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Craniofacial Morphology of Subjects With Hypodontia– Effects Of Severity And Location.

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ABSTRACT

Hypodontia is the most common developmental anomaly of the human dentition. The aim of this study was to determine the effects of severity and location of hypodontia on craniofacial morphology of Croatian patients by using cephalometric radiographic methods. The sample consisted of 194 patients (119 females and 75 males) diagnosed with permanent dentition hypodontia. Patients were divided into subgroups according to the severity (mild, moderate, severe) and location of hypodontia (anterior, posterior, anteroposterior). A customized cephalometric analysis consisting of 31 angular and linear parameters was performed by DOLPHIN IMAGE software (*v.11.5*) on lateral cephalograms that were taken as a part of a standard procedure prior to treatment. Our results showed that aneroposterior and severe hypodontia groups have the largest cephalometric differences compared to other subgroups- smaller U1: ANS-PNS angle and especially L1: Me-Go and L1: N-B angles, greater U1:L1 angle and a greater Li-E distance. Combination of a tendency towards Class III malocclusion, due to a clinically significant decrease of SNA and ANB angles and a significantly greater distance between lower lip and E-line leads to a conclusion that subjects with severe and anteroposterior hypodontia are more prone to have a concave profile.

Keywords: hypodontia, craniofacial morphology, cephalogram, incisors, class III

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INTRODUCTION

Hypodontia is congenital absence of one or more permanent teeth, excluding third molars and is the most common developmental anomaly of the human dentition. [1] Prevalence of hypodontia differs by continent and gender: 5.5% for European, 6.6% for Australian and 3.9% for North American Caucasians. In addition, the prevalence of dental agenesis in females is 1.37 times higher than in males. The mandibular second premolar is the most affected tooth, followed by the maxillary lateral incisor and the maxillary second premolar. Unilateral occurrence of dental agenesis is more common than bilateral occurrence. However, bilateral agenesis of maxillary lateral incisors is more common than unilateral agenesis.[2]

Hypodontia may present as an independent anomaly or may be associated with more than 160 craniofacial syndromes. Etiologically, genes such as PAX9 and MSX1 have a key role in non-syndromic hypodontia. [3] Combination of genetic and environmental components (infection, trauma, irradiation,..) is also a common cause of hypodontia.

Therapy of hypodontia is in general considered as difficult among orthodontists and multidisciplinary approach is often required. This primarily refers to the combined orthodontic-implant logical and prosthetic therapy

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The aim of this study was to determine the soft tissue profile, skeletal and dental relationships among patients with hypo dontia by using rtgce phalometric analysis as well as to analyze the effects of hypodontias everity and location of missing teeth.

MATERIALS AND METHODS

SAMPLE

The sample for this cross-sectional study was taken from the patients data base of the Department of Orthodontics, Dental Clinic, Clinical Hospital Center Zagreb. It consisted of 194 patients (119 females and 75 males) with a mean age of 12 years, diagnosed with per manentd entition hypo dontiabyradio graphic and clinical examination. All patients were divided in to three groups according to these verity of hypodontia. The hypo dontia was classified as mild (1-2 missing teeth), moderate (3-5 missing teeth) and severe (6 or more missing teeth). All patients were also divided into three groups according to the location of missing teeth.

The hypodontia was classified as anterior (inter canineregion),411posterior (premolars and molars) and antero posterior (both anterior and posteriorregion) (**Table 1**). Recorded clinicald at a were: age at the moment a later alcephalo gram was taken, gender and number of missing per manent teeth.

Table 1: Distribution of the sample

Total number of patients	194	
Gender		
Male	75	38,7%
Female	119	61,3%
Severity of hypodontia		
Mild (1-2 teeth)	155	80%
Moderate (3-5 teeth)	28	14%
Severe (≥ 6 teeth)	11	6%
Location of hypodontia		
Anterior	85	44%
Posterior	85	44%
Anteroposterior	24	12%

The inclusion criteria for this study were:

- Per manentd entition hypodontia
- Good quality of pretreatment later alcephalo gram and panora mictomo gram

- Croatianethnicity

The exclusion criteria for this study were:

- craniofacialsyndromes
- cleft lip and/or palate
- history of teeth trauma
- previous orthodontic treatment

The Ethics Committee of the Zagreb School of Dental Medicine approved this study. An informed consent forms authorizing the use of patients radiograms were signed by each patient or their parent, if they were under 18.

CEPHALOMETRIC ANALYSIS

A thoroughce phalometric analysis of later alcephalo grams was performed for each patient. Later alcephalo grams were taken as a part of a standard procedure before starting anorthodontic therapy, under standardized conditions: in the maximal inter cuspal position, with the head in the natural position and using earrods for stabilization (median plane focal distance: 1.55 m; detector to mid sagittal distance 0.125 m). 38 cephalograms were taken with the Planmeca PM 2002 CC Proline (Planmeca, Helsinki, Finland).

These an alogcephalo grams were digitized using Scan Maker i900 (Microtek, Willich, Germany). Another 156 cephalo grams were stored on a CD-ROM or via e-mail indigital format and were taken with the Orthopantomo graph OP200D (InstrumentariumOy, Tuusula, Finland) with an average exposure time of 10 seconds with a valueof 85 kV – 13 mA.

Cephalometric analysis was performed with DOLPHIN IMAGE software (v.11.5). To prevent magnification error and to calibrate each cephalo gram in the DOLPHIN software in order to obtain real linear values, pictures were taken with a metal calibration ruler in corporated in the cephalostat and two ruler points reproduced on the head film.

Twenty two hard and soft tissuel and marks were recorded for each cephalo gram. A customized cephalo metric analysis consisting of 31 angular and linear parameters was used in this study.

Parameters were divided in to three categories: skeletal, dental and soft tissue profile relationships (**Table 2**).

Table 2: Measured cephalometric parameters

SKELETAL RELATIONSHIPS	DENTAL RELATIONSHIPS	SOFT TISSUE PROFILE
S-N (mm)	U1:N-A (mm)	Cm-Sn-Ls (°)
N-Ar (mm)	L1:N-B (mm)	Li-Sm-Pg (°)
S-Ar (mm)	U1:ANS-PNS (°)	Ls-E line (mm)
N-S-Ar (°)	L1:Me-Go (°)	Li-E line (mm)
Co-A (mm)	U1:L1 (°)	Gl'-Prn-Pg'
Me-Go (mm)	Overjet (mm)	
Ar-Go (mm)	Overbite (mm)	
Co-Gn (mm)		
SNA (°)		
SNB (°)		
ANB (°)		
Witts appraisal		
N-Me (mm)		
N-ANS (mm)		
ANS-Me (mm)		
S-Go (mm)		

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S-Go:N-Me (%)		
Me-Go-Ar (°)		
N-A-Pg (°)		

The results were compared to Croatiance phalometric standards according to Zagreb 82 MOD2 analysis.[4]

ERROR ANALYSIS

One investigator performed the complete analysis by digitizing max. 10 cephalo grams per day. Intra operator error was evaluated by re-digitizing 20 randomly chosence phalo grams two weeks after initial digitization, which was also performed by the same investigator.

Error analysis was performed by using the intra class correlation coefficient (ICC) with their respective 95% confidence intervals, measurement error (ME), smallest detectable change (SDC), limits of agreement (LoA) and the relationship between the differences of the two measurements that were with in the limits of agreement.

ME was measured according to Bland and Altman's procedure as the square root of the mean square error from ananalysis of variance.[5]

Examiner reproducibility was substantial to excellent (ICC=0,54-0,95). Measurement error was low to substantial (0,55-5,52) and was always lower than the biological variability of the associated variable.

STATISTICAL ANALYSIS

Commercial software sof Statistical Package for Social Sciences software, version 16.0 (SPSS Inc., Chicago, SAD) and STATISTICA 10.0 (StatSoftInc., Tulsa, SAD) were used to perform statistical analysis for this study. Level of significance was set at P-values of <.05.

Normality of distribution was verified using the Kolmogorov-Smirnov and Shapiro-Wilktests.

For normally distributed variables t-test, analysis of variance and Tukey post-hoc test as well as arithmetic mean and standard deviation were used. Levene's test was used to assess the equality of variances.

For non-normally distributed variables , the Kruskal-Wallis and Mann-Whitney tests were used, complemented by the Bonferroni correction.

The power effect with in analysis of variance was quantified as ŋ2, and for the Mann-Whitney test, it was calculated according to the Rosenthal formula, r=Z/√N.[6]

RESULTS

Distribution of cephalometric parameters among hypodontia groups according to the severity is presented in **Tables 3 and 4**.

Table 3: Distribution of cephalometric parameters among hypodontia groups according to the severity (arithmetic mean ± standard deviation)

VARIABLES	MILD (N=155) AM±SD	MODERATE (N=28) AM±SD	SEVERE (N=11) AM±SD	TOTAL (N=194) AM±SD	p
Age	13,5±2,4	13,7±1,7	13,8±2,2	13,6±2,3	0,875
N-A-Pg	3,9±6,7	4,2±5,2	-0,5±7,3	3,7±6,6	0,089
SNA	81,9±3,6	81,6±2,9	80,3±4,3	81,8±3,6	0,306

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SNB	78,7±3,6	78,0±2,9	78,7±4,1	78,6±3,5	0,579
ANB	3,2±2,8	3,6±2,2	1,6±2,7	3,2±2,8	0,121
N-S-Ar	120,6±5,0	118,8±5,0	117,9±5,5	120,2±5,1	0,069
M-Go-Ar	130,3±8,9	127,0±6,9	127,5±6,3	129,7±8,6	0,114
Anterior facial height	103,4±10,0	104,2±8,9	100,2±8,1	103,4±9,8	0,503
S-Ar	33,5±3,9	34,6±4,5	34,2±3,3	33,7±3,9	0,396
N-ANS	46,6±5,1	47,9±5,2	46,5±4,1	46,8±5,1	0,496
ANS-Me	55,6±6,0	55,2±5,7	52,6±4,3	55,4±5,9	0,267
Me-Go	56,1±6,6	55,8±7,3	54,3±6,9	55,9±6,7	0,697
Wits	1,2±3,7	1,5±2,6	-0,2±4,5	1,2±3,6	0,381
Jarabak	67,4±5,0	68,2±4,2	68,8±4,9	67,6±4,9	0,505
U1:ANS-PNS	109,5±8,2[a]	104,9±9,5[b]	104,3±7,3[ab]	108,6±8,6	**0,007**
L1:Me-Go	94,0±7,3[a]	95,8±5,8[a]	86,7±10,7[b]	93,8±7,5	**0,002**
Overbite	2,1±1,9[a]	3,2±1,8[b]	2,2±2,6[ab]	2,3±2,0	**0,025**
Mentolabial angle	125,0±16,7	121,4±15,4	119,0±13,1	124,1±16,3	0,320
Nasolabial angle	120,1±12,5	117,9±13,5	117,5±14,0	119,6±12,7	0,585
Soft tissue profile	157,2±7,5	157,2±6,0	158,9±6,9	157,3±7,2	0,766

Table 4: Non-normally distributed variables among hypodontia groups according to the severity

VARIABLES	MILD (N=155)		MODERATE (N=28)		SEVERE (N=11)		p
	Median	IQR	Median	IQR	Median	IQR	
N-Ar	78,8	74,8-83,5	79,0	75,8-85,6	79,0	74,0-81,7	0,796
Posterior facial height	70,0	65,3-74,4	70,1	66,5-75,3	70,1	65,3-72,5	0,813
S-N	66,6	62,9-69,8	68,4	65,4-71,9	66,2	65,5-67,6	0,237
Ar-Go	40,6	37,3-44,0	40,8	36,0-43,0	38,1	36,3-39,8	0,202
Co-Gn	109,3	101,6-113,6	105,8	101,9-113,6	101,7	101,0-105,8	0,140
Co-A	80,3	74,5-83,7	79,1	75,6-88,3	78,1	73,9-79,1	0,187
U1:L1	129,8[a]	123,4-139,3	135,5[ab]	124,2-145,3	145,6[b]	130,8-157,8	**0,007**
U1:N-A	3,6	1,4-4,8	2,7	-0,1-4,6	2,2	0,1-3,6	0,059
L1:N-B	3,6[a]	2,3-5,3	2,8[ab]	2,2-3,9	0,3[b]	-1,0-2,8	**0,001**
Overjet	3,5	2,6-4,7	3,4	3,0-4,6	3,2	1,7-4,6	0,670
Li-E	-2,3	-3,8-(-8)	-3,6	-4,5-(-1,8)	-5,3	-5,9-(-1,8)	**0,038**
Ls-E	-4,0	-5,6-(-2,3)	-4,6	-6,4-2,6	-5,0	-7,2-(-2,1)	0,407

There were no significant differences in skeletal relationships among hypodontia groups.

Mild group showed greater protrusion of the upper incisors than the other two groups ($P < .01$). Excessive retrusion of the lower incisors was found in the severe group ($P < .01$).

Overbite was found to be greater in the moderate group than in the mild and severe group ($P < .05$). Interincisal angle was significantly smaller in the mild group than in the severe group ($P < .01$). There were no significant differences in over jet values among hypodontia groups.

In soft tissue measurements only the distance between lower lip and E-line was found to be significantly greater in the severe group than in the other two groups ($P < .05$).

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Distribution of cephalometric parameters among hypodontia groups according to the location of missing teeth is presented in **Tables 5 and 6**.

Table 5: Distribution of cephalometric parameters among hypodontiagroups according to the location (arithmetic mean ± standard deviation)

VARIABLES	ANTERIOR (N=85) AM±SD	POSTERIOR(N=85) AM±SD	ANTERO POSTERIOR(N=24) AM±SD	p
SNA	82,0±3,1	81,8±4,0	80,7±3,5	0,281
SNB	79,0±3,3	78,4±3,9	78,3±3,0	0,499
N-S-Ar	120,9±4,7	119,7±5,3	119,3±5,4	0,225
M-Go-Ar	131,0±9,1	129,1±8,4	127,0±6,7	0,097
Anterior facial height	102,9±9,6	103,9±9,7	103,3±10,9	0,779
S-Ar	33,6±3,8	33,4±3,8	35,0±4,7	0,241
Ar-Go	40,9±5,7	39,7±5,0	39,7±5,0	0,286
ANS-Me	55,2±6,0	55,8±5,8	54,2±5,9	0,459
Me-Go	55,9±6,8	56,0±6,4	55,9±7,5	0,994
Wits	1,4±3,8	1,1±3,5	0,7±3,6	0,749
Jarabak	68,0±4,4	66,9±5,3	68,5±4,7	0,192
U1:ANS-PNS	109,4±8,7	108,6±8,3	105,3±8,4	0,189
U1:L1	**131,1±12,1[a]**	**130,7±12,6[a]**	**140,6±16,4[b]**	**0,003**
Overbite	2,2±2,0	2,3±2,0	2,6±2,2	0,410
Mentolabial angle	125,8±16,8	123,3±16,1	121,3±15,3	0,410
Nasolabial angle	119,8±13,3	119,6±11,9	119,1±14,0	0,969
Soft tissue profile	157,1±8,1	157,3±6,6	157,8±6,2	0,922

Table 6: Non-normally distributed variables among hypodontia groups according to the location

VARIABLES	ANTERIOR (N=85) Median	ANTERIOR (N=85) IQR	POSTERIOR (N=85) Median	POSTERIOR (N=85) IQR	ANTEROPOSTERIOR (N=24) Median	ANTEROPOSTERIOR (N=24) IQR	p
Age	14,0	12,1-16,0	13,1	12,1-15,1	14,1	12,1-15,1	0,576
N-A-Pg	4,3	0,6-8,6	4,6	0,2-7,5	1,5	-4,6-5,6	0,092
ANB	3,4	1,5-5,1	3,4	1,6-4,9	2,6	0,4-4,1	0,242
N-Ar	78,8	75,0-83,2	78,8	74,8-83,0	80,7	76,-87,35	0,396
Posterior facial height	70,0	65,3-74,8	69,7	66,2-73,3	71,1	67,1-75,4	0,657
S-N	66,4	62,8-69,3	66,7	64,0-69,8	67,6	65,5-72,3	0,154
N-ANS	46,4	43,6-49,8	47,5	42,8-50,7	49,0	45,7-51,4	0,298
Co-Gn	107,9	101,1-113,6	108,5	103,1-111,9	105,1	101,5-115,2	0,908
Co-A	80,3	74,5-83,4	79,3	75,0-83,5	79,1	75,1-85,8	0,093
L1:Me-Go	92,9	89,6-99,6	96,1	88,7-99,3	92,2	87,6-96,9	0,337
U1:N-A	3,6	1,5-4,6	3,6	1,2-5,0	2,5	0,2-3,7	0,142
L1:N-B	3,5[a]	2,3-5,2	3,6[a]	2,3-5,3	1,9[b]	-0,2-3,7	**0,003**
Overjet	3,2	2,5-4,5	3,5	2,9-4,7	3,5	2,4-4,9	0,537
Li-E	-2,5	-3,9-(-1,0)	-2,3	-3,7-(-0,8)	-4,5	-5,8-(-1,8)	**0,048**
Ls-E	-3,9	-5,8-(-2,2)	-4,0	-5,6-(-2,5)	-4,9	-6,6-(-2,1)	0,542

There were no significant differences in skeletal relationships among hypodontia groups.

Patients with anteroposterior tooth absence, compared to other groups, showed greater interincisal angle and greater retrusion of both the upper and lower incisors, but with the lower ones with statistical significance ($P < .01$). Other dental measurements showed no significant differences between groups.
In soft tissue measurements only the distance between lower lip and E-line was found to be significantly greater in the anteroposterior group than in the other two groups
($P < .05$).

Although there were no statistically significant differences ($P > .05$) in skeletal relationships among all hypodontia subjects examined, results showed evidently smaller values of SNA and ANB angles in the severe and anteroposterior groups, as well as decrease of anterior face height and lower face height in the severe group.

DISCUSSION

The effect of hypodontia on skeletodental and soft tissue patterns has been reported in various research publications over the past few years.

As in most of the other studies, we observed that patients with aneroposterior tooth absence and patients with an increasing number of missing teeth are showing the largest cephalometric differences compared to other subgroups.

Skeletal relationships

Many publications have reported decreased SNA and ANB angles among patients with hypodontia. [3,9,10,11,12,16,17] On the other hand, few authors have found little or no correlation between hypodontia and SNA and ANB angles.[8,14,17] Our results showed insignificantly smaller SNA and ANB angles, but also that the values were evidently smaller in the severe and anteroposterior groups, compared to other groups. That can be related to a tendency towards Class III malocclusion, as the severity and location increase, which was also reported in several previous studies. [3, 10, 13] In regards to SNB angle values, previous researches gave us opposite findings. Some of them have reported of a larger SNB angle among hypodontia patients [9,14], while others claim that its value is smaller than the standard values.[10,11,12,16] in our study no significant differences in SNB angle values were found.

Reduction of the anterior face height has been reported previously. [3, 8, 15, 17] We have also noticed that patients with severe hypodontia have shorter anterior and lower face heights, compared to others, but with no statistically significant differences.

Dental relationships

Among all the parameters we have analyzed, dental relationships were the most affected by an increase of hypodontia severity and location. Significant retrusion of both, upper and lower incisors is in accordance with many of the other studies. [8, 9, 14, 15, 16] Although, some authors wouldn't agree with that. [3 ,13] Few studies have found an increase of the interincisal angle [8, 14, 16], which was also shown in our results.

Soft tissue profile

A very little correlation between soft tissue measurements and hypodontia was found in this research. The only parameter that showed significant differences was the distance between lower lip and E-line, which was the greatest in severe and anteroposterior groups. Ogaard and Krogstad[15] reported that patients with hypodontia have more retruded upper and lower lips.

Due to increase in the number and location of missing teeth it could be expected that alveolar bone development would be more and more insufficient. As a result, maxillary retrognathism (decreased SNA angle) and shorter anterior face height can occur.

When many teeth are missing, others tend to fulfill the gaps by inclining themselves that is maybe why so many authors found retrusion of the incisors, especially the lower ones.

Consequently, lower lip is retruded , which in combination with a tendency towards Class III could lead to a more concave profile.

CONCLUSION

Hypodontia has a significant effect on the craniofacial morphology, with dental relationships as the most affected.

Patients with 6 or more missing teeth showed the largest number of variable deviations, compared to other groups (retrusion of the upper and lower incisors, an increase of the interincisal angle and a greater distance between lower lip and E-line).

As for the location of hypodontia, variable deviations were more remarkable in the anteroposterior group than in either the anterior or posterior group (retrusion of the upper and lower incisors, an increase of the interincisal angle and a greater distance between lower lip and E-line)

Due to clinically significant smaller values of SNA and ANB angles in the severe and anteroposterior groups, we can presume that maxillary retrognathism and a tendency towards Class III malocclusion increase proportionally with the number and location of missing teeth. That, combined with the significantly greater distance between lower lip and E-line in mentioned groups, leads to a conclusion that subjects with severe and anteroposterior hypodontia are more prone to have a concave profile.

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