Assessment of Skeletal and Dental Pattern of Class II Division 1 Malocclusion with Relevance to Clinical Practice

Antanas Sidlauskas, Vilma Svalkauskiene, Mantas Sidlauskas

SUMMARY

Class II division 1 malocclusion represents the most common skeletal discrepancy which orthodontists see in daily practice. The understanding of the morphology is a key element in planning dentofacial orthopedic treatment for this type of malocclusion. The purpose of the present study was to examine prepubertal children with Class II division 1 malocclusion and to evaluate maxillary and mandibular skeletal positions in comparison with normal growth standards by means of cephalometric measurements used by clinical practitioners. For the study casts and cephalograms of 86 consecutive patients with Class II division 1 malocclusion were used. The Class II division 1 malocclusion demonstrates broad variation in its skeletal and dental morphology. The retrognathic mandible (60%), maxillary prognathism (55.8%) and reduce vertical skeletal jaw relationship is the most common characteristic of Class II division1 malocclusion.

The optimal correction of the anteroposterior and vertical dental and skeletal discrepancies could be designed on the base of individual diagnosis for every Class II division 1 patient.

Key words: Class II division 1 malocclusion, cephalometrics, mandibular retrognathism.

INTRODUCTION

Class II division 1 malocclusion represents the most common skeletal discrepancy which orthodontists see in daily practice. The understanding of the morphology is a key element in planning dentofacial orthopedic treatment for this type of malocclusion (1). Clinically widely accepted term "skeletal Class II" does not specify whether the mandible is retruded in relation to the maxilla, or whether the maxilla is protruded in relation to the mandible. The findings from the literature review are still inconclusive regarding the dentofacial characteristics of Class II division 1. The opinions of leading orthodontic researchers are controversial. McNamara (2) concluded that mandibular skeletal retrusion was the most common single characteristic of the Class II sample, whereas maxillary skeletal protrusion was not common finding. In contrast, Rothstein (3) stated that, "The mandible was most often within the range of normal for size, form and positional characteristics". Rosenblum (4) found that 56,6% of subjects with Class II malocclusion had maxillary protrusion and only 26.7% had mandibular retrusion. Bishara (5) reported that maxilla is positioned normally. There are some reports stating that

maxilla in this malocclusion is even in a retrognathic position (6).

The other problem with the radiological evaluation of skeletal pattern in a Class II Division 1 malocclusion is selection of normal sample (control group). It is difficult to select truly equivalent control group from Class 1 normal growing individuals who do not need treatment, at least for ethical considerations. The normative longitudinal growth records are suitable alternative.

Some criticism from ordinary clinicians is addressed to contemporary research because of usage of very sophisticated cephalometric and statistical analyses, which has very little with everyday orthodontic practice.

The purpose of the present study was to examine prepubertal children with Class II division 1 malocclusion and to evaluate maxillary and mandibular skeletal positions in comparison with normal growth standards by means of cephalometric measurements used in everyday clinical practice.

MATERIAL AND METHOD

For the study casts and cephalograms of 86 consecutive patients were used (49 girls and 37 boys). All the participants were aged between 9 and 12 years with no orthodontic treatment at the time of study.

The criteria for inclusion of a given patient into this study were the existance of :
- the Class II division 1 dental type: distal molar and canine occlusion of at least ½ premolar width;
- overjet ≥4.0 mm, protrusion of the maxillary incisors;

Kaunas University of Medicine, Lithuania

Antanas Sidlauskas - *D.D.S., PhD, MOrthoRCSEd, prof., Head of the Clinic of Orthodontics*
Vilma Svalkauskiene - *D.D.S., specialist orthodontist*
Mantas Sidlauskas - *D.D.S., postgraduate student*

Address correspondence to dr.Antanas Sidlauskas, Clinic of Orthodontics, Kaunas University of Medicine, Luksos-Daumanto 6, Kaunas LT-50106, Lithuania
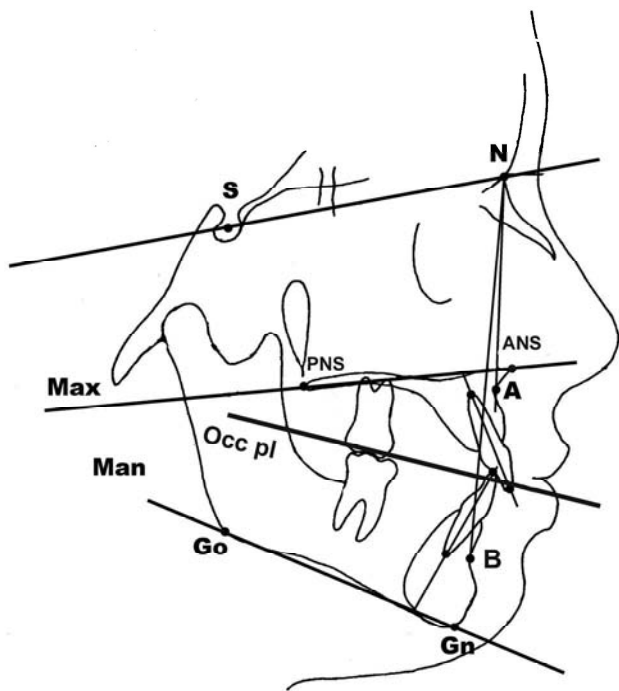*E-mail: antanas@kaunas.omnite.net*

Stomatologija, Baltic Dental and Maxillofacial Journal, 2006, Vol. 8., No. 1.

3

Fig. 1. Points and planes used in the cephalometric analysis

- Class II skeletal type, ANB angle ≥4º;
- Occlusal development – late mixed or early perma nent dentition.

The cephalograms were taken in centric occlusion under standard conditions (constant film-focus distance of 1.50 m; object-film distance 0.15 m). The decisive structures of all cephalograms were traced by one of the authors with the pencil on acetate foil and all necessary reference points were marked. The radiographs were traced in random order to reduce bias. A sliding calliper was used to measure distances between reference points to a nearest half millimetre. Angular measurements were made to the nearest degree, using a protractor. When there were two images of a structure, the reference point was placed at the midpoint between the images. The correction was made for enlargement of the radiographs (approximately 8.2%) in the median plane to adjust all linear measurements to natural size. Cephalomet-
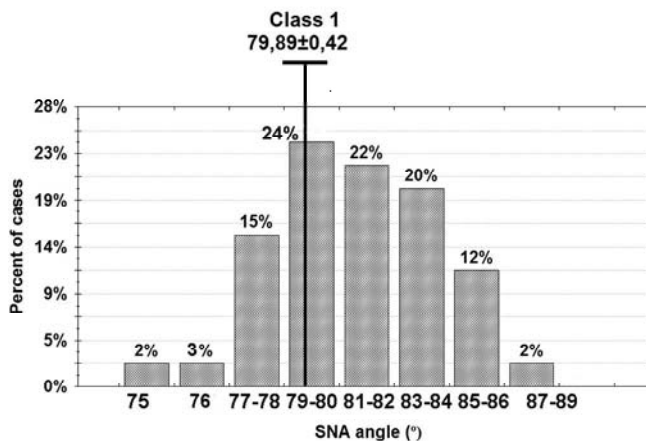

Fig. 2. Distribution of the SNA angle in percent in the Class II division 1 sample

ric analysis comprised the 10 variables: SNA, SNB, ANB, Wits appraisal, mandibular plane angle to cranial base (SN/ Man), mandibular plane angle to maxillary plane (Max/Man), maxillary incisor angle to maxillary plane (Ui/Max), mandibular incisor angle to mandibular plane (Li/Man), overjet and overbite. The points and planes used in the cephalometric analysis shown in Figure 1.

To evaluate maxillary and mandibular skeletal as well as dental positions in comparison with normal growth standards, the normative data published by Bhatia and Leighton (7) derived from London school children were used. The normative data were matched for age and gender.

The following values were calculated for every single variable: mean, standard deviation (SD), minimum and maximum. All mean values of Class II division 1 malocclusion patients were compared with the means of age and gender matched normative data. Intra-observer method error was analyzed using a method suggested by Bland and Altman (8). The reliability of the method was tested by tracing and measuring 20 randomly selected lateral cephalograms twice. The estimated error between the measurements was calculated using the formula:
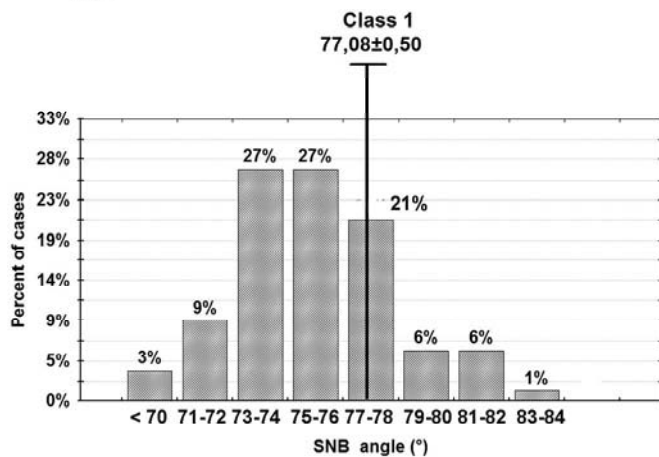

Fig. 3. Distribution of the SNB angle in percent in the Class II division 1 sample

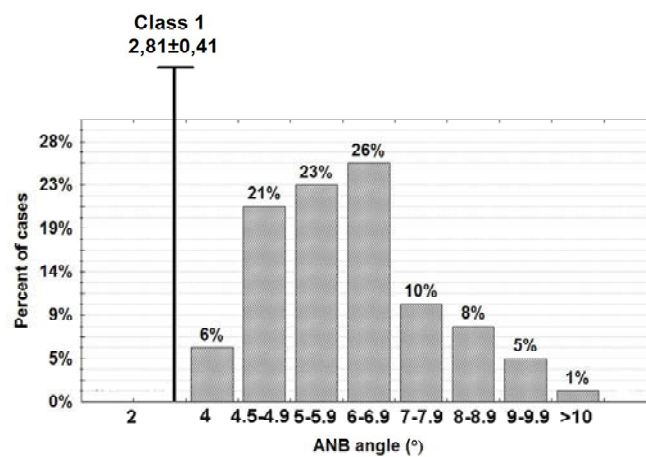

Fig. 4. Distribution of the ANB angle in percent in the Class II division 1 sample.

4

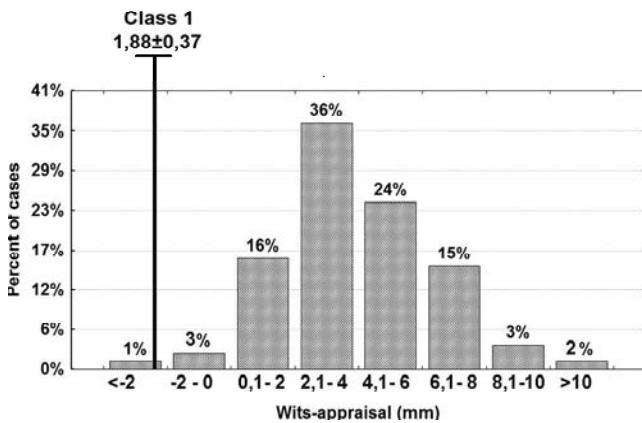Stomatologija, Baltic Dental and Maxillofacial Journal, 2006, Vol. 8., No. 1.

Wits-appraisal

Fig. 5. Distribution of the Wits appraisal in percent in the Class II division 1 sample**.**

$$ME = \sqrt{\sum (d_1 - d_2)^2 / 2\,(n-1)}$$

Where d_1 – first measurement, d_2 – second measurement; N – number of patients.

The measurement errors were very small. The error of measurement given in ±2SD of the differences between the repeated measurements ranged between ±0.12 and ±1.04 degrees for angular and between ±0.15 and ±0.84 mm for linear measurements. These errors were deemed to have insignificant effect on reliability of the results.

RESULTS

Cephalometric measurements of Class II division 1 malocclusion patients as well as normative data of the matched control group given in the Table. The distributions in percent of all variables of Class II division 1 malocclusion group around the mean value ± standard deviation of normative data are presented in Figures 2 to 11.

The position of maxilla relative to cranial base structures was determined by SNA angle. All values ranged between 75.0° and 89.0°. In 8 % of the sample this angle was less than

SN/Man

Fig. 6. Distribution of the SN/Man angle in percent in the Class II division 1 sample

77.0° and in 55.8% it was greater than 81.0°. The rest part of the group was in the average range of the Class I (Figure 2).

The sagittal position of mandible was evaluated by measuring the SNB angle. All SNB angle values ranged between 69.0° and 84.0° for Class II division 1 patients. In 60 % of the cases the SNB was less than Class I mean value and in the 31.4% it was in the average range. In 8.6% SNB angle value exceeded average range of the control group (Figure 3).

Relationship of skeletal maxilla to mandible of all 86 patients demonstrated increased ANB angle compare to the mean of control group (Figure 4). The Wits appraisal value for the majority of Class II division 1 representatives (80.2%) was remarkably greater than in the group of Class I patients, respectively the average values 4.3 and 1.9 mm (Figure 5).

The vertical skeletal jaw relationship was assessed by two angles. Mandibular plane to cranial base (SN/Man) angle was smaller for 61.6%, bigger for 23.3% of the patients when compare to the control group (Figure 6). Mandibular plane to maxillary plane (Max/Man) angle also was reduced for 53.4% of patients, increased for 30.0% and the remaining was in the average range, when compare to the mean of normative data (Figure 7).

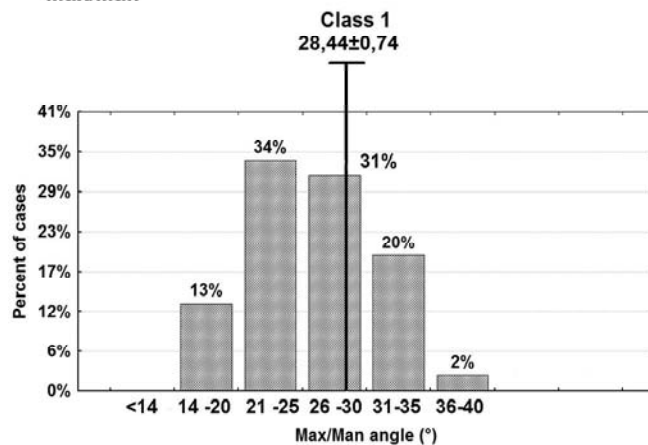The dental component of Class II division 1 maloc-

Max/Man

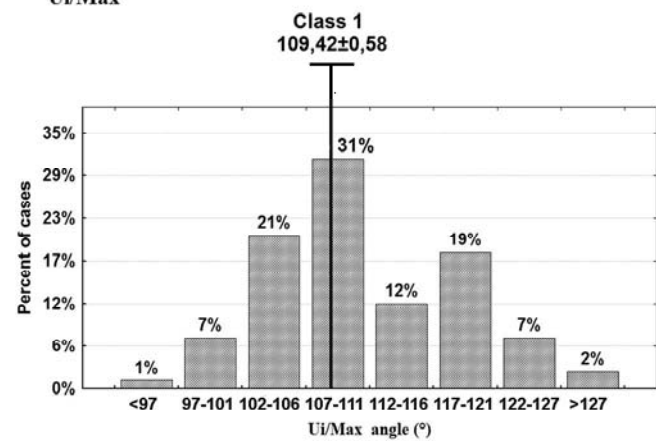**Fig. 7.** Distribution of the Max/Man angle in percent in the Class II division 1 sample

Ui/Max

Fig. 8. Distribution of the Ui/Max angle in percent in the Class II division 1 sample
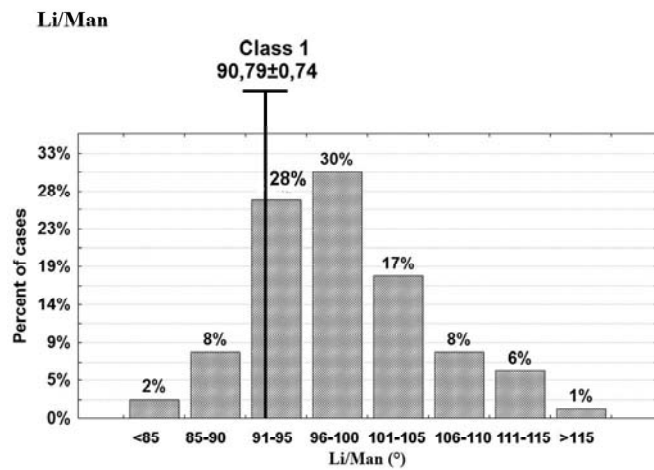
Li/Man

Class 1
90,79±0,74

Fig. 9. Distribution of the Li/Man angle in percent in the Class II division 1 sample
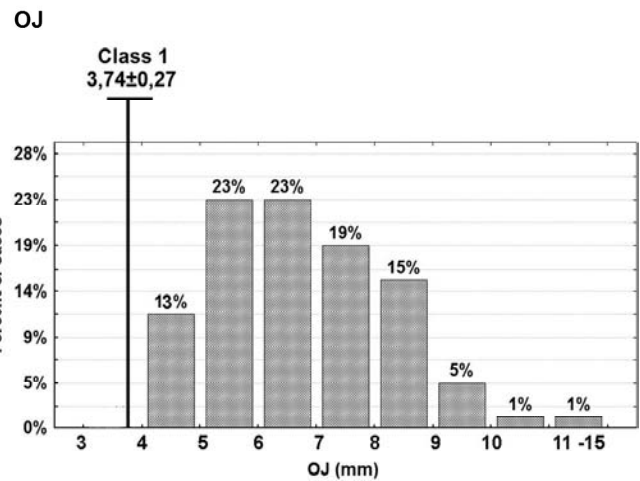
OJ

Class 1
3,74±0,27

Fig. 10. Distribution of the overjet in percent in the Class II division 1 sample

clusion was evaluated by assessing position of upper and lower incisors to their jaw basis and by measuring overjet and overbite. Increased maxillary incisor inclination (Ui/Max) comparatively to Class I mean ± SD value was registered for 51.2% of the patients (Figure 8). The remaining cases were in the average range or even slightly retroclined. The mandibular incisor inclination angle (Li/Man) on average, was remarkably greater than the mean of the control group and ranged between 80.0° and 115.5°. The lower incisor proclined more than the mean ± SD value of the control group was registered in 81.4% of Class II division 1 malocclusion cases (Figure 9). The overjet was increased in 95.3% (Figure 10) and overbite in 76.7% (Figure 11) of the patients with Class II division 1 malocclusion.

The summary of distribution in percent for all variables of individuals with Class II division 1 malocclusion below and above the mean ± standard deviation value of normative data presented in the Figure 12.

DISCUSSION

Class II division 1 malocclusion incorporates many variations of dental, skeletal and functional components that

can significantly influence the treatment plan (9). Treatment approach including extraoral traction, expansion appliances, extraction procedures and functional jaw orthopedic should correspond to the true aetiology (10). Correction of the anteroposterior and vertical dental and skeletal discrepancies usually is recommended in the late mixed dentition by taking advantage of the patient's growth potential. These considerations determined the age range of our study group, from 9 to 12 years. To determine the extent of discrepancies of a Class II division 1 malocclusion dentofacial characteristics we compared these patients with the data obtained from individuals with "normal" occlusion and facial relationships (7). We used only cephalometric measurements generally accepted and used in everyday orthodontic practice expecting to attract primarily attention of the clinicians.

The analysis indicates that some skeletal discrepancy was present in the majority of our Class II division 1 malocclusion cases. More than half of our Class II division 1 group demonstrated maxillary prognatism, 1/3 was in the average range of the Class I and about 8 percent had less or more expressed retrognathic position of the maxilla. The very similar results have been found by Rosenblum (4).

The analysis of mandibular position revealed that in
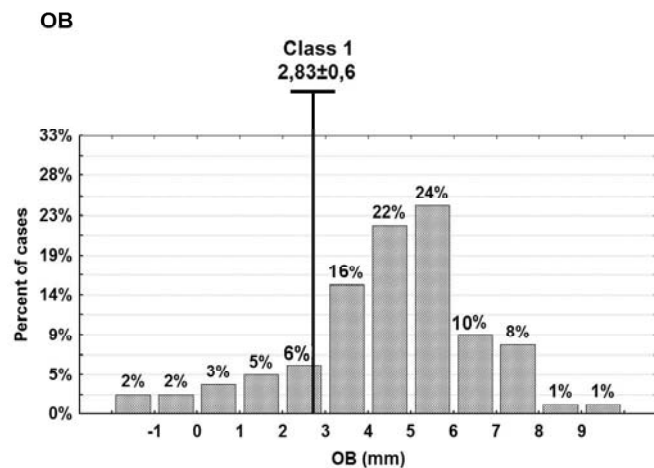
OB

Class 1
2,83±0,6

Fig. 11. Distribution of the overbite in percent in the Class II division 1 sample
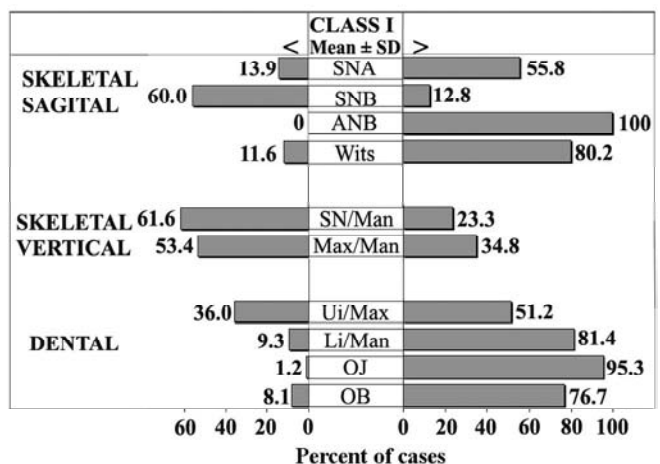
Fig. 12. The summary of distribution in percent for all variables in the Class II division 1 sample

6

Stomatologija, Baltic Dental and Maxillofacial Journal, 2006, Vol. 8., No. 1.

Table. Descriptive statistics and results of cephalometric measurements

No.	Variable	Class II:1				Control (normative standard)				p
		mean	SD	min	max	mean	SD	min	max	
1.	SNA (°)	81.98	3.00	75.00	89.00	79.89	0.42	79.00	80.70	0.001
2.	SNB (°)	75.41	2.97	69.00	84.00	77.08	0.50	76.00	77.90	0.001
3.	ANB (°)	6.57	1.59	4.00	11.00	2.81	0.41	2.10	3.60	0.001
4.	Wits (mm)	4.28	2.51	-2.00	10.50	1.88	0.37	1.30	2.70	0.001
5.	SN/Man (°)	32.24	5.75	14.50	43.00	35.62	0.52	34.70	37.00	0.001
6.	Max/Man (°)	26.38	5.06	15.00	37.00	28.44	0.74	26.70	29.80	0.001
7.	Ui/Max (°)	111.94	7.30	96.00	129.00	109.42	0.58	107.30	110.50	0.01
8.	Li/Man (°)	97.99	7.04	80.00	115.50	90.79	0.74	89.00	91.80	0.001
9.	OJ (mm)	7.83	2.35	4.00	15.00	3.74	0.27	3.20	4.20	0.001
10.	OB (mm)	4.84	2.18	-2.00	9.50	2.83	0.60	0.70	3.20	0.001

about 2/3 of the Class II division 1 cases SNB angle was smaller than the average of the control group. Our findings are in agreement with other cephalometric studies (12) indicating that the mandible is significantly retrusive with the chin located posteriorly. On the other hand there are studies that found minor differences in the skeletal patterns of normal individuals and Class II division 1 malocclusion (13, 14). According to our results about 1/3 of Class II division 1 individuals have mandible normally positioned in relationship to cranial base. More than 8 percent of the cases in our study had the SNB angle greater than the control average. But this does not mean that the pure mandibular prognatism have been registered. In those cases the maxilla also was positioned more anteriorly. The results of ANB angle analysis support this statement, because all 86 patients demonstrated increased ANB angle. The more anterior position of mandible in some cases also might be result of unusually located reference points (4, 15). So, the findings from the literature indicates that a Class II division 1 malocclusion is accompanied by a broad range of sagittal skeletal relationships, but we support idea that in the majority of the cases retrognathic mandible is present.

The vertical skeletal jaw positions were evaluated by the SN/Man and Max/Man angles. In general the more reduce vertical skeletal relationship dominated. About 70 percent of the Class II division 1 malocclusion cases had reduced or normal SN/Man and Max/Man angles. On the other hand it has to be mentioned that SN/Man and Max/Man angles demonstrated considerable variation. So, it was more or less only tendency of generally reduced vertical skeletal proportions. Similar results were published by Hoyer (16).

Another major component of the Class II division 1 malocclusion is the position of the dentition relative to the jaw skeletal structures. More than 50 percent of our study group cases demonstrated proclined upper incisors and only 15 percent was with the Ui/Max angle less than 105 degrees. The same is true concerning the lower incisor position to mandible skeleton. More than 80 percent of Class II division cases demonstrated proclination of lower incisors. But it should be noticed that majority of these cases with mandibular dental protrusion were subsistent with mandibular skeletal retrusion. This could be considered as a dentoalveolar adaptation compensating for retrognathic mandible. The same results have been reported by other investigators (16, 17). The relationship of both jaws incisors could be characterized by remarkable increase of overjet (more then 95 percent) and overbite (more then 76 percent).

The analysis of skeletal morphology is critical for Class II division 1 malocclusion treatment plan and appliances employed. The midface prognathism is an imperative to use distal extraoral traction of maxilla and in case of mandibular retrognathism treatment should focus on optimizing mandibular growth with functional jaw orthopedic appliances (18). Our study as many others (2, 10, 17) demonstrates that in the majority of Class II division 1 cases the malocclusion is determined by mandibular retrognathism.

CONCLUSIONS

1. The retrognathic mandible, maxillary prognathism and reduce vertical skeletal jaw relationship is the most common characteristics of Class II division1 malocclusion.
2. The Class II division 1 malocclusion demonstrates broad variation in its skeletal and dental morphology. The optimal correction of the anteroposterior and vertical dental and skeletal discrepancies could be designed on the base of individual diagnosis for every Class II division 1 patient.

REFERENCES

1. Šidlauskas A. The effects of the Twin-block appliance treatment on the skeletal and dentoalveolar changes in Class II Division 1 malocclusion. *Medicina* 2005; 5: 392–400.
2. McNamara JA. Components of Class II malocclusion in children 8-10 years of age. *Angle Orthod* 1981; 51: 177–201.
3. Rothstein TL. Facial morphology and growth from 10 to 14 years of age in children presenting Class II Division 1, malocclusion: a comparative roentgenographic cephalometric study. *Am J Orthod* 1971; 60: 619–20.
4. Rosenblum ER. Class II malocclusion: mandibular retrusion or

maxillary protrusion? *Angle Orthod* 1995; 65: 49–62.

5. Bishara SE. Mandibular changes in persons with untreated and treated Class II division 1 malocclusion. *Am J Orthod Dentofacial Orthop* 1998; 113: 661–73.

6. Henry RG. A classification of Class II division 1 malocclusion. *Angle Orthod* 1957; 27: 83–92.

7. Bhatia S, Leighton B. A manual of facial growth: a computer analysis of longitudinal cephalometric growth data. Oxford: Oxford university press; 1993.

8. Bland J, Altman D. Statistical methods for assessing agreement between two methods of clinical measurement. *The Lancet* 1986; 1: 307–10.

9. Rondeau B. Class II malocclusion in mixed dentition. *J Clin Pediatr Dent* 1994; 1: 1–11.

10. Bishara SE, Jakobsen JR, Vorhies B, Bayati P. Changes in dentofacial structures in untreated Class II division 1 and normal subjects: A longitudinal study. *Angle Orthod* 1997; 1: 55–66.

11. Bishara S. Class II malocclusions: diagnostic and clinical considerations with and without treatment. *Semin Orthod* 2006; 1: 11–24.

12. Craig EC. The skeletal patterns characteristic of Class I and Class II Divison 1malocclusions in Norma Lateralis. *Angle Orthod* 1951; 21: 44–56.

13. Blair SE. A cephalometric roentgenographic appraisal of the skeletal morphology of Class I, Class II Division 1 and Class II Division 2 (Angle) malocclusion. *Angle Orthod* 1954; 24: 106–14.

14. Gilmore WA. Morphology of the adult mandible in Class II division 1 malocclusion and excellent occlusion. *Angle Orthod* 1950; 20: 137–46.

15. Miethke R, Heyn A. Die bedeutung des ANB-Winkels und des Wits-Appraisals nach Jacobson zur bestimmung der sagittalen kieferrelation im fernrontgenseitenbild. *Prakt Kieferorthop* 1987; 1: 165–72.

16. Hoyer B. Die dentoskelettale morphologie bei dysgnathien der Angle klasse II,1. Doctorial thesis. Giesen; 1995.

17. Miethke RR, Lemke U. The Angle Class II division 1 is most often caused by mandibular retrognathism. *Orthodontics* 2004; 1: 133–40.

18. Moyers R. et all. Differential diagnosis of Class II malocclusion. Part 1. *Am J Orthod* 1980; 5: 477–94.

● ●

Prof. Andrejs Skagers – recipient of the P. Stradins Award

Prof. Andrejs Skagers, Oral and Maxillofacial surgeon, has recently been presented with the P.Stradins Award for outstanding contribution to medical sciences and clinical medicine.

"Prof. Andrejs Skagers is a highly experienced surgeon commanding respect and appreciation among medical specialists", said Academician Janis Stradins, President of Latvian Academy of Sciences, when introducing to the laureate of the P.Stradins Award. The Award is being presented to Prof. A.Skagers for the remarkable contribution to the development of Oral and Maxillofacial Surgery in Latvia and for introducing new technologies in the clinical work.

Prof. A.Skagers was born on August 30, 1940 in Dzelzava parish, Madona region, Latvia. After graduating Riga Medical Institute, he started working as a traumatologist- orthopaedist at 2nd Riga City Hospital in 1967 (till year 1977). Since 1977, Prof. A. Skagers has been working both as the Head of Department of Oral and Maxillofacial Surgery of Riga Stradins University and the Head of Surgery Clinic of Institute of Stomatology. He is also the founder and president of the Baltic Association for Maxillofacial and Plastic Surgery, as well as the author of several scientific papers, monographs and educational publications.

Since 1983, the P.Stradins Award is being annualy granted by Latvian Academy of Sciences and the P. Stradins Museum of History of Medicine.

Paul Stradins was at the same time a general practitioner and a medical historian. Accordingly, one award is being presented by Latvian Academy of Sciences for the most remarkable contribution to medical sciences and clinical medicine, while the other is being granted by P.Stradins Museum of History of Medicine for an outstanding achievements in the scientific research of medical history.

The P.Stradins Award has been presented to many prominent doctors and medical scientists like Academician Janis Stradins, Prof. Ilmars Lazovskis, Prof.Janis Vetra, Prof. Kristaps Kegi, Prof. Janis Erenpreiss, Prof. Kristaps Zarins, Prof.Viktors Kalnberzs a. o.

Our warmest congratulations to Prof. Andrejs Skagers on behalf of Latvian Dental Association!

Guntis Zigurs
President of Latvian Dental Association