Research Article

JRAD Journal of Research and Advancement in Dentistry

J Res Adv Dent 2018;8:2:248-254.

Study of Position of Mental Foramen on Panoramic Radiograph as an Index for Estimation of Mandibular Bone Resorption and Age Estimation

Arpita Srivastava[1] Padmavathi B N[2] Rahul Shrivastava[3] Prashanthi Reddy Srivastava[4] Meenakshi Sharma[5*] Gunjan Singh[6]

[1]Ex Senior Lecturer, Department of Oral Medicine and Radiology, Modern Dental College, Indore, MP, India.
[2]Professor and Head, Department of Oral Medicine and Radiology, Darshan Dental College, Udaipur, Rajasthan, India.
[3]Ex Reader, Department of Prosthodontics, Modern Dental College, Indore, MP, India.
[4]Reader, Department of Oral Medicine and Radiology, Govt Dental College, Indore, India.
[5]Reader, Department of Pedodontics and Preventive Dentistry, Government Dental College, Jaipur, Rajasthan, India.
[6]Senior Lecturer, Department of Pedodontics and Preventive Dentistry, Vyas Dental College, Jodhpur, Rajasthan, India.

ABSTRACT

Aim: Age estimation using alveolar bone resorption.

Materials and Method: Completely edentulous patients attending the OPD of Pacific Dental College, Udaipur, were included in the study after routine clinical examination and recorded in the case file of the department. Total number of 237 volunteers formed study group. Participants were included in the study considering inclusion and exclusion criteria. Consent of the patients for a panoramic radiograph was obtained. Exposure was accomplished. All the films were processed with visual method. The radiographs were dried, labeled and stored for further evaluation. Mandibular bone height was measured & alveolar bone resorption was calculated using position of mental foramen on panoramic radiograph. Entire data of the study was recorded in numerical value & the results were evaluated for the statistical significance.

Results: In the present study, age estimation was not possible in the later age groups because there was no significant difference in alveolar bone resorption in the later age groups.

Conclusion: In the study, mandibular alveolar bone resorption did not correlate with advancing age. Age estimation could be possible only when early age groups are compared with later age groups in edentulous mandibles.

Keywords: Mental foramen, panoramic radiograph, mandibular bone resorption.

INTRODUCTION

Age is a period of human life, measured from years of birth. It's a process of systems deterioration with time, which follows the period of development with organism. Aging refers to irreversible and inevitable changes which occur with time, which encompass all aspects of human life, like anatomic, physiologic and psychologic. The need to determine age using effective and reliable scientific methods has become increasingly important. Age estimation finds application in health sciences, law and jurisprudence, constitution politics and employment. Chronologic age estimation of humans has a significant impact in the field of forensic odontology, and in dentistry, particularly in the disciplines of Oral Medicine, Orthodontics, Pedodontics, and Prosthodontics. The procedures for age determination are complex and involve the consideration of various factors. Changes related to

Received: July. 11, 2018: **Accepted**: Aug. 3, 2018
*Correspondence Dr. Meenakshi Sharma.
Department of Pedodontics and Preventive Dentistry, Government Dental College, Jaipur, Rajasthan, India.
Email: dr.mesharma@gmail.com

pISSN 2278-0076
eISSN 2321-9270

chronologic age are seen both in hard and soft tissue. Amongst the hard tissues bones are important as they undergo a series of changes from prenatal to post natal life and changes in their composition and structure continue into old age and even after death. Hence, bones form a reliable source of information regarding growth and growth changes. Normally well-defined skeletal development in bones, cranial sutures and teeth take place at specific ages. However, these changes are significantly affected by genetics, general health and other environmental factors.[1] The determination of age becomes more difficult as maturity increases. Where fetal material is concerned, a result may be achieved with an accuracy measured almost in days. As age advances, the situation remains fairly satisfactory until about the cessation of growth and especially the cessation of dental changes so that by the age of 20–25 years all growth markers have ceased to be of assistance. As time goes on through adult life into middle age and into old age, matters become progressively more difficult and the margin of error increases.[2]

A number of methods for age determination have been proposed. These can be classified in four categories, namely, clinical, radiological, histological and chemical analysis. In the living persons, any or all of the above methods can be used to determine age, in cases where actual age is not known or is to be confirmed. However, in case of a dead person, post-mortem changes such as decomposition, mutilation or skeletonization may make identification progressively more difficult almost to the point of impossibility.[3] Dental hard tissues and bone are extremely resistant to fire and are usually the only remains after an extended period of burial. As a result, forensic odontology has gained importance as a tool in identifying the skeletal/dental remains. In last few years, forensic odontology has shown increasing interest in search for optimal age estimation procedures in individuals using dental structures. Forensic Dentistry, a branch of forensic medicine which in turn is a branch of forensic science has been defined by Keiser Nielsen (1970), as that branch of odontology which in interest of justice – deals with proper handling and examination of the dental evidence and with the proper evaluation and presentation of dental findings.[4]

The routine radiographic examination by orthopantomography of the mandible of the dental patients is necessary and justifiable for treatment. Also, it is not always possible to obtain permission to produce sections to make age estimation by morphologic methods alone, where the non-destructive radiologic methods are considered as an adjunctive method to establish the age. [5, 6.]

MATERIALS AND METHOD

SOURCE OF DATA

Those attending the department of Oral Medicine and Radiology, Pacific Dental College & Hospital, Udaipur were included in the study after being briefed about the procedure and on giving their consent.

2. STUDY DESIGN:

The study group comprised of 237 participants all above 40 years.

a) Inclusion Criteria:

1) Completely edentulous volunteers.

2) Good quality panoramic radiographs of the volunteers in which mental foramen are clear and distinct on both the sides.

b) Exclusion criteria:

1) Patients with developmental malformations of the jaws.

2) Patients with acute infections and clinical or radiographic evidence of pathologies.

3. MATERIALS USED:

Routine diagnostic instruments, Kodak Lanex imaging screen used with T-MAT G/RA green sensitive dental Kodak Films of 15x30 cm in size, Xtropan 2000 panoramic machine ,Radiographic view box, Magnifying lens, Engineering T scale, Measuring scale, Permanent marker pen.

Participants were included in the study considering inclusion and exclusion criteria. Consent of the patients for a panoramic radiograph was obtained. The study participants were briefed about the radiographic procedure. Exposure was

accomplished at 65 kv and set exposure of approximately15 seconds. All the films were processed with visual method. The radiographs were dried, labeled and stored for further evaluation. Evaluation of radiographs was done in a quiet room with subdued lighting. Out of 237 panoramic radiographs, 37 radiographs in which mental foramen was not traced were discarded from study. Thus the study included 200 panoramic radiographs of 157 males and 43 females. The study population was divided into 5 age groups as 40-49, 50-59, 60-69, 70-79 and >79 years. The panoramic radiograph was properly oriented on the flat view box emitting even light. The mental foramen was located bilaterally with the help of a magnifying lens. A permanent marker was used to draw a tangent connecting lower most points at the angle of mandible and the inferior border of the mandible close to mental foramen, with the help of engineering T scale (Figure 1). A perpendicular was drawn from the mandibular alveolar crest passing through the centre of mental foramen[7]. After drawing the tangent and the perpendicular on panoramic radiographs, following measurements were recorded on right and left side using measurement scale (Figure 2):

- a= Mandibular bone height measured from inferior border of mandible to alveolar crest at premolar region
- b= Inferior margin of mental foramen to inferior border of mandible

e=3b-a, where e is alveolar bone resorption, '3b' is considered the original height of the alveolar process before resorption and 'a' is mandibular height after resorption as measured on panoramic radiograph.[8]

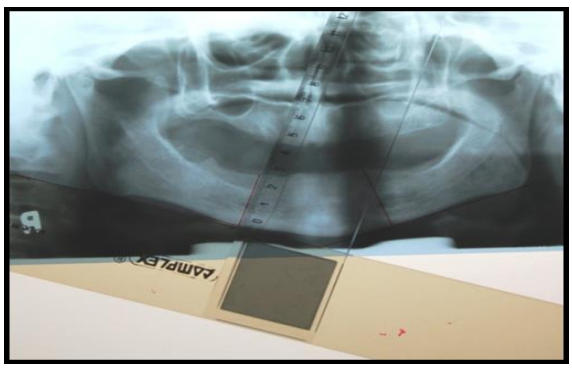


Fig 1: Demonstration of measurement of mandibular bone height.

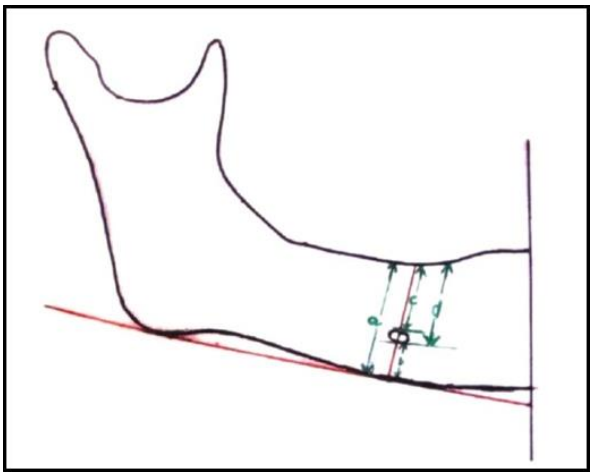


Fig 2: Schematic diagram for measurement of the various parameters.

Difference in magnification between right and left sides was noted and percentage of variance was calculated as follows. An edentulous mandible was stabilized and its position was standardized. Metal balls measuring 1cmx1cm, 1.8x1.8cm, 2.1x1.9cm, 1.9x1.5cm, 2.6x2.6cm were placed near the premolar region with reference to mental foramen with the help of wax sheet and panoramic radiographs were made. Measurements were made of the images of the metal balls and the percentage of variance for magnification on the right and left sides was calculated.[7] It was found to be 2.6%. A master chart was prepared including all the above measurements. Entire data of the study was recorded in numerical value using Microsoft excel sheet 2007, SPSS version 16 and the results were evaluated for their statistical significance using Post Hoc Test, ANOVA, T- test.

RESULTS

When mandibular alveolar bone resorption 'e' was correlated with age groups on right and left sides, the following significant correlation between age groups was observed: Re (p 0.005) and Le (p 0.025) (Table I). When mandibular alveolar bone resorption 'e' for all age groups were correlated on right and left sides, 'e' was significantly different between following age groups:

Re:

- Mean difference of Re between age groups 1 & 2 was 0.31, and the difference was statistically significant (p 0.031).

- Mean difference of Re between age groups 1 & 3 was 0.49, and the difference was statistically significant (p 0.001).
- Mean difference of Re between age groups 1 & 4 was 0.34, and the difference was statistically significant (p 0.030).
- Mean difference of Re between age groups 3 & 5 was 0.53, and the difference was statistically significant (p 0.027) (Table II) (Graph I)

Le:

- Mean difference of Le between age groups 1 & 2 was 0.34, and the difference was statistically significant (p 0.016).

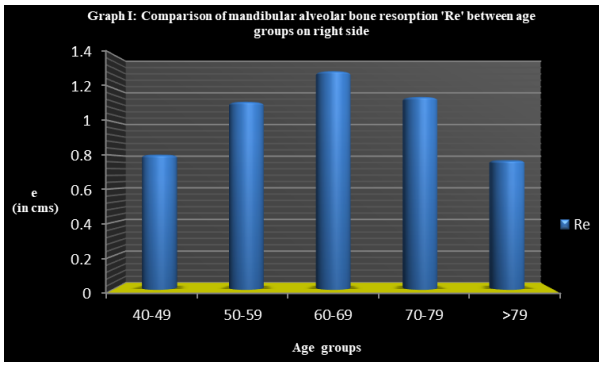
Mean difference of Le between age groups 1 & 3 was 0.44, and the difference was statistically significant (p 0.002) (Table II) (Graph II).

Table 1: Study group.

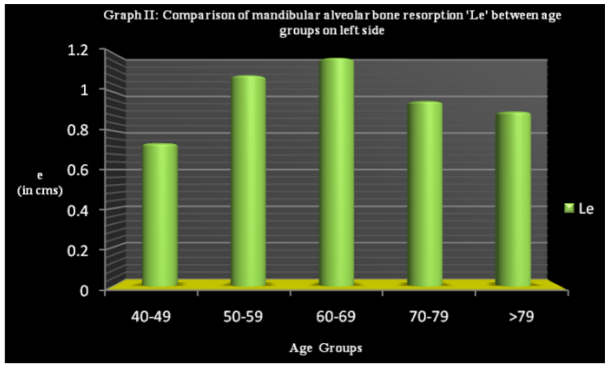
Between Groups	df	Sum of Squares (cms)	Mean Square (cms)	F	p value	Between Groups	df	Sum of Squares (cms)	Mean Square (cms)	F	p value
Re	4	5.568	1.392	3.856	.005	Le	4	4.075	1.019	2.840	.025

Table 2: Comparison of mandibular alveolar bone resorption 'e' between age groups on right and left sides.

Comparison of Ra between age groups			Mean Difference (cms)	Std. Error	P value	Comparison of La between age groups			Mean Difference (cms)	Std. Error	p value
	1	2	.3237*	.1163	.006		1	2	.1580	.1213	.194
		3	.3437*	.1140	.003			3	.1734	.1189	.146
		4	.1066	.1265	.400			4	.1605	.1320	.225
		5	.1244	.2073	.549			5	.0589	.2163	.786
	2	1	-.3237*	.1163	.006		2	1	-.1580	.1213	.194
		3	.0200	.0843	.812			3	.0154	.0879	.861
		4	-.2171*	.1006	.032			4	.0025	.1049	.981
		5	-.1993	.1926	.302			5	-.0991	.2010	.623
	3	1	-.3437*	.1140	.003		3	1	-.1734	.1189	.146
		2	-.0200	.0843	.812			2	-.0154	.0879	.861
		4	-.2371*	.0979	.016			4	-.0129	.1021	.899
		5	-.2193	.1912	.253			5	-.1145	.1995	.567
	4	1	-.1066	.1265	.400		4	1	-.1605	.1320	.225
		2	.2171*	.1006	.032			2	-.0025	.1049	.981
		3	.2371*	.0979	.016			3	.0129	.1021	.899
		5	.0178	.1989	.929			5	-.1015	.2076	.625
	5	1	-.1244	.2073	.549		5	1	-.0589	.2163	.786
		2	.1993	.1926	.302			2	.0991	.2010	.623
		3	.2193	.1912	.253			3	.1145	.1995	.567
		4	-.0178	.1989	.929			4	.1015	.2076	.625



Graph 1: Comparison of mandibular alveolar bone resorption 'Re' between age groups on right side.



Graph 2: Comparison of mandibular alveolar bone resorption 'Le' between age groups on left side.

DISCUSSION

The purpose of this study was to correlate the amount of mandibular ridge résorption to aging. Mandibular alveolar bone resorption in the study population was calculated using the formula 3b-a (Figure 6) given by Wical and Swoop.[8, 9] 'b' is the height of mandible from inferior border of mental foramen to the inferior border of the mandible which is not significantly affected by resorption. Hence it can be used as the basis for quantitative estimation of the original height of the mandible which has undergone resorption; 3b is the original height of the mandible before resorption and 'a' being height of the mandibular body in the study group after resorption[10].

Radiography being a non-destructive method also plays a vital role in forensic dentistry to uncover the hidden facts which cannot be seen by means of physical examination. Panoramic radiographs are also helpful to determine the age of the individual. [11] The principle advantages of panoramic images are broad coverage of facial bone and teeth, low patient radiation dose, use in patients unable to open mouths and the short time required. [12]

The mental foramen is defined as the entire funnel-like opening in the lateral surface of the mandible at the terminus of the mental canal. This foramen is contained entirely within the buccal cortical plate of bone. [13]The location of mental foramen could change during development of jaws, [14] therefore panoramic radiographs taken from patients who had completed their development were evaluated in the present study.

Bone loss varies from patient to patient, but the most dramatic changes occur in the mandibular arch. In microscopic pathology of this disease, there is an osteoclastic activity, especially on the external surface of the crest of residual ridges. In gross pathology, on dry specimens the external cortical surfaces of the mandible are uniformly smooth, while the crestal area of the residual ridge is much more porous. Mandibles having severe résorption may display gross porosity of the medullary bone on the crest of the ridge and may eventually display the uncovering of the inferior alveolar canal. Resorption of the residual ridge has been measured using a variety of radiographic techniques. Lateral cephalometric radiographs provide a possibility for determining the amount of residual ridge and the rate of its reduction over a period of time. The panoramic radiographic technique described by Wical and Swoope is a simple, useful method for arriving at a gross estimate of the amount of residual ridge résorption in a given patient and has been used in many studies.[8] The present study uses this method to calculate mandibular ridge resorption.

In the present study when comparison of alveolar bone resorption was made between age groups, statistical significant difference was observed on right and left sides (Table II). In the study, age estimation was not possible in the later age groups because there was no significant difference in alveolar bone resorption in the later age groups. The rate of mandibular bone resorption was not correlating with advancing age. When mandibular bone resorption was compared on right and left sides it was not significantly different (Table X). But it was found that alveolar bone resorption was

greater on the right side than the left side for all the age groups except for >79 years (Graph VI).

In growing individuals, bone formation is greater than bone resorption. The two processes are in equilibrium in the adult. However, in the aged, the resorption may not be compensated by production of bone resulting in senile osteoporosis. Thus, it can be argued that bone resorption is a part of normal aging and is balanced between the anabolic and catabolic metabolism of the body. Several studies have evaluated age-related changes in mandibular bone. According to these studies, it can be summarized that bone loss appears to be physiologic and the reduction in mandibular bone volume has a linear relationship with age. However, a low correlation between the rate of reduction of residual ridges and age was established by Atwood and Coy. [8]Bulem Yuzugullu et al. found that the alveolar bone loss was not affected by age.[15]In another study Andres Lopez-Roldan et al. analysed the distribution differences between age levels within each group (under 70, between 70-74 and over 74) using a non parametric Kruskal-Wallis test. They concluded that age is not an influential factor in bone loss for either of the age groups.[16] But in another study Timo et al. found that the amount of bone resorption and the location of the mental foramen correlated with each other, with age, and with the number of years of edentulism.[17]Studies have shown that the rate of resorption depends on diet, [6] use of dentures, [6] and period of edentulism.[17]

REFERENCES

1. Prabhu SR, Wilson DF, Daftary DK, Johnson NW, Oral diseases in tropics. Oxford University Press. 1993: 758-759.
2. Paul P, Murder under the microscope: the story of Scotland yards Forensic Science Laboratory, Mc Donald Publishing London. 1990.
3. Maat GJ, Maes A, Aarents MJ, Nagelkerke NJ, Histologic age predilection from the femur on a contemporary dutch sample: The decrease in non remodel bone in anterior cortex. J Forensic Sci. 2006; 51(2): 230-237.
4. Phillip E. O'. Shaughnessy, Introduction to forensic science. Dental Clinics of North America. 2001; 45: 2.
5. Rai, Anand, S.K. Dhattarwal, H.James, The value of dental records in identification. Indian Medical Gazette. 2006; 5: 237-240.
6. Balwant Rai, Possible identification marker in orthopantomograms: Edentulous. Middle – East Journal of Scientific Resarch. 2007; 2(2): 82- 83.
7. Cagri Ural, Cihan Bereket, Ismail Sener, Bone height measurement of maxillary and mandibular bones in panoramic radiographs of edentulous patients. J Clin Exp Dent. 2011; 3(1): 5-9.
8. Lale Karaagaçlioglu, Pelin Ozkan, Changes in Mandibular Ridge Height in Relation to Aging and Length of Edentulism Period. The international journal of Prosthodontics. 1994; 7(4): 368-71.
9. Kenneth E. Wical, Charles C. Swoope, Studies of residual ridge resorption. Part II. The relationship of dietary calcium and phosphorus to residual ridge resorption. Journal of Prosthet Dent. 1974; 32: 7-12.
10. Anshuman Jamadade, Late Dr. Anil John, Mental foramen on panoramic radiograph: As an index for quantitative estimation of mandibular alveolar bone resorption. JIDA. 2010; 1: 1-3.
11. Susmita Saxena, Preeti Sharma, Nitin Gupta, Experimental studies of forensic odontology to aid in the identification process. Journal of Forensic Dental Sciences. 2010; 2(2): 69–76.
12. Pervin Imirzalioglu, Bulem Yuzugullu, Ayse Gulsahi, Correlation between residual ridge resorption and radiomorphometric indices. Gerodontology. 2011: 1-7
13. Wei Cheong Ngeow and Yusof Yuzawati, The location of the mental foramen in a selected Malay population. Journal of Oral Science. 2003; 45(3): 171-175.
14. Kahraman Gungor, Mustafa Ozturk, Mustafa Semiz, A Radiographic Study of Location of Mental Foramen in a selected Turkish population on Panoramic Radiograph. Coll. Antropol. 2006; 30(4): 801-805.
15. Bulem Yuzugullu, Ayse Gulsahi, Pervin Imirzalioglu, Radiomorphometric indices and their relation to alveolar bone loss in completely edentulous Turkish patients: A retrospective study. 2009; 101(3): 160-165.
16. Andres Lopez-Roldan, Diego Santolaya Abad, Isabel Gregori, Bone resorption process in patients wearing overdentures. A 6-years

retrospective study. J Cin Exp Dent. 2009; 1(1): 24-30.
17. Timo O Nahri, Ronald L. Ettinger, Ernest W.M. Lam, Radiographic Findings, Ridge Resorption, and Subjective Complaints of Complete Denture Patients. The International Journal of Prosthodontics. 1997; 10(2): 183-189.