Lateral Cephalometric Norms for Libyans

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■ **Abstract:**

Objective: To establish lateral cephalometric norms for young Libyans and to compare these with the published norms of other populations.

Materials and Methods: Cross sectional study of a sample selected on the basis of a balanced face and Class I occlusion. Lateral cephalograms were taken of 136 young Libyan nationals by birth having white complexion. Study comprised 70 females and 66 males aged 10 to 18 years with a mean age of 14 years attending the Central Dental Clinic, Tripoli, Libya. The sample was selected based on satisfying certain criteria - i) Class I molar relation, ii) Average over jet / over bite, iii) Acceptable profile and iv) No previous history of orthodontic treatment. Twenty-two cephalometric landmarks were identified and traced in a standard manner.

Results: Twenty-one variables representing linear and angular measurements were evaluated and subjected to statistical analysis which established the cephalometric norms for Libyans.

Conclusion: The study revealed that Libyans have distinctly different cephalometric measurements compared to other populations including the Arabs. The Libyans have a flatter facial profile, prominent lips and a tendency for skeletal Class 2. The other significant findings in the Libyan population were noted to be an increased anterior facial height together with a marked dento- alveolar protrusion. Gender and age differences were limited and noted only in the linear variables.

Key Words: - Cephalometric norms; Lateral cephalograms; Libyan facial features.

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■ **المستخلص:**

الهدف: وضع معايير الأنسجة الصلبة الرأسية الجانبية للشباب الليبي ومقارنتها مع المعايير المنشورة لشعوب أخرى.

المواد والطرق: دراسة مقطعية لعينة مختارة على أساس الوجه المتوازن والإطباق من الدرجة الأولى. تم أخذ صور رأسية جانبية لـ 136 شابًا ليبيًا بالولادة ذوي بشرة بيضاء. شملت الدراسة 70 أنثى و66 ذكراً تتراوح أعمارهم بين 10 سنوات إلى 18 سنة بمتوسط عمر 14 سنة يراجعون العيادة المركزية لطب الأسنان طرابلس_ ليبيا. تم اختيار العينة بناءً على استيفاء معايير معينة: 1- العلاقة المولية من الدرجة الأولى. 2- متوسط النفث / العضة. 3- المظهر المقبول. 4- لا يوجد تاريخ سابق لعلاج تقويم الأسنان.

- تم تحديد وتتبع اثنين وعشرين من المعالم الرأسية بطريقة قياسية.

النتائج: تم تقييم واحد وعشرون متغيرا تمثل القياسات الخطية والزاوية وإخضاعها للتحليل الإحصائي الذي وضع معايير قياس الرأس لليبيين.

الاستنتاج: كشفت الدراسة أن الليبيين لديهم معايير قياس رأسية مختلفة بشكل واضح مقارنة بالسكان الآخرين بما في ذلك العرب. «الليبيون لديهم مظهر وجه مسطح، وشفاه بارزة وميل للفئة الهيكلية 2. ولوحظ أن النتائج الهامة الأخرى في السكان الليبيين هي زيادة ارتفاع الوجه الأمامي مع نتوء سني سنخي ملحوظ. وكانت الفروق بين الجنسين والعمر محدودة ويلاحظ فقط في المتغيرات الخطية.

● **الكلمات المفتاحية:** معايير قياس الرأس؛ مخططات الرأس الجانبية؛ ملامح الوجه الليبي.

■ Introduction:

Cephalometric norms have been established for different populations, races, ethnic groups, and regions. These 'norms' are of significant clinical importance and valuable for treatment planning in Orthodontics and Dento-facial orthopedics only if specific norms are applied to the related specific population. The majority of the published norms have been for the European)1,2,3(, Eastern)4,5(, White (6,7.8) or Black population)9,10,11(. Several studies relating to such norms have also been reported of the Aborigines)12,13(, Ethnic groups)14,15(, including the Arabs like Saudis)16,17(, Kuwaitis (18) Egyptians (19) Iraq (20) and Jordanians)21(. Most of the above selected specific cephalometric variables which were compared directly with the standard results of a known cephalometric analysis like that of Steiner)22(, Downs)6(, Tweed)23(, Taylor and Hitchcock)8(, Ricketts)7(, or Reidel)24(. In addition, age and sex cephalometric norms have also been suggested

by Gianelly)25(. Loi et al determined cephalometric norms for the Japanese with normal occlusion based on angular and linear variables for skeletal, dental and soft tissue analysis)4(. The results when compared with the Caucasian norms showed that in the AP dimension the Japanese had a more retruded chin position, protruding mandibular incisors and protruded lip positions than the Caucasians. In the vertical dimension, Japanese had significant steep mandibular plane. The Japanese females had a significant larger lower facial height and increased dental height. Kam Hung Chan (26) studied ideal occlusion found in 30 Chinese adults of Hong Kong having ideal occlusion and acceptable profiles. The results were compared with Down's and Alabama Analyses. Bi-maxillary protrusion and retrognathic mandible with a smaller facial angle were noted. A larger 'Y' axis angle showed increased convexity and posterior divergence of the face in the Chinese. Kolotkov (27) studied 90 samples of children and adults in Moscow and reported that the majority (48.9 %) with orthognathic occlusion had a convex profile. Hajighadimi and associates (28) evaluated cephalometric norms in 67 Iranian children with normal occlusion and studied 32 variables compared with Tweeds and Steiner's analysis. They found significant retrognathic facial profiles and dental protrusion in the Iranians. Shaikh and Alvi have established cephalometric norms for aesthetically pleasing Pakistani faces and compared them with accepted standards for Caucasians)5(. They found significant differences between the two groups. The study revealed greater cranial lengths, short faces and tendency towards bi-maxillary protrusion with a prominent chin in the Pakistanis. The Pakistani males had higher values of measurement in AP, transverse and vertical dimensions while the females showed more dental protrusion. Fonseca (29) determined cephalometric norms for American Blacks women and compared them with a sample of white women. He found significant bimaxillary prognathism & bi-dental protrusion with smaller inter-incisor angles in Black women with marked differences in nose and lips. Alexander et al studied 150 Black children with normal occlusion and found bi-maxillary prognathism and bidental protrusion)9(. Angle's Class II & Class III were rarely found in the Blacks compared to the whites. Drummond (10) studied a sample of 40 Black people using Alabama's analysis and analyzed 14 variables using lateral Cephalographs. He has reported a high prevalence of maxillary prognathism, denture protrusion and increased mandibular plane angle in Black people. Platou and Zachrisson studied Norwegian children with excellent occlusion in permanent dentition and applied

Steiner's and Ricketts analysis standards)30(. They observed slight protrusion of both upper and lower incisors with small inter-incisor angles. The lower incisors were found placed in front of the A-Po line. Al-Jame et al)18 (have suggested lateral cephalometric norms for adolescent Kuwaitis through hard tissue measurements using lateral cephalographs. Hassan (17) did a regional study to establish cephalometric norms for Saudis living in the western region of Saudi Arabia. Compared with European-Americans, Saudis were found to have an increased facial convexity, a more convex profile and a steeper mandibular plane. In addition, the upper and lower incisors were significantly more proclined and more protruded. The y-axis angle was significantly steeper and the anterior lower face height insignificantly shorter in Saudis than in Europeans or Americans. Males were found to have more prognathic mandibles and tended to have a steeper mandibular plane angle when related to the anterior cranial base than female. Al-Jasser (16) has described Cephalometric norms for Saudi adults and compared them with accepted standards for Caucasians on the basis of Ricketts' analysis. He showed that the facial axis, Mandibular plane to Frankfort plane, facial convexity (A-N-Pog) and lower lip to esthetic plane were statistically not significant. On the other hand, all the angular and linear measurements of the upper and lower incisor positions were markedly increased and the inter-incisor angle was much lower for the Saudi than for the Caucasians. In another article, Al Jasser analyzed the formulated cephalometric norms for Saudi Arabs using Down's and Steiners' analysis and compared them with white Caucasian population)31(. He reports that Saudis have slightly protrusive maxillae, a tendency to class II facial pattern and high mandibular plane angle. Hamdan and Rock (21) in a cross-sectional study of 65 individuals aged 14 to 17 years have identified cephalometric norms for the Jordanian Arabs. They found that the angles SNA and SNB in the Jordanians were close to the Eastman standards. The MMPA was significantly lower. The angles upper incisor to maxillary plane and lower incisor to mandibular plane were significantly lower. Further, they noted that lower incisors were 4 to 6mm forward in relation to A-Pog line. Bascifti (32) and coworkers analyzed the cranio-facial structure of Anatolian Turkish adults with normal occlusions and well-balanced faces with an aim of developing cephalometric standards for Anatolian Turks. They report significant racial differences in skeletal, dental, and soft tissue measurements. In addition, significant sex differences were observed for the linear variables Condylion to 'A' point, Condylion to

Gnathion, ANS to Menton, and Nasion to ANS. Hany et al (33) conducted a study to develop standardized cephalometric norms for Egyptian adults. Lateral cephalograms were taken in NHP. The sample included 80 Egyptian adults (41 females and 39 males) with a mean age of 20.5 years, having acceptable facial proportions and occlusion. Cephalometric analysis was carried out comparing 21 parameters in relation to extra cranial lines (true vertical and true horizontal). Standardized cephalometric norms in the natural head posture were presented. Sexual dimorphism was found in the standardized cephalometric norms in some measurements. Lahlou (34) and associates performed a retrospective study of 102 adult Moroccan university students. They report significant differences in the cephalometric norms of Moroccans compared to others like Anatolian Turks and Arabs (35). However, the positions of incisors were found to be similar to that of the Saudi Arab population. In comparison to Caucasian cephalometric norms, their study found significant bi maxillary protrusion in the Moroccans, this research was attempted to establish cephalometric norms for the distinct population of Libya.

■ Materials and methods

The study comprised 136 young Libyan nationals by the birth of white complexion. It included 70 females, and 66 males aged 10 to 18 years with a mean age of 14 years attending the Central Dental Clinic, in Tripoli, Libya (Table-1).

Table 1- 'The structure of selected sample of Libyan population

Age	Female	Male	Total	
10	8	8	16	
11	8	8	16	
12	8	8	16	N=80
13	8	8	16	
14	8	8	16	
15	7	7	14	
16	8	6	14	
17	8	6	14	N=56
18	7	7	14	
N	70	66	136	

The selection of the sample was based on satisfying certain criteria:

i) Class I molar relation.

ii) Average over-jet /over-bite.

iii) Acceptable profile.

iv) No previous history of orthodontic treatment.

Lateral cephalograms were taken of the 136 subjects in a standard procedure. Twenty-two cephalometric landmarks were identified and traced manually (Table I; Figure-1).

.Table I: Selected Cephalometric landmarks

fl - tangent point on the forehead (soft tissue)
unt - upper tangent point of the nose (soft tissue)
Int - lower tangent point of the nose (soft tissue)
Ct- tangent point of the chin (soft tissue)
n` - nasion, horizontal projection of bone nasion to soft profile
sn` - subnasal
gn` - gnathion, vertical projection of bone nasion to soft tissue of chin
li - labrale inferius
s - sella
ss - subspinal (A)
sp - spinale
sm - supermentale (B)
pg - pogonion
gn - gnathion
m - menton
go - gonion
ar- articulare
po - porion
or - orbitale
pm - pterygo-maxillary fissure
I- long axis of the maxillary incisor
Ī- long axis of mandibular incisor.

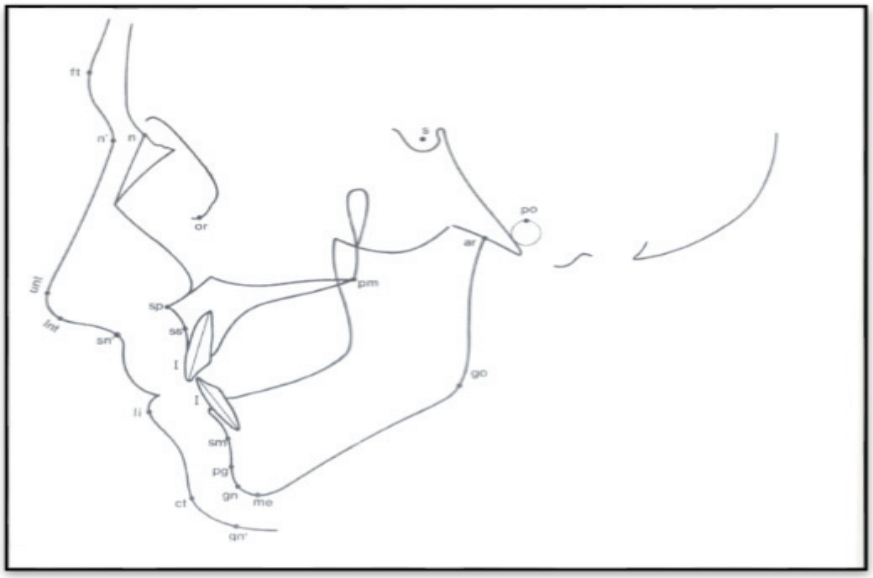

Figure 1: Position of selected cephalometric landmark

Twenty-one variables (Table II) representing linear and angular measurements (Figures 2, 3, 4, and 5) were evaluated and subjected to statistical analysis.

Table II: Selected variables
Vl. Ft-unt:lnt-ct
V2. lnt-ct:li
V3. n`-sn`: sn` - gn`
V4. s-n-ss
V5. s-n-sm
V6. ss-n- sm
V7. s-n-pg
V8. n-ss-pg
V9. n-s-gn
V10. n-s,ar
V11.m-go-ar
V12. s-ar-go
V13.Sum 10, 11, 12

V14. s-go

V15. n-m

V16. s-go: n-m X 100

VI7. sp-pm: m-go

V18.I: sp-pm

V19. Ī: m-go

V20. I: s-n

V21. I:Ī

Figure 2: Variables on soft tissue 1, 2, and 3

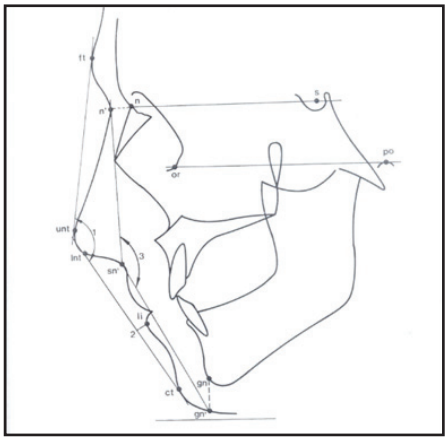

Figure 3: Angular variables 4, 5, 6, 7, 8, 9, 10, 11, 12, and 17

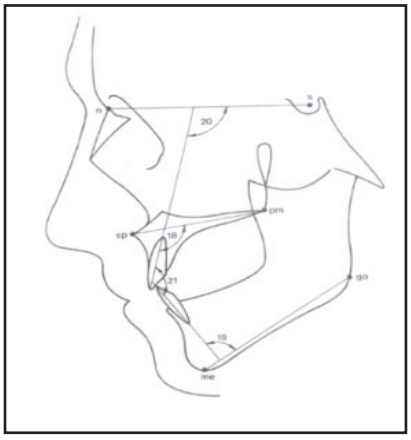

Figure 4: Angular variables 18, 19, 20, and 21

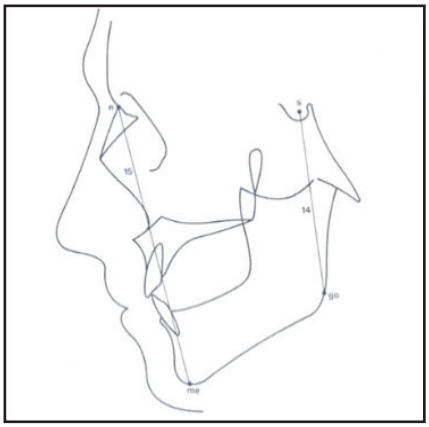

Figure 5: Linear variables 14, and 15

■ Results

The results of arithmetic means and corresponding measure of variability of 21 selected angular and linear cephalometric variables in this study were subjected to standard statistical analyses. These included the application of basic parameters *t* 'test (Table-3) and factor of discriminatory analysis to determine the cephalometric standards or norms for Libyans.

Table -3، Basic Statistical Results of Examined Characteristics

Country	Libya		
Characteristics	X	SD	Test*
AGE	13.85	2.58	p.0.05
V1	146.2	4.74	P0.05
V2	-0.09	3.24	P0.05
V3	152.7	9.5	P0.05
V4	80.67	3.26	P0.05
V5	77.33	3.32	P0.05
V6	3.34	1.87	P0.05
V7	78.2	3.52	P0.05
V8	5.75	4.84	P0.05
V9	68.82	3.48	P0.05
V10	124.7	5.3	P0.05
V11	128.5	5.6	P0.05
V12	145.0	6.4	P0.05
V13	397.8	2.1	P0.05
V14	77.1	6.0	P0.05

Country	Libya		
Characteristics	X	SD	Test*
V15	125.1	7.2	P0.05
V16	61.5	3.9	P0.05
V17	28.03	4.49	P0.05
V18	116.2	5.1	P0.05
V19	99.01	5.80	P0.05
V20	106.5	4.95	P0.05
V21	117.5	7.86	P0.05

*Student ‹t'-test

■ Discussion

Twenty-one variables were studied to establish cephalometric norms or standards of the Libyan population. The analyzed data was evaluated and herein discussed according to the variable examined.

Variable 1 (Degree of convexity of the facial profile): The average value for the angle of convexity obtained in this study was 146.2°. This value is considerably higher than that recorded by Solow (36) how reported an angle of convexity of 140.1° for males and 133° for female examinees. Subtelny (37) recorded 137° for men and 133° for women. This indicates a lower angle of convexity of the facial profile in the Libyan sample.

Variable 2 (Position of lower lip to the aesthetic line): The mean value in the sample was 0.09mm suggesting that the lower lip touches the nose-chin tangent. The original values given by Ricketts (38) were 2mm for children and 4mm for adults which means that the lower lip is behind the aesthetic line. Fosberg and Odenrick)39 (reported values of 12mm for children while Scheidman et al (40) state 6.8mm for men and 5.8mm for women which again indicates that in Libyans, the lower lip touches

the aesthetic line because of probable dento-alveolar protrusion.

Variable 3 (Soft tissue profile): The profile angle was measured to be 152.7°. This result was consistent with the results of Abdurazzag (41) since it is an original variable, it cannot be compared with other populations.

Variables 4, 5, and 6: represent the angles SNA, SNB, and angle ANB respectively which are of major clinical importance. The mean values obtained for these angular measurements in this study were - Angle SNA = 80.6°, Angle SNB = 77.3° and Angle ANB = 3.3°. Values of these angular measurements from a few earlier studies in some other populations are shown in Table III. In comparison to the above values, the result of this study in Libyans shows that the angle SNA or anterior position of the maxillae in relation to the cranial base does not differ significantly. However, the angle SNB is found to be significantly low, and angle ANB is larger demonstrating a more posterior position of the mandible or mandibular retrognathia in the Libyan population.

Table III

Angle SNA	Angle SNB	Angle ANB	Investigators
80.0°	78.3°	2.4°	Hajigadimi et al (28)
82.0°	79.9°	2.0°	Riedel (24)
82.0°	80.0°	2.0°	Steiner (22)
81.9°	79.4°	2.4°	Solow (36)
80.0°	78.0°	2.0°	Taylor & Hithcock (8)
81.9°	78.9°	2.9°	Beaton & Cleal (45)
81.5°	78.8°	2.7°	Haralabakis et al (2)

Variable 7: was the measurement of the angle S-N-Pg to evaluate the anterior location of the chin in relation to the cranial base. Solow (36) have reported a value of 81.2° while Bjork and Palling (42) give a value of 81.7° for this angle in their studies. In the Libyans, a value of 78.2° obtained for the angle S-N-Pg reconfirms the posterior position of the mandible in comparison to the Scandinavians.

Variable 8: The Angle of Convexity as described by Downs (6), in the Libyan population was found to be of an average value of 4.8°. The value of this angle in previous studies in other populations is as in Table IV. The angle of convexity in the Libyans is of a lower average value compared to the other populations revealing a flatter facial profile.

Table IV

Angle of convexity	Population studied	Investigators
1.62°	Adults	Graber (46)
4.2°	Children	
4.9°	Adult + Acceptable occlusion	Beaton and Cleal (45)
9.6°	Blacks	Alexander T.L and Perry H (9)
7.5°	Chinese	Cotton et al (14)
3.6°	Japanese	
1°	Americans	Goldman (48)

Variable 9: (Angle N-S-Gn) estimates the sagittal and vertical position of the mandible. Earlier studies such as those of Downs (6) have reported the value of this angle as 59.4° Alabama analysis (8) gives a value of 66.1° while Haralabakis et al (2) reports a value of 67.9°. This study in the Libyans revealed an average angle N-S-GN of 68.8° which points to a more distal and lower position of the mandible compared to the above studies.

Variable 10: represents the Flexion angle of the cranial base. Bjork (12) gave a value of 123.1° and Solow (36) reports a value of 123.8°. In the Libyans, the flexion angle was found to be higher with an average of 124.7°.

Variable 11: (M-Go-Ar) There is considerable variation in the value of this angle for different population groups. Solow)36 (obtained a value of 120.3° while in this study the mandibular angle was much higher with a mean value of 128.5°.

Variable 12: (S-Ar-Go) angle or the articulatory angle in the Libyans was found to be 145°. No previous data exists for comparison with other groups.

Variable 13: is expressed as a total of the values of variables 10, 11 and 12. The value of 397.8° obtained in the Libyans of this study does not show any sizeable difference when compared with the Swedish population examined by Bjork (12) who reported a value of 396° for this cumulative measurement.

Variables 14, 15, and 16: estimate the relationship between anterior and posterior facial height. The specific variable 16 (S-Go, N-M: XI00) in this study for Libyans was 61.50 % which is within the normal range of 61 – 65 % for a population as opined by Jarabak and Fizzel (43), Rani and El Faituri(44)

Variable 17: (Sp-Pm: M-Go) defines the vertical relationship of the maxilla and mandible. This study revealed a value of 28.0° and the comparison does not seem reliable. This was due to a large variation in the values, 25.5° reported by earlier studies of Beaton and Cleal (45) and a value of 41° by Solow)36(.

Variable 18: gives the angle of the upper incisor to the Sp -Pm plane (11, 21: Sp-Pm) or the average inclination of the upper incisor to the corresponding base. For the Libyans, a value of 116.2° was determined which points to marked upper incisor protrusion greater than the value reported by Solow (36) who obtained a value of 110.2° for this angle.

Variable 19: indicates the angle of the lower incisor to the Mandibular plane (31, 41 to M-Go). In this study the average angle was 99° denoting marked lower incisor proclination in the Libyans. The value in the Libyan population is much higher than that reported for other populations in several studies. Haralabakis et al (2) obtained a value of 91.5° in the Greeks, Taylor and Hitchcock (8) reported value 97.3°, Downs (6) noted a value of 91.4°, Beaton and Cleal (45) obtained a value of 97.3° and Solow (36) reported a value of 96.7°.

Variable 20: (11,21 to S- N) or the upper incisor inclination to the SN plane or cranial base in the Libyans was 106.5°. Graber (46) reported a value of 103.9° and Haralabakis (2) noted a value of 99.6° in the Greeks. The

higher value for this angle measured in this study reconfirms the marked protrusion of upper incisors in the Libyan population. This finding is in agreement with those of Elkaseh et al (47)

Variable 21: The inter-incisor angle (Upper central incisor to lower central incisor) reported by various authors for different population groups as shown in Table V. The average inter-incisor angle obtained in this study was 117.5° which represents the lowest value in comparison to the above results. It indicates marked protrusion of both the upper and especially, the lower incisors in Libyans.

Table V

Inter-incisor angle	Investigators
130.9°	Reidel (24)
135.4°	Down (6)
131.0°	Steiner (22)
122.0°- men	Hajighadimi (28)
128.0°- women	
128.5°	Solow (36)
138.2°	Haralabakis (2)

■ Conclusion

Libyans have distinctly different maxillofacial cephalometric measurements compared to other populations including the Arabs with a flatter facial profile, prominent lips, and a tendency for skeletal class 2. Even though the angle SNA does not differ much, angle SNB was found to be significantly lower, and angle ANB was larger demonstrating a more posterior position of the mandible in the Libyans. The most significant findings of this study were the increased anterior face height and marked dento-alveolar protrusion. Marked protrusions of both the upper and especially the lower incisors were also documented in the Libyans. Regarding age and sex, only linear variables were found to be different with gender differences of linear variables being higher in males. It is suggested that these norms ought to be adopted and considered in the orthodontic diagnosis and treatment planning for Libyan patients.

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