The relation among ramal width and length with some cervical and cranio-facial measurements in different skeletal classes

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ABSTRACT

Background: The purpose of this study was to assess the relation among the ramal length and width with various cervical and cranio-facial measurements for a sample of Iraqi adults with different skeletal classes.

Materials and method: The sample composed of 71 Iraqi adults (36 females and 35 males) with an age ranged between 17-30 years and had different skeletal mal-relations using SNA, SNB and ANB to differentiate between them and assorting them into CL.I, CL.II and CL.III mal-relation. Each individual was subjected to clinical examination and digital true lateral cephalometric radiograph that had been analyzed using AutoCAD 2007 software computer program to determine sixteen linear and ten angular measurements. Descriptive statistics were obtained and independent samples t-test was performed to evaluate the gender differences in different classes. ANOVA test as used to compare the measurements among the skeletal classes in each gender, while Pearson's correlation coefficient test was used to determine the relations among ramal length and width with other measurements in all classes.

Results and Conclusions: All of the linear measurements were significantly higher in males than females. On the other hand, the angular measurements showed non-significant gender difference except for SN-PP angle in class II group. ANOVA test showed statistically significant difference in upper gonial angle, Y-axis angle and the mandibular length. Ramal length and width correlated significantly with PFH, SN-MP angle and Co-Gn.

Key words: Ramal height, Ramal width, first cervical vertebral morphology, mandibular morphology. (J Bagh Coll Dentistry 2014; 26(4):167-174).

INTRODUCTION

Almost 50 years later, orthopedic modification of facial growth is still a topic of great interest to practicing orthodontists. A review of the literature revealed a general consensus that, while clinicians can use orthopedic appliances such as headgear to modify maxillary growth, the effects of mandibular orthopedic appliances, such as bionators, on mandibular growth are more controversial. One reason for the unpredictable response of the mandible to orthopedic treatment may be related to the complex morphology of the bone. The mandible can be divided into four functional components: the condyle, the ramus, the corpus, and the alveolus [(1)].

Björk stated that different individuals exhibit different patterns of mandibular growth and the other authors have proposed that the mandible does not follow one characteristic pattern throughout life; it is likely that the map of mandibular growth varies with the age of the individual [(2)].

A significant point to mention is that, the rami are important compensatory structures involved in mandibular adaptations during growth, because if the mandibular ramus is just three or four millimeters too wide or too narrow, a corresponding retrusive or protrusive malocclusion can exist and if the ramus is vertically a few millimeters too short or too long, there is a basis for a vertical malocclusion [(3)] but what about the different skeletal classes? For that reason, a trial to study the relation among the ramus width and length with different cervical and cranio-facial parameters in different skeletal classes was established.

The aim of this study was to find the relation between the ramus height {measured from Condylion to Gonion [(4)]} and ramus width {measured the length of the line drawn from mid-planed deepest points on posterior and anterior borders of ramus [(5)]} with some cervical and cranio-facial measurements in a sample of Iraqi adults with different skeletal classes.

MATERIAL AND METHODS

Sample

The sample comprised of 71 subjects including dental students and some patients attending the Orthodontic department at the College of Dentistry, University of Baghdad. All individuals were Iraqi adults (36 females and 35 males) with an age ranged between 17-30 years.

All the subjects had complete permanent dentition regardless the third molars. They were clinically healthy with no syndromes or evidence of craniofacial anomalies such as cleft lip and/or palate. None had a history facial trauma or previous orthodontic, orthopedic or surgical treatment [(6)].

The samples were classified according to ANB angle [(7)] into:

1. Skeletal Cl I: ANB 2°- 4°.
2. Skeletal Cl II: ANB > 4°.
3. Skeletal Cl III: ANB < 2°.

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Methods

A digital true lateral cephalometric radiograph was taken for each individual using Planmeca ProMax radiograph unit after clinical examination for him/her. The individual was positioned within the cephalostat with the sagittal plane of the head vertical, the Frankfort plane horizontal and the teeth were in centric occlusion. Every radiograph was analyzed by AutoCAD 2007 software computer program to calculate the angular and linear measurements after correcting the magnification.

Cephalometric landmarks, planes and measurements (Figure 1)

-Cephalometric landmarks:

1. Point N (Nasion): The most anterior point on the naso-frontal suture in the median plane [9].
2. Point S (Sella): The midpoint of the hypophysial fossa [8].
3. Point Ar (Articulare): The point of intersection of the external dorsal contour of the mandibular condyle and the temporal bone [11].
4. Point Go (Gonion): A point on the curvature of the angle of the mandible located by bisecting the angle formed by the lines tangent to the posterior ramus and inferior border of the mandible [7].
5. Point Gn (Gnation): A point located between the most anterior and the most inferior point of the chin [8].
6. Point Me (Menton): The lowest point on the symphyseal shadow of the mandible seen on a lateral cephalogram [7].
7. Point A (Subspinale): The deepest midline point on the premaxilla between the anterior nasal spine and Prosthion [9].
8. Point B (Supramentale): The deepest midline point on the mandible between Infradentale and Pogonion [9].
9. Point ANS (Anterior Nasal Spine): It is the tip of the bony anterior nasal spine in the median plane [8].
10. Point PNS (Posterior Nasal Spine): This is a constructed radiological point, the intersection of a continuation of the anterior wall of the pterygopalatine fossa and the floor of the nose. It marks the dorsal limit of the maxilla [8].

-Cephalometric planes:

1. N-A line: Formed by a line joining Nasion and point A [8,9,12].
2. N-B line: Formed by a line joining Nasion and point B [8,9,12].
3. S-N plane: Formed by a line joining Sella turcica and Nasion. It represents the length of anterior cranial base [8].
4. S-Ar plane: Formed by a line joining Sella turcica and Articulare. It represents the Lateral extent of the cranial base [8].
5. Ar-Go plane: Formed by a line joining Articulare and Gonion [8].
6. Go-Gn line: Formed by a line joining Gonion and Gnation and represent the external body length of mandible [5].
7. Co-Gn line (maximum mandibular length): Formed by a line joining Condylion and Gnathion [5,21].
8. Palatal plane (PP): Formed by a line joining anterior and posterior nasal spines [8].
9. Mandibular plane (Go-Me): Formed by a line joining Gonion and Menton [8].
10. Anterior facial height (N-Me): The distance between Nasion and Menton [8].
11. Posterior facial height (S-Go): The distance between Sella turcica and Gonion [8].
12. Ramus height (Co-Go): It is measured from Condylion to Gonion [4].
13. Ramus width: It is measured the length of the line drawn from mid-planed deepest points on posterior and anterior borders of ramus [5].
14. a-p line: It is the maximum antero-posterior extent of atlas vertebra [8,15].
15. Atlas Venter: It is the maximum vertical extent of the atlas ventral arch perpendicular to the length of the atlas a-p [8,15].
16. Atlas dors: It is the maximum vertical extent of the atlas dorsal arch perpendicular to the length of the atlas a-p [8,15].

-Cephalometric angles:

1. ANB angle: The angle between lines N-A and N-B. It represents the difference between SNA and SNB angles or it may be measured directly as the angle ANB. It is the most commonly used measurement for appraising anteroposterior disharmony of the jaws [10].
2. SN-MP angle: The angle between the S-N plane and the mandibular plane [8].
3. SN-PP angle: The angle between the S-N plane and the palatal plane [13].
4. PP-MP: The angle between palatal plane and mandibular plane [8].
5. N-S-Ar: Saddle angle, between the anterior and the posterior cranial base. This angle formed at the point of intersection of the S-N plane and the S-Ar plane [12].
6. S-Ar-Go: Articular angle, formed at the point of intersection of the S-Ar plane and the Ar-Go plane [12].
7. Ar-Go-Me: Gonial angle, formed at the point of intersection of Ar-Go plane and the mandibular plane (Go-Me) [12].

8. Go1 angle: Formed by the ascending ramus and the line joining Nasion and Gonion and it indicate anterior direction of growth [8].
9. Go2 angle: Formed by the line joining Nasion and Gonion with mandibular plane [8].
10. Y-axis angle (N-S-Gn): is formed at the point of intersection of S-N plane and S-Gn plane [8].

Statistical analyses

All the data of the sample were subjected to computerized statistical analysis using SPSS version 15 (2006) computer program. The statistical analyses included:

- Descriptive Statistics; include Means, standard deviations (S.D.) and statistical tables.
- Inferential Statistics; include
  - Independent-samples t-test: for the comparison of the measurements between genders in each class.
  - ANOVA test: for the comparison of the measurements among the classes in each gender.
  - LSD test: used to test the significant between every two groups if ANOVA gives significant results.
  - Pearson correlation coefficient test (r): It is used to find the relationship between the measured variables.

In the statistical evaluation, the following levels of significance were used:

Non-significant	NS	P>0.05
Significant	*	0.05≥P>0.01
Highly significant	**	P≤0.01

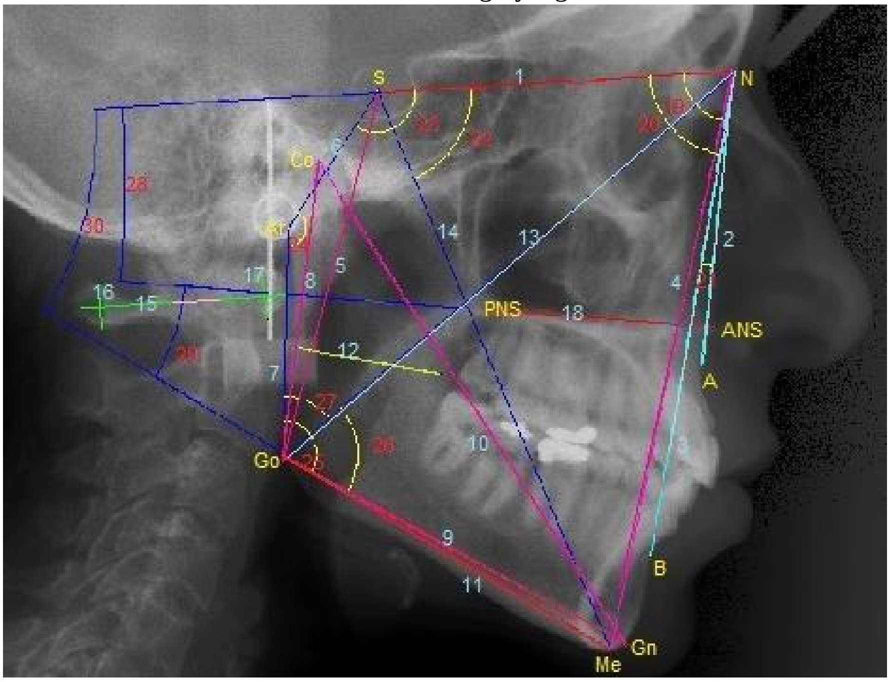

Figure 1: Cephalometric landmarks and measurements: N: Nasion. S: Sella turcica. Ar: articulare. Go: Gonion. Me: Menton. Gn: Gnation. A: Subspinale. B: Supramentale. ANS: Anterior nasal spine. PNS: Posterior nasal spine. Co: Condylion 1: S-N. 2: N-A. 3: N-B. 4: N-Me (AFH). 5: S-Go (PFH). 6: S-Ar. 7: Ar-Go. 8: Co-Go (Ramus height). 9: Go-Gn (External body length of mandible). 10: Co-Gn (Maximum mandibular length). 11: Go-Me (Mandibular plane). 12: Ramus width. 13: N-Go. 14: S-Me. 15: a-p line. 16: Atlas dors. 17: Atlas venter. 18: ANS-PNS (PP line). 19: SNA. 20: SNB. 21: ANB. 22: N-S-Me (Y-axis). 23: N-SA-r (Saddle angle). 24: S-Ar-Go (Articular angle). 25: Ar-Go-Me (Gonial angle). 26: Go 1. 27: Go 2. 28: SN-PP. 29: PP-MP. 20: SN-MP.

RESULTS

Table 1 showed the descriptive statistics of the linear measurements for both males and females in different skeletal classes. Generally, all of the mandibular measurements were higher significantly in males than females in all classes except. The ventricle and dorsal lengths of Atlas showed non-significant genders difference in all classes and the anteroposterior extent of Atlas in class I only.

ANOVA test show significant difference in the Co-Go and Go-Gn in males and in Co-Gn in females.

Table 2 demonstrated the descriptive statistics of the angular measurements used in this study for both genders. In all of the measured variables, there was no significant gender difference except for SN-PP angle where there was highly significant difference. Classes' difference showed significant difference in upper gonial angle and Y-axis angle only.

Table 3 showed the relation between the ramal width and height with the other variables. The mandibular length and posterior facial height were the most variables that showed significant relation.

DISCUSSION

This study aimed to found if there is any relation among ramal width and length with some cervical and cranio-facial parameters in different skeletal classes.

All of the linear measurements were significantly higher in males than females in all classes as shown in table 1; this comes in agreement with the previous study [16-20]. This may be due to the fact that the maturation period is attained earlier in females than males and that gives chance for more growth period in males. Other explanation may be attributed to the differences in muscular mass and force which are greater in males than females [14].

The highly significant difference in all skeletal classes for SN is due to the positive relation between the growth of anterior cranial base and the growth of mandible as explained by Knott [22] and since that the direction of mandibular growth affect on skeletal classes so the SN will differ in different skeletal classes [6,23,24], the same thing for PFH, mandibular length (Go-Gn) and maximum mandibular length (Co-Gn) where there is abundance of literatures explained this relation.

When the mandible rotates during growth, it affect the vertical relationships of the face, that mean the over development of anterior facial height result in backward rotation of mandible and vice versa; for that reason the AFH show highly significant difference in CL.II because it's greatly affected by the direction of mandibular rotation [6, 26].

The results of ANOVA test in this study show significant difference in Go.1 angle and Co-Gn in female which is most commonly seen between CL.I-II and CL.I-III as resulted in LSD test, and that is because the Go angle give an expression for the form of the mandible, with reference to the relation between body and ramus [8]. The Go angle also plays a role in growth prognosis, if the upper gonial angle is increased; the direction of mandibular growth may be expected to be sagittal. While, if the lower angle is small; the direction of growth is likely to be caudal. Such a changes can be found in both CL.II and C.III, for that reason a significant differences can be found in Go angle and also maximum length of mandible [8,25,26].

Since the growth at the head of the condyle occurs in an upward and backward direction, the mandibular growth is expressed as a downward and forward displacement, the growth at the condyles compensates for the vertical displacement of the mandible and accommodates for the eruption of the teeth vertically. On the other hand, bone resorption at the anterior border and deposition at the posterior border of the two rami account for the anteroposterior growth of the mandibular rami and body. These changes increase the posterior length of the body of the mandible to accommodate for the erupting permanent molars [27].

McLaughlin et al. [28] and Proffit et al. [29] mentioned that adolescent patients can tolerate molar extrusion, because any extrusion is compensated by vertical growth of the ramus, but in adults this extrusion tends to rotate the mandible downward and backward, that explain the significant correlation between ramus length and width with other angular and linear variables (table 3).

Al-Hashimi and Al-Azawi [14] explain the positive relation between the a-p length of the atlas vertebra with each of ramus length and body length of mandible. So the increase a-p line length associated with increased ramus length, forward upward rotation of mandible, reduction of ArGoMe angle, reduction of Go2 angle and reduction of Mp-PP angle as in CL.III, for that reason significant correlation found between CL.I and CL.III and between CL.I and CL.II (table 3).

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Table 1: Descriptive statistics, gender difference and classes' difference of the linear measurements

Variable (mm.)	Sex	CL.I		CL.II		CL.III		ANOVA		LSD test		
		Mean	**S.D.**	**Mean**	**S.D.**	**Mean**	**S.D.**	**F-test**	**P-value**	**I-II**	**I-III**	**II-III**
SN	**Male**	72.93	2.63	70.06	3.02	71.56	2.76	2.814	.075			
	Female	67.44	2.58	66.1	3.94	66.25	3.26	.524	.597			
	t-test	4.823		2.815		4.582						
	P-val.	**.000**		**.010**		**.000**						
AFH	**Male**	119.80	6.1	122.24	8.03	121.57	6.24	1.415	.258			
	Female	109.13	5.9	113.5	6.5	111.9	7.6	1.206	.312			
	t-test	1.142		2.988		3.606						
	P-val.	**.002**		**.007**		**.001**						
PFH	**Male**	81.82	4.71	77.57	5.7	76.57	6.8	2.252	.122			
	Female	71.51	6.86	70.17	5.62	70.1	5.03	.204	.816			
	t-test	3.777		3.263		2.785						
	P-val.	**.002**		**.003**		.101						
Co-Go	**Male**	61.05	3.86	56.98	5.64	54.91	5.75	3.696	**.036**	**(NS)**	*	**NS**
	Female	53.65	6.4	51.81	8.17	52.87	3.3	.249	.781			
	t-test	3.007		1.827		1.121						
	P-val.	**.008**		.081		.273						
Go-Gn	**Male**	83.16	6.93	77.53	3.94	82.35	5.95	3.329	**.049**	*	**NS**	*
	Female	74.44	5.09	72.87	4.98	76.75	5.6	1.800	.181			
	t-test	3.151		2.587		2.515						
	P-val.	**.006**		**.016**		**.019**						
Co-Gn	**Male**	121.7	4.86	117.9	5.4	119.8	5.7	1.275	.293			
	Female	108.8	5.13	107.04	6.26	113.2	5.48	4.052	**.027**	**NS**	*	*
	t-test	5.595		4.628		3.023						
	P-val.	**.000**		**.000**		**.006**						
Ramal width	**Male**	30.52	2.51	34.6	15.3	29.26	3.001	1.110	.342			
	Female	27.52	2.55	27.3	2.73	26.87	2.99	.165	.849			
	t-test	2.575		1.684		2.067						
	P-val.	**.040**		**.016**		**.049**						
Vent. Length	**Male**	10.53	2.01	10.53	1.3	10.89	1.25	1.190	.317			
	Female	10.13	1.57	11.55	2.55	10.2	1.23	2.211	.126			
	t-test	1.716		-1.246		1.443						
	P-val.	.104		.225		.161						
Dors Length	**Male**	10.4	1.89	10.65	1.85	9.87	1.83	.076	.927			
	Female	9.6	1.37	9.78	1.98	9.87	1.83	.065	.938			
	t-test	1.068		1.132		1.224						
	P-val.	.301		.269		.232						
a-p line	**Male**	48.11	3.38	46.6	3.2	44.7	2.02	.814	.452			
	Female	44.72	3.46	43.86	3.6	44.7	2.02	.322	.727			
	t-test	2.157		2.019		3.786						
	P-val.	**.046**		.055		.100						

Table 2: Descriptive statistics, gender difference and classes' difference of the angular measurements

Variable (º)	Sex	CL.I		CL.II		CL.III		ANOVA		LSD test		
		Mean	S.D.	Mean	S.D.	Mean	S.D.	F-test	P-value	I-II	I-III	II-III
N-S-Ar	Male	121.78	4.82	121.0	4.45	122.14	5.9	.162	.852			
	Female	125.3	7.65	124.0	6.5	124.54	7.22	.095	.909			
	t-test	-1.185		-1.336		-.949						
	P-val.	.252		.195		.352						
S-Ar-Go	Male	145.4	5.9	146.5	5.13	145	6.29	.221	.803			
	Female	142.6	8.75	148.85	7.06	141.9	7.84	2.995	.064			
	t-test	0.820		-.944		1.129						
	P-val.	.423		.355		.269						
S-Ar-Go-Me	Male	122.9	4.6	127.9	6.13	126.5	8.26	1.466	.246			
	Female	126	6.09	124.08	6.7	127.7	11.06	.599	.555			
	t-test	-1.245		1.489		-.319						
	P-val.	.230		.150		.752						
Go.1	Male	51.2	2.22	51.58	2.9	52.6	3.59	.697	.505			
	Female	52.9	3.44	49.38	3.48	53.85	4.31	4.902	**.014**	*	NS	**
	t-test	-1.244		1.707		-.790						
	P-val.	.230		.101		.437						
Go.2	Male	71.67	3.93	76.08	6.05	74.14	6.38	1.519	.234			
	Female	73.3	9.3	74.77	5.56	73.77	8.67	.155	.857			
	t-test	-0.905		.566		.128						
	P-val.	.378		.577		.899						
Y-axis	Male	64.78	3.46	68.9	3.48	67	3.46	3.408	**.046**	*	NS	NS
	Female	66.6	3.01	70.85	2.41	66.7	6.03	3.947	**.029**	*	NS	*
	t-test	-1.156		-1.516		.164						
	P-val.	.264		.143		.871						
SN-MP	Male	30.33	4.04	35.25	6.3	33.78	7.12	1.667	.205			
	Female	33.7	5.44	36.92	5.53	33.85	10.2	.718	.495			
	t-test	-1.514		-.707		-.018						
	P-val.	.148		.487		.986						
SN-PP	Male	4.78	3.3	3.75	3.02	6.64	3.27	2.738	.080			
	Female	6.2	2.15	7.7	3.71	6.46	4.14	.617	.545			
	t-test	-1.123		-2.901		.127						
	P-val.	.277		**.008**		.900						
PP-MP	Male	25.56	5.05	31.67	7.41	27.14	5.76	2.870	.071			
	Female	27.5	5.68	29.38	6.79	27.3	9.77	.276	.761			
	t-test	-0.784		.803		-.054						
	P-val.	.444		.430		.957						

Table 3: The relation among the ramal length and width with the cervical and cranio-facial measurements in both genders of different skeletal classes

Variables		CL.I				CL.II				CL.III			
		Female		Male		Female		Male		Female		Male	
		Length	Width	Length	Width	Length	Width	Length	Width	Length	Width	Length	Width
N-S-Ar	r	0.57	-0.02	0.11	-0.01	-0.15	0.16	0.36	0.33	-0.12	-0.21	-0.21	0.51
	p	0.08	0.95	0.79	0.97	0.62	0.6	0.25	0.29	0.69	0.49	0.47	0.06
S-Ar-Go	r	-0.53	-0.17	-0.11	0.19	-0.31	-0.2	-0.37	-0.03	0.27	0.26	0.08	-0.33
	p	0.11	0.64	0.78	0.62	0.3	0.51	0.24	0.92	0.37	0.39	0.79	0.26
Ar-Go-Me	r	-0.69	-0.2	-0.24	-0.71	0.07	-0.21	-0.18	-0.29	-0.63	-0.51	-0.36	-0.25
	p	**0.03**	0.58	0.53	**0.03**	0.82	0.49	0.57	0.35	**0.02**	0.07	0.21	0.4
Go1	r	-0.34	0.06	-0.51	-0.05	0.18	0.02	-0.41	0.15	-0.52	-0.15	-0.37	0.06
	p	0.34	0.86	0.16	0.89	0.56	0.96	0.19	0.65	0.07	0.62	0.2	0.83
Go2	r	-0.81	-0.39	0	-0.8	-0.07	-0.25	0	-0.35	-0.54	-0.58	-0.24	-0.36
	p	**0.000**	0.26	0.99	**0.01**	0.82	0.41	0.99	0.26	**0.05**	**0.04**	0.41	0.2
Y-axis	r	-0.14	-0.37	0.27	-0.57	-0.59	-0.09	0.24	-0.12	-0.49	-0.5	-0.25	0
	p	0.71	0.29	0.49	0.11	**0.03**	0.77	0.45	0.71	0.09	0.08	0.39	0.99
SN-MP	r	-0.78	-0.47	-0.31	-0.51	-0.52	-0.34	-0.24	-0.07	-0.53	-0.5	-0.56	-0.17
	p	**0.01**	0.17	0.42	0.16	0.07	0.26	0.46	0.82	0.06	0.08	**0.04**	0.55
SN-PP	r	0.11	-0.46	0.35	-0.09	-0.19	-0.14	0	0.2	-0.55	-0.25	-0.16	-0.13
	p	0.77	0.18	0.36	0.82	0.53	0.66	1	0.53	**0.05**	0.4	0.59	0.67
MP-PP	r	-0.82	-0.27	-0.47	-0.35	-0.32	-0.14	-0.2	-0.15	-0.33	-0.41	-0.58	-0.14
	p	**0.000**	0.45	0.2	0.35	0.29	0.64	0.54	0.64	0.27	0.16	**0.03**	0.63
SN	r	0.34	-0.1	-0.24	0.8	0.05	-0.19	-0.13	-0.14	0.13	0.6	0.21	0.64
	p	0.34	0.78	0.54	**0.01**	0.88	0.54	0.68	0.67	0.67	**0.03**	0.48	**0.01**
AFH	r	0.28	-0.13	0.57	-0.37	-0.06	-0.22	0.38	-0.48	-0.22	-0.23	-0.03	0.18
	p	0.43	0.72	0.11	0.32	0.86	0.47	0.23	0.11	0.47	0.45	0.92	0.54
PFH	r	0.94	0.37	0.9	-0.11	0.6	0.14	0.94	-0.61	0.61	0.45	0.78	0.26
	p	**0.000**	0.3	**0.000**	0.79	**0.03**	0.65	**0.000**	**0.04**	**0.03**	0.12	**0.000**	0.38
Go-Gn	r	0.27	0.13	-0.16	0.85	-0.25	-0.06	-0.29	0.08	0.72	0.62	-0.22	0.49
	p	0.45	0.73	0.68	**0.000**	0.42	0.84	0.36	0.81	**0.01**	**0.02**	0.46	0.07
Co-Gn	r	0.74	0.41	0.3	0.52	0.3	-0.1	0.71	-0.66	0.61	0.46	0.07	0.3
	p	**0.02**	0.24	0.44	0.15	0.32	0.75	**0.01**	**0.02**	**0.03**	0.11	0.81	0.29
Vent-length	r	0.15	-0.37	0.11	0.73	-0.37	0.22	0.5	-0.53	0.36	-0.15	-0.05	0.21
	p	0.67	0.29	0.79	**0.02**	0.21	0.46	0.1	0.08	0.23	0.64	0.87	0.47
dors-length	r	-0.06	0.19	-0.29	0.15	0.08	-0.03	0.06	-0.43	0.12	-0.2	0.16	0.37
	p	0.86	0.59	0.45	0.69	0.8	0.92	0.86	0.16	0.7	0.5	0.59	0.19
a-p line	r	0	-0.23	0.55	0.13	0.07	-0.4	0.05	-0.33	0.27	0.12	-0.62	0.38
	p	1	0.53	0.12	0.75	0.83	0.18	0.87	0.29	0.37	0.7	**0.02**	0.19
R. length	r		0.46		-0.34		0.08		-0.55		0.57		0.11
	p		0.18		0.36		0.79		0.06		**0.04**		0.7