Povezanost prostora u segmentima I_2 - M_1 s određenim parametrima rasta orofacijalne regije utvrđenim rendgenkefalomterijskom raščlambom

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Sažetak

Radom se željelo ispitati povezanost stanja prostora u segmentima I_2-M_1 zubnih lukova s tipom rotacije lica. Kao materijal poslužili su sadreni odljevi čeljusti i LL telerendgenogrami glave 109 ispitanika s mješovitom denticijom. Pri ocjeni tipa rotacije lica uzeti su obzir sljedeći rendgenkefalometrijski parametri: Björkov poligon, segmenti čeljusnoga kuta, međučeljusni kut te odnos stražnje i prednje visine lica. Vrjednovanje prostora u zubnome luku provedeno je metodom po Mayersu uz primjenu tablica predvidljivih širina kruna neniklih očnjaka i pretkutnjaka prilagođednih našoj populaciji. χ^2 testom utvrđeno je da između stanja prostora u segmentima I_2-M_1 obiju čeljusti i analiziranih rendgenokefalometrijskih parametara nema statistički značajne povezanosti.

Ključne riječi: *prostor u zubnome luku, rotacija lica*

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Nedostatak prostora u zubnome luku za pravilan razmještaj zuba najčešći je simptom ortodontskih nepravilnosti. Razvojem denticije, od mliječne prema trajnoj, njegova se čestoća povećava (1,2,3). U regiji sjekutića on je najčešće određen nasljeđem, a u postraničnom ga segmentu uglavnom uzrokuju pomaci zuba nakon vađenja ili karioznih destrukcija mliječnih očnjaka i kutnjaka.

Zubi u zubnome luku nemaju stalan položaj. Remećenjem harmonije: zub, susjedni zubi, antagonisti, okolni mišići, zubi se postupno pomiču sve dok se ne uspostave nove ravnoteže. Pri tome je osobito karakteristična mezijalna tendencija pomaka lateralnih zuba (4), koju su neki autori ispitivali longitudinalnim praćenjem pozicije zuba s pomoću raščlambe sadrenih odljeva čeljusti (5), raščlambom histoloških preparata čeljusti (6) ili pozicijskim odnosima zuba s određenim anatomskim strukturama (7).

Prema Björku i Skiellerovoj (8), važna uloga za smjer nicanja zuba, za razvoj denticije, postavu frontalnih zuba te za sudbinu orotodontskih nepravilnosti pripada tipu rasta lica-rotaciji lica. Niz pozitivnih utjecaja rasta povezano je s prednjom rotacijom lica.

Stützmannova i Petrović (9) navode da su terapeutski učinci u smislu pregradnje čeljusnih baza, alveolarne kosti, pomaka zuba, rasta kondilarne

hrskavice pri terapiji bionatorom ortodontskih anomalija, koje karakterizira distalan položaj mandibule u odnosu prema maksili i bazi lubanje, u izravnoj vezi s tipom rasta lica.

Ovaj rad imao je cilj ispitati povezanost stanja prostora u segmentima I_2 - M_1 (segment zubnoga luka od distoaproksimalne plohe postraničnog sjekutića do mezioproksimalne plohe prvoga trajnog kutnjaka) zubnih lukova s tipom rasta lica utvrđenim na LL telerendgenogramu glave kefalometrijskom raščlambom.

Ispitanici i postupci

Kao materijal poslužili su LL telerendgenogrami glave i sadreni odljevi čeljusti 109 ispitanika (53 dječaka i 56 djevojčica) s mješovitom denticijom u dobi od 8,3 do 9,5 godina (uz uvjete: nikla sva četiri trajna sjekutića u objema čeljustima, nikli i intaktni su ili uredno sanirani svi prvi trajni kutnjaci, kliničkim pregledom i raščlambom ortopantomograma isključena mogućnost postojanja mikrodoncije ili hipodoncije) liječenih zbog raznih ortodontskih anomalija u Domu zdravlja Poreč.

Pri evaulaciji rasta lica u obzir su uzeti parametri: Björkov poligon (suma kuteva n-s-ar kut fleksije kranijalne baze, s-ar-go zglobni kut, te ar-ge-m mandibularni kut), segmenti mandibularnoga kuta (ar-go-n gornji isječak i n-go-m donji isječak), međučeljusni kut (sp-pm:m-go), te postotni odnos stražnje (udaljenost s-go) i prednje (udaljenost n-m) visine lica.

Rast lica vrjednovan je: bez rotacije (odnos stražnje visine prema prednjoj visini lica od 62-65%, vrijednosti Björkova poligona i kuta n-go-n 52-55°, n-go-m 70-72°), s anteriornom rotacijom (odnos stražnje pema prednjoj visini lica veći od 65%, vrijednosti Björkova poligona i kuta n-go-m ispod normale, a kuta ar-go-n veće od normale) i posteriornom rotacijom (odnos stražnje visine lica prema prednjoj visini lica manji od normale, vrijednosti Björkova poligona i kuta n-m-go veća od normale, a kuta ar-go-n manje od normale).

Prostor u segmentima I_2 - M_1 zubnih lukova određivan je na sadrenim odljevima s pomoću klizne mjerke po Berendonkijevoj na točnost 0,1 mm.

Raspoloživ prostor određivan je Moyersovom metodom (11). Potreban prostor suma meziodistalnih promjera kruna neniklih očnjaka i pretkutnjaka određen je s pomoću korelacijskih tablica uz poznavanje donje sume sjekutića uz razinu signifikantosti od 75% (12).

Prostor u analiziranim segmentima zubnoga luka definiran je kao višak prostora (kad je izmjereni prostor u zubnome luku bio veći od sume predvidivih meziodistalnih promjera kruna očnjaka i pretkutnjaka), ili pak kao nedostatak prostora (kad je izmjereni prostor u zubnome luku bio manji od sume predvidivih meziodistalnih promjera kruna očnjaka i pretkutnjaka).

χ^2 testom, određenim računskom obradom podataka, ispitana je povezanost stanja prostora u segmentima I_2 - M_1 pojedine čeljusti s: tipom rotacije lica, iznosom Björkova poligona, i međučeljusnim kutom.

Rezultati

Rezultati rada prikazani su u Tablicama 1 do 6. Prostor u ispitivanim segmentima nije vrjednovan glede strane čeljusti, nego za čeljust kao cjelinu (109 ispitanika 218 segmenata u pojedinoj čeljusti).

Na Tablicama 1 i 2 prikazani su rezultati povezanosti prostora u segmentima I_2 - M_1 gornje i donje čeljusti s iznosom Björkova poligona. Varijabla Björkov poligon označena je kao normalan (suma kuteva koji ga čine je 396°), povećan i smanjen. χ^2

Tablica 1. *Povezanost u segmentima I_2-M_1 gornje čeljusti i Björkova poligona*

Table 1. *Correlation of space in segments I_2-M_1 of the upper jaw with Björk's polygon*

Björkov poligon Björk's polygon	Prostor u segmentima I_2-M_1 Space in segments I_2-M_1		Ukupno Total
	Višak prostora Surplus of space	Manjak prostora Shortage of space	
Normalan Normal	26	21	47
Povećan Incerased	28	54	82
Smanjen Decerased	31	58	89
Ukupno Total	85	133	218

$\chi^2 = 6,7$ $p > 0,01$

Tablica 2. *Povezanost prostora u segmentima I_2-M_1 donje čeljusti i Björkova poligona*

Table 2. *Correlation of space in segments I_2-M_1 of the lower jaw with Björk's polygon*

Björkov poligon Björk's polygon	Prostor u segmentima I_2-M_1 Space in segments I_2-M_1		Ukupno Total
	Višak prostora Surplus of space	Manjak prostora Shortage of space	
Normalan Normal	24	15	39
Povećan Incerased	39	46	85
Smanjen Decerased	48	46	94
Ukupno Total	111	107	218

$\chi^2 = 2,6$ $p > 0,01$

test pokazuje da između analiziranih varijabla nema statistički znatne povezanosti.

Na Tablicama 3 i 4 prikazani su rezultati povezanosti prostora u segmentima I_2 - M_1 obiju čeljusti i rasta lica. Vrijednosti χ^2 testa za obje čeljusti ne potvrđuju postojanje statistički značajne povezanosti ispitivanih parametara.

Na Tablicama 5 i 6 prikazani su rezultati povezanosti prostora u segmentima I_2 - M_1 pojedine čeljusti i međučeljusnoga kuta. Međučeljusni kut (normala 20± 5°) analiziran je kao normalan, povećan ili smanjen. Iz rezultata je vidljivo da između ana-

Tablica 3. *Povezanost prostora u segmentima I_2-M_1 gornje čeljusti i rasta lica*

Table 3. *Correlation of space in segments I_2-M_1 of the upper jaw with facial development*

Björkov poligon Björk's polygon	Prostor u segmentima I_2-M_1 Space in segments I_2-M_1		Ukupno Total
	Višak prostora Surplus of space	Manjak prostora Shortage of space	
Bez rotacije Absence of rotation	26	40	66
Anteriorna rotacija Anterior rotation	33	45	78
Posteriorna rotacija Posterior rotation	26	48	74
Ukupno Total	85	133	218

$\chi^2 = 0,8$ $p > 0,01$

Tablica 4. *Povezanost prostora u segmentima I_2-M_1 donje čeljusti i rasta lica*

Table 4. *Correlation of space in segments I_2-M_1 of the lower jaw with facial development*

Björkov poligon Björk's polygon	Prostor u segmentima I_2-M_1 Space in segments I_2-M_1		Ukupno Total
	Višak prostora Surplus of space	Manjak prostora Shortage of space	
Bez rotacije Absence of rotation	42	25	67
Anteriorna rotacija Anterior rotation	38	40	78
Posteriorna rotacija Posterior rotation	31	42	73
Ukupno Total	111	107	218

$\chi^2 = 5,9$ $p > 0,01$

Tablica 5. *Povezanost prostora u segmentima I_2 - M_1 gornje čeljusti i međučljusnoga kuta*

Table 5. *Correlation of space in segments I_2-M_1 of the upper jaw with the angle between jaws*

Björkov poligon Björk's polygon	Prostor u segmentima I_2-M_1 Space in segments I_2-M_1		Ukupno Total
	Višak prostora Surplus of space	Manjak prostora Shortage of space	
Normalan Normal	14	21	35
Povećan Incerased	42	78	120
Smanjen Decerased	29	34	63
Ukupno Total	85	133	215

$\chi^2 = 2,2$ $p > 0,01$

Tablica 6. *Povezanost prostora u segmentima I_2-M_1 donje čeljusti i međučeljusnoga kuta*

Table 6. *Correlation of space in segments I_2-M_1 of the lower jaw with the angle between jaws*

Björkov poligon Björk's polygon	Prostor u segmentima I_2-M_1 Space in segments I_2-M_1		Ukupno Total
	Višak prostora Surplus of space	Manjak prostora Shortage of space	
Normalan Normal	15	16	31
Povećan Incerased	62	61	123
Smanjen Decerased	34	30	64
Ukupno Total	111	107	218

$\chi^2 = 0,2$ $p > 0,01$

liziranih varijabla nema statistički značajnih povezanosti.

Rasprava

Rendgenkefalimetrija je vrlo važna u procesima praćenja rasta kraniofacijalne regije. S pomoću nje se spoznalo da tijekom rasta nastaje rotacijsko otiskivanje kostiju viscerocraniuma u odnosu prema kostima baze lubanje, a zbog toga i tri tipa rasta (13). Kod rasta lica bez rotacije, što se tiče svih triju načina njegova vrjednovanja, utvrđena je najpovoljnija situacija u pogledu prostora u zubnom luku. Tu je u maksili u 10,8% segmenata bio češći manjak prostora, a u mandibuli u 18,2%, segmenata višak prostora. Kod rasta lica s anteriornom rotacijom, u maksili su za 19,2% prevladavali segmenti s manjkom prostora, a u mandibuli za 1,7% segmenti s viškom prostora. Najnepovoljnije stanje glede prostora u zubnome luku utvrđeno je kod ispitanika s posteriornom rotacijom lica. Tu su u maksili za 30,4%, a u mandibuli za 6,2% prevladavali segmenti s manjkom prostora. U sve tri mogućnosti rasta lica stanje prostora u segmentima I_2-M_1 bilo je nepovoljnije u maksili, što pokazuju i rezultati drugih autora (14,15,16,17).

Utvrđene razlike stanja prostora u zubnim lukovima i tipa rasta lica nisu statistički značajne, što se prema nalazima nekih autora očekivlo (8, 9, 18, 19, 20, 21). Stüzmannova i Petrović (9) su kod terapije distalne okluzije bionaotorom utvrdili znatnu povazanost terapijskih promjena i načina rasta lica. Kod ispitanika s posteriornom rotacijom pronađene su znatnije resorpcijske promjene na mezijalnoj strani alveole, a apozicijske na distalnoj strani. Većina terapijskih učinaka obuhvatila je samo dentoalveolarno područje. Za razliku od toga, u ispitanika s anteriornom rotacijom lica većina terapijskih učinaka utvrđena je u području kondilarnog nastavka, a promjene u dentoalveolarnom području bile su zanemarive. Davey (22) je ispitivao korelaciju između prostora u segmentima I_2-M_1 i visine kvržica zuba postraničnog segmenta. Rezultati nisu potvrdili statistički značajnu povezanost.

Statistički neznačajnu povezanost između prostora u segmentima I_2-M_1 i dominantne strane kod žvakanja utvrdila je Motschova (23). Gubitak prostora bio je kod 36% slučajeva u objema čeljustima veći na strani dominantnoj kod žvakanja, u 22% slučajeva na strani nedominantnoj kod žvakanja, a u 42% slučajeva u jednoj čeljusti gubitak prostora bio je veći na dominantnoj, a u drugoj čeljusti na strani nedominantnoj kod žvakanja.

Eksperimentalni radovi Mossa (24) pokazali su da sile okluzalnog podrijetla usporavaju a ne potpomažu mezijalne pomake zuba. Radovi Solowa, Palmera, Profita i Kidda (cit. Langlade) (25) te Mossa (26) daju veliko značenje utjecaja mišića svih sila koje na njega utječu.

Velik utjecaj na poziciju zuba i stanje prostora u zubnome luku ima prerani gubitak. No i prema tome opće priznatom čimbeniku u pogledu stanja prostora u zubnome luku postoje oprečna mišljenja: Wough "karijes mliječnih zuba osnovni je uzrok nastanka anomalije trajne denticije" ili Lundström "prerani gubitak mliječnih zuba nema općeg utjecaja na razvoj denticije" (cit. Tollaro i sur.) (27). U prilog Lundströmova shvaćanja važnosti preranog gubitka jesu i rezultati Blayneya. Njima on potvrđuje da fluoridacijom zuba djece SAD nije nastao statistički značajan pad ortodontskih anomalija (23). Tvrdnje Blayneya i Lundströma mogu biti samo djelomice točne ako se u obzir uzme broj anomalija, ali nikako i anomalijskih simptoma pojedine anomalije. Rijetko koja anomalija ima samo jedan anomalijski simptom, a gubitak prostora za smještaj C, P_1 i P_2 u zubni luk vrlo je čest anomalijski simptom kod mnogih osnovnih anomalija (17).

Problem prostora u zubnome luku često je velik terapijski problem ortodontskih anomalija. Tip rasta lica samo je jedan od mnogih čimbenika koji ga u zajedničkom djelovanju određuju.

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Correlation of Space in Segments I_2 - M_1 and Certain Parameters of the Development of the Orofacial Region Determined by Roentgencephalometric Analysis

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Summary

The aim of this study was to examine the correlation between space in segments I_2-M_1 of dental arches and the type of facial rotation. Plaster casts of jaws and LL teleroentgenograms of the heads of 109 subjects with mixed dentition served as material. For evaluation of the type of facial rotation the following roentgencephalometric parameters were examined: Björk's polygon, segments of the mandibular angle, intermaxillary angle and the relation of the posterior and anterior height of the face. Evaluation of space in the dental arch was carried out according to the method by Meyers, with the application of tables showing the anticipated width of the crowns of non-erupted canines and premolars, adjusted to our population. The results of the χ^2 test showed that there were no statistically significant correlations between the condition of space in segments I_2-M_1 in both jaws and the analyzed roentgencephalometric parameters.

Key words: *space in the dental arch, facial rotation*

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Shortage of space in the dental arch for correct placement of teeth is the most frequent symptom of orthodontic disproportion. With the development of dentition from milk to permanent teeth the frequency of this symptom increases (1, 2, 3). In the region of the incisors it is most often determined by inheritance, while in the lateral segment the cause is usually shifting of the teeth after extraction or carious destruction of milk canines and molars.

Teeth do not have a permanent position in the dental arch. Disruption of harmony (symmetry) of a tooth, neighbouring teeth, antagonists or surrounding muscles causes a shifting of teeth until new balance has been established, during which mesial tendency of the shifting of lateral teeth is particularly characteristic (4). Some authors have investigated this phenomena by longitudinal monitoring of teeth positions by analysis of plaster casts of jaws (5), analysis of histologic specimens of the jaws (6) or by the positional relationship of teeth with certain anatomic structures (7).

According to Björk and Skieller (8) the type of facial development-facial rotation plays an important part in the direction of the eruption of teeth, de-

velopment of dentition, of anterior teeth and occurrence of orthodontic disproportion. Several positive influences on growth are connected with anterior facial rotation.

Stützmann and Petrović (9) state that the therapeutic effects with regard to the partition of jaw bases, alveolar bones, teeth shifting, growth of condylar cartilage during bionator treatment of orthodontic anomalies, which are characterized by the distal position of the mandibula in relation to the maxilla and base of the skull, directly connected with the type of facial development.

The aim of this study was to examine the correlation between the condition of space in segments I_2 - M_1 (segment of the dental arch from the disto-approximate surface of the postlateral incisor up to the mesioapproximate surface of the first permanent molar) dental arches with type of facial development determined by LL teleroentgenograms of the head by cephalometric analysis.

Subjects and Methods

For the study LL teleroentgenograms of the head and plaster casts of the jaws of 109 subjects were used (53 boys and 56 girls) with mixed dentition, aged from 8.3 to 9.5 years, treated for various orthodontic anomalies in the Health Centre at Poreč. The following were conditions for inclusion: all four permanent incisors had erupted in both jaws; all first permanent molars had erupted and were intact or had been correctly treated; exclusion of the possibility of microdontition or hypodontition by clinical examination and analysis of an orthopantomogram. The following parameters were taken into account during evaluation of facial development: Björk's polygon (sum of angles n-s-ar angle of flexion of the cranial base, s-ar-go joint angle, and ar-go-m mandibular angle), segments of the mandibular angle (ar-go-n upper section and n-go-m lower section, intermaxillary angle (sp-pm:m-go), and the percentage of the posterior relation (s-go distance) and anterior (n-m distance) facial height.

Facial development was evaluated: without rotation (relation of posterior height according to the anterior facial height of 62-65%, value of Björk's polygon 396°, angles ar-go-n 52-55°, n-go-m 70--72°), anterior rotation (relation of the posterior to the anterior facial height greater than 65%, values of Björk's polygon and angle n-go-m below normal, and the angle ar-go-n above normal) and posterior rotation (relation of posterior facial height to the anterior facial height less than normal, values of Björk's polygon and angle n-m-go greater than normal, and angle ar-go-n less than normal).

The space in segments I_2-M_1 of dental arches was determined on plaster casts by means of a sliding scale according to Berendon, to accuracy of 0.1 mm. Moyer's method was used to determine available space (11). The necessary space sum of the mesiodistal diameter of the crowns of non-erupted canines and premolars, was determined by means of correlation tables, with knowledge of the lower sums of incisors, level of significance 75% (12).

Space in the analyzed segments of the dental arch was defined as surplus space (when the measured space in the dental arch was more than the sum of anticipated mesiodistal diameter of the crowns of canines and premolars), and shortage of space (when the measured space in the dental arch was less than the sum of anticipated mesiodistal diameter of the crowns of canines and premolars).

χ^2 test, determined by computer analysis of data, was used to examine the correlation between condition of space in segments I_2-M_1 in a single jaw and 1) type of facial rotation 2) amount of Björk's polygon and 3) intermaxillary angle.

Results

The results of the study are presented in Tables 1-6. The space in the examined segments was not evaluated from the side of the jaws, but for the jaw as a whole (109 subjects; 218 segments in a single jaw).

Tables 1 and 2 show the results of correlation of space in segments I_2-M_1 of the upper and lower jaws with the amount of Björk's polygon. Variables of Björk's polygon are marked as normal (the sum of its angles is 396°), increased and reduced. χ^2 test showed that there were no statistically significant correlations between the analyzed variables.

Tables 3 and 4 show the results of correlation between space in segments I_2-M_1 of both jaws and face growth. Values of the χ^2 test for both jaws did

not indicate the existence of statistically significant correlations of the examined parameters.

Tables 5 and 6 present the results of correlation between space in segments I_2-M_1 in individual jaws and intermaxillary angle. The intermaxillary angle (normal 20±5°) was analyzed as normal, increased or decreased. From the results it can be seen that there were no statistically significant correlations between the analyzed variables.

Discussion

When monitoring the development of the craniofacial region roentgencephometry is very important. It has shown that during development rotational pushing of the bones of the viscerocranium occurs in relation to the bones of the base of the skull, leading to three types of development (13). In the case of facial development without rotation, considering all three methods of evaluation, the most satisfactory situation with regard to space in the dental arch was determined. In the maxilla most frequent shortage of space was found in 10.8% of segments, and in the mandibula surplus of space in 18.2% of segments. In the case of facial development with anterior rotation in the maxilla, segments with shortage of space were dominant with 19.2% and in the mandibulla 1.7% of segments with surplus of space. The most unsatisfactory situation with regard to space in the dental arch was determined in subjects with posterior facial rotation, in whom segments with shortage of space dominated in 30.4% in the maxilla and 6.2% in the mandibula. In all three types of facial development, the condition of space in segments I_2-M_1 was unsatisfactory in the maxilla, which agrees with the results of other authors (14, 15, 16, 17).

As was anticipated, the differences determined with regard to the condition of space in the dental arches and the type of facial development were not statistically significant, in corroboration with the findings of other authors (8, 9, 18, 19, 20, 21). During treatment of distal occlusion with a bionator, Stuzmann and Petrović (9) established significant correlation between therapeutic changes and the manner of facial development. In subjects with posterior rotation significant resorptional changes were found on the mesial, and apositional on the distal side of the alveolar. Most of the therapeutic effects comprised only the dentoalveolar region. On the other hand, in subjects with anterior facial rotation most of the therapeutic effects were determined in the area of the condylar process, while changes in the dentoalveolar area were negligible. Davey (22) examined the correlation between the area in segments I_2-M_1 and the height of the tubercula of the teeth of the postlateral segment. The results did not show statistical significant correlation.

Motsch (23) determined statistically insignificant correlation between the area in segments I_2-M_1 and the dominant side during mastication. Shortage of space determined in 36% of cases in both jaws was greater on the dominant side during mastication, in 22% cases on the nondominant side during mastication, and in 42% of cases in shortage of space was greater on the dominant side in one jaw during mastication, and in the other jaw on the nondominant side.

In experimental studies Moss (24) demonstrated that the force of occlusal origin slowed down, but did not bring about mesial shifting of teeth. Studies by Solow, Palmer, Profit and Kidd (cit. Langlade) (25), and Moss (26) give great importance to the influence of muscles with regard to the positioning of teeth. The position of a tooth will be stable when all relevant forces are balanced.

Premature loss has a significant effect on the position of teeth and the condition of space in the dental arch. However, opinions vary regarding this generally accepted fact, and the condition of space in the dental arch: Wough "caries of milk teeth is the basic cause of the occurrence of anomalies in permanent dentition", and Lundström "premature loss of milk teeth has no general effect on the development of dentition" (cit. Tollaro et al.) (27). The results of Blayney corroborated Lundstrom's opinion on premature loss, which indicated that fluoridation of teeth in children in the USA did not result in a statistically significant reduction in orthodontic anomalies (28). However, Blayney and Lundström may only be partially correct, if one takes into account the number of anomalies, but not the anomalous symptoms of certain anomalies. Rarely does an anomaly have only one anomalous symptom, and shortage of space for placement F, P_1 and P_2 in the dental arch is often an anomalous symptom in many common anomalies (17).

The problem of space in the dental arch is often a major therapeutic problem in orthodontic anomalies and the type of facial development is merely one of the numerous relevant interacting factors.