# The reliability of Rickett's analysis using cephalometric tracing on Iraqi sample aged 8-10 year

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## Abstract

Cephalometric radiographs were taken for (48) subjects with class I occlusion ; (25) females and (23) males , which selected on the standarization of the radiographs. Sample ages range 8-10 years . cephlometric tracing are carried out using the same points, lines, angles and axis of Rickett's analysis.

On comparing the results of this research which is carried out on Iraqi sample with Rickett's analysis on Caucasian people of the same age appears that there are differences in most of these measurements and this due to racial factors and ethnic variations which play a great role in differences between each ethnic group .

The results of Iraqi measurements (mean values ) as fallows:-

facial axis (Y-axis) =91.3°; facial depth angle =81.2° ; Frankfort-mandibular plane angle=30°; convexity of point A (mm)=2.7mm; lower incisor to A-pog =1.8mm;angle =26.1° and finally ANS-Xi-Pm angle (lower facial height) = 45.8°.


**key wards: Cephalometric X-rays , cephalometric tracing, Rickett's analysis, points, planes, angles.**

## Introduction

Cephalometric radiographs can be used to diagnose the location and the severity of dentofacial discrepancies , since the original purpose of cephalometric radiography was to assess the growth pattern in the craniofacial complex and also to provide a clinical tool for study of malocclusion and underlying skeletal disproportion [1] , vertically and horizontally of a jaw to a cranial base and to each other , and the relationships of the teeth to their supporting bone [2] .

Knowledge of the normal dentofacial patterns of each ethnic group concerning the age , information of both gender are very important since morphologic features of different races and ethnic groups are not randomly distributed , so the development of cephalometric norms and analysis in an attempt to define the skeletal characteristics of a "good face" and "good occlusion"[3] .

Cephalometric was introduced to orthodntic society by Broadbent [4].

Rakosi [5] has reported that more than one hundred method of cephalometric tracing have been developed . Each method has its aims, advantages and limitations. Some of them were very simple as Tweed's analysis[6], and others were relatively complicated as Bjork's analysis [7] and Sassounis analysis [8].

While Brown [9] estimate about fifty different methods of analysis. The most common methods of analysis include:

Down's analysis ; Riedel analysis; Steiner analysis; Wit's analysis, East man's analysis, Mills. Sassouni analysis, Harvold analysis, McNamara analysis, Enlow's counterpart analysis; template analysis, finally the computerized cephalometric analysis.

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Where Rickett's analysis[10,11,12,13] : which is one of the most commonly used cephalometric analysis who proposed to use points , planes and axes in addition to the traditional land mark for specific analysis , to analyze the chin in space , facial convexity , teeth position and facial profile . On young caucasion children aged 9 years of age and records his findings in a table having the mean values of the facial axis, facial depth, mandibular plane ; convexity of point A on the maxilla and lower incisors inclination , also he study the shape of the mandible and locate Xi point to explain the corpus axis which extend form Xi to Pm and use it to describe the morphology of the mandible (Skeletal and orthopedic conditions) . Before treatment to know the lower facial height which describes the vertical relation of the maxilla to the mandible and horizontally , the maxilla and mandible of the normal caucasion profile are in perfect alignment , and both falling along the facial plane .

Many Iraqi studies concerning cephalometric analysis like Odeh[14] who reported that there was no Iraqi cephalometric data which were needed urgently .

Odeh[15] carried out another cephalometric study on Iraqi orthodontic patients 10-17 years old giving the norm values for Iraqi patients using Eastman method of compensation for orthodentic patient only and not for general population , which may not be applied to general population . Normative cephalometric data growth prediction require thorough information concerning the age , for both gender and for each race .

Ali F. A.[16] designed his study to analyze some skeletal facial and dental characteristics for both gender including 11 angular and 7 linear measurement by using cephabometric radiography for 9-10 years old Iraqi children .

Also Al-Sahaf N.H.[17] she carried a cross- sectional study of cephalometric standards and associated growth changes on a sample 9-17 years .

Her sample was classified into three skeletal groups based on the facial angles differences , age and genders ; concluded that there were no sever skeletal variations among Iraqi population since they possessed mild to moderate skeletal class II and relatively mild skeletal class III .

Al-Kannaq M.R.[18] carried a cephalometric study of class II division I aged 11-14 years (growth study). Also he carried another cephalemetric study in (2000) to determine the angulation and the distance of the centrals to their basal bones.

Many other Iraqi cephalometric studies carried out like Al-Sarraf [19] in Mosul city: AlSayaph N.M.[20] ; Al-Hamdany A. K. [21]; Al-taani M.M.C. [22]; Amasha H.F. [23]

But no one have apply Rickett's analysis on Iraqi sample, therefore this study is done to assess the validity and reliability of Rickett's analysis on Iraqi sample aged 8-10 year in order to obtain the fallowing:-

1. To obtain the mean values of cranial base, mandible & maxilla measurement in Iraqi sample.
2. To study these measurement in both genders.

## Materials and Methods :

Cephalometric radiographs were taken for (48) subjects with class I occlusion ; (25) females and (23) males , which selected on the standarization of the radiographs . sample ages range 8-10 years .

The cephalometric radiographs were taken for each subject with the teeth in centric occlusion , based on the

Broadbent technique (1931) and as adopted by Odeh (1979) .

The film was placed on the veiwer Houstin [24] with image facing to the right Jacobson [25]. Trace the external and internal contour of cranium and frontal sinus the out line of orbital bone, pituitary fossa (Sella tursica) , maxilla and nasal bone , ptregomaxillary fissure , finally the lower border of the mandible Krogram [26] or intermediate line when double image appeared Nanda [27].

The following cephalometric landmarks (points) were used as described by Ricketts (Fig. 1).Point (A); ANS; Point (B); Gonion (Go) Menton (Me) ;Nasion (N);Orbital (Or); Pogonion (Pog); Porion (Po); Sella (S); Pm (Protuberance menti).

The lines or planes which are used by Rickett's analysis as follows (Fig.2): SN line; Mandibular plane;Facial plane;Pt.v (pterygoid vertical);Basio-Nasion plane& A-pog line.

The most widely used axis by Ricketts analysis are (Fig 2).

- Facial axis: A line extending from the faramen rotundum (Pt.v to Gn).
- Corpus axis: Extends from Xi to Pm which is used to describe the morphology of the mandible to evaluate dentition changes.

Xi a point located at the geographic center of the ramus. Its location is keyed geometrically to Po-Or (F.H) and (Fig. 3) perpendicular through PT (Pt.v) in the following steps:

1- By constructing a plane perpendicular to FH and Pt.v.
2- These constructed planes are tangent to points (R1, R2, R3, R4)* on the borders of the ramus.
3- The constructed planes will form a rectangle enclosing the ramus.
4- Xi is located in the center of this rectangle at the intersection of diagonals.

The measurement includes five (5) angular measurements and three (3) linear measurements; as described by Rickett (Fig. 4) they are as fallows:

**1- Facial axis angle:** This angle is formed by the intersection of the Basion - Nasion line and the facial axis . On the average and a cording to Rickett's analysis it's $90^o$ with clinical variation of $\pm 3^o$ degree . (It's a modification of y axis) which joins the center of sella turcica to gnathion point , this axis gives the general direction of the facial growth in addition to the facial height .

**2- Facial (Depth) angle :** This measurement is the angle formed by the intersection of the facial plane (N.pog) and the frankfort horizontal plane . This angle gives an indication of the antero – posterior (Horizontal) position of the most anterior point of the mandible (pogonion). It 87° according to Ricketts measurement with clinical variation of ($\pm 3^o$) degrees.

**3- Mandibular plane angle :**This angle is formed by the intersection of the mandibular plane and the frankfort horizontal plane. This angle gives the clinician an indication of the cant of the mandibular corpus. it’s $26^o$ according to Rickett's measurement and decreases approximately 1° every 3 years.

**4- Convexity:**

Convexity at point A: (subspinale). It represent anterior Limit of maxilla or the convexity of middle face.

It’s the distance in millimeters from point A to the facial plane (N-pog) measured perpendicular to that plane.

It gives an idea about the growth of maxilla; it’s 2mm according to Rickett's measurement with a clinical deviation of 2mm. It decreases 1° every 5 years.

**5- Lower incisor to A- pog (mm)(Lo.inc-A.pog):** "Ideally" the lower incisor should be located 1.0mm a head of the A – pog line (Rickett's analysis). This measurement is used to define the protrusion of the lower arch .

**6- Upper molar to Pt.v (Up.Mo-Pt.v) :** It is the distance in mm from the pterygoid vertical (Back of the maxilla) to the distal of upper molar(mm) . On average this measurement should equal the age the patient +3.0 mm according to Rickett's analysis; it assists in determining whether a malocclusion is due to the position of upper or lower molar. Its also useful in deciding whether extraction are necessary .

**7- Lower incisor to A-pog (Lo.inc- A. pog):** The angle between a long axis of a lower incisor and the A pog plane. it's $22^o$ according to Rickett's measurement this measurement provides some idea of lower incisor procumbency) .

**8- ANS –Xi-Pm:**

This angle is formed between the anterior nasal spine to the Xi (on the corpous of mandible) and to the protuberance mentalis on the inner surface of the symphysis of mandible (fig5). This describes the divergence of the oral cavity.

Rickett's measurement of this angle it 9 years caucasian children was $45^o$ with clinical deviation 4.0 degree.

It refered to the lower facial height skeletally as it describes the vertical relation of the mandible and maxilla , so low values indicative of skeletal deepbite and high values indicative of skeletal open bite .

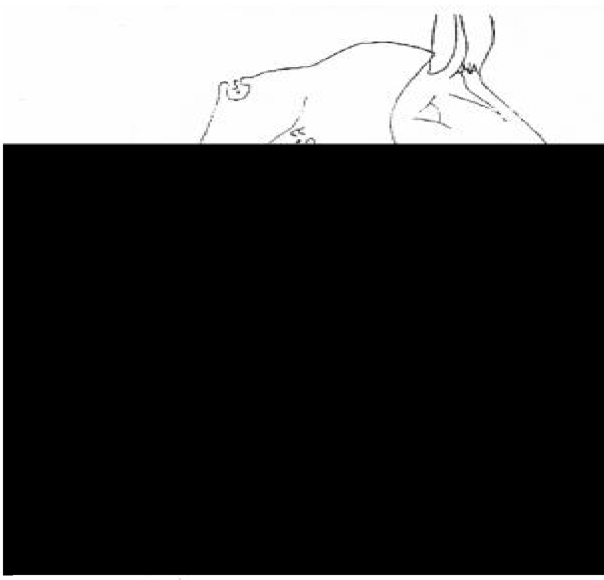
## Result &Discussion :

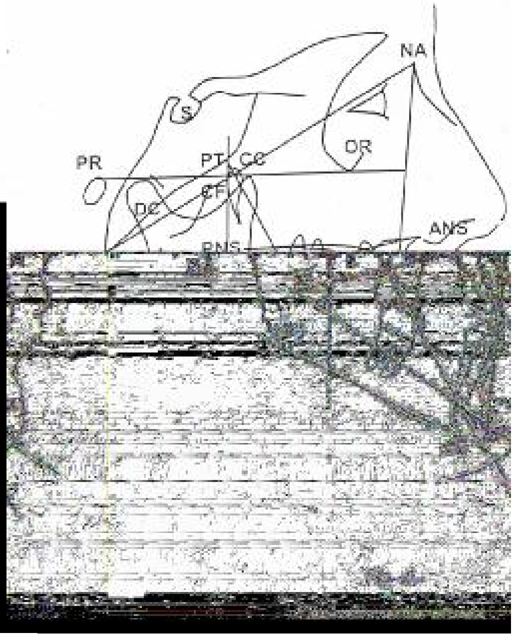
**1- Facial axis (Y-axis)**

From table (1) (total) shows that the mean of the facial axis (Y) was found to be ($91.3^o$) with standard deviation ($2.1^o$) for all the sample (male and female) which is coincide with Rickett's analysis [11,12] table (2) which is found to be ($90^o$) with standard deviation ($3.5^o$) this finding coordinate with finding of Ali F.A.[16] who study Iraqi sample aged 9-10 years.

Table (3)&(4) shows no significant difference between the mean Y-axis angle of female and male.Since Y axis refers to the growth pattern diagonally relative to the cranium or base of the skull (point N. Ba) and the gnathion point (Gn) tip of the chine .

So its decrease means retroposition of the chin which means tendency toward class II skeletal pattern while its increase or greater than ($90^o$) suggest a protrusive or forward growing chin or skeletal class III .





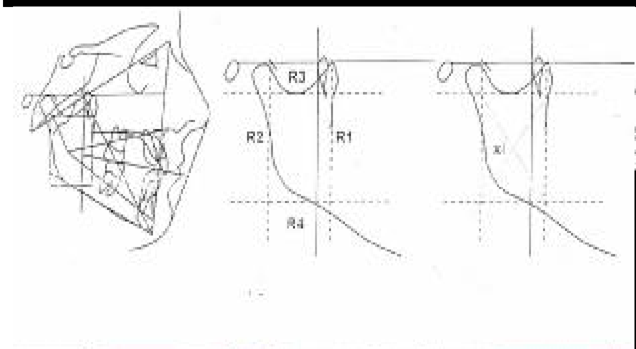
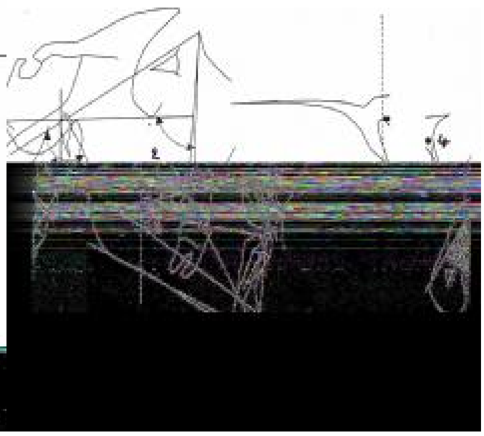




Fig -3-
Localization of Xi on the mandible



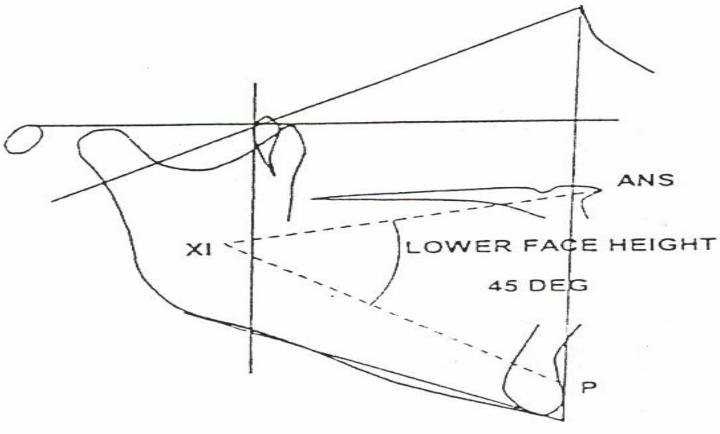



Fig -5-
Determination of Lower facial height (ANS-Xi-Pm)

**2- Facial depth (F. angle) :**

From table (1) total shows that the mean statistical description for the facial depth angle (81.27°) with standered deviation of (±4°) in comparison with the sample of Rickett on caucasian people aged 9-10 year table (2) which was 87° with S. D. (±3°).

This angle which measured between the facial plane (N-pog) and the Frankfort horizontal which provide indication of the horizontal position of the chin this angle was changed due to the change in position of N point during growth at age 8-10 years and this finding coordinate with the discussion of Ali F.A.[16] about the point N. for Iraq , sample of 9-10 years old .

From table (3)&(4) which shows that this angle was less in male than female due to the anterior position of point N during growth period in males which was reported by knot et al [28] and Williams et al [29].

**3- Mandibular plane angle (Fr-M-angle):**

This angle which formed between the mandibular plane and frankfort plane Rickett's analysis shows that this angle will decrease I degree every 3 years.

Table (1) shows that the mean degree for this angle is (30°) with S.D. of (±4) in comparison with Rickett's table (2). Shows higher degree in Iraqi sample than Rickett's sample (Caucasian people) aged 9 years.this result is coordinate with Odeh [14] and Al-Sahaf [17] , Odeh reported that the international cephalometric values might not necessary applied to Iraqi people which related to racial variation and genetic differences.

Also Al-Sahaf reported that there is significant increase from 9-11 years but it decreases after that.

From table (3) & (4) measurement there are no differences between male and female.

**4- Convexity of point A:**

As point A refers to the convexity of the middle face which is linear measurement from point A on the maxilla to the facial plane (N-pog). This distance describes the skeletal relationships (i.e) relation of the maxilla horizontally to the mandible.

From table (1) shows that the mean for this distance in Iraqi sample approximately (2.7mm) with S.D. (1 mm) .

Table (2) shows that this linear measurements slightly higher than Rickett's measurement and this may be due to ethnic variation and racial differences Odeh [14] .

Table (3)&(4) shows this linear measurements was more in female than male and this may be due to the position of point N. in males as this point (N) comes more anterior in males due to greater measurement in males during growth Knot etal.[28] ; Williams etal [29] ; and Ali [16] .

**5- Lower incisor to A pog :(Lo.inc-A.pog)**

As the A-pog line or plane called denture plane so its important for the position of anterior teeth .

This measurement is used to define the protrusion of lower arch .

From table (1)&(2) this linear measurement shows higher than that of caucasian people which measured by Rickett's and this due to more proclined lower incisor in Iraqi people and this in accordance with Al-Kanaqi [18] .

This also due to ethnic variation and from table 3 and 4 shows that there is no difference between male and female .

**6- Upper molar Pt.v : (Up.Mo-Pt.v)**

As this linear measurement denotes to the distance from the pterygoid vertical (back of the maxilla) to the distal of the upper molar . On the average this measurement equal to the age of the patient +3.0mm according to Rickett's analysis . Its an indicative measurement for the position of the upper molar to the back of the maxilla to the (Pt.v) fissure which is difficult to be locate in young growing child and super imposed with the other structure .

Iraqi people results table (2) shows its slightly lower than that of Ricketts measurement on caucasian children aged 9 years and this may be due to ethnic variation and racial differences which get faster growth in hot areas .

**7- Lower incisor inclination to A-pog angle:(Lo.inc-A.pog angle)**

This angular measurement formed between the lower incisor and the A-pog plane.

A cording to Rickett's analysis its ($22^{o}$) with S.D. of ($\pm 4^{o}$) for caucasian children aged 9 years but for Iraqi children at the same age group its greater as shown in table (1) and table (2) this fact indicative that the lower central incisors are more proclined in Iraqi people and this in accordance with (Ali F.A. [16] and Al-Kanaqe [18] ) .

**8-ANS-XI-Pm ( Lower facial height)**

Maxillo-mandibular relationship: Horizontally the maxilla and mandible of the normal caucasion adult profile are in perfect alignment, both falling along the facial plane.

Vertically, the relation of the maxilla to the mandible is described by the lower facial height, (the intersection of two planes, ANS-XI and XI-Pm). The norm for this measurement is ($45^{o}$) degrees acording to Rickett's analysis in young 9 years old caucasion child with S.D. ($4.0^{o}$) degree.

Table (1) show this angle in Iraqi sample is ($45.8^{o}$) with S.D. ($3.6^{o}$) which is approximately smiller to Richett's analysis (table 2) there is no difference between both gender table (3) and table (4) .

Corpus axis : Extends from Xi to Pm :used to describe the morphology of the mandible and to evaluate dentition changes (Fig. 5) .

Table 1 Total descriptive statistics measurements for Iraqi sample (male & female aged 8-10year)

Descriptive Statistics

| | N | Minimum | Maximum | Mean | Std. Deviation |
|---|---|---|---|---|---|
| F-angle | 48 | 86.00 | 95.00 | 91.3750 | 2.1100 |
| Fr-M_angle | 48 | 70.00 | 90.00 | 81.2708 | 4.1088 |
| CONVEXITY OF A | 48 | 23.00 | 37.00 | 30.0833 | 4.2015 |
| Lo-Inc. A-linear | 48 | .50 | 5.00 | 2.7812 | 1.0258 |
| Up-Mo-ptv-Linear | 48 | -2.00 | 4.00 | 1.8021 | 1.0455 |
| Lo-Inc.A-pog-angle | 48 | 8.00 | 13.00 | 102917 | 1.4434 |
| ANS-XI-pm angle | 48 | 17.00 | 35.00 | 26.1042 | 4.3479 |
| Valid N (listwise) | 48 | 39.00 | 55.00 | 45.8125 | 3.6650 |

Table 2 comparison between Iraqi sample & Caucasian sample (Rickett's analysis ) aged 8-10 year

| Measurements | Iraqi sample | | Caucasian sample (Rickett's analysis) | |
|---|---|---|---|---|
| | mean | Std.deviation | mean | Std.deviation |
| Y-axis | 91.3750 | 2.1100 | 90 | 3.5 |
| F-angle | 81.2708 | 4.1088 | 87 | 3 |
| Fr-M-angle | 30.0833 | 4.2015 | 26 | 4.5 |
| Convexity (mm) | 2.7812 | 1.0258 | 2 | 2 |
| Lo-inc.A-linear (mm) | 1.8021 | 1.0455 | 1 | 2 |
| Up-Mo-ptv linear (mm) | Age+2 | | Age +3 | |
| Lo-inc.A-pog angle | 26.1042 | 4.3479 | 22 | 4 |
| ANS-xi-pm angle | 45.8125 | 3.6650 | 46 | 4 |

Table 3 Female descriptive statistical measurement for Iraqi sample aged 8-10 year

Descriptive Statistics

| | N | Minimum | Maximum | Mean | Std. Deviation |
|---|---|---|---|---|---|
| Y-axis | 25 | 86.00 | 95.00 | 91.200 | 2.3804 |
| F-angle | 25 | 75.00 | 90.00 | 81.9600 | 4.0258 |
| Fr-M-angle | 25 | 23.00 | 37.00 | 29.7200 | 4.7039 |
| CONVEXITY | 25 | 1.00 | 4.00 | 3.0000 | .8292 |
| Lo-inc.A-Linear | 25 | .00 | 3.00 | 1.7400 | .6633 |
| Up-Mo-ptv_Line | 25 | 8.00 | 13.00 | 9.8800 | 1.7156 |
| Lo-Inc.A-angle | 25 | 17.00 | 35.00 | 25.8800 | 4.9271 |
| ANS-XI-Pm angle | 25 | 39.00 | 51.00 | 45.240 | 3.6162 |
| Valid N (listwise) | 25 | | | | |

Table 4 Male descriptive statistical measurement for Iraqi sample aged 8-10 year

Descriptive Statistics

| | N | Minimum | Maximum | Mean | Std. Deviation |
|---|---|---|---|---|---|
| Y-axis | 23 | 88.00 | 95.00 | 91.5652 | 1.8047 |
| F-angle | 23 | 70.00 | 90.00 | 80.5217 | 4.1546 |
| Fr-M-plane | 23 | 23.00 | 36.00 | 30.4783 | 3.6415 |
| CONVEXITY | 23 | .50 | 5.00 | 2.5435 | 1.1766 |
| Lo-Inc.A-Linear | 23 | -2.00 | 4.00 | 1.8696 | 1.3586 |
| Up-Mo-ptv-Linear | 23 | 9.00 | 12.00 | 10.7391 | .9154 |
| Lo-Inc. A-pog-angle | 23 | 17.00 | 35.00 | 26.3478 | 3.7125 |
| ANS-XI-Pm angle | 23 | 39.00 | 55.00 | 46.4783 | 4.0099 |
| Valid N (listwise) | 23 | | | | |

## Conclusion

On comparing the results of this research which is carried out on Iraqi sample with Rickett's analysis on Caucasian people of the same age , using the same points, lines, angles and axis of Rickett, appears that there are differences in most of these measurements and this due to racial factors and ethnic variations which play a great role in differences between each ethnic group .

The measurements of this research as fallows:

1- **Facial axis angle:** The mean of it ($91^o$ )with S.D.( ±2°) which is approximately near to the Rickett's reading and there is no difference bet both genders.
2- **Facial depth angle:** The mean of this angle is ($81.5^o$) with S.D.( ± 4°) which is less than Rickett's analysis and the male reading is slightly less than female.
3- **Frankfort mandbular plane angle**: The mean of it ($30^o$) with S.D. (± 4°) and this Iraqi reading is higher than Rickett's analysis and there is no differences between both genders.
4- **Convexity point A**: The mean of this distance in Iraqi sample is (2.7mm) with S.D. (±1mm) which shows slightly higher than Rickett's analysis. This linear measurement is more in female than that in male.
5- **Lower inc to A-pog.** : The mean of this linear measurement is (1.8mm) with S.D. (1mm) and this linear measurement shows slightly more than Rickett's reading. There is no difference between both genders.
6- **Upper molar to Pt.v.**: The mean of this distance is ($10.5^o$ ) with S.D. (1.4) which referred to the age (+ 2 mm) , which is less than Rickett's analysis and there is no differences between both genders .
7- **Lower incisor inclination angle to A.pog:** The mean of this angle in Iraqi sample is ($26^o$) with S.D.(± 4°). This result shows higher than Rickett's analysis.
8- **ANS–Xi-Pm**: The mean of this angle ($45.8^o$) with S.D. (3.6°) which is approximately similar to that of Rickett's analysis. There is no difference between both genders.

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## الخلاصة

اجري هذا البحث لمعرفة مدى امكانية تطبيق طريقة قياسات (Rickett ) باستخدام اشعة جانبية للرأس والفكين على الواقين الذين تتراوح اعمارهم من ٨-١٠ سنوات باخذ ٤٨ عينة من نوع الاطباق الاول (٢٥) اناث و (٢٣) ذكور باستخدام ذات النقاط والخطوط و الزواية والمحاور التي استخدمها Rickett.

واضهرت النتائج ان هناك اختلافات واضحة لقياسات هؤلاء الاشخاص العراقين عن القوقازين من الفئة العمرية ذاتها، نتيجة الاختلافات العرقية،الوراثية و البيئية