid process locking: a prospective study of frequency and association with internal derangement of temporomandibular joint ; *Oral Surgery, Oral Med, Oral Pathol*., 63;275-279

August M, Troulismj, Kaban LB: Hypomobility and hypermobility disorders of temporomandibular joint in miloro m *et al*, editor: peterson's principles

Bell WE. 1990. Temporomandibular joint disorders: classification, diagnosis, management ed 3, Chicago, year book medical publicaters.

Chapter 1; Functional Anatomy and Biomechanics of the Masticatory Apparatus; Pg10-11; *Textbook of Oral and Maxillofacial Surgery* – Laskin

Chapter 47; Functional Disorders of Temporomandibular Joint;Pg-900-901; Textbook of Oral and Maxillofacial Surgery – Fonseca

Coonan TJ. *et al*. 1985. Ankylosis of temporomandibular joint after craniotomy: a cause of difficult intubation, can anesth society journal 32 (2): 158-160.

De Leeuw R. Orofacial Pain, 2008. Guidelines for Classification, Assessment, And Management. 4th Ed. Chicago: Quintessence Publ. Co.

Dos AnjosPontual, ML., JSL Freire, JMN Barbosa, MAG Frazao, A Dos AnjosPontual and MM Fonseca Da Silveira; 2012. Evaluation of bone changes in temporomandibular joint using cone beam CT Dentomaxillofacial Radiology, 41, 24-29

Farrer WB. and Mccarty WL. 1982. An Clinical Outline Of Temporomandibular Joint Diagnosis And Treatment Ed 7, Monotgomerymala; Normandie Publications

Gray'sTextbook of Anatomy for Students the Anatomical Basis of Clinical Practice (20th Edition) ; Henry Gray FRS, H. V Carter M.D

Greenan RW. 1997. Panoramics for temporomandibular joint, functorthod, 14;26-8

Jaslkolka MS. 2007. Eppleybl, van aalstja mandibular coronoid hyperplasia in pediatric patients; *J of Craniofacial Surgery*, 18 849-854

Kawaguchi M *et al*. 1996. Pseudoankylosis of the mandible after supra tentorial craniotomy, *Anesthanalog*, 83(4):731-734.

Koyama J, nishiyama H, Hayashi T. 2007. Followup study of condylar bony changes using helical computed tomographyin patients with temporomandibular joint disorder. *Dentomaxillofacial Radiology*, 36; 472-477

Maurer Rm Wildin Be, 1964. Hypertrophy Of Coronoid Process of Mandiblae a Cause of Restricted Mouth Opening of the Mouth Radiology, 83; 1060-1063.

Mcloughlin PM, Hopper C, Bowley NB. 1995. Hyperplasia of the Mandibular Coronoid Process: An Analysis Of 31 Cases And A Review, of the Literature. *J Oral Maxillofacsurg*., 53:250-255.

Meropi N. Spyropoulos. 1977. The Morphogenetic Relationship of the Temporal Muscle to the Coronoid Process in Human Embryos and Fetuses. American Journal of Anatomy Volume 150, Issue 3, Pages 395–409, November.

Narayanan K, Nayak SR, Prasanthin. 2004. Morphology ofLingula, Coronoid Process and Mandibular Notch In Indian Dry Mandibles. *Folia Anatomica*, 31:13-16

Nayak, S., S. Patra, G. Singh, C. Mohapatra, S. Rath, 2015. Study Of The Size Of The Coronoid Process Of Mandible; IOSR Journal Of Dental And Medical Sciences; Volume 14, Issue 6 Ver. I (Jun.), PP 66-69

Pradhan, S., D. P.Bara, S.Patra, S.Nayak, C.Mohapatra; 2014. Anatomical Study of Various Shapes of Mandibular Coronoid Process in Relation to Gender &Age; IOSR Journal of Dental and Medical Sciences; Volume 13, Issue 8 Ver. II (Aug.), PP 09-14

Shrijanashakya, Ravikiranongole, Sumanthkumbagerenagraj; 2013. Morphology of Coronoid Process And Sigmoid Notch In Orthopantamograms Of South Indian Population; *World Journal Of Dentistry* ; January – March, 4(1) : 1-3

Snells R.S. 1995. Clinical Anatomy For Medical Students (3rd Edition), New York; Churchchill Livingstone, 773.

Sunita Nayak, Swagatika Pradhan, DibyaPraba Bara, Smita Patra; Bilateral Elongated Coronoid Process: A Case Report; *IOSR Journal of Dental and Medical Sciences*, Volume 14, Issue 5 Ver.VI (May 2015), PP 61-63

Tsiklakis K, Syripoulos K, Stamatakis HC. 2004. Radiographic examination of temporomandibular joint

using cone beam computed tomography, *Dentomaxillofacial radiology*, 33; 196-201.

Van Hoof Rf, Besling Wfj. Coronoid Process Enlargement Br *J Oral Surgery,* 10m 339-348, 1973

Vikas C Desai, Desai SD, Hussain N Aruna, 2014. Morphological study of mandible, *Journal of Pharmaceutical Sciences and Research*, Vol 6(4), 175-177.

William C. Scarfe, 2006. Clinical Applications of Cone Beam Computed Tomography in Dental Practice; *Journal of Canadian Dental Association*, 72(1); 75-80.

Williams PL, Bannister LH, BERRY MM, Collins P, Dyson M, Dussek JE *et al*. 1995. Skeletal System –Individual Cranial Bones Grays Anatomy (38th Edition) Great Britain: Chruchchill Livingstone, 577.

****