

## Analysis of Soft Tissue Facial Profile in Different Vertical Growth Patterns

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### الخلاصة

**الأهداف:** تهدف الدراسة الى تحري الاختلاف في شكل الأنسجة الرخوة للوجه ضمن مجاميع ذات أنماط وجمعية عمودية مختلفة. فضلا عن محاولة استكشاف الفوارق بين الجنسين ضمن كل مجموعة. **المواد و طرائق العمل:** تكونت العينة من ١٢٠ شخصا عراقيا بالغا (٦٠ ذكرا و ٦٠ أنثى) من ذوي الصنف الأول من الإطباق الطبيعي. تم أخذ أشعة قياسات الرأس الجانبية لكل شخص ثم تم تقسيم العينة حسب النمط العمودي إلى ثلاث مجاميع: النمط العمودي القصير، النمط الوجهي المتوسط، النمط الوجهي الطويل. تم تسجيل ١٣ قياسا لأشعة الرأس وتم تحليل البيانات باستخدام تحليل التباين باتجاه واحد، واختبار دنكن المتعدد بالإضافة إلى اختبار *t* لعينتين مستقلتين عند مستوى الدلالة  $p \leq 0.5$ . **النتائج:** أظهرت النتائج أن الأشخاص في مجموعة النمط الوجهي القصير لديهم أطوالا أدنى فيما يخص ارتفاع الوجه السفلي وطول الشفة السفلية مقارنة بالمجموعتين الأخرين فيما أظهر الأشخاص في مجموعة النمط الوجهي الطويل سمكا أكبر للشفة السفلية عند النقطة B. كما أظهرت الدراسة وجود اختلافات معنوية بين الجنسين في كل مجموعة من المجاميع الثلاثة حيث أظهر الذكور سمكا أكبر للشفين العلوية والسفلية وكذلك فيما أكبر لارتفاع الوجه العلوي وطول الشفة السفلية. **الاستنتاجات:** إن غطاء الوجه من الأنسجة الرخوة وخاصة أبعاد الوجه العمودية تتأثر بالنمط العمودي الهيكلي الواقع تحتها.

### ABSTRACT

**Aims:** To investigate the difference in soft tissue facial morphology in various groups of vertical facial pattern and to explore gender dimorphism within each type. **Materials and Methods:** One hundred and twenty Iraqi adults (60 males and 60 females) with Class I normal occlusion were selected. Standardized lateral cephalometric radiograph was taken for each subject and then the sample was divided into 3 groups according to vertical pattern, short, average and long facial types. Thirteen linear measurements were recorded on each lateral cephalometric radiograph and the data were analyzed using one way analysis of variance and Duncan's multiple range analysis test and independent sample *t* test at  $p \leq 0.05$ . **Results:** The short faced subjects showed the lowest dimension for lower facial height and lower lip height, while the long faced subjects exhibited thicker lower lip thickness at point B than the other 2 types. Gender dimorphism was recorded, as males showed thicker upper lip and lower lips, as well as longer upper facial height and lower lip height in the 3 groups of facial type. **Conclusions:** The soft tissue drape particularly facial vertical dimensions are influenced by the underlying skeletal vertical pattern.

**Key words:** Soft tissue profile, Vertical pattern, Facial type.

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### INTRODUCTION

Facial esthetics is considered as one of the main goals of orthodontic treatment and increased emphasis has been placed on it in recent years by both patients and orthodontists since the soft tissue outline largely determines the esthetics of the whole face<sup>(1,2)</sup>.

It has been long emphasized that patients with malocclusion should not be treated by standardized cephalometric analysis, but rather by the individualized

norms of cephalometric analysis and a wide range of normal variations in the dentofacial relationships has been reported even in normal occlusion samples<sup>(3-7)</sup>.

The description of the dentofacial relationships of subjects with normal and abnormal facial morphology is one of the most frequently addressed subject in orthodontic literature<sup>(8-12)</sup>. This wealth of knowledge has consistently pointed to the large variation that exists in each population evaluated, as a result many attempts

were made to describe the range of normal variation in human face and designed a system that identifies the various facial types<sup>(13)</sup>.

The vertical growth pattern is very important factor to be considered in orthodontic treatment planning which should be designed to serve the morphologic characteristics of long and short facial types<sup>(14,15)</sup>, including how facial soft tissues adapt to the aberrant vertical skeletal patterns<sup>(16)</sup>.

This study aims to: 1. Investigate the variation in soft tissue morphology among different vertical facial types (average, short and long) for Iraqi adults in Mosul City with Class I normal occlusion. 2. To explore the gender dimorphism within each group of facial type.

### MATERIALS AND METHODS

The sample of this study consisted of 120 Iraqi adults (60 males and 60 females) aged 20–30 years who were selected from clinical examination of the students at Mosul University. The selection criteria of the sample were as follows: 1. Full set of permanent teeth in both jaws excluding the third molars. 2. Bilateral Class I molar and canine relationship. 3. Normal overbite and overjet ranging from 2–4 mm. 4. Harmonious facial features. 5. Minimal crowding (less than 3mm) and spacing (less than 1 mm). 6. No significant medical history and no history of facial trauma. 7. No history of orthodontic treatment or maxillofacial surgery or excessive restorative dentistry.

A lateral cephalogram was taken for each subject under rigidly standardized conditions with the mandible in centric occlusion and the lips in light contact using SS White cephalometric machine with a Wehmer cephalostat.

The 120 subjects were divided into three groups according to facial pattern (short, average and long) based on an evaluation of the following facial parameters:

1. The inclination of the mandibular plane relative to the Frankfort Horizontal plane<sup>(13)</sup>.
2. The inclination of the mandibular plane relative to the anterior cranial base<sup>(13)</sup>.

The first parameter is based on anatomical landmark, while the second parameter involves a plane of orientation.

This approach insures that neither anatomic variation nor inaccurate orientation would influence ranking of the cases. For each of these parameters, all subjects were rank ordered and divided into 3 groups. Each single group consisted of 20 males and 20 females.

The following cephalometric points were identified on each cephalogram<sup>(17,18)</sup> (Figure 1): Soft tissue nasion (Ns): The point of deepest concavity of the soft tissue contour of the root of the nose. Pronasale (Prn): The most prominent point of nose. Subnasal (Sn): The point where the lower border of the nose meets the outer contour of the upper lip. Superior labial sulcus (SlS): The point of greatest concavity in the midline of the upper lip between subnasal and labrale superius. Labrale superius (Ls): The median point in the upper margin of the upper membranous lip. Stomion (St): The midpoint of the oral embrasure when the lips are closed. Labrale inferius (Li): The median point in the lower margin of the lower membranous lip. Inferior labial sulcus (IlS): The point of greatest concavity in the midline of the lower lip between labrale inferius and menton. Soft tissue pogonion (Pogs): The most prominent point of the soft tissue contour of the chin. Soft tissue menton (Ms): The constructed point of intersection of a vertical co-ordinate from menton and the inferior soft tissue contour of the chin. U1: The most labial point on the crown of the maxillary central incisor. L1: The most labial point on the crown of the mandibular central incisor.

From these landmarks 13 linear measurements (8 horizontal and 5 vertical) were constructed to the nearest 0.5 mm in accordance to Park and Burston<sup>(17)</sup> and Athanasios<sup>(18)</sup>. The following horizontal linear measurements were recorded (Figure 1): 1. Anterior nose depth (Sn–Prn). 2. Soft tissue thickness at point A (A–SlS). 3. Soft tissue thickness at point B (B–IlS). 4. Soft tissue thickness at pogonion point (Pog–Pogs). 5. Upper lip thickness at labrale superius (Ls–U1). 6. Lower lip thickness at labrale inferius (Li–L1). 7. Upper lip distance to esthetic plane (Ls/ Prn–Pogs). 8. Lower lip distance to esthetic plane (Li/ Prn–Pogs).



Figure (1): the horizontal soft tissue measurements; 1: anterior nose depth. 2: soft tissue thickness at point A. 3: soft tissue thickness at labrale superius. 4: soft tissue thickness at labrale inferius. 5: soft tissue thickness at point B. 6: soft tissue thickness at pogonion. 7: upper lip to esthetic plane distance. 8: lower lip to esthetic plane distance.

Five vertical linear measurements were recorded and are depicted in Figure (2): 1. Upper facial height (Ns–Sn). 2. Upper lip height (Sn–St). 3. Lower lip height (St–Ils). 4. Chin height (Ils–Ms). 5. Lower facial height (Sn–Ms). All statistical analyses were performed using statistical package for social sciences (SPSS) version 10. The mean and stand-

ard deviation for each variable in the different vertical growth patterns were calculated. gender dimorphism was explored for each variable using independent samples *t*-test at  $p \leq 0.05$  significance level. Analysis of variance and Duncan's multiple range analysis test were used to examine difference among the groups at  $p \leq 0.05$ .



Figure (2): the vertical soft tissue measurements; 1: upper facial height. 2. Upper lip height. 3. Lower lip height. 4. Chin height. 5. Lower facial height.

## RESULTS

Results for comparing variables among the 3 groups of facial types are presented in Table (1) for males and in Table (2) for females.

The long faced males showed significantly higher lower lip thickness at point B when compared with both average and short facial types. While, the short face males showed significantly smaller lower facial height (Sn–Ms) compared with the other two groups and significantly smaller

lower lip height (st–IIs) as compared to the average facial type.

On the other hand, long face females showed significantly greater lower lip thickness and longer lower facial height (Sn–Ms) and chin height (IIs–Ms) when compared with the other two facial types. females with the short facial type demonstrated a significantly smaller dimensions than both average and long facial types for upper lip height (Sn–st), lower lip height (st–IIs) and lower facial height (Sn–Ms).

Table (1): Comparison of variables among the three facial types for males.

Variables	Facial type	Mean	SD	F value	Sig.	Duncan's grouping*
<b>Sn – Prn</b>	Average face	18.500	4.089	0.318	0.731	A
	Short face	16.888	2.088			A
	Long face	18.555	1.666			A
<b>A – Th</b>	Average face	19.500	2.635	0.365	0.698	A
	Short face	18.666	2.598			A
	Long face	20.000	2.645			A
<b>UL – Th</b>	Average face	14.450	2.586	0.504	0.610	A
	Short face	14.111	2.012			A
	Long face	13.333	2.549			A
<b>UL – EL</b>	Average face	5.750	1.438	0.312	0.735	A
	Short face	6.666	2.449			A
	Long face	5.833	2.397			A
<b>LL – Th</b>	Average face	16.900	1.286	1.243	0.306	A
	Short face	17.611	1.536			A
	Long face	16.444	2.297			A
<b>B – Thick</b>	Average face	13.100	1.595	3.228	0.056	A
	Short face	12.833	1.871			A
	Long face	14.888	2.147			B
<b>LL – EL</b>	Average face	3.400	1.852	1.081	0.355	A
	Short face	4.444	3.004			A
	Long face	2.667	2.872			A
<b>Pog – Th</b>	Average face	13.200	2.658	0.719	0.497	A
	Short face	14.000	2.291			A
	Long face	14.111	1.833			A
<b>Ns – Sn</b>	Average face	65.400	4.221	1.747	0.195	A
	Short face	60.100	3.281			A
	Long face	67.333	5.074			A
<b>Sn – St</b>	Average face	24.700	2.541	1.852	0.178	A
	Short face	22.333	2.598			A
	Long face	23.889	2.977			A
<b>St – IIs</b>	Average face	21.900	2.514	4.081	0.029*	B
	Short face	18.556	2.651			A
	Long face	20.556	2.506			AB
<b>IIs – Ms</b>	Average face	32.400	4.551	2.142	1.138	A
	Short face	31.222	2.279			A
	Long face	34.778	3.833			A
<b>Sn - Ms</b>	Average face	79.000	5.518	5.928	0.008*	B
	Short face	72.111	2.848			A
	Long face	79.222	6.037			B

SD=Standard deviation; \* significant difference at  $p \leq 0.05$ . \*Different letters mean significant difference.

Table (2): Comparison of variables among the three facial types for females.

Variables	Facial type	Mean	SD	F value	Sig.	Duncan's grouping*
<b>Sn – Prn</b>	Average face	17.500	2.173	1.445	0.254	A
	Short face	15.750	2.395			A
	Long face	17.400	3.098			A
<b>A – Th</b>	Average face	15.750	1.513	0.820	0.451	A
	Short face	15.800	2.485			A
	Long face	16.900	2.643			A
<b>UL – Th</b>	Average face	11.300	2.110	0.026	0.974	A
	Short face	11.100	1.911			A
	Long face	11.200	1.813			A
<b>UL – EL</b>	Average face	4.950	2.241	1.681	0.205	A
	Short face	6.850	2.789			A
	Long face	5.550	2.006			A
<b>LL – Th</b>	Average face	13.650	1.415	0.904	0.417	A
	Short face	13.950	1.739			A
	Long face	14.700	2.162			A
<b>B – Thick</b>	Average face	11.900	1.197	14.953	0.000*	A
	Short face	11.550	0.761			A
	Long face	13.900	1.100			B
<b>LL – EL</b>	Average face	2.300	1.843	6.783	0.440	A
	Short face	5.150	2.427			A
	Long face	5.000	1.900			A
<b>Pog – Th</b>	Average face	12.150	1.667	1.154	0.330	A
	Short face	12.200	2.043			A
	Long face	14.111	1.833			A
<b>Ns– Sn</b>	Average face	61.300	3.831	1.091	0.350	A
	Short face	60.100	3.281			A
	Long face	62.400	3.306			A
<b>Sn – St</b>	Average face	24.200	1.873	17.926	0.000*	B
	Short face	19.400	2.221			A
	Long face	23.900	1.911			B
<b>St – IIs</b>	Average face	24.200	1.873	17.926	0.000*	B
	Short face	19.400	2.221			A
	Long face	23.900	1.911			B
<b>IIs – Ms</b>	Average face	28.400	2.756	9.357	0.001*	A
	Short face	30	2.788			A
	Long face	33.800	3.047			B
<b>Sn - Ms</b>	Average face	72.350	4.176	28.537	0.000*	B
	Short face	65.200	2.780			A
	Long face	77.900	4.173			C

SD=Standard deviation; \* significant difference at  $p \leq 0.05$ . \*Different letters mean significant difference.

Gender dimorphism was detected in many variables in the 3 groups of facial types. In the average face group (Table 3), males showed significantly greater upper

lip thickness both at point A and at Ls as well as for lower lip thickness at Li. Upper facial height (Ns–Sn), lower facial height (Sn–Ms) and chin height (IIs Ms) were

also significantly larger in males. Comparisons between males and females of the short face group are demonstrated in Table (4).

The thickness of upper lip at point A and at Ls and lower lip thickness at Li were significantly greater in males than

females as well as all the vertical soft tissue measurements. The long face males revealed a significantly greater dimensions than females for upper lip thickness at point A and at Ls, upper facial height (Ns-Sn) and lower lip height (st-Ils) as presented in Table (5).

Table (3): Comparison between males and females for the average facial type.

Variables	Gender	Min.	Max.	Mean	SD	F value	Sig.
<b>Sn – Prn</b>	Male	13.00	28.00	18.500	4.080	-0.683	0.503
	Female	14.00	21.00	17.500	2.173		
<b>A – Th</b>	Male	16.00	24.00	19.500	2.635	-3.902	0.001*
	Female	14.00	19.00	15.750	1.513		
<b>UL – Th</b>	Male	11.00	20.00	14.450	2.586	-2.980	0.008*
	Female	7.00	14.00	11.300	2.635		
<b>UL – EL</b>	Male	3.00	8.00	5.750	1.438	-0.950	0.355
	Female	1.00	8.00	4.950	2.241		
<b>LL – Th</b>	Male	14.00	18.00	16.900	1.286	-5.373	0.000*
	Female	11.50	16.00	13.650	1.412		
<b>B – Thick</b>	Male	11.00	15.00	13.100	1.595	1.903	0.073
	Female	10.00	14.00	11.900	1.197		
<b>LL – EL</b>	Male	-1.00	5.50	3.400	1.852	-1.331	0.200
	Female	-1.00	5.00	2.300	1.843		
<b>Pog – Th</b>	Male	10.00	19.00	13.000	2.658	-1.058	0.304
	Female	10.00	15.00	12.00	1.667		
<b>Ns – Sn</b>	Male	58.00	72.00	65.400	4.221	-2.274	0.035*
	Female	53.00	66.00	61.300	3.831		
<b>Sn – st</b>	Male	22.00	30.00	24.700	2.540	0.501	0.623
	Female	20.00	26.00	24.200	1.873		
<b>st – Ils</b>	Male	17.00	25.00	21.900	2.514	1.850	0.081
	Female	15.00	25.00	19.750	2.679		
<b>Ils – Ms</b>	Male	26.00	39.00	32.400	4.550	2.377	0.029*
	Female	24.00	32.00	28.400	2.756		
<b>Sn - Ms</b>	Male	72.00	88.00	79.000	5.517	3.039	0.007*
	Female	64.00	78.00	72.350	4.176		

SD=Standard deviation; \* significant difference at  $p \leq 0.05$ .

Table (4): Comparison between males and females for the short facial type.

Variables	Gender	Min.	Max.	Mean	SD	F value	Sig.
<b>Sn – Prn</b>	Male	14.00	20.00	16.888	2.088	-1.099	0.287
	Female	11.00	19.00	15.750	2.395		
<b>A – Th</b>	Male	14.00	21.00	18.666	2.598	-2.457	0.025*
	Female	13.00	20.00	15.800	2.485		
<b>UL – Th</b>	Male	10.50	16.50	14.11	2.012	-3.344	0.004*
	Female	9.00	15.00	11.10	1.911		
<b>UL – EL</b>	Male	2.00	10.00	6.667	2.449	-0.151	0.881
	Female	3.00	12.00	6.850	2.789		
<b>LL – Th</b>	Male	15.00	20.00	17.611	1.536	4.838	0.000*
	Female	11.00	16.00	13.950	1.739		
<b>B – Thick</b>	Male	9.00	15.00	12.833	1.870	1.998	0.062
	Female	10.00	12.50	11.550	0.761		
<b>LL – EL</b>	Male	0.00	9.00	4.444	3.064	0.566	0.579
	Female	2.00	10.00	5.150	2.427		
<b>Pog – Th</b>	Male	10.00	18.00	14.06	2.291	-1.810	0.088
	Female	8.00	15.00	12.00	2.043		
<b>Ns – Sn</b>	Male	59.00	69.00	63.777	3.345	-2.417	0.027*
	Female	55.00	66.00	60.100	3.281		
<b>Sn – st</b>	Male	18.00	27.00	22.333	2.598	2.654	0.017*
	Female	16.00	23.00	19.400	2.221		
<b>st – IIs</b>	Male	16.00	23.00	18.555	2.651	2.768	0.013*
	Female	14.00	19.00	15.800	1.619		
<b>IIs – Ms</b>	Male	28.00	36.00	31.222	2.279	5.348	0.000*
	Female	26.00	35.00	30.000	2.788		
<b>Sn - Ms</b>	Male	68.00	75.00	72.111	2.848	5.348	0.000*
	Female	61.00	68.00	65.200	2.780		

SD=Standard deviation; \* significant difference at  $p \leq 0.05$ .



Table (5): Comparison between males and females for the long facial type.

<b>Variables</b>	<b>Gender</b>	<b>Min.</b>	<b>Max.</b>	<b>Mean</b>	<b>SD</b>	<b>F value</b>	<b>Sig.</b>
<b>Sn – Prn</b>	Male	17.00	21.00	18.555	1.666	-0.995	0.334
	Female	12.00	24.00	17.400	3.098		
<b>A – Th</b>	Male	18.00	25.00	20.00	2.645	-2.551	0.021*
	Female	13.00	22.00	16.900	2.643		
<b>UL – Th</b>	Male	8.00	17.00	13.333	2.549	-2.119	0.049*
	Female	8.00	14.00	11.200	1.813		
<b>UL – EL</b>	Male	2.00	9.00	5.833	2.397	-0.280	0.783
	Female	3.00	9.00	5.550	2.000		
<b>LL – Th</b>	Male	14.00	21.00	16.440	2.297	1.705	0.106
	Female	12.00	18.00	14.700	2.162		
<b>B – Thick</b>	Male	12.00	19.00	14.880	2.147	1.284	0.820
	Female	13.00	16.00	13.900	1.100		
<b>LL – EL</b>	Male	-3.00	6.00	2.667	2.872	0.664	0.516
	Female	-1.50	5.00	1.900	2.144		
<b>Pog – Th</b>	Male	12.00	18.00	14.111	1.833	-0.545	0.593
	Female	10.00	18.00	13.500	2.877		
<b>Ns – Sn</b>	Male	62.00	76.00	67.330	5.074	-2.537	0.021*
	Female	57.00	66.00	62.000	3.306		
<b>Sn – st</b>	Male	20.00	29.00	23.888	2.976	-0.010	0.992
	Female	21.00	27.00	23.900	1.911		
<b>st – IIs</b>	Male	17.00	25.00	20.556	2.505	0.289	0.013*
	Female	17.00	27.00	20.200	2.820		
<b>IIs – Ms</b>	Male	28.00	40.00	34.770	3.833	0.619	0.544
	Female	29.00	40.00	33.800	3.047		
<b>Sn - Ms</b>	Male	67.00	88.00	79.222	6.036	0.560	0.583
	Female	71.00	83.00	77.900	4.175		

SD=Standard deviation; \* significant difference at  $p \leq 0.05$ .

### DISCUSSION

Most of the differences among the 3 groups of facial types were in the vertical soft tissue measurements the only difference that was detected for thickness of soft tissue drape was in lower lip thickness at point B, where the long face males and females showed significantly thicker lower lip when compared with both average and short facial types. This can be explained as an attempt of soft tissue to compensate for the long vertical skeletal pattern. Similar findings were reported by Blanchette *et al.*,<sup>(16)</sup> who claimed that this may have been nature's way of compensating for the shorter mandibular corpus length in the long faced subjects in an effort to mask the condition and to provide a more normal facial appearance.

Subject with short facial type showed the smallest dimensions for soft tissue heights as compared with the other two groups. However, this difference reached the level of significance for lower facial height and lower lip height in both gender and for upper lip height in female subjects only. On the other hand, subjects with long facial type had the highest lower facial height as compared to both other types for females, while in males this difference approached significance in comparison with short facial type only. The long face females also showed the largest chin height. All those findings lead to the inference that soft tissue facial heights are affected by the skeletal vertical pattern particularly in the lower facial third, and this again can be considered as a compensatory mechanism

for subjects with increased vertical pattern to perform a lip seal, while in the short face subjects the length of the upper and lower lips would not have to be as long for a seal to be produced<sup>(16)</sup>.

Regarding differences between males and females, sexual dimorphism was noticed for upper lip thickness both at point A and at Ls in the three groups of facial types and for lower lip thickness at Li in the average and short types, and since the sample of the present study is comprised of subjects who represent variation in the range of normal relationship the results obtained for comparison between sexes can be compared with the findings of other researchers who investigated soft tissue facial characteristics of normal occlusion subjects. The greater lip thickness in males that was reported in the current study coincides with those of Basciftici *et al.*,<sup>(19)</sup> Kalha *et al.*,<sup>(20)</sup> and Taki *et al.*,<sup>(21)</sup>.

Regarding soft tissue facial lengths males showed significantly longer upper facial height than females in all facial types and longer chin height and lower facial height in average and short facial types, this coincides with the findings of Fernandez-Riveiro *et al.*,<sup>(22)</sup> and of Kalha *et al.*,<sup>(20)</sup> regarding lower facial height. Lower lip height was significantly greater in males than females in both short and long facial types, while the upper lip height showed significant difference only in the short type these findings come in agreement with those of Blanchette *et al.*,<sup>(16)</sup> who reported that gender dimorphism in long and short faced subjects was more evident for lower lip than upper lip.

No significant difference was noticed between genders for nose depth, lower lip thickness at point B, chin thickness and upper and lower lip distances from esthetic plane. Several researchers have reported similar findings for nose depth<sup>(23,24)</sup> and for distances of both lips from esthetic plane<sup>(23,25-27)</sup>. However, the results of the current study regarding chin thickness disagree with the results of other researchers<sup>(19-21)</sup> who reported gender dimorphism for this variable and this may be attributed to variation in sample size and allocation.

### CONCLUSIONS

The variation in skeletal vertical pattern is reflected on the soft tissue facial

drape, this was observed particularly for the vertical soft tissue dimensions where the short faced subjects showed the smallest dimension for lower facial height and lower lip height. While, the long face males and females showed the greatest lower lip thickness at point B than the other two facial types. Gender difference was noticed in the three facial types for upper lip thickness at point A and Ls and upper facial height.

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