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ASSESSMENT OF RELIABILITY OF ANGLES MSG, MGS AND LINEAR MEASUREMENT MM'-GG', THREE NEW PARAMETERS IN MEASURING MAXILLO-MANDIBULAR SAGITTAL DISCREPANCY – A CEPHALOMETRIC STUDY

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ABSTRACT

Aims: The current study aimed to assess the reliability of three new cephalometric parameters called angle MSG, angle MGS and linear measurement MM'- GG' using three skeletal landmarks— S : mid point of sella turcica, M : mid point of premaxilla, and G : mid point of symphysis and derived landmarks, M': M point perpendicular projected on to the true vertical , G': G point perpendicular projected on to the true vertical to evaluate the sagittal relationship between the maxilla and mandible. **Methods:** A total of sixty pre-treatment lateral cephalograms of subjects aged 18-30 years undergoing Orthodontic treatment were selected randomly and divided into Classes I, II, and III groups based on the inclusion and exclusion criteria. The lateral cephalograms were traced on an acetate paper using a 0.3mm lead pencil. The new cephalometric parameters i.e., linear measurement MM'- GG', angles MSG and MGS were constructed and measured to evaluate the sagittal discrepancies. **Results:** The mean MSG angle in Class I subjects was 21.55 ± 1.15, in Class II subjects was 26.85 ± 2.58 and in Class III subjects was 19.35 ± 1.87. The mean MGS angle in Class I subjects was 33.75 ± 1.62, in Class II subjects was 37.45 ± 3.15 and in Class III subjects was 28.40 ± 3.15. The mean MM"-GG" values in Class I subjects was 2.70 ± 1.87, in Class II subjects was 9.85 ± 4.10 and in Class III subjects was -6.05 ± 4.29. The test results demonstrated a significant strong positive correlation between ANB and MSG & MGS values in Class I subjects, in Class II subjects and also in Class III subjects. It also demonstrated a significant strong positive correlation between Wit's Appraisal & MM'-GG' values in Class I subjects, in Class II subjects and also in Class III subjects. **Conclusion:** The angle MSG, MGS and linear measurement MM'- GG' are reliable cephalometric parameters and can be used as a potential alternative to assess sagittal jaw dysplasia.

KEYWORDS

MSG angle; MGS angle; MM'-GG'; point M, point G; point S; sagittal jaw dysplasia

INTRODUCTION

Cephalometric roentgenography has long been an essential tool in orthodontic diagnosis, treatment planning, and monitoring growth and development. The sagittal relationship between the maxilla and mandible is particularly significant for patients and requires meticulous evaluation.[1]

Numerous angular and linear measurements have been proposed to diagnose sagittal discrepancies effectively. There are many approaches like angular measurement between the anterior cranial base and points A and B, , ANB angular measurement, Witts approval on the maxillary and mandibular dental bases has traditionally been used to determine the extent of sagittal skeletal dysplasia.

In cephalometric analysis, both angular and linear measurements are employed to devise the most accurate treatment plan. The ANB angle[2] is frequently used to describe skeletal discrepancies between the upper and lower jaws. However, the ANB angle's reliability is questioned[3-5] due to its dependence on the position of Nasion and some factors. To overcome the ANB angle limitation various methods are used.

Recently a new cephalometric parameter [6] was introduced which uses three reference points were used: midpoint of the Sella turcica(S), mid-point of the premaxilla(M), and center of the largest circle that is tangent to the internal inferior, anterior, and posterior surfaces of the mandibular symphysis(G). However, the true sagittal dysplasia is masked by the rotation of jaws here also. Another sagittal dysplasia indicator [7], W angle was introduced in the year 2014. The points used in Yen angle, i.e., M, S and G are used here again.

In the year 2020, a cephalometric parameter [10] called the MKG angle which uses three skeletal landmarks—point KR (key ridge), point M, and point G was introduced to evaluate the antero-posterior relationship between the maxilla and mandible. Rotation of the jaws could still affect the readings of the MKG angle.

Given the limitations of the numerous cephalometric parameters quoted above, there is a constant need to discover a parameter to diagnose sagittal discrepancy, one that would be comparatively stable even during growth and orthodontic treatment. The parameter must also be reliable and easily reproducible. Since, mid point of premaxilla (M)[8] , mid point of symphysis (G)[9] and mid point of sella turcica (S)[10] are free from influence of bone remodelling and rotation of jaws due to either growth or orthodontic treatment, these points have been considered in this study, to develop a reliable parameter which can diagnose antero-posterior discrepancy accurately.

AIM:

The aim of the present study is to evaluate the reliability of three new cephalometric parameters called angle MSG, angle MGS and linear measurement MM'- GG' using three skeletal landmarks

MATERIALS AND METHODS:

A total of 60 pre-treatment lateral cephalograms of subjects (aged 18-30 years) undergoing Orthodontic treatment in the Department of Orthodontics and Dentofacial Orthopaedics in M.R. Ambedkar Dental College were selected.

They were made in standardized conditions with the Frankfort Horizontal plane kept parallel to the floor and mid facial plane kept in a vertical position using Carestream CS 8100 SC by the same operator. The size of all the lateral cephalogram films were 8x10 inches, exposure data 78kV and 8mA for 10 seconds. The equipment had a fixed x ray tube to the subject's midsagittal plane of distance 5 feet.

These lateral cephalograms were divided into three groups as follows: Class I, Class II and Class III comprising 20 in each group. The lateral cephalograms were traced on an acetate paper using a 0.3mm lead pencil.

The new cephalometric parameters i.e., linear measurement MM'-GG', angles MSG and MGS were constructed and measured to determine the sagittal discrepancies. It used the three skeletal reference points, that is: Point S: Midpoint of Sella turcica, Point M: Center of largest circle that is tangent to the anterior, superior and palatal surface of premaxilla , Point G: Center of the largest circle that is tangent to the internal inferior, anterior, and posterior surfaces of the mandibular symphysis. The centers of premaxilla and mandibular symphysis were identified by constructing a template with concentric circles whose diameters increased in 0.5-inch increments. The center of the template was marked, and points M and G were identified on the tracings [9,10]. A horizontal plane was drawn through point S which was 7^0 to the SN plane and then, a vertical line was dropped through point S which was 90^0 to the newly constructed horizontal plane, known as the true vertical [11]

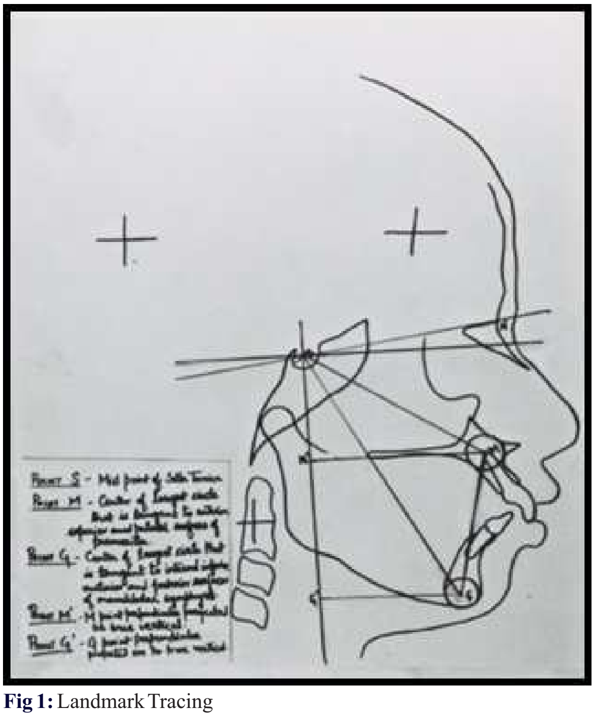

Fig 1: Landmark Tracing

The MSG angle was constructed between the lines drawn from point M to point S and point S to point G. Similarly, the MGS angle was constructed between the lines drawn from point M to point G to point S. Two perpendiculars from point M and point G was dropped on the true vertical, resulting in points M' and G'. The linear measurement of MM'- GG' was measured.

The data was collected n ms excel and forwarded for statistical analysis.

RESULTS:

In the present study , The mean ANB angle in Class I subjects was 1.90 ± 0.79, in Class II subjects was 6.70 ± 1.84 and in Class III subjects was -2.95 ± 2.21. The test results demonstrated that there was a significant difference in the mean ANB angle between 3 groups at $p<0.001$.

Multiple comparison of mean difference in ANB values between Skeletal Classes using Dunn's post hoc Test

Parameter	(I) Groups	(J) Groups	Mean Diff. (I-J)	95% CI for the Diff.		p-value
				Lower	Upper	
ANB	Class I	Class II	-4.80	-6.11	-3.49	<0.001*
		Class III	4.85	3.54	6.16	<0.001*
	Class II	Class III	9.65	8.34	10.96	<0.001*

The mean difference was statistically significant at $p<0.001$. This infers that the mean ANB angle was significantly least in Class III, followed by Class I & highest in Class II subjects.

Multiple Comparison Of Mean Difference In Wit's Appraisal Values Between Skeletal Classes Using Dunn's Post HOC Test

Parameter	(I) Groups	(J) Groups	Mean Diff. (I-J)	95% CI for the Diff.		p-value
				Lower	Upper	
Wit's Appraisal	Class I	Class II	-3.60	-5.08	-2.12	<0.001*
		Class III	5.35	3.87	6.83	<0.001*
	Class II	Class III	8.95	7.47	10.43	<0.001*

The mean Wit's Appraisal values in Class I subjects was 1.65 ± 0.99, in Class II subjects was 5.25 ± 1.83 and in Class III subjects was -3.70 ± 2.64. The test results demonstrated that there was a significant difference in the mean Wit's Appraisal values between 3 groups at $p<0.001$.

Mean Wit's Appraisal values was significantly least in Class III, followed by Class I & highest in Class II subjects.

The mean MSG angle in Class I subjects was 21.55 ± 1.15, in Class II subjects was 26.85 ± 2.58 and in Class III subjects was 19.35 ± 1.87. The test results demonstrated that there was a significant difference in the mean MSG angle between 3 groups at $p<0.001$.

Multiple comparison of mean difference in MSG values between Skeletal Classes using Dunn's post hoc Test

Parameter	(I) Groups	(J) Groups	Mean Diff. (I-J)	95% CI for the Diff.		p-value
				Lower	Upper	
MSG	Class I	Class II	-5.30	-6.79	-3.81	<0.001*
		Class III	2.20	0.71	3.69	<0.001*
	Class II	Class III	7.50	6.01	8.99	<0.001*

Mean MSG angle was significantly least in Class III, followed by Class I & highest in Class II subjects.

Multiple Comparison Of Mean Difference In MM"-GG" Values Between Skeletal Classes Using Dunn's Post Hoc Test

Parameter	(I) Groups	(J) Groups	Mean Diff. (I-J)	95% CI for the Diff.		p-value
				Lower	Upper	
MM"-GG"	Class I	Class II	-7.15	-9.88	-4.42	<0.001*
		Class III	8.75	6.02	11.48	<0.001*
	Class II	Class III	15.90	13.17	18.63	<0.001*

The mean MM"-GG" values in Class I subjects was 2.70 ± 1.87, in Class II subjects was 9.85 ± 4.10 and in Class III subjects was -6.05 ± 4.29. The test results demonstrated that there was a significant difference in the mean MM"-GG" values between 3 groups at $p<0.001$. The mean MM"-GG" values were significantly least in Class III, followed by Class I & highest in Class II subjects.

The correlation coefficients are denoted by 'rho'

Correlation coefficient range

0.0 - No Correlation; 0.01 - 0.20 - Very Weak Correlation ; 0.21 - 0.40 - Weak Correlation; 0.41 - 0.60 - Moderate Correlation; 0.61 - 0.80 - Strong Correlation; 0.81 - 1.00 - Very Strong Correlation.

Spearman's Rank correlation test to determine the relationship b/w Wit's Appraisal & MM"-GG" in each group

Parameter	Values	Class I	Class II	Class III
Wit's Appraisal	Rho	0.75	0.80	0.74
	p-value	<0.001*	<0.001*	<0.001*

The test results demonstrated a significant strong positive correlation between Wit's Appraisal & MM"-GG" values in Class I subjects [rho = 0.75], in class II subjects [rho = 0.80] and also in Class III subjects [rho = 0.74] and these relationships were statistically significant at $p<0.001$ respectively.

Spearman's Rank correlation test to determine the relationship b/w ANB, MSG & MGS in each group

Classes	Parameter	values	MSG	MGS
Class I	ANB	rho	0.78	0.79
		p-value	<0.001*	<0.001*
Class II	ANB	rho	0.72	0.77
		p-value	<0.001*	<0.001*
Class III	ANB	rho	0.74	0.70
		p-value	<0.001*	0.001*

ROC is a plot of the true positive rate against the false positive rate for the different possible cutoff points of a diagnostic test.

Accuracy is measured by the area under the ROC curve i.e AUC. An area of 1 represents a perfect test; an area of .5 represents a worthless test. A rough guide for classifying the accuracy of a diagnostic test as follows:
.90-1 = excellent (A)
.80-.90 = good (B)
.70-.80 = fair (C)

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.60-.70 = poor (D)
.50-.60 = fail (F)

ROC Curve analysis for MGS parameter in differentiating the Skeletal bases in Class I, II & III subjects								
Class	AUC	Std. Error	95% Conf. Interval		p-value	Cut off	Sn (%)	Sp (%)
			Lower	Upper				
I vs II	0.85	0.06	0.71	0.94	<0.001*	>75	70.00	90.00
I vs III	0.96	0.03	0.85	0.99	<0.001*	≤ 30	90.00	95.00
II vs III	0.99	0.01	0.90	1.00	<0.001*	≤ 31	95.00	100.00

The ROC [Receiver Operator Characteristic] Curve analysis revealed that the MSG angle demonstrated a cut off value of > 23, with an AUC of 0.94 [95% CI 0.82 – 0.99] to differentiate the Skeletal base between Class I & II subjects with Sensitivity and Specificity of 85% & Specificity of 100.0%, indicating that it will serve as an excellent diagnostic parameter to differentiate between Class I & Class II Subjects. Similarly, a cut off value of≤ 20, with an AUC of 0.74 [95% CI 0.58 – 0.86] to differentiate the Skeletal base between Class I & III subjects with Sensitivity of 60.0% & Specificity of 80.0%, indicating that it will serve as a fair diagnostic parameter to differentiate between Class I & Class III Subjects. And a cut off value of≤ 22, with an AUC of 0.91 [95% CI 0.79 – 0.98] to differentiate the Skeletal base between Class II& III subjects with Sensitivity of & Specificity of 90.0%, indicating that it will serve as an excellent diagnostic parameter to differentiate between Class II & Class III Subjects.

ROC Curve analysis for MM"-GG" parameter in differentiating the Skeletal bases in Class I, II & III subjects								
Class	AUC	Std. Error	95% Conf. Interval		p-value	Cut off	Sn (%)	Sp (%)
			Lower	Upper				
I vs II	0.99	0.02	0.89	1.00	<0.001*	> 5	95.00	100.00
I vs III	1.00	0.01	0.91	1.00	<0.001*	≤ -2	100.00	100.00
II vs III	1.00	0.01	0.91	1.00	<0.001*	≤ -2	100.00	100.00

The ROC [Receiver Operator Characteristic] Curve analysis revealed that the MGS angle demonstrated a cut off value of >75, with an AUC of 0.85 [95% CI 0.71 – 0.94] to differentiate the Skeletal base between Class I & II subjects with Sensitivity and Specificity of 70% & Specificity of 90.0%, indicating that it will serve as a good diagnostic parameter to differentiate between Class I & Class II Subjects. Similarly, a cut off value of≤30, with an AUC of 0.96 [95% CI 0.85 – 0.99] to differentiate the Skeletal base between Class I & III subjects with Sensitivity of 90.0% & Specificity of 95.0%, indicating that it will serve as an excellent diagnostic parameter to differentiate between Class I & Class III Subjects. And a cut off value of≤31, with an AUC of 0.99 [95% CI 0.90 – 1.00] to differentiate the Skeletal base between Class II & III subjects with Sensitivity of 95.0% & Specificity of 100.0%, indicating that it will serve as an excellent diagnostic parameter to differentiate between Class II & Class III Subjects.

The ROC [Receiver Operator Characteristic] Curve analysis revealed that the MM"-GG" values demonstrated a cut off value of >5, with an AUC of 0.99 [95% CI 0.89 – 1.00] to differentiate the Skeletal base between Class I & II subjects with Sensitivity and Specificity of 95.0% & Specificity of 100.0%, indicating that it will serve as an excellent diagnostic parameter to differentiate between Class I & Class II Subjects. Similarly, a cut off value of≤-2, with an AUC of 1.00 [95% CI 0.91 – 1.00] to differentiate the Skeletal base between Class I & III subjects and also Class II & III subjects with Sensitivity of 100.0% & Specificity of 100.0%, indicating that it will serve as an excellent diagnostic parameter to differentiate between Class I & Class III Subjects and also between Class II & Class III Subject

DISCUSSION:

Cephalometric roentgenography is pivotal in assessing jaw relationships in the antero-posterior, vertical, and transverse planes[1].

Various cephalometric analyses have introduced linear and angular measurements to assess sagittal base discrepancies. Given the limitations of existing cephalometric parameters, there is a need for a reliable and easily reproducible parameter to diagnose sagittal discrepancies. This study proposes the MSG, MGS angles, and linear measurement MM'-GG' using stable points M, G, and S, free from the influence of bone remodeling and jaw rotation due to growth and orthodontic treatment.

These cephalometric parameters utilize the skeletal landmarks G and M points to represent the mandible and maxilla, respectively. These points were originally introduced by Nanda and Merrill and later popularized by Braun and co-workers. [9,10] These points are not affected by local remodeling secondary to dental movements.

Moreover, points M and G can be used to assess the growth vector of maxilla and mandible, respectively, which in itself defines the stability of these points even during active growth periods.

In the present study, A total of sixty pre-treatment lateral cephalograms of subjects undergoing orthodontic treatment were randomly chosen. These lateral cephalograms were classified into three groups as follows: Class I, Class II and Class III comprising 20 in each group on the basis of inclusion and exclusion criteria. The lateral cephalograms were traced on an acetate paper using a 0.3mm lead pencil.

In the present study, there was a significant difference in the mean MSG angle between 3 groups at p<0.001.

In the present study, multiple comparison of mean differences between 3 skeletal classes revealed that the mean MSG angle was significantly least in Class III, followed by Class I and highest in Class II subjects.

In the present study there was a significant difference in the mean MGS angle between 3 groups at p<0.001.

In the present study the mean MGS angle was significantly least in Class III, followed by Class I and highest in Class II subjects.

In the present study, there was a significant difference in the mean MM'-GG' values between 3 groups at p<0.001.

In the present study, the mean MM'-GG' values were significantly least in Class III, followed by Class I and highest in Class II subjects.

The test results demonstrated a significant strong positive correlation between ANB and MSG & MGS values in Class I subjects, in Class II subjects and also in Class III subjects and these relationships were statistically significant at p<0.001 & p=0.001 respectively. It also correlates strongly between Wit's Appraisal & MM'-GG' values in Class I subjects, in Class II subjects and also in Class III subjects and these relationships were statistically significant at p<0.001 respectively.

While ANB is one of the most frequently used cephalometric parameter to assess maxillo-mandibular dysplasia, it is not without its criticisms. Identification of landmarks introduces the possibility of error, particularly at Point A and Point B, which have been shown to be susceptible to tracing errors of greater than 1.50 mm in more than 20% of lateral cephalograms[12,13].

Jacobson[14] sugested an alternate method to locate Point A. A point plotted 3.0 mm labial to a point between the upper third and lower two thirds of the long axis of the root of the maxillary central incisor was found to be a suitable point. Another disadvantage of angle ANB is that, the points A and B are subject to change due to regional remodelling since these reference points are located in the alveolar process of maxilla and mandible. [15]

This is overcome in the current study with the usage of points M and G which are the core points of maxilla and mandible, respectively. [15] They are located at the center of the largest circle placed tangent to the anterior, superior (represented by the nasal floor), and palatal surfaces of the premaxilla and the internal anterior, inferior, and posterior surfaces at the mandibular symphysis, respectively.[9,10]

Point S is chosen as the third reference point in this study because, as mentioned by Steiner[16], it is located in the mid sagittal plane of the head and therefore is least affected by head deviation. Hence, there is no ambiguity in locating the landmark.

Another important reference line used in the study is the True Vertical plane[17], which is formed by drawing a perpendicular line to the constructed horizontal plane[17] through Point S.

The reference plane used in Wits appraisal is the occlusal plane. It is drawn through the area of maximal intercuspation. [18]

The limitations of such a reference plane is that, it uses a dental parameter to describe the skeletal discrepancies. Occlusal plane is easily affected by tooth eruption and orthodontic treatment. Also, precise identification of the occlusal plane is challenging, [19,20] especially in mixed dention, patients with multiple impactions, missing teeth and steep Curve of Spee. Therefore, the True Vertical plane was felt to be more stable and reliable.

Though the new cephalometric parameters prove to be more advantageous compared to the ones currently available, further studies on larger population and different ethnic groups would be required to substantiate the results derived from the present study.

CONCLUSION:

From the present study it can be concluded that angle MSG, MGS correlates strongly with the gold standard, ANB angle and linear measurement MM'-GG' show a significant strong positive correlation with Wits appraisal. Since the reference points used in the present study overcome the disadvantages of the currently available cephalometric parameters, it is proposed that angle MSG, MGS and linear measurement MM'-GG' are reliable cephalometric parameters and can be used as a potential alternative to assess sagittal jaw dysplasia.

REFERENCES :

1. Kumar V, Sundareswaran S. Cephalometric Assessment of Sagittal Dysplasia: A Review of Twenty One Methods. J Indian Orthod Soc. 2014;48(1):33-41.
2. Riedel RA. The relation of maxillary structures to cranium in malocclusion and in normal occlusion. Angle Orthod. 1952;22:142-145.
3. Freeman RS. Adjusting A-N-B angles to reflect the effect of maxillary position. Angle Orthod. 1981;51(2):162-71.
4. Taylor CM. Changes in the relationship of Nasion, point A, and point B and the effect upon ANB. Am J Orthod. 1969;56(2):143-63.
5. Hussels W., Nanda RS. Analysis of factors affecting angle ANB. Am J Orthod. 1984;85(5):411-23.
6. Neela PK., Mascarenhas R., Husain A. A new sagittal dysplasia indicator: The Yen angle. World J Orthod. 2009;10(2):147-15.
7. Bhad WA., Nayak S., Doshi UH. A new approach of assessing sagittal dysplasia: The W angle. Eur J Orthod 2013;35(1): 66-70.
8. Nanda RS., Merrill RM. Cephalometric assessment of sagittal relationship between maxilla and mandible. Am J Orthod Dentofacial Orthop. 1994;105:328-344.
9. Braun S., Kittleson R., Kim K. The G-Axis: A growth vector for the mandible. Angle Orthod. 2004;74:328–331.
10. Björk A.Cranial base development: A follow-up x-ray study of the individual variation in growth occurring between the ages of 12 and 20 years and its relation to brain case and face development. Am J Orthod. 1955;41(3)198-225.
11. Al-Abdwani R., Moles DR., Noar JH. Change of incisor inclination effects on points A and B. Angle Orthod . 2009 ;79(3):462-7.
12. Baumrind S, Frantz RC. The reliability of head film measurements part II: Conventional angular and linear measures. Am J Orthod. 1971:60(5):505-517.
13. Jacobson, R. L., & Jacobson, A. Point A revisited. Am J Orthod. 1980.77(1), 92–96.
14. Steiner, C. C. (1953). Cephalometrics for you and me. Am J Orthod. 39(10), 729–755.
15. Asaduaria.B.M, Jadav.C, Srinivasulu, Manikanta Swamy.S, Mothe.G. Reliability of W-angle to assess sagittal skeletal dysplacia in Class I, Class II, Class III, patients: A Cephalometric study. Int J of Applied Dent Sciences 2021; 7(1): 414-417
16. Sayinsu, K. (2006). Unilateral molar distalization with a modified slider. Eur J Orthod, *28(4), 361–365.*
17. Baumrind S, Frantz RC. The reliability of head film measurements part I: Landmark identification. Am J Orthod. 1971:60(2):111-127.
18. Jacobson A. The 'Wits' appraisal of jaw disharmony. Am J Orthod. 1975;67(2):125-138
19. Haynes S, Chau M. The reproducibility and repeatability of the Wits analysis. Am J Orthod Dentofacial Orthop 1995;107: 640-647.
20. Bjork A. Facial growth in man, studied with the aid of metallic implants. *Acta Odont Scan*. 1955;13:9-34