CLINICAL STUDY

Orofacial clefts and their influence on chosen anthropometric parameters of craniofacial part children at the age of eight

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Abstract

The aim of this study was to choose and to measure craniofacial parameters that were expected to be influenced by cleft defects. Eight-year-old children (both boys and girls) with operated clefts (15 antropometric parameters) were measured. The measurements were carried out at the Department of Reconstructive Surgery, Hospital Ružinov, Bratislava. The obtained parameters were compared to 4 types of clefts by means of modification t-test, and also with healthy population by means of normalization indices, on the base of which morphograms were performed. On the base of our results, we can say that the most significant deviations when compared with healthy population were found in children with the worst type of cleft, i.e. complete bilateral cleft.
Key words: orofacial clefts, anthropometric parameters, normalization indices, morphograms.

Orofacial clefts afflict the middle third of face and cause many anatomic and functional changes. The extent of these changes depends on the extent of the very defect. Modern conception of the cleft cure lies in the precise cooperation in a team consisting of a large number of specialists. Just owing to the cooperation of the surgeon, jaw orthopedist, phoniatrist and other specialists, it was possible to attain the most favourable aesthetic and functional results as well as psychic rehabilitation (Hajdu, 1970). Then it is possible to evaluate the attained medical results by several methods. Some of them are more complicated. as e.g. the cephalometric analysis of distant X-rays. The method of postsurgical anthropometric evaluation of skeleton and soft parts of the face is more accessible. The objective result of the actual condition can be gained by means of the aimed choice of anthropometric points of the face and subsequently by measuring the necessary facial dimensions and their comparison with referential values.

The aim of this study was to choose suitable anthropometric parameters and to measure them in children at the age of 8, being influenced by cleft defects, as well as healthy children at the same age. The values of the latter group served as referential values.

Material and methods

The anthropometric parameters were obtained from 54 children (28 boys and 26 girls) with the diagnosis of orofacial cleft at the age of 8 (younger school age). The anthropometric research was performed at the Cleft Clinic, which is regularly visited by patients from the whole Slovak Republic in purpose of medical control. Fifteen parameters of face and head and body height were measured during the anthropometric research of children with orofacial clefts as well as those of healthy children. The parameters were measured by use of the methods of Martin and Saller (1957). The choice of anthropometric points was made in compliance with the needs of the study.

The part lying anterior to foramen incisivum belongs to the primary palate, the part lying posterior belongs to the secondary palate. There are 3 basic groups of embryological divisions:
A) Primary cleft palate (lip, jaw),
B) Secondary cleft palate (uvula, soft and hard palate),
C) Primary and secondary cleft palate:
   complete cleft lip, cleft jaw and palate:
a) unilateral,
b) bilateral (Kernahan and Stark, 1958)

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Absolute values of anthropometric dimensions in children with orofacial clefts were compared with average values gained from being healthy children in the same age category. Due to the fact that the numbers of children with clefts were rather low in particular age categories, in order to be able to judge the deviation from the healthy population of the same sex and at the same age, we used the normalization index (z – score, SD – score) counted according to the following formula:

$$i = \frac{x - \overline{x}}{SD}$$

i = normalization index, x = the value observed of individual or group, $\overline{x}$ = average value of normal population for age and sex (norm), SD = = standard deviation of average value $\overline{x}$.

Normalization indices are suitable for the comparison of physical dimensions and for expressing the proportionality kept within the population. They enable to compare some parameters of different sex and age, and to evaluate statistically the average differences from normal parameters (Riegerová and Ulrichová, 1993).

The result value of "i" expresses the share of standard deviation in which the examined individual (or group) differs from the average population in the given parameter. It enables to place an individual (a group) as average or subnormal according to the degree of deviation (Nováková and Hloušková, 1984).

The morphograms were worked out from the normalization indices of observed parameters that were calculated individually in respect to the respective type of orofacial cleft and sex. This means that we divided the group of 8-year-old children into 8 following subgroups:
8-year-old children

A) boys:
    I. 8-year-old boys with cleft palate
    II. 8-year-old boys with cleft lip
    III. 8-year-old boys with complete unilateral cleft
    IV. 8-year-old boys with complete bilateral cleft
B) girls:
    I. 8-year-old girls with cleft palate
    II. 8-year-old girls with e cleft lip
    III. 8-year-old girls with complete unilateral cleft
    IV. 8-year-old girls with complete bilateral cleft

The results of measures gained from 157 (80 boys and 77 girls) 8-year-old healthy children of the author Martináková (1997) were used as the control group.

On the base of values of normalization indices, we worked out the morphograms of measured parameters. By this way we chaarted a graph for boys containing 4 following morphograms:
    – morphogram of 8-year-old boys with cleft palate,
    – morphogram of 8-year-old boys with cleft lip,
    – morphogram of 8-year-old boys with complete unilateral cleft,
    – morphogram of 8-year-old boys with complete bilateral cleft.

For the final statistic analysis of differences between individual types of clefts, we used a modified t-test for standardized deviations (Reisenauer, 1970).

Results and discussion

The results of mathematical statistical analysis of anthropometrics parameters of 8-year-old children with orofacial clefts are given in Tables 1—8 as well as in Figs 1 and 2.

Tab. 1. The basic statistical characteristics of anthropometric parameters of 8-year-old boys with CP (n=7) and of 8-year-old healthy boys (n=80).

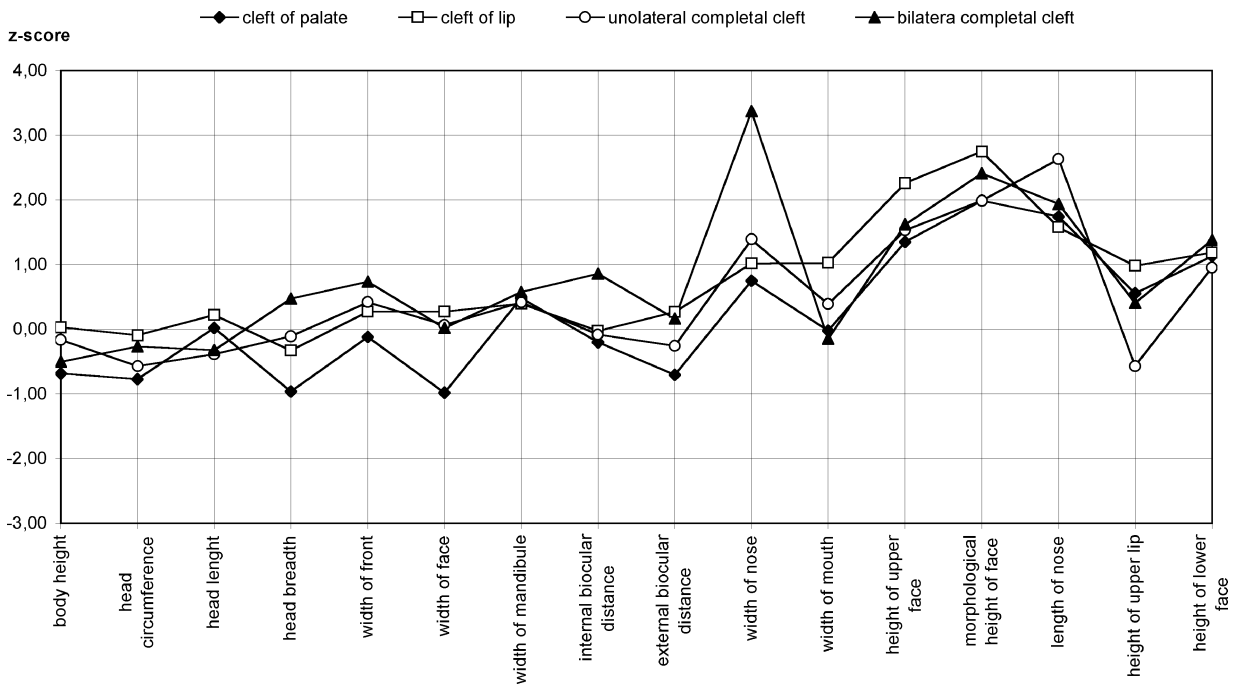| Anthropometric parameters	Boys with CP		Healthy boys (Martináková,1997)		z-score
	$\overline{x}$	SD	$\overline{x}$	SD	
body height	127.714	5.594	132.270	6.680	-0.682
head circumference	52.114	1.931	53.200	1.410	-0.770
head length	17.871	1.131	17.860	0.630	0.018
head breadth	14.057	0.607	14.680	0.650	-0.958
width of front	10.386	0.653	10.440	0.470	-0.116
width of face	11.414	0.900	12.030	0.630	-0.977
width of mandibule	9.543	0.558	9.310	0.480	0.485
internal biocular distance	2.986	0.181	3.040	0.270	-0.201
external biocular distance	8.671	0.580	9.030	0.510	-0.703
width of nose	2.986	0.146	2.850	0.180	0.754
width of mouth	4.143	0.206	4.150	0.340	-0.021
height of upper face	6.343	0.346	5.910	0.320	1.353
morphological height of face	10.457	0.518	9.640	0.410	1.993
length of nose	4.414	0.344	3.910	0.290	1.739
height of upper lip	1.986	0.112	1.880	0.190	0.556
height of lower face	4.114	0.412	3.730	0.340	1.130

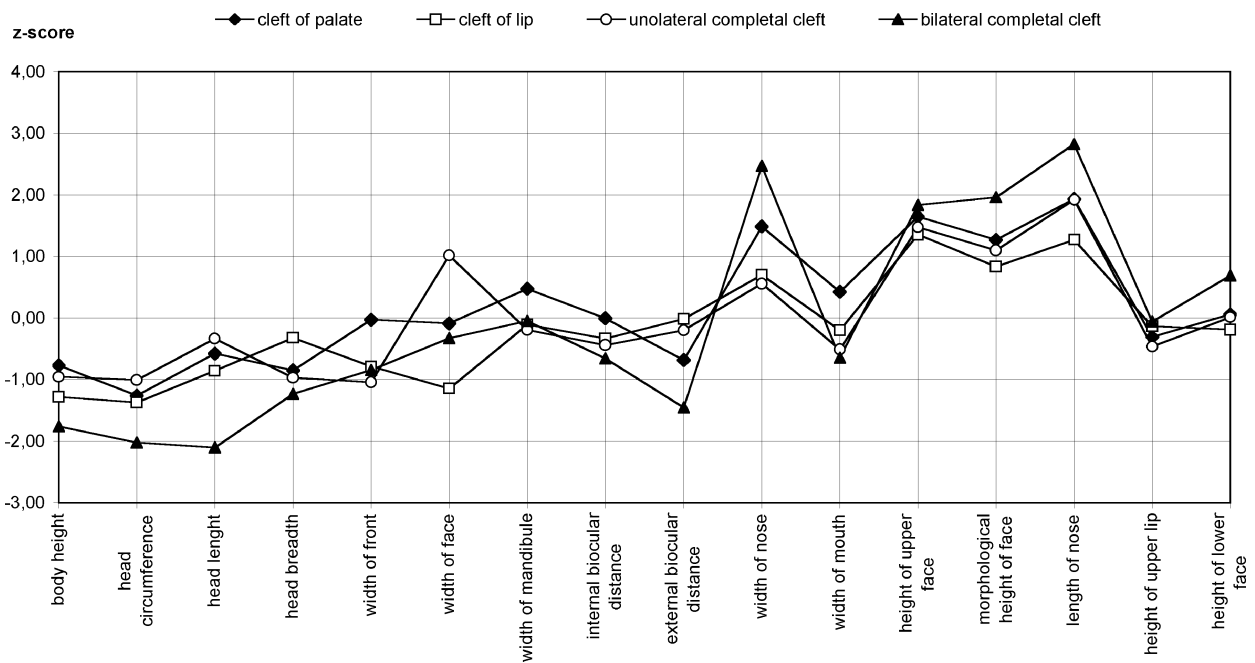Fig. 1. Morphogram of measured characters 8-years-old boys.

Fig. 2. Morphogram of measured characters 8-years-old girls.

Tab. 2. The basic statistical characteristics of anthropometric parameters of 8-year-old boys with CL (n=3) and of 8-year-old healthy boys (n=80).

Anthropometric parameters	Boys with CL		Healthy boys (Martináková,1997)		z-score
	$\bar{x}$	SD	$\bar{x}$	SD	
body height	132.467	3.512	132.270	6.680	0.029
head circumference	53.067	0.785	53.200	1.410	-0.095
head length	18.000	0.141	17.860	0.630	0.222
head breadth	14.467	0.591	14.680	0.650	-0.328
width of front	10.567	0.655	10.440	0.470	0.270
width of face	12.200	0.497	12.030	0.630	0.270
width of mandibule	9.500	0.327	9.310	0.480	0.396
internal biocular distance	3.033	0.205	3.040	0.270	-0.025
external biocular distance	9.167	0.419	9.030	0.510	0.268
width of nose	3.033	0.094	2.850	0.180	1.019
width of mouth	4.500	0.163	4.150	0.340	1.029
height of upper face	6.633	0.205	5.910	0.320	2.260
morphological height of face	10.767	0.340	9.640	0.410	2.748
length of nose	4.367	0.125	3.910	0.290	1.575
height of upper lip	2.067	0.047	1.880	0.190	0.982
height of lower face	4.133	0.170	3.730	0.340	1.186

Tab. 3. The basic statistical characteristics of anthropometric parameters of 8-year-old boys with UCLP (n=11) and of 8-year-old healthy boys (n=80).

Anthropometric parameters	Boys with UCLP		Healthy boys (Martináková,1997)		z-score
	$\bar{x}$	SD	$\bar{x}$	SD	
body height	131.182	5.102	132.270	6.680	-0.163
head circumference	52.400	1.401	53.200	1.410	-0.567
head length	17.618	0.607	17.860	0.630	-0.384
head breadth	14.609	0.653	14.680	0.650	-0.109
width of front	10.636	0.342	10.440	0.470	0.418
width of face	12.073	0.519	12.030	0.630	0.068
width of mandibule	9.509	0.436	9.310	0.480	0.415
internal biocular distance	3.018	0.147	3.040	0.270	-0.081
external biocular distance	8.900	0.338	9.030	0.510	-0.255
width of nose	3.100	0.191	2.850	0.180	1.389
width of mouth	4.282	0.159	4.150	0.340	0.388
height of upper face	6.400	0.513	5.910	0.320	1.531
morphological height of face	10.455	0.618	9.640	0.410	1.987
length of nose	4.673	0.521	3.910	0.290	2.630
height of upper lip	1.773	0.154	1.880	0.190	-0.565
height of lower face	4.055	0.231	3.730	0.340	0.955

Measured parameters: b-v body height, g-op-g head circumference, g-op maximum head length, eu-eu maximum head breadth, ft-ft minimum width of the front, zy-zy width of the face, go-go width of the mandibular angle, en-en internal biocular distance, ex-ex external biocular distance, al-al width of the nose, ch-ch width of the mouse, n-sto physiognomic height of the upper face, n-gn morphological height of the face, n-prn length of the nose, sto-sn height of the upper lip, sto-gn height of lower face.

Type of orofacial clefts: CP – cleft palate, CL – cleft lip, UCLP – complete unilateral cleft, BCLP – complete bilateral cleft.

Analysis of morphograms of anthropometric parameters of 8-year-old boys

From the Figure 1 it implies that all normalization indices of measured parameters of 8-year-old boys with CP are in the range of physiological variability ±2 SD. The head length (0.018)

Tab. 4. The basic statistical characteristics of anthropometric parameters of 8-year-old boys with BCLP (n=7) and of 8-year-old healthy boys (n=80).

Anthropometric parameters	Boys with BCLP		Healthy boys (Martináková,1997)		z-score
	$\bar{x}$	SD	$\bar{x}$	SD	
body height	128.914	3.993	132.270	6.680	-0.502
head circumference	52.829	1.763	53.200	1.410	-0.263
head length	17.657	0.872	17.860	0.630	-0.322
head breadth	14.986	0.525	14.680	0.650	0.470
width of front	10.786	0.505	10.440	0.470	0.736
width of face	12.043	0.713	12.030	0.630	0.020
width of mandibule	9.586	0.482	9.310	0.480	0.574
internal biocular distance	3.271	0.266	3.040	0.270	0.857
external biocular distance	9.114	0.541	9.030	0.510	0.165
width of nose	3.457	0.206	2.850	0.180	3.373
width of mouth	4.100	0.131	4.150	0.340	-0.147
height of upper face	6.429	1.054	5.910	0.320	1.621
morphological height of face	10.629	0.486	9.640	0.410	2.411
length of nose	4.471	0.310	3.910	0.290	1.936
height of upper lip	1.957	0.350	1.880	0.190	0.406
height of lower face	4.200	0.845	3.730	0.340	1.382

Tab. 5. The basic statistical characteristics of anthropometric parameters of 8-year-old girls with CP (n=12) and of 8-year-old healthy girls (n=77).

Anthropometric parameters	Girls with CP		Healthy girls (Martináková,1997)		z-score
	$\bar{x}$	SD	$\bar{x}$	SD	
body height	127.033	7.487	131.660	6.040	-0.766
head circumference	51.208	1.799	52.960	1.390	-1.260
head length	17.183	0.671	17.460	0.480	-0.576
head breadth	13.850	0.807	14.290	0.520	-0.846
width of front	10.308	0.732	10.320	0.440	-0.027
width of face	11.775	0.949	11.820	0.520	-0.087
width of mandibule	9.475	0.640	9.270	0.430	0.477
internal biocular distance	3.000	0.196	3.001	0.230	-0.004
external biocular distance	8.508	0.596	8.780	0.400	-0.679
width of nose	3.083	0.276	2.830	0.170	1.490
width of mouth	4.250	0.399	4.130	0.280	0.429
height of upper face	6.292	1.382	5.780	0.310	1.651
morphological height of face	10.058	0.759	9.525	0.420	1.270
length of nose	4.442	0.393	3.880	0.290	1.937
height of upper lip	1.767	0.272	1.870	0.340	-0.304
height of lower face	3.767	0.527	3.745	0.370	0.059

and mouth width (-0.021) differ in the values of z-score only subtly from the norm, from the healthy population.

The boys with CL are out of the stated limit of proportionality ±2 SD at two parameters — height of upper face (z-score = 2.260) and height of face (z-score = 2.748). The majority of observed parameters are above the norm, except for normalization indices of head circum ference (-0.095), head width (-0.328) and internal biocular distance (-0.025) that are below the norm, however with very small differences.

The nose length of boys with UCLP is positionally pathological with the value of z-score (2.630), as it exceeds the limit of physiological variability ±2 SD. The largest deviations in keeping with the norm were found in boys with BCLP, where the limits are exceeded in two parameters, particularly the nose width and face height. The largest deviation concerns the nose width, and its value of z-score 3.373 is higher than limit ±3 SD. According to Nováková and Hloušková (1984) the values bigger than ±3 SD show and confirm that the given parameter

Tab. 6. The basic statistical characteristics of anthropometric parameters of 8-year-old girls with CL (n=4) and of 8-year-old healthy girls (n=77).

Anthropometric parameters	Girls with CL		Healthy girls (Martináková,1997)		z-score
	$\bar{x}$	SD	$\bar{x}$	SD	
body height	123.925	4.729	131.660	6.040	-1.281
head circumference	51.050	0.673	52.960	1.390	-1.374
head length	17.050	0.296	17.460	0.480	-0.854
head breadth	14.125	0.687	14.290	0.520	-0.317
width of front	9.975	0.471	10.320	0.440	-0.784
width of face	11.225	1.018	11.820	0.520	-1.144
width of mandible	9.225	0.259	9.270	0.430	-0.105
internal biocular distance	2.925	0.043	3.001	0.230	-0.330
external biocular distance	8.775	0.487	8.780	0.400	-0.012
width of nose	2.950	0.150	2.830	0.170	0.706
width of mouth	4.075	0.148	4.130	0.280	-0.196
height of upper face	6.200	1.316	5.780	0.310	1.355
morphological height of face	9.875	0.249	9.525	0.420	0.833
length of nose	4.250	0.166	3.880	0.290	1.276
height of upper lip	1.825	0.192	1.870	0.340	-0.132
height of lower face	3.675	0.228	3.745	0.370	-0.189

Tab. 7. The basic statistical characteristics of anthropometric parameters of 8-year-old girls with UCLP (n=8) and of 8-year-old healthy girls (n=77).

Anthropometric parameters	Girls with UCLP		Healthy girls (Martináková,1997)		z-score
	$\bar{x}$	SD	$\bar{x}$	SD	
body height	125.913	4.006	131.660	6.040	-0.952
head circumference	51.563	0.995	52.960	1.390	-1.005
head length	17.300	0.316	17.460	0.480	-0.333
head breadth	13.788	0.486	14.290	0.520	-0.966
width of front	9.863	0.534	10.320	0.440	-1.040
width of face	12.350	2.569	11.820	0.520	1.019
width of mandible	9.188	0.348	9.270	0.430	-0.192
internal biocular distance	2.900	0.332	3.001	0.230	-0.439
external biocular distance	8.700	0.574	8.780	0.400	-0.200
width of nose	2.925	0.179	2.830	0.170	0.559
width of mouth	3.988	0.362	4.130	0.280	-0.509
height of upper face	6.238	0.450	5.780	0.310	1.476
morphological height of face	9.988	0.697	9.525	0.420	1.101
length of nose	4.438	0.223	3.880	0.290	1.922
height of upper lip	1.713	0.117	1.870	0.340	-0.463
height of lower face	3.750	0.357	3.745	0.370	0.014

is pathological. The nose of these boys is not only extremely wide, but in keeping with the norm also the nose length is larger (1.936).

The graph shows a certain tendency of creating bigger deviations in the dimensions closely hang together with the middle third of face. The structures presented further are less influenced.

Analysis of morphograms of anthropometric parameters in 8-year-old girls

The morphogram of anthropometric parameters in 8-year-old girls with CP are similar to those of boys with CP. The values of z-score of parameters of girls with CP do not exceed the range ±2 SD. Nine of the observed parameters are below the norm.

Concerning the girls with CL, none of the observed parameters exceed the limit of physiological variability ±2 SD, but twelve of them are below the norm.

Tab. 8. The basic statistical characteristics of anthropometric parameters of 8-year-old girls with BCLP (n=2) and of 8-year-old healthy girls (n=77).

Anthropometric parameters	Girls with BCLP		Healthy girls (Martináková,1997)		z-score
	$\bar{x}$	SD	$\bar{x}$	SD	
body height	121.050	0.550	131.660	6.040	-1.757
head circumference	50.150	0.950	52.960	1.390	-2.022
head length	16.450	0.250	17.460	0.480	-2.104
head breadth	13.650	0.450	14.290	0.520	-1.231
width of front	9.950	0.050	10.320	0.440	-0.841
width of face	11.650	0.150	11.820	0.520	-0.327
width of mandible	9.250	0.150	9.270	0.430	-0.047
internal biocular distance	2.850	0.050	3.001	0.230	-0.657
external biocular distance	8.200	0.100	8.780	0.400	-1.450
width of nose	3.250	0.050	2.830	0.170	2.471
width of mouth	3.250	0.350	4.130	0.280	-0.643
height of upper face	6.950	0.050	5.780	0.310	1.839
morphological height of face	10.350	0.450	9.525	0.420	1.964
length of nose	4.350	0.200	3.880	0.290	2.828
height of upper lip	1.850	0.150	1.870	0.340	-0.059
height of lower face	4.000	0.400	3.745	0.370	0.689

Also in the group of girls with UCLP, no z-score of anthropometric parameters exceed the limit of physiological variability, but ten of the parameters are below the norm. On the other hand, in the group of girls with BCLP there are four parameters that exceed the norm in their values of z-score limit of physiological variability ±2 SD, two in positive width of nose and length of nose and two in negative ways (head circumference and head length). The values of z-score of nose width (2.471) and the nose length (2.828) show long and wide noses in comparison with the norm. Before the operation, Farkaš et al (1993) found out that the width of nose was abnormal in 100 % patients with BCLP.

From the graph, it is obvious that in all types of clefts, the height of upper lip is below the norm as well as the head parameters and eye area.

On the base of our results, we can conclude that more marked differences were found among individual groups of clefts when compared with the norm, than among individual 4 types of clefts when compared mutually. The largest deviations in keeping with healthy population occurred in the wors forms of cleft – the complete bilateral cleft. The biggest differences in both boys and girls were in the value of nose width. In girls, the biggest difference was found in the value of nose length. In boys, the latter dimension is closely below the limit of physiological variability ±2 SD.

On the base of our results, we recommend for each probant with cleft to work out his or her own morphogram, in order to gain a more exact picture as well as judgement of influencing the concrete stage of orofacial parameters.

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