Dužinski prediktori rotacijskog obrasca rasta lica na hrvatskoj populaciji s anomalijom skeletne klase III

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Dužinski prediktori rotacijskog obrasca rasta lica na hrvatskoj populaciji s anomalijom skeletne klase III

Linear Predictors of Facial Rotation Pattern in Croatian Subjects with Skeletal Class III Malocclusion

Introduction

Class III malocclusions have been harnessing the attention of clinicians for hundreds of years due to the complexity of therapy, the possibility of relapses conditioned by individual growth and development and due to their great influence on facial esthetics. The incidence of relapse is reported in one article up to 50% (1). Additionally, etiologic diversity makes it more difficult to diagnose and plan the therapy. Genetic and environmental factors are considered the cause of Class III malocclusions. Diversity of loci and suspicious genes have been identified using the linkage analysis and association studies (2-9). The tooth size and dental arch asymmetry were also recognized as important contributing factors to the etiology of malocclusions (10-12). In their research on fluctuating dental arch asymmetry, Škrinjarić et al. (13) concluded that the highest fluctuating asymmetry appeared in Class III anomalies, which suggest that patients with this malocclu-
i okolišnog stresa.

Prevalencija anomalija klase III varira između različitih etničkih skupina – raspon je od 0 do 26 % (14). U azijskoj populaciji je veća negoli u ostalima (15). Kineska i malezijanska populacija imaju razmjerno visoku prevalenciju – 16 % (14), odnosno 17 % (14). Većina afričke populacije pokazala je razmjerno nisku prevalenciju, iako je u dvjema zemljama pronađena veća učestalost anomalija klase III (16). Nedavna istraživanja pokazala su raspon od 2 do 6 % za europsku populaciju (14).

Vertikalni obrazac rasta kod pacijenata sa skeletnom klasom III vrlo je važan čimbenik i treba ga se razmotriti pri određivanju dijagnoze i detaljnog plana te vremena terapije. Schudy (17) je istraživao interakciju horizontalnih i vertikalnih displazija lica i na temelju SN – MP kuta odredio proporcije prema kojima razlikujemo prosječne fazične tipove i one ekstremne. Podijelio je uzorak od 120 pacijenata u tri skupine na temelju njihova SN – P kuta i uveo izraz divergence lica za metodu indikacije vertikalne varijacije. Dva ekstremna tipa divergencije lica opisana su kao hiperdivergentan za osobe s velikim kutom mandibularne ravnine prema kranijalnoj bazi i hipodivergentan za one s malim kutom mandibularne ravnine prema kranijalnoj bazi. Ostali pojmovi koji su korišteni za opisivanje različitih tipova vertikalnog obrasca rasta lica su povećani i smanjeni kut (high and low angle) koji također upućuju na stupanj divergencije lica, zatim dugo ili kratko lice na temelju linearnih mjerenja visine lica. Jarabakov omjer određuje postotak prednje i stražnje proporcije lica. Taj se odnos dobiva sljedećom formulo: stražnja visina lica/prednja visina lica x 100. Prednja visina lica mjeri se od točke nasion do točke menton, a stražnja od točke sela do točke gonion. Vrijednosti između 62 i 65 % upućuju na prosječno lice, veći postotak se vidi u slučajevima smanjenog kata (low angle), a manji postotak upućuje na povećani kut (high angle)(18).

Uzimajući u obzir plan terapije, upitno je treba li početi s ranom terapijom ili to učiniti tek nakon završetka rasta i razvoja. Bilo bi dobro da se može predvidjeti mogućnost ishoda terapije prije njezina početka rashodi smjera. Treba je razmotriti prema učinku na stražnju i prednju visinu lica (high angle) i kući, a manji postotak upućuje na povećani kut (high angle)(18).

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Ispitnici i postupci

Uzorak

Uzorak ove retrospektivne studije sastojao se od 201 ispitanika s anomalijom klase III (90 muškaraca i 111 žena; dob od 12 do 20 godina; srednja dob 15 ± 3 godine). Uzorak je dobiven iz baze podataka pacijenata Zavoda za ortodonciju. Sample

The sample of this retrospective study consisted of 201 patients with Class III malocclusion (90 male and 111 female; aged 12-20 years; mean age 15±3 years) and they were obtained from the archives of the

Subjects and methods

Sample

The sample of this retrospective study consisted of 201 patients with Class III malocclusion (90 male and 111 female; aged 12-20 years; mean age 15±3 years) and they were obtained from the archives of the
Department of Orthodontics, Dental Clinic, Clinical Hospital Center Zagreb, Croatia. More than one thousand patient files were reviewed.

The inclusion criteria were as follows: 1. high quality of pretreatment lateral cephalograms, 2. age between 12 and 20 years, 3. Croatian ethnicity, 4. ANB angle less than 0.5°, 5. Wits appraisal of less than 0 mm for girls and less than: -1 mm for boys.

The standard of the ANB value was derived from a previous study on subjects of Croatian ethnicity with normal occlusion (21).

Patients who exhibited an anterior mandibular shift, craniofacial syndromes, clefts, trauma, hypodontia and those who had already received orthodontic therapy were excluded.

The Ethics Committee of the School of Dental Medicine approved this study, as the patients were examined for routine diagnostic needs and future orthodontic treatment planning. All patients or their parents (if the patients were under 18) signed an informed consent form authorizing the use of their radiograms.

Cephalometric analysis

Lateral cephalograms were obtained under standardized conditions: in the maximal intercuspal position, using ear rods for stabilization (median plane focal distance: 1.55 m; detector to midsagittal distance: 0.125 m). Two devices were used. Twenty cephalograms were taken with a Planmeca PM 2002 CC Proline (Planmeca, Helsinki, Finland). Analog cephalograms digitalized are Scan Maker i900 (Microtek, Willich, Germany). 181 digital cephalograms were stored on a CD-ROM in digital format and were taken with an Orthopantomograph OP200D (Instrumentarium Oy, Tuusula, Finland) with an average exposure time of 10 seconds and at values of 85 kV – 13 mA.

Cephalometric analysis was performed with DOLPHIN IMAGE software (v.11.0). To prevent magnification error and to calibrate each cephalogram in the DOLPHIN software to obtain real linear values, pictures were taken with a metal calibration ruler incorporated in the cephalostat and two ruler points reproduced on the headfilm.
Statistička analiza

Statistička analiza obavljena je u komercijalnom programu Statistical Package for Social Sciences (verzija 10.0, SPSS, Chicago, SAD). Razina značajnosti postavljena je na P vrijednost < 0.05. Normalnost svih kefalometrijskih varijabli potvrdjena je Shapiro-Wilkovim testom. Nakon deskriptivne statistike korištena je klasificirana u pet kategorija za analizu – kranijalna baza, skeletni maksilarni i skeletni mandibularni odnosi, sagitalni međučeljunski i vertikalni odnosi (tablica 1.). Kao mjera za svrstavanje u kategoriju obrasca rasta lica korištena su tri parametra – Bjorkov, Jarabakov i N-N-Me : S-Go omjer.

Ako su barem dva upućivala na isti obrazac rast, pacijent je svrstan u dotičnu kategoriju.

Table 1. Pet kategorija za analizu

| Kategorija                                    | Kategorija                                    | Kategorija                                    | Kategorija                                    | Kategorija                                    |
|-----------------------------------------------|-----------------------------------------------|-----------------------------------------------|-----------------------------------------------|-----------------------------------------------|
| Kranijalna baza • Cranial base                | Linearno • Linear: S – N, S – Ar               | Angulorno • Angular: N – S – Ar                | Linearno • Linear: Go – A                     | Angulorno • Angular: S – N : ANS – PNS        |
| Skeletne maksilarnar varijable • Maxillary skeletal relationships variables | Linearno • Linear: Co – Gm, Ar – Go, Go – Gn  | Angulorno • Angular: Me – Go – Ar, Me : Go : S – N | Angulorno • Angular: ANS – PNS : Me – Go      | Angulorno • Angular: S – N : ANS – PNS        |
| Skeletne mandibularne varijable • Mandibular skeletal relationships variables  | Linearno • Linear: Co – Gn, Ar – Go, Go – Gn  | Angulorno • Angular: S – N : ANS – PNS         | Angulorno • Angular: ANS – PNS : Me – Go      | Angulorno • Angular: S – N : ANS – PNS        |
| Sagitalni međučeljunski odnosi • Intermaxillary relationships variables | Linearno • Linear: Co – Gm, Ar – Go, Go – Gn  | Angulorno • Angular: S – N : ANS – PNS         | Angulorno • Angular: ANS – PNS : Me – Go      | Angulorno • Angular: S – N : ANS – PNS        |
| Vertikalni odnosi • Vertical relationships   | Linearno • Linear: S – N, S – Ar               | Angulorno • Angular: N – S – Ar                | Linearno • Linear: Go – A                     | Angulorno • Angular: S – N : ANS – PNS        |
| Omjer • Ratio: S : Go : N – Me (%)            |                                              |                                              |                                              |                                              |

On each cephalogram, ten cephalometric landmarks, representing hard tissues, were identified (Figure 1.). From these landmarks, thirteen angular and linear measurements were recorded and analysed. The measurements were divided into five categories for analysis: cranial base, skeletal maxillary and sagittal mandibular relationships, sagittal intermaxillary and vertical relationships (Table 1). To determine the vertical growth pattern, the Bjork and Jarabak analysis and N-Me/S-Go were used. If at least two parameters indicated the same growth pattern, the patient was classified in that category.

Statistical analysis

Statistical analyses were performed using Statistical Package for Social Sciences software (version 10.0, SPSS, Chicago, SAD). The level of significance was set at P-values of < 0.05.

The normality of all cephalometric variables used for multivariate tests was confirmed using the Shapiro-Wilk test. After deriving descriptive statistics, multiple linear regression analysis was used to study the associations between linear measurements of maxilla, mandible and cranial base and facial growth rotation. As age and gender may influence the results and act as confounders, their significance was also tested for inclusion in the analysis.

To test the measurement error for the cephalometric variables used in this study, the lateral cephalograms of 30 randomly selected patients were redigitized 1 month later by the same examiner and were measured again using intraclass correlation coefficients (ICCs) with their respective 95% confidence intervals, measurement errors (MEs), smallest detectable changes (SDCs), limits of agreement (LoAs) and the relationship between the differences of the two measurements that were within the limits of agreement.

ME was measured according to the procedure described by Bland and Altman as the square root of the mean square error from an analysis of variance (22).

Intraexaminer reproducibility was substantial to excellent (ICC=0.65–1.00). Measurement error was low (0.12–3.01) and was always lower than the biological variability of the associated variables.

Reproducibilnost ispitivača u mjerjenju bila je znatna do izvrsna (ICC = 0.65 – 1.00). Pogreška mjerjenja bila je niska (raspon 0.12 – 3.01) i uvijek je bila manja od biološke varijabilnosti pripadajuće varijable.
Results

The multiple linear regression model for prediction of facial rotation pattern estimated by the Jarabak’s ratio

Univariate correlations are presented in Table 2. With the control of gender, linear measurements of the maxilla, mandible and cranial base are statistically significant predictors of facial growth rotation estimated by the Jarabak’s ratio (p<0.001). The entire regression model accounts for 69.3% of variability of the facial growth rotation. The largest independent contribution to the explanation of rotation pattern variability is the height of the ramus (Ar-Go) and the effective length of the mandible (Co-Gn) accounting for 46.8 and 34.3% of the variability. The length of anterior cranial base (S-N) and the length of maxilla (Co-A) (3.1 and 4.8%) (Table 3) had the smallest contribution. The horizontal growth pattern tendency was associated with shorter S-N, longer posterior cranial base length (S-Ar), longer Co-A, longer Ar-

| Table 2. Spearmanov korelacija | Table 2 | Spearman’s correlation |
|---------------------------------|-----------|------------------------|

|                          | Jarabak  | s-n       | s-ar      | co-a      | ar-go     | go-gn     | co-gn     | Spol • Gender | Dob • Age |
|--------------------------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|--------------|-----------|
| Jarabak                  | r 1.000   | 0.112     | 0.362     | 0.211     | 0.418     | -0.008    | 0.005     | -0.050       | 0.049     |
| s-n                      | r 1.000   | 0.475     | 0.820     | 0.576     | 0.691     | 0.708     | -0.219    | 0.289        |           |
| s-ar                     | r 1.000   | 0.597     | 0.413     | 0.483     | 0.549     | 0.549     | -0.229    | 0.315        |           |
| co-a                     | r 1.000   | 0.572     | 0.759     | 0.781     | 0.781     | -0.205    | 0.316     |              |           |
| ar-go                    | r 0.495   |           |           |           | 0.745     | -0.172    | 0.530     |              |           |
| go-gn                    | r 1.000   | 0.870     | -0.135    | 0.447     |           |           |           |              |           |
| co-gn                    | r 1.000   |           |           |           |           |           |           |              |           |
| gender                   | r 1.000   |           | 0.056     |           |           |           |           |              |           |
| age                      | r 1.000   |           |           |           |           |           |           |              |           |
| Jarabak                  | p 0.056   | <0.001    | 0.001     | <0.001    | 0.456     | 0.472     | 0.242     | 0.243        |           |
| s-n                      | p <0.001  | <0.001    | <0.001    | <0.001    | <0.001    | <0.001    | <0.001    | <0.001       |           |
| s-ar                     | p <0.001  | <0.001    | <0.001    | <0.001    | <0.001    | <0.001    | <0.001    | <0.001       |           |
| co-a                     | p <0.001  | <0.001    | <0.001    | <0.001    | <0.001    | <0.001    | <0.001    | <0.001       |           |
| ar-go                    | p <0.001  | <0.001    | <0.001    | 0.007     | <0.001    | <0.001    | <0.001    |              |           |
| go-gn                    | p <0.001  | <0.001    | 0.028     | <0.001    |           |           |           |              |           |
| co-gn                    | p <0.001  | <0.001    | <0.001    |           |           |           |           |              |           |
| Spol • Gender            | p <0.001  |           |           |           |           |           |           |              |           |
| Dob • Age                | p <0.001  |           |           |           |           |           |           |              |           |

| Table 3. Model multiple linearne regresije za predikciju obrasca rasta lica procijenjenu Jarabakovim omjerom stražnje i prednje visine lica | Table 3 | Multivariate linear regression model for prediction of rotational growth pattern estimated by Jarabak’s ratio posterior and anterior facial height |

|                          | Nesticlanizirani koeficijent B • Non-standardized coefficient B | Std. pogreška • Standard error | Standardizirani koeficijent Beta • Standardized coefficient Beta | Sig. | Nultog reda • Zero order | Parcijalna • Partial | Semiparcijalna • Semipartial |
|--------------------------|---------------------------------------------------------------|--------------------------------|---------------------------------------------------------------|------|-------------------------|---------------------|------------------------|
| (konstanta) • (Constant) | 62.066                                                       | 2.768                          | <0.001                                                         |      | 0.112                   | -0.307              | -0.176                  |
| s-n                      | -0.296                                                      | 0.066                          | -0.323                                                         | <0.001 | 0.362                  | 0.524               | 0.335                  |
| s-ar                     | 0.494                                                       | 0.058                          | 0.428                                                         | <0.001 | 0.418                  | 0.782               | 0.684                  |
| co-a                     | 0.314                                                       | 0.057                          | 0.466                                                         | <0.001 | 0.211                  | 0.371               | 0.218                  |
| ar-go                    | 0.901                                                       | 0.052                          | 1.196                                                         | <0.001 | 0.418                  | 0.782               | 0.684                  |
| go-gn                    | 0.346                                                       | 0.051                          | 0.647                                                         | <0.001 | -0.008                 | 0.436               | 0.264                  |
| co-gn                    | -0.720                                                      | 0.048                          | -1.822                                                        | <0.001 | 0.005                  | -0.733              | -0.586                 |
| Spol • Gender            | -0.135                                                      | 0.356                          | -0.016                                                        | 0.706 | -0.050                 | -0.027              | -0.015                 |

R=0.839; R²=0.703; Prilagodeni • Adjusted R²=0.693; p<0.001
smanjenjem Co – Gn-a (tablice 2 i 3). Spol nije značajan prediktor rotacijskog obrasca rasta lica. Dob pozitivno linearno korelira sa svakom linearnom varijablom (raspon r = 0,29 – 0,57) te je u multiplom regresiji stvarala problem multikolinearnosti zbog čega nije uključena u analizu.

Model multiple linearne regresije za predikciju obrasca rasta lica procijenjenu inklinicijom mandibularne ravnine na kranjalnu bazu

Cijeli regresijski model objašnjava 60,5 % varijabiliteta rotacijskog rasta lica (p < 0,001; tablica 4.). Uz kontrolu spola, tendencija prema vertikalnom obliku rasta povezana je s povećanjem S – N-a i smanjenjem S – Ar-a, Co – A-e, Ar – Go-a, Go – Gn-a te povećanjem Co – G-n-a. Najveći samo-stalni doprinos objašnjenju varijabiliteta rotacijskog rasta lica daju Ar – Go i Co – Gn koji objašnjavaju 29,4 i 51,3 % varijabiliteta. Najmanji je udjel u objašnjenju S – N-a i S – Ar-a od 2,2 i 2,8 %. Spol ponovno nije značajan prediktor obrasca rotacijskog rasta lica, ali ni dob zbog problema multikolinearnosti, pa nisu uključeni u analizu.

The multiple linear regression model for prediction of facial rotation pattern estimated by angle between the mandibular plane and cranial base

The mandibular plane angle model accounted for 60.5% of the variability in facial rotation pattern (p<0.001; Table 4.). With the control of gender, the vertical growth pattern tendency was associated with longer S-N and decreased S-Ar, Co-A, Ar-Go,Go-Gn and increased Co-Gn. Ar-Go and Co-Gn contributed the most (29.4 and 51.3%, respectively). The S-N and S-Ar (2.2 and 2.8%) had the smallest contribution. Again, gender was not a significant predictor and age was not included due to multicolinearity problem.

| Tablica 4. Model multiple linearne regresije za predikciju obrasca rasta lica procijenjenu inclinacijom mandibule na kranjalnu bazu
Table 4 Multivariate linear regression model for prediction of rotational growth pattern estimated by inclination of the mandible in relation to the cranial base |
|---|---|---|---|---|---|---|---|
| (konstanta) | Non-standardized coefficient B | Standard error | Standardized coefficient Beta | Sig. | Zero order | Partial | Semipartial |
| s-n | 0.339 | 0.102 | 0.271 | 0.001 | -0.161 | 0.232 | 0.147 |
| s-ar | -0.334 | 0.090 | -0.212 | <0.001 | -0.222 | -0.259 | -0.166 |
| co-a | -0.617 | 0.088 | -0.672 | <0.001 | -0.266 | -0.452 | -0.313 |
| ar-go | -0.976 | 0.080 | -0.948 | <0.001 | -0.186 | -0.660 | -0.542 |
| go-gn | -0.847 | 0.087 | -1.159 | <0.001 | -0.122 | -0.608 | -0.473 |
| co-gn | 1.201 | 0.075 | 2.225 | <0.001 | 0.053 | 0.757 | 0.716 |
| Spol • Gender | 0.443 | 0.551 | 0.037 | 0.422 | 0.018 | 0.058 | 0.036 |

Model multiple linearne regresije za predikciju obrasca rasta lica procijenjenu Bjorkovim poligonom

Nalaz regresije koji kao ishodnu varijablu uzima inklinaciju mandibularne ravnine na kranjalnu bazu, potvrđuje i regresija s Bjorkovim poligonom kao ishodom (tablica 5).

| Tablica 5. Model multiple linearne regresije za predikciju obrasca rasta lica procijenjenu Bjorkovim poligonom
Table 5 Multivariate linear regression model for prediction of rotational growth pattern estimated by Bjork polygon |
|---|---|---|---|---|---|---|---|
| (konstanta) | Non-standardized coefficient B | Standard error | Standardized coefficient Beta | Sig. | Zero order | Partial | Semipartial |
| s-n | 0.340 | 0.102 | 0.272 | 0.001 | -0.161 | 0.233 | 0.148 |
| s-ar | -0.333 | 0.089 | -0.211 | <0.001 | -0.222 | -0.259 | -0.165 |
| co-a | -0.619 | 0.087 | -0.674 | <0.001 | -0.267 | -0.454 | -0.315 |
| ar-go | -0.977 | 0.080 | -0.950 | <0.001 | -0.187 | -0.661 | -0.543 |
| go-gn | -0.844 | 0.079 | -1.158 | <0.001 | -0.121 | -0.608 | -0.472 |
| co-gn | 1.200 | 0.074 | 2.226 | <0.001 | 0.054 | 0.758 | 0.716 |
| Spol • Gender | 0.445 | 0.550 | 0.038 | 0.420 | 0.018 | 0.058 | 0.036 |

Multiple linear regression model for prediction of facial rotation pattern estimated by Bjork polygon

A finding of regression that as an initial variable assumes inclination of the mandibular plane in relation to the cranial base also confirms regression with Bjork polygon as the outcome, accounting for 60.6% of variability (Table 5).
Model multiple linear regression model for prediction of facial rotation pattern estimated by inclination of the maxillary plane to the cranial base

The statistically significant predictors of the growth rotation of the maxilla were the S-N and S-Ar and gender (Table 6). The posterior rotation of maxilla, which is related to female gender, increased S-N and reduced S-Ar. The model accounted for 14.3% of variability and the most significant independent contribution gave S-Ar (7.1%).

**Table 6**  
Multivariate linear regression model for prediction of rotational growth pattern estimated by inclination of the maxilla in relation to the cranial base

| (konstanta) • (Constant) | Non-standardized coefficient B | Standard error | Standardized coefficient Beta | Sig. | Nultog reda • Zero order | Parcialna • Partial | Semiparcijalna • Semipartial |
|--------------------------|--------------------------------|----------------|-----------------------------|------|-------------------------|-------------------|--------------------------|
| s-n                      | 0.207                          | 0.086          | 0.290                       | 0.017| -0.053                  | 0.171             | 0.158                    |
| s-ar                     | -0.307                         | 0.075          | -0.340                      | <0.001| -0.337                 | -0.281            | -0.266                   |
| co-a                     | -0.018                         | 0.074          | -0.035                      | 0.803| -0.151                  | -0.018            | -0.016                   |
| ar-go                    | -0.085                         | 0.067          | -0.144                      | 0.210| -0.150                 | -0.090            | -0.082                   |
| go-gn                    | -0.090                         | 0.067          | -0.215                      | 0.183| -0.194                 | -0.096            | -0.087                   |
| co-gn                    | 0.052                          | 0.063          | 0.170                       | 0.405| -0.172                 | 0.060             | 0.055                    |
| Spol • Gender            | -0.826                         | 0.464          | 0.188                       | 0.006| 0.228                  | 0.194             | 0.180                    |

R²=0.416; R²adj=0.173; P<0.001

Model multiple linear regression model for prediction of facial rotation pattern estimated by intermaxillary plane angle

Significant predictors of hyperdivergent jaw growth pattern were decreased Co-A, decreased Ar-Go and Go-Gn and increased Co-Gn (Table 7). The entire regression model accounted for 56.8% of the rotational growth variability.

**Table 7**  
Multivariate linear regression model for prediction of rotational growth pattern estimated by intermaxillary angle

| (konstanta) • (Constant) | Non-standardized coefficient B | Standard error | Standardized coefficient Beta | Sig. | Nultog reda • Zero order | Parcialna • Partial | Semiparcijalna • Semipartial |
|--------------------------|--------------------------------|----------------|-----------------------------|------|-------------------------|-------------------|--------------------------|
| s-n                      | 0.133                          | 0.091          | 0.109                       | 0.203| -0.133                  | 0.092             | 0.059                    |
| s-ar                     | -0.599                         | 0.089          | -0.668                      | <0.001| -0.184                 | -0.435            | -0.312                   |
| co-a                     | -0.891                         | 0.082          | -0.888                      | <0.001| -0.104                 | -0.618            | -0.508                   |
| ar-go                    | -0.756                         | 0.081          | -1.061                      | <0.001| -0.034                 | -0.557            | -0.433                   |
| go-gn                    | 1.147                          | 0.076          | 2.179                       | <0.001| 0.155                  | 0.736             | 0.701                    |
| Spol • Gender            | -0.826                         | 0.562          | -0.071                      | 0.143| -0.115                 | -0.105            | -0.068                   |

R²=0.764; R²adj=0.584; P<0.001

Rasprava

Anomalija klase III može biti rezultat mnogobrojnih kombinacija skeletnih i dentoalveolarnih komponenti. Sadržava morfološke značajke koje se razlikuju u različitim etničkim skupinama (23). Ortodonti bi trebali poznavati morfološke značajke lica tih različitih etničkih skupina kako bi u
Dužinski prediktori rotacijskog obrasca rasta lica kod klase III

Radolj Miličić i sur.

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giba mandibularne ravnine prema kranijalnoj bazi (MP – SN kuta), tj. ramus je kraći što je MP – SN kut veći i obrnuto.

Smanjena dužina maksile također je prediktor vertikalnog obrasca rasta. To može biti zbog toga što je maksila smještena distalnije i uzrokuje postrotaciju mandibule kao posljedicu kompenzacijonskog mehanizma. Slične podatke dobili su Ferrario i suradnici (38) koji su proučavali odnos između mandibularne veličine i oblika prema skeletnoj divergensiji (prema MP – SN kantu) i ustanovili da hiperdivergentni ispitanci općenito imaju manju maksilu i mandibulu.

U četvrtom modelu zanimljivo je da dužina maksile uopšteno nije prediktor rotacijskog rasta maksile, nego samo prednja i stražnja duljina kranijalne baze (povećan S – N i smanjen S – Ar povezani su sa stražnjom rotacijom maksile). To se može objasniti činjenicom da duljina Co – A utječe na anteroposteriorni položaj maksile, a rast kranijalne baze (prednji dio) uzrokuje translaciju nasomaksilarnog kompleksa (sekundarni pomak) i utječe i na vertikalnu dimenziju. Značajno veća srednja vrijednost kuta nagiba gornje čeljusti prema kranijalnoj bazi (ANS – PNS : S – N) kod žena negoli kod muškaraca znači da je maksila više usmjerena prema dolje u odnosu prema bazi lubanje; to se može odnositi na kaudalni rotacijski rast čeljusti kod žena.

U petom modelu statistički značajni prediktori divergentnog obrasca rasta čeljusti su smanjenja dužine maksile, smještenja visine ramusa i dužine korpusa mandibule te povećanja efektivne dužine mandibule. Björk (39) je tvrdio da je otvoreni zagriz povezan s većom visinom ramusa mandibule, a Sassouni (40) i Schudy (17) isticali su da je otvoreni zagriz povezan sa smanjenom visinom ramusa mandibule. Hellman (41) je izvijestio da isključivo smanjenje visina ramusa i smanjenja dužina korpusa mandibule dovode do otvorenog zagriza prije negoli vertikalnom razvoju nasomaksilarnog kompleksa.

U četvrtom od pet modela, vertikalni obrasac rasta je povezan sa smanjenom visinom ramusa, smanjenom dužinom mandibularnog korpusa i povećanom efektivnom dužinom mandibule. Slično su istaknuli u istraživanju Mangla i suradnici (42) o mandibularnoj morfološkoj različitosti lica, naime, da se visina ramusa značajno povećava u hipodivergentnim i normodivergentnim skupinama u usporedbi s hiperdivergentnom skupinom. Ti su rezultati bili u skladu i sa zaključcima Sassounija (40, 43), Mullera (44) i Schudy (17) koji su uočili značajno smanjenje širine i visine ramusa u hiperdivergentnoj skupini. Taj se nalaz može objasniti vrlo značajnom negativnom korelacijom između visine ramusa i korpusa mandibule rotacije (SN – MP, PP – MP, AR – Go – Me) koji kompenziraju učinak spuštanja mandibule s povećanjem visine ramusa i tako smanjuju njihov učinak na visinu prednjeg lica.

Zaključak

Efektivna dužina mandibule najznačajniji je prediktor rotacijskog rasta lica pri čemu povećana dužina u velikoj mjeri predispobira tendenciju vertikalnom obrascu rasta. Nije pronađena značajna spolna dihotomija, osim u četvrтом modelu gdje je stražnja rotacija maksile povezana sa ženskim spolom.

A decreased maxillary length was also a predictor of vertical rotation pattern. This may be because the maxilla is positioned more distally, thus causing the post-rotation of the mandible. Similar results were given by Ferrario et al. (38). The aim of their study was to find the relationship between the mandibular size and the shape to skeletal divergency (according to MP-SN angle) and found that hyperdivergent subjects generally have a smaller maxilla and mandible.

In the fourth model it is interesting that the length of the maxilla is not at all a predictor of the rotational growth of the maxilla, only anterior and posterior cranial base length (increased S-N and reduced S-AR are related to the posterior rotation of the maxilla). It may be explained by the fact that the length Co-A affects anteroposterior position of maxilla whereas the growth of cranial base (anterior part) causes the translation of the nasomaxillary complex-secondary displacement and affects also a vertical dimension. Significantly higher mean value of ANS-PNS:S-N angle in females than males means that the maxillary plane is more downward positioned relative to the cranial base; this may relate to a caudal jaw growth rotation in females.

In the fifth model, the statistically significant predictors of divergent jaw growth pattern are a decreased maxillary length, decrease of ramus height and mandibular corpus length, and increase in effective mandibular length. Björk (39) demonstrated that an open bite is associated with a large ramus while Sassouni (40) and Schudy (17) reported that open bite usually goes with shorter ramus. Hellman (41) suggested that a short ramus and corpus, rather than vertical development in nasomaxillary complex, leads to the development of open bite.

In four out of five models, the vertical growth pattern is associated with decreased ramus height and mandibular corpus length and increased effective mandibular length. Mangla et al. (42) evaluated mandibular morphology in different facial types and found a significantly increased ramus height in hypodivergent and normodivergent groups when compared to hyperdivergent group. These results coincide with conclusions of a study by Sassouni (40, 43), Muller (44) and Schudy (17) who observed a significant reduction in the width and height of ramus in the hyperdivergent group. This finding may be explained by highly significant negative correlations between the ramus height and angles of mandibular rotations (SN-MP, PP-MP, AR-Go-Me), which compensate the effect of downward mandibular movement with the increase in ramus height and hence decrease its effect on the anterior facial height.

Conclusion

The effective length of the mandible was the most important predictor of facial rotation pattern, with the increased length largely predisposing the tendency to the vertical growth pattern. No significant dichotomy regarding gender was found except in the fourth model where the posterior rotation of the maxilla is related to female gender.
Kod pacijenata s maksilarnim retrognatizmom, zbog veće visine mandibularnog ramusa i kraće efektivne dužine mandibule, veća je vjerojatnost da će rana terapija obraznom maskom biti uspješna.

Sukob interesa
Nije bilo sukoba interesa.

Abstract
Objectives: The objective of this study was to determine whether the linear measures of the maxilla, mandible and cranial base were predictors of facial growth rotation in a Croatian population with Class III malocclusion by cephalometric radiographic methods. Material and methods: The examined sample consisted of pretreatment lateral cephalometric records of 201 (111 females and 90 males) untreated Class III patients of Caucasian Croatian ancestry from the Department of Orthodontics at Zagreb University. The measurements were divided into five categories for analysis: cranial base, skeletal maxillary and skeletal mandibular relationships, sagittal intermaxillary and vertical relationships. Five multiple linear regression models were used to identify predictors of facial rotation pattern. Results: The effective length of the mandible was the most important predictor of facial rotation pattern, with the increased length largely predisposing the tendency to the vertical growth pattern. No significant dichotomy was found regarding gender apart from the fourth model in which the posterior rotation of maxilla is related to female gender. Conclusion: These predictors could help orthodontists determine timing and therapy for Croatian patients with Class III malocclusions.

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Conflict of interest
None declared

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