J Stoma 2017; 70, 3: 224-237
DOI: 10.5604/01.3001.0010.5016

ORIGINAL ARTICLE

Characteristics of Class II division 2 malocclusion and implications in connection with treatment planning

Charakter wady zgryzu klasy II grupy 2 i konsekwencje związane z planowaniem leczenia

Anna Hille-Padalis, Stephen Williams, Bartłomiej W. Loster

Katedra Ortodoncji, Instytut Stomatologii, Wydział Lekarski, Uniwersytet Jagielloński Collegium Medicum w Krakowie, Polska
Department of Orthodontics, Dental Institute, Faculty of Medicine, Jagiellonian University Medical College in Cracow, Poland
Head: prof. *B.W. Loster*

Abstract

The aim of the present report is to describe the morphology of Class II division 2 malocclusion based on a cephalometric comparison of a group of 48 individuals (Björk). Results demonstrate a clear increase in the sagittal jaw relationship related to a retrognathic mandible, which demonstrates morphology indicative of an anterior rotational growth pattern. In the vertical plane, a skeletal deep bite was seen though the distribution of this anomaly was seen to be dichotomous suggesting that two morphologically different groups could be identified. The role of perioral musculature in the development of the retroclined incisors (maxillary and mandibular) was discussed. As an addendum to the main report a differentiated treatment protocol relating particularly to the vertical jaw relationship was presented and discussed.

Streszczenie

Celem niniejszego raportu jest opisanie morfologii wady zgryzu klasy II grupy 2 w oparciu o porównanie analizy cefalometrycznej grupy 48 osób (wg Bjorka). Wyniki wskazują na wyraźny wzrost strzałkowej relacji podstaw kostnych związany z retrognacją żuchwy, której morfologia wykazuje doprzednią rotację kierunku wzrostu. W płaszczyźnie pionowej zaobserwowano zgryz głęboki szkieletowy, a rozkład wyników wskazywał na możliwość identyfikacji dwóch morfologicznie różnych podgrup. Omówiono rolę mięśni w rozwoju retroklinacji zębów siecznych górnych i dolnych. Jako uzupełnienie raportu głównego zaprezentowano i omówiono zróżnicowany protokół leczenia odnoszący się zwłaszcza do pionowej relacji podstaw kostnych.

KEYWORDS:
Angle's Class II division 2, vertical jaw relationship, anterior rotation growth pattern

HASŁA INDEKSOWE:
wada klasy II grupy 2, pionowa relacja podstaw kostnych, doprzednia rotacja kierunku wzrostu

Introduction

With its very distinctive occlusal morphology, combining a distal molar relationship and palatally inclined incisors, it is not surprising that in his classification of malocclusion Angle[1] described Class II division 2 malocclusion as a separate entity compared with Class II division 1 malocclusion which exhibited protrusive maxillary incisors. The implication was that the two forms of malocclusion, though both exhibiting a distal molar relationship were in fact clearly different forms of malocclusion with a differing aetiology, and should consequently be treated differently. Since approximately 5% of individuals demonstrate this type of malocclusion an understanding of the aetiology of this specific type of malocclusion must be considered important.[2] A number of cephalometric studies have attempted to describe the skeletal and dento-alveolar factors incorporated with this malocclusion.[3-6] Summarizing the

many reports it is suggested that this type of malocclusion presents with only a minor sagittal skeletal discrepancy,[4] though with a palatal tipping of the maxillary incisors. Other reports suggest, however, that the ANB angle in a Class II division 2 case can be clearly greater than that of "normal" control material.

In the vertical plane a general, though mild, reduction in the skeletal jaw relationship is also frequently described.[4,7] The report by *Arvystas*[8] suggests the existence of a number of subgroups within the defined malocclusion, though it fails to describe them fully.

In an implant study of facial development and tooth eruption, attempting to describe the aetiological factors resulting in the typical Class II division 2 morphology, *Björk* and *Skieller*[4] suggest that the strong anterior mandibular rotational growth pattern observed in these cases is accompanied by a similar rotation of the maxilla, a development which promotes a palatal tipping of the maxillary incisors as a type of compensation. Concerning the position of the maxillary incisors *Delivanis* and *Kuftinec*[9] suggest that the morphology of these teeth is somehow modified, such that the angle formed between the long axis of the crown and the root is reduced in Class II division 2 cases, possibly as a result of muscle forces acting on the forming incisors. An alternative theory regarding incisor position was suggested by *Leighton* and *Adams*[10] who reported that the path of eruption of the permanent maxillary incisors altered in an increasingly palatal direction as these teeth erupt into the mouth.

A further, although somewhat disputed, factor concerning the occlusion of Class II div 2 patients concerns the pattern of mandibular movement in connection with closing.[11] *Thomsen*[12] in 1986 suggested that as a result of the palatal tipping of the maxillary incisors the final part of the mandibular closing movement is in the dorsal direction, possibly also affecting the position of the condyle in the articular fossa. A study based on the position of the mandibular condyle by *Demisch*, *Ingervall* and *Thüer*[13] would seem to contradict this hypothesis though it would seem to be supported by the findings of *Grzegocka* et al.[14] of significant abrasion on lower incisal edges and the palatal surface of maxillary incisors could be observed in cases of Class II division 2 malocclusion, even in late adolescent individuals. It is felt that this abrasion reflects the dorsally directed forced-bite associated with the palatally tipped maxillary incisors.

Aim of study

The aim of the present study is to investigate the dento-facial morphology of a group of mixed adult and adolescent subjects, all exhibiting Angle's Class II division 2 malocclusion with intent to analyse specific characteristics of this form of malocclusion by means of a comparison with a large control material of mixed forms of occlusion (Björk material). Special attention should be given to mandibular form and the vertical dimension. Based on the findings of the study a treatment protocol for this type of malocclusion should be presented. The study should attempt to cast light on the following aspects:

(a) How does the dento-facial morphology of individuals presenting Class II division 2 malocclusion vary from a statistical average material?

(b) Does the investigated material, in particular the homeogenity of the parameters measured, suggest a lack of standardisation of the anomaly or the existence of subgroups?

(c) Considering the importance of mandibular form in the estimation of future growth (growth pattern) do the findings of the investigation influence the choice of orthodontic technique and/or the extraction/non-extraction decision?[15]

(d) Considering the findings of the investigation as given in (a)-(c) a differentiated protocol for the treatment of subjects with a Class II div 2 malocclusion should be outlined.

Material and method

The present study consisted of lateral cephalograms recorded under identical conditions for forty-eight individuals who were selected from the private office of one of the authors (SW) on the basis of a preliminary examination of plaster model casts confirming the nature of

the malocclusion according to the established definition. The cephalograms were scanned and measured using the Facad® cephalometric program and subsequently analysed by means of the Kracovia Composite System reported previously.[16] All data were imported to a standard computer program (Excel®). From the individual data derived, group means, standard deviations and distribution characteristics were calculated. The parameters measured can be seen in Table 1 as can the results of a statistical comparison with average values was made using the data of the Björk thesis study reported in the literature as control material.[17,18] Using the same computer programme a series of histograms was generated illustrating the distribution of a series of factors relevant to the description of Class II div 2, which can be seen in Figures 1-6.

Table. 1. Description of the experimental (Class II division 2) material and results of a comparison with the control material

CEPHALOMETRIC VALUES		STUDY GROUP n=48		CONTROL GROUP n=320		t-value	sign
		average	S.D.	average	S.D.		
SAGGITAL							
Maxillary prognatism	SNA	81.10	3.81	82	3.5	1.541	
Mandibular prognatism (Pg)	SNPg	78.38	3.86	80	3.5	2.743	**
Mandibular Prognatism (B)	SNB	76.51	3.72	79	3	4.426	***
Sag. Jaw Rel. (Pg)	ANPg	3.10	2.76	2	2.5	2.605	**
Sag. Jaw Rel. (B)	ANB	4.83	2.23	3	3.5	4.858	***
Max. alveol. prognathism	PrNA	1.96	1.13	2	1	0.232	
Mand. alveol. prognathism	CL-ML	71.57	5.75	70	6	1.753	
Mand. alveol. prognathism (sm)	PgNB	1.80	0.99	1	2.5	4.002	***
Max. inc. inclin.	1+:NL	93.39	11.56	110	6	9.759	***
Mand. inc. inclin.	1-:ML	89.97	8.55	94	7	3.112	**
VERTICAL							
Vert. Jaw rel.	ML-NL	22.81	5.10	25	6	2.707	**
Max. inclination	NL-NSL	6.92	3.15	8	3	2.286	*
Mand. inclination	ML-NSL	29.74	5.67	33	6	3.685	***
Max. zone	NL-OLs	13.57	3.78	10	4	6.054	***
Mand. zone	ML-OLi	19.24	4.40	20	5	1.095	
MANDIBULAR MORPH							
Beta Angle	Beta	21.97	3.04	19	2.5	6.449	***
Cranial Base FLEXURE							
N-S-Ba	NSBa	132.09	4.58	131	4.5	1.541	

*p< 0.05, **p>0.01 ***p> 0.001.

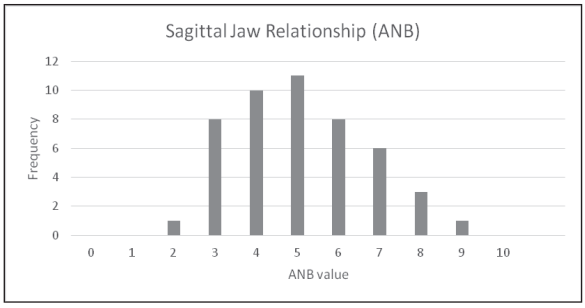

Fig. 1. *Distribution of subjects according to sagittal jaw relationship (ANB).*

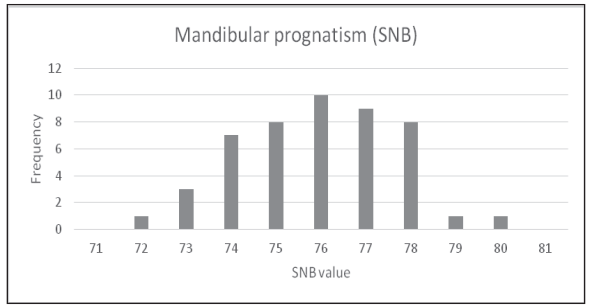

Fig. 2. *Distribution of subjects according to mandibular prognathism (SNB).*

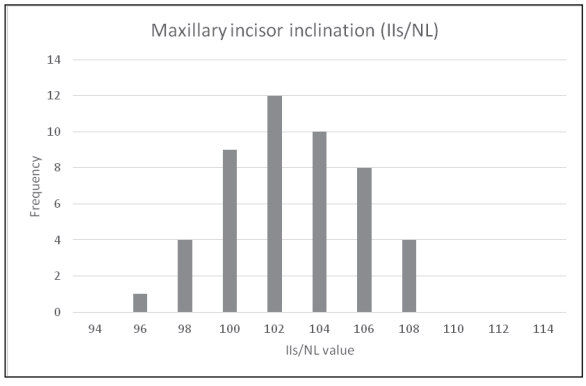

Fig. 3. *Distribution of subjects according to maxillary incisor inclination (IL_s/NL).*

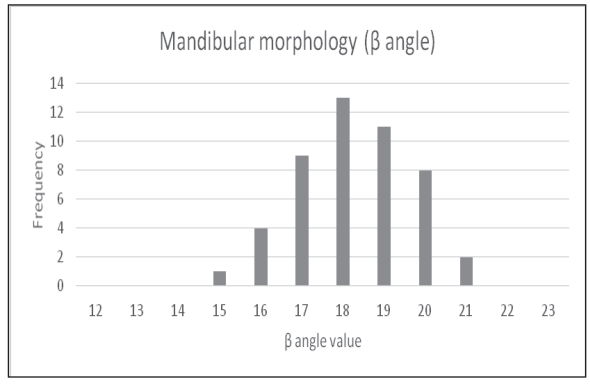

Fig. 4. *Distribution of subjects according to mandibular morphology (Beta angle).*

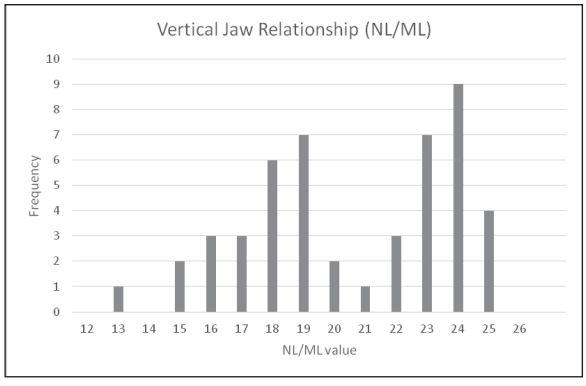

Fig. 5. *Distribution of subjects according to vertical jaw relationship (NL/ML).*

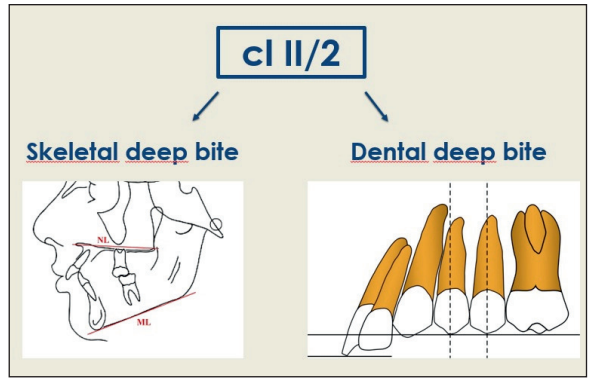

Fig. 6. *Differentiation between skeletal and dento-alveolar deep bite.*

Results

Comparing the results of the cephalometric analysis of the Class II div 2 material with the Björk control material it can be seen that the experimental material exhibited a significant increase in the sagittal jaw relationship (ANB t=4.858***) as a result of a reduction in the mandibular prognathism expressed both as the SNPg (t=2.743**) and SNB (t=4.426***) angles. In the maxilla, the incisors were strongly palatally tipped (1+/NL t=9.759***) though the protrusion of the alveolar process (PrNA) was found to be normal. Interestingly, the inclination of the mandibular incisors was also strongly reduced (1-/ML t=3.112**) as was the inclination of the alveolar process to the mandibular base (1-/ML

t=4.002***). One special characteristic of the Class II div 2 morphology is the significantly enlarged angle formed by the Pogonion and Supramentale points (B point) formed with the Nasion point (t=4.002***).

In the vertical plane the skeletal relationship expressed by the NL/ML angle was reduced in the experimental group (t=2.707**) in connection with a strong anterior inclination of the mandible (ML/NSL t=3.685***) with a corresponding though less pronounced anterior inclination of the palatal plane (Maxilla) (NL/NSL t=2.286**). It could be seen that while there was no compensatory reduction of the mandibular zone (ML/OL_i T=1.095 n.s.) a dysplastic increase in the maxillary zone NL/OL_s t= 6.054***), probably as a result of an extrusion of the maxillary incisors. The flexure of the cranial base as expressed by the NSba angle was similar in the Class II div 2 group to that of the control group.

The shape of the mandible, especially the height of the ramus described by the "Beta angle" was considerably increased in the Class II div 2 groups (t= 6.449***)

Considering the distribution of the subjects according to various important parameters the results can be seen in Figures 1-6.

Fig. 1 displays the frequency and distribution of the sagittal jaw relationship as expressed by the ANB angle. The distribution looks relatively normal with a mode at 5.0º with only one subject displaying an ANB of 2,º which would be considered normal. Many subjects had a sagittal jaw relationship well above the average for the control material reaching a maximum of 9.0º.

Fig. 2 demonstrates the frequency and distribution of the angle depicting the mandibular prognathism i.e. SNB. It can be seen that the mode is established at 76.0,º which is clearly retrognathic, some values coming closer to the mean value for the control material of 80.0º. It can also be seen that the distribution demonstrates a tendency towards platykurtosis.

Fig. 3 demonstrates the distribution of the angle depicting the inclination of the maxillary incisors relative to the palatal plane. The distribution is relatively normal with a mode of 102.0º though with values ranging up to what would be considered, i.e. 110.0º.

Fig. 4 represents the distribution and frequency of the "Beta angle" describing mandibular shape in particular the height of the ramus and demonstrates reasonably normal distribution, though with a slight tendency to negative skewness. All values are above normal levels with a mode at 33.0,º which is well above the mean value for the control material.

Fig. 5 shows the distribution and frequency of values representing the vertical jaw relation NL/ML. It can clearly be seen that the observations describe a dichotomy in this parameter with values well below 25.0,º which is the mean for the control material.

Discussion

The cephalometric analysis of Class II div 2 malocclusion shows clearly that there exists a series of parameters which differ markedly from values for a control material and which should be taken into consideration when a treatment protocol is adopted. The literature seems to show agreement as to the basic morphological problem – an increase in the sagittal jaw relationships – which some previous reports consider to be severe and others mild.[19,20] The observation of the low vertical jaw relationship is characteristic of this type of malocclusion but is not present in all cases, vertical skeletal relationships being approximately normal in a number of cases supporting the contention that subgroups within the defined angle Class II div 2 category could exist. This should be taken into account when a treatment strategy is planned. In the case of the deep bite, which characterises this form of malocclusion, there are basically two strategies which can be employed namely skeletal bite raising by means of extrusion/eruption of buccal teeth,[21] possible in connection with the use of a bite plate, or incisor intrusion.[22,23] This malocclusion also involves a low maxillary smile line associated with the extruded incisors, a factor which can be significantly improved if true maxillary intrusion can be achieved. Incisor intrusion has

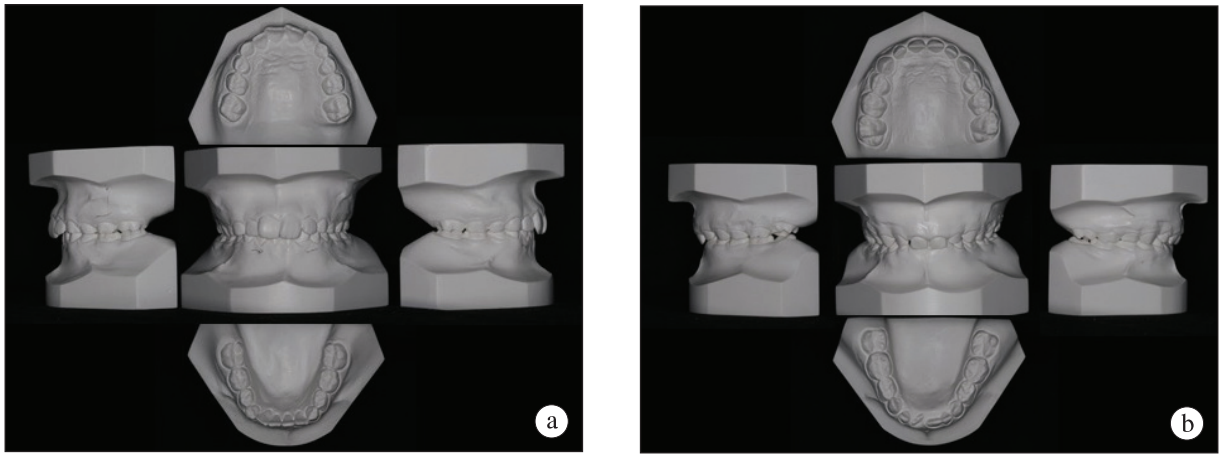

Fig. 7 (a, b). *Models of two young patients (a) DS2, (B) DS3 who later developed a classical Class II div 2 malocclusion. Note the increased overjet and the low position of the maxillary incisors (relative to the occlusal plane), which seem to be characteristic of the developing Class II division 2 patient.*

previously been a difficult movement to achieve but an understanding of the biomechanics and the invention of the super elastic wires has simplified the technique considerably.[22] In a previous report, *Williams* and *Cannon*[24] have described the differential diagnosis (see Fig. 6) and technique based on a modern twin slot bracket, which makes a differentiated diagnosis-based treatment strategy possible. It is widely recognised that eruption/extrusion of buccal teeth has the side effect of induced posterior rotation of the mandible and a worsening of the sagittal position of the chin, which this study has shown to be retrognathic in this group of patients! Skeletal bite raising in these patients should be used with caution.

The major problem with these patients is the enlargement in the sagittal jaw relationship, which not only affects the occlusion but also the soft tissue profile characterised by a retrusive chin profile and a deep mento-labial sulcus. As shown by Björk in his implant studies mandibular growth and development patients with a high mandibular ramus usually have a growth pattern which brings the mandibular symphysis in a ventral direction. Since the majority of patients exhibiting Class II div 2 malocclusion have this type of growth pattern a good response to therapy can be expected IF the patient is treated at the correct time, which is in the period of maximal growth.

The shape of the mandible, with the relatively high ramus, would indicate the probability of an anterior rotational growth pattern as described by Björk,[17] which would suggest that the growth of the mandible itself could result in an anterior displacement of the symphysis bringing about a reduction in the sagittal jaw relationship and an improvement in the molar relationship. This growth-induced improvement as a result of a favourable growth pattern was also described by *Schudy*[15] and underlines the fact that optimal growth conditions in the treatment of Angle's Class II division 2 would prevail in a period of rapid skeletal development. In an excellent article comparing interceptive treatment of Class II division 2 cases compared with later treatment *Litt* and *Nielsen*[25] came to the conclusion that earlier treatment resulted in greater benefit from natural growth, not least as a result of the development of the mandible. It must be remembered that the patients representing interceptive treatment were in fact 13-year-old males who demonstrated significant mandibular development. The alternative was a somewhat later approach (late-juvenile, early-adult treatment) which resulted in a poor mandibular response. A further problem resulting from the later treatment protocol is the development of an adverse facial profile with a protrusive chin and a deep mento-labial sulcus,

factors which are difficult to eradicate with subsequent treatment.

Summing all the evidence it is still difficult to define the real difference between Class II division 2 malocclusion and Class II division 1. The obvious morphological differences observed in the mouth – the distal molar relationship, the retroclined maxillary incisors and the deep bite – are all reflected in the cephalometric studies as is the special mandibular morphology, which appears to reflect a clear anterior rotational growth pattern. The growth pattern seems to apply to all cases and appears therefore to be a constant characteristic of this type of malocclusion. In their study of tooth eruption and facial development *Björk* and *Skieller* underline the importance of incisal contact in connection with anterior mandibular rotation if the development of skeletal deep bite is to be avoided. It is obvious that the increased overjet, which is probably a constant feature of the young individual with developing Class II div 2 malocclusion (Fig. 7) in combination with the anterior rotational growth pattern, could represent the aetiology of the skeletal deep bite, which also characterises the group. It could well be that it is this low tooth position which results in a relatively high lip line resulting in the palatal tipping of the maxillary incisors so frequently seen in these cases. The study by *Lapatka* et al.[26] based on an experimental study concludes that non-pathological pressure from the upper lip on the extruded maxillary incisors would be the main aetiological factor determining the palatal tipping of these incisors, and suggests that incisor intrusion should therefore be incorporated in the treatment plan. The hypothesis related to the lip pressure would seem a plausible explanation of the lingual tipping of the mandibular incisors, which would not be explained by the theory of the anterior rotation of the palatal plane as described by *Björk* and *Skieller*.[4]

Conclusion

The study illustrates that compared with Class I controls Class II div 2 exhibits a different morphology probably due to a strong anterior rotational growth pattern (β angle) of both mandible (NSL/ML) and maxilla (NSL/NL), the retroclined maxillary incisors compensation for the maxillary rotation leading to a loss of incisor contact, deep bite and the retroclination of the mandibular incisors. The suggestion of the intra-group dichotomy on the basis of the vertical skeletal analysis has clinical consequences connected with the solution of the deep bite problem. Patients with low vertical jaw relationship – skeletal deep bite – should be treated by means of molar extrusion with the use of a bite-plate whereas patients with normal vertical jaw relationship and dental deep bite should be treated by means of incisors intrusion.

Addendum

The creation of a differentiated treatment protocol for Angle's Class II division 2 considering patient's vertical skeletal jaw relationship.

General comments

In the experimental part of this report the main relevant points concerning the differential diagnosis of Class II division 2 malocclusion were outlined and can be summarised as follows:

(1) increased sagittal jaw relationship (of varying severity),
(2) strong retroclination of both maxillary and mandibular incisors,
(3) deep bite, frequently as a result of a strong anterior inclination of the mandible (though occasionally without) combined with an overeruption of the maxillary incisors,
(4) an anterior rotational mandibular growth pattern which will result in a good ventral development of the mandible (especially if this movement is not "blocked" by a deep bite) but will create a skeletal deep bite if incisal contact is not created.

Based on the above conditions the general conditions of a treatment protocol for this type of malocclusion can be summarized as follows:

(1) Treatment should ideally be initiated in a period of strong general growth, which would imply a period of strong mandibular growth.

(2) Elimination of the deep bite will encourage sagittal mandibular development and should be achieved by means of intrusion of the maxillary incisors to the level of the occlusal plane and determined by the vertical level of the premolars. In cases of skeletal deep bite with a reduced NSL/ML value some degree of molar extrusion can be expected in connection with the use of a fixed bite plate.

(3) Sagittal correction should be aimed at optimisation of mandibular development by the use of a bite plate though it can be supplemented with light Class II elastic traction.

(4) Retention should include a fixed labial wire from tooth 33 to 43 supplemented with a passive small monoblock activator until the period of rapid group has ceased.

The following two cases represent typical treatment protocols for patients with differing vertical proportions.

Case 1:
Patient K.F., age 13 years 5 months

Class II division 2 with a normal vertical jaw relationship (NL/ML 24.2º) (Fig. 8, 9).

Cephalometric analysis (Summary)

The sagittal jaw relationship is slightly increased in the case of bi maxillary retrognathism. The maxillary incisors are severely retroclined as are the mandibular incisors and the mandibular alveolar process. The vertical jaw relationship is virtually normal though both the maxillary and mandibular planes are anteriorly inclined.

Treatment will be performed using the Cannon twin slot bracket system. Full fixed appliances in both arches. Tooth 11 and 21 should be intruded and subsequently levelled into the arch. The sagittal relationships should be corrected with Class II elastic traction (1/4”x 4.5 oz) (Fig. 10, 11, 12).

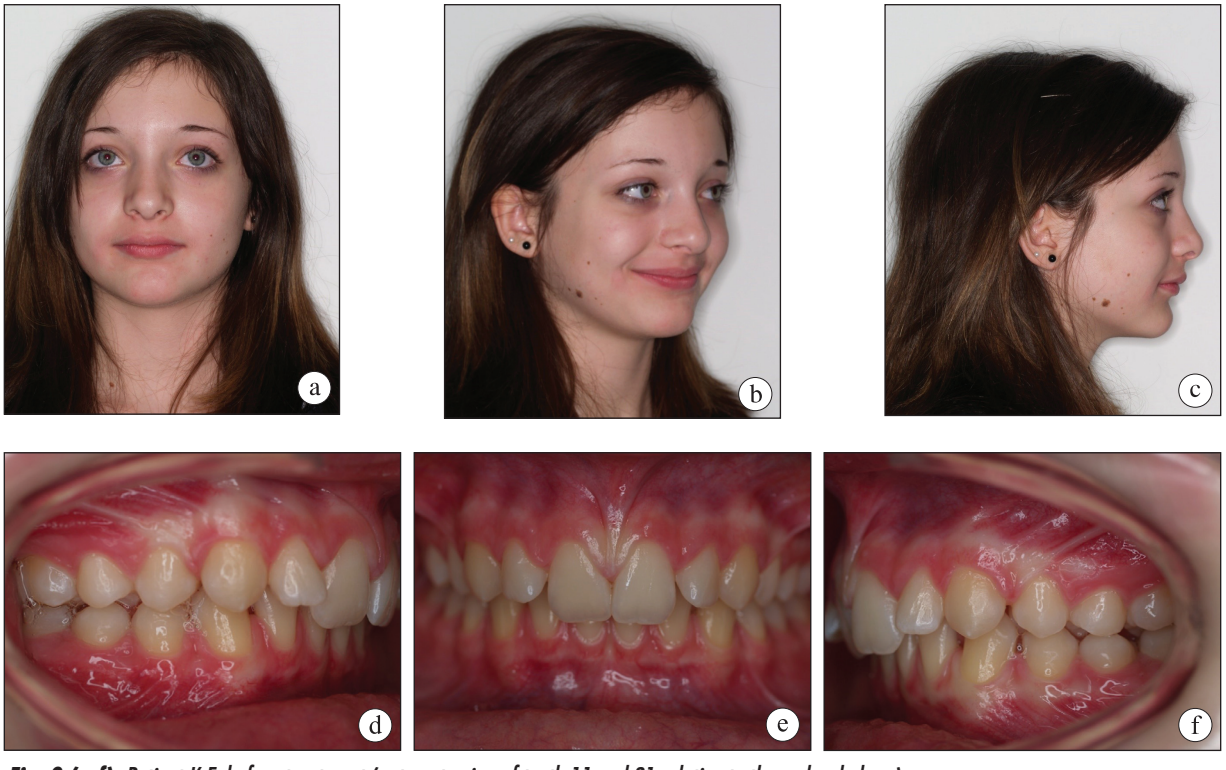

Fig. 8 (a-f). *Patient K.F. before treatment (note extrusion of teeth 11 and 21 relative to the occlusal plane).*

b

		value	mean	sd/Range
SAGITTAL JAW RELATIONSHIP				
A-N-pg	A-N-pg	0.4	2.0°	2.5°
A-N-B	A-N-B	3.7	3.0°	2.5°
JAW PROGNATHISM				
Maxillary (A)	S-N-A	79.1	82.0°	3.5°
Mandibular (pg)	S-N-pg	79.0	80.0°	3.5°
Mandibular (B)	S-N-B	75.3	79.0°	3.0°
DENTO-ALVEOLAR PROGNATHISM				
Maxillary	pr-N-A	1.8	2.0°	1.0°
Mandibular (CL)	CL/ML	65.8	70.0°	6.0°
Mandibular (B)	pg-N-B	4.0	1.0°	2.5°
INCISOR INCLINATION/BASE				
Maxillary	IIs/NL	99.4	110.0°	6.0°
Mandibular	IIi/ML	97.6	94.0°	7.0°
WITS APPRAISAL				
WITS		3.4	0.0°	
VERTICAL RELATIONSHIP				
Vertical jaw relationship	NL/ML	24.2	25.0°	6.0°
Maxillary inclination	NL/NSL	5.7	8.0°	3.0°
Mandibular inclination	ML/NSL	29.9	33.0°	6.0°
VERTICAL DENTO-ALVEOLAR CONDITION				
Maxillary zone	NL/OLs	12.3	10.0°	4.0°
Mandibular zone	Oli/ML	16.2	20.0°	5.0°
INCISAL RELATIONSHIP				
Horizontal overjet		2.7	3.0 mm	
Vertical overbite		2.9	2.5 mm	
Inter-incisal angle		138.8	132.0°	
ii to A-pg		0.1	1.0 mm	
Max. incisor to upper lip		5.6	3.0 mm	
Max. incisor to occlusal plane		1.1	0.0 mm	

***Fig. 9. a** – profile cephalogram of K.F. before treatment, **b** – cephalometric analysis of K.F.*

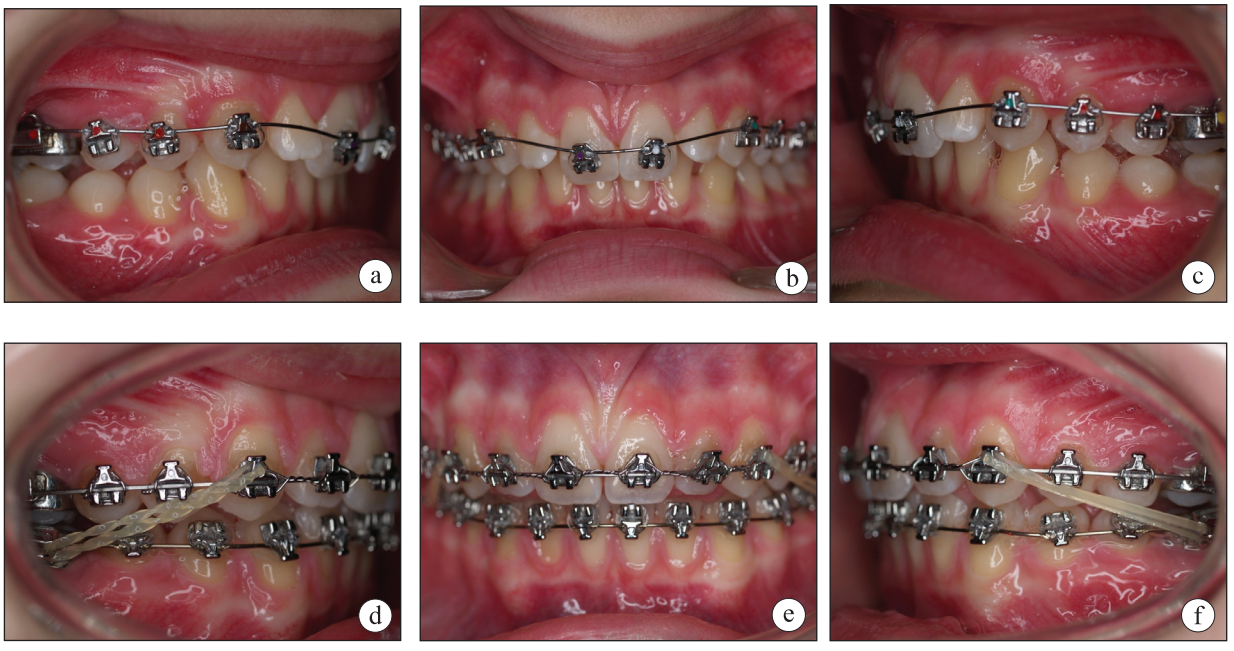

***Fig. 10. a, b, c** – Intrusion "set up" using a 0.016" NiTi wire in the "wing slot". **d, e, f** – maxillary arch levelled, now with 0.018" steel wire edgewise slot. Mandibular levelling (0.016" NiTi wire in "wing slot") Class II traction 24 hrs daily.*

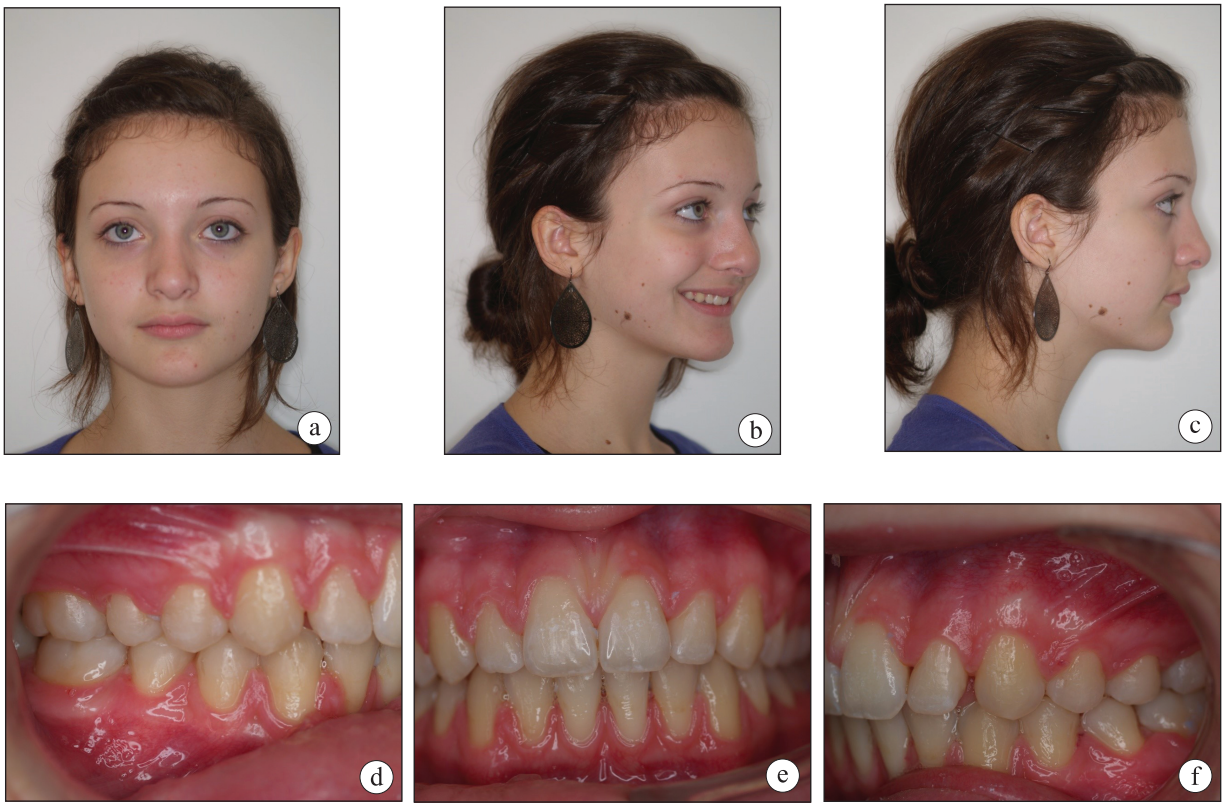

Fig. 11 (a-f). *Patient K.F. after treatment.*

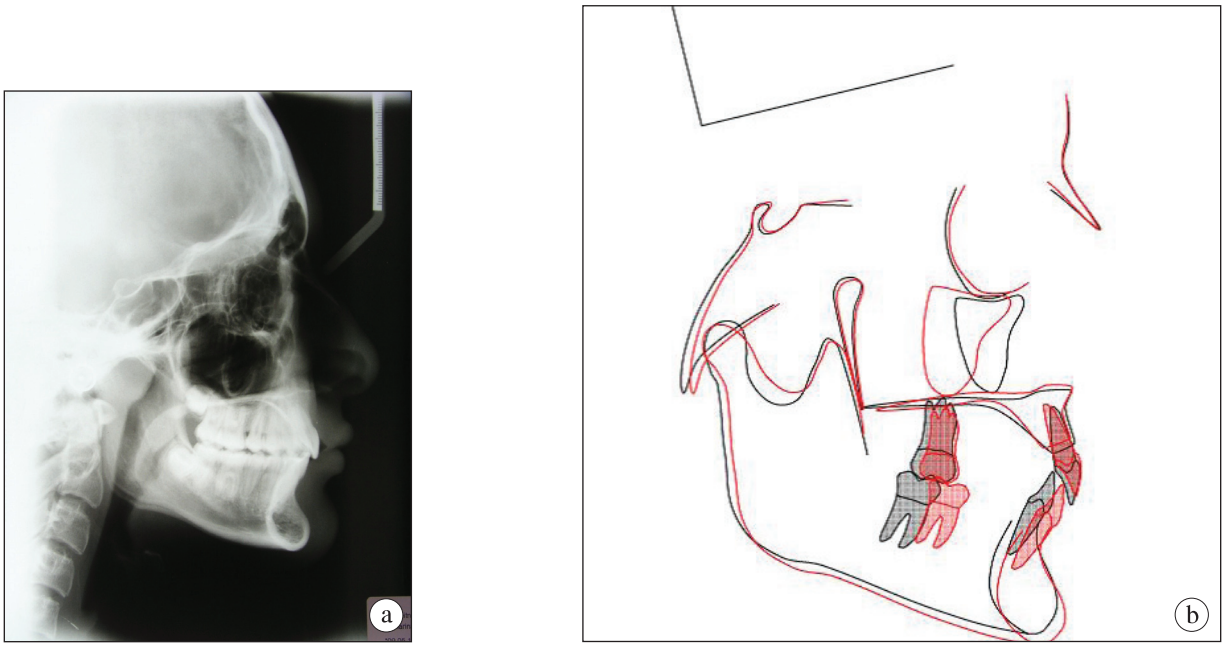

Fig. 12. a *– cephalogram post treatment and 12,* ***b*** *– cephalometric 2-stage comparison after superimposition on anterior cranial base. Note the positive mandibular development signified by the ventral displacement of the mandibular symphysis.*

Case 2:
Patient S.S., age 16 years 11 months

Class II division 2 with a severely reduced vertical jaw relationship (NL/ML 17.7º) (Fig. 13, 14).

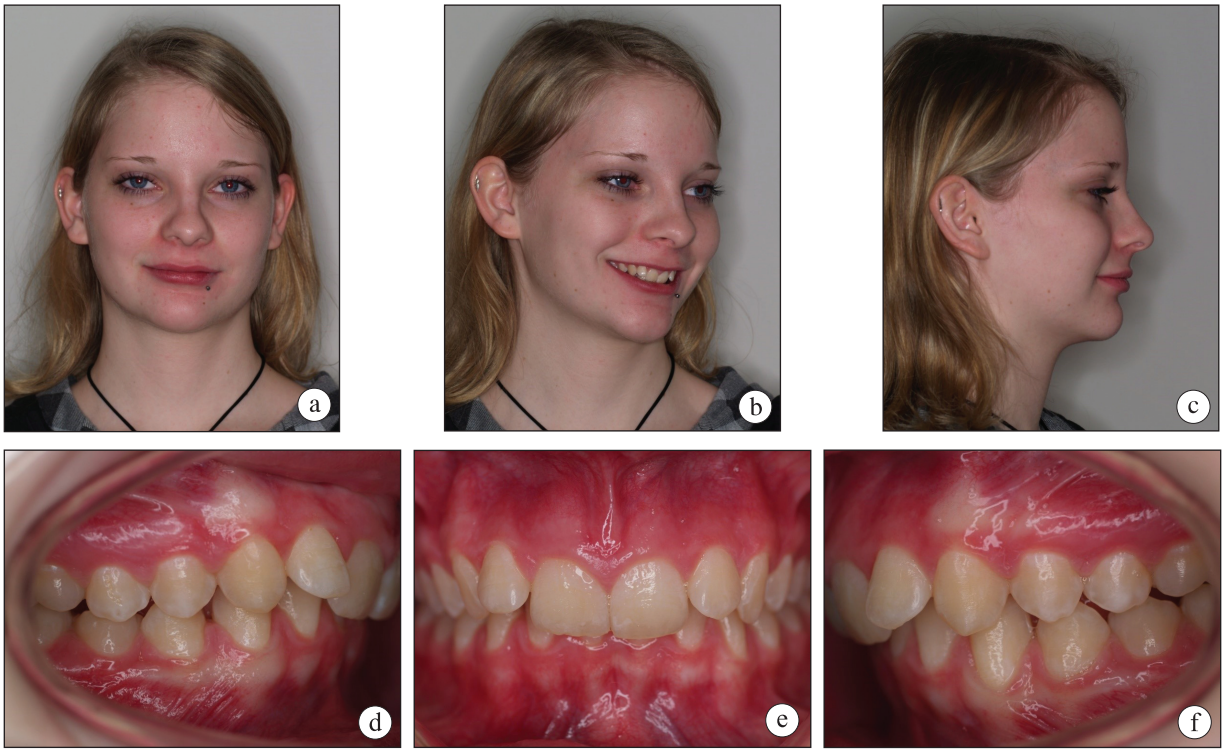

Fig. 13 (a-f). *Patient S.S. before treatment (note extrusion of teeth 11 and 21 relative to the occlusal plane).*

b

		value	mean	sd/Range
SAGITTAL JAW RELATIONSHIP				
A-N-pg	A-N-pg	2.6	2.0º	2.5º
A-N-B	A-N-B	5.0	3.0º	2.5º
JAW PROGNATHISM				
Maxillary (A)	S-N-A	84.2	82.0º	3.5º
Mandibular (pg)	S-N-pg	81.6	80.0º	3.5º
Mandibular (B)	S-N-B	79.2	79.0º	3.0º
DENTO-ALVEOLAR PROGNATHISM				
Maxillary	pr-N-A	2.2	2.0º	1.0º
Mandibular (CL)	CL/ML	68.0	70.0º	6.0º
Mandibular (B)	pg-N-B	2.5	1.0º	2.5º
INCISOR INCLINATION/BASE				
Maxillary	Ils/NL	97.5	110.0º	6.0º
Mandibular	Ili/ML	85.4	94.0º	7.0º
WITS APPRAISAL				
WITS		3.1	0.0º	
VERTICAL RELATIONSHIP				
Vertical jaw relationship	NL/ML	17.7	25.0º	6.0º
Maxillary inclination	NL/NSL	8.7	8.0º	3.0º
Mandibular inclination	ML/NSL	26.4	33.0º	6.0º
VERTICAL DENTO-ALVEOLAR CONDITION				
Maxillary zone	NL/OLs	9.4	10.0º	4.0º
Mandibular zone	Oli/ML	19.4	20.0º	5.0º
INCISAL RELATIONSHIP				
Horizontal overjet		4.0	3.0 mm	
Vertical overbite		7.7	2.5 mm	
Inter-incisal angle		159.4	132.0º	
ii to A-pg		-2.7	1.0 mm	
Max. incisor to upper lip		6.8	3.0 mm	
Max. incisor to occlusal plane		1.1	0.0 mm	

Fig. 14. a *– profile cephalogram of S.S. before treatment,* ***b*** *– cephalometric analysis of S.S.*

Cephalometric analysis (Summary)

The sagittal jaw relationship is clearly increased in the case of increased maxillary prognathism. The maxillary incisors are severely retroclined as are the mandibular incisors and the mandibular alveolar process. The sagittal position of the mandibular incisors is well dorsal of the A-Pg line. The vertical jaw relationship is severely decreased in connection with a strong anterior inclination of the mandible (Fig. 15, 16, 17).

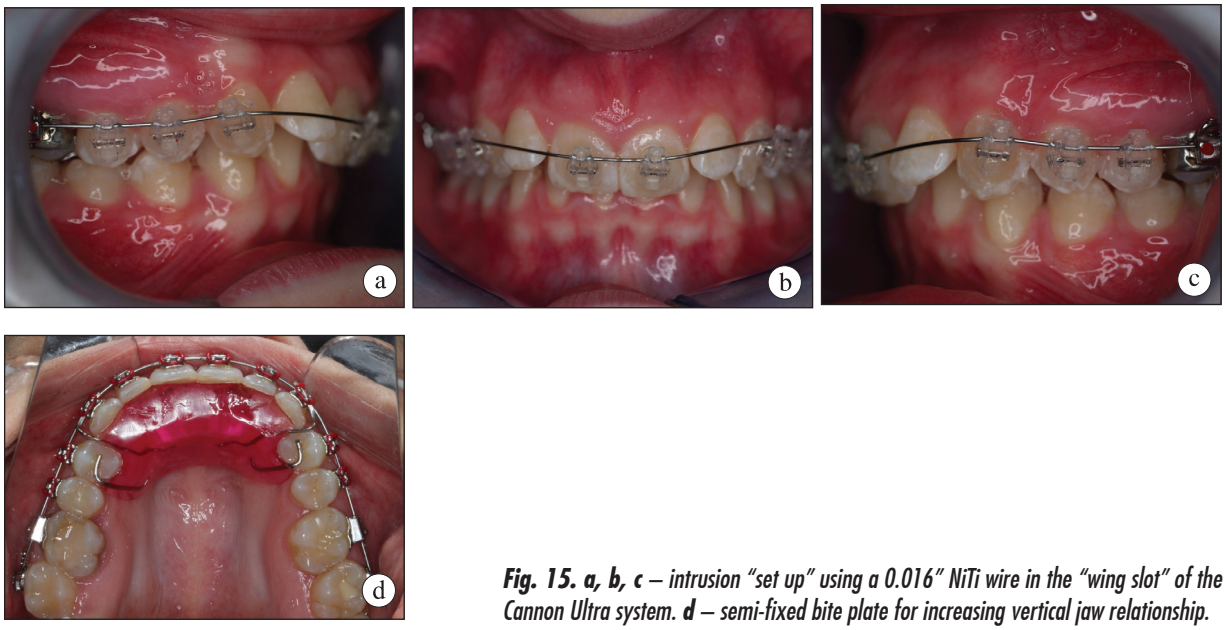

***Fig. 15. a, b, c** – intrusion "set up" using a 0.016" NiTi wire in the "wing slot" of the Cannon Ultra system. **d** – semi-fixed bite plate for increasing vertical jaw relationship.*

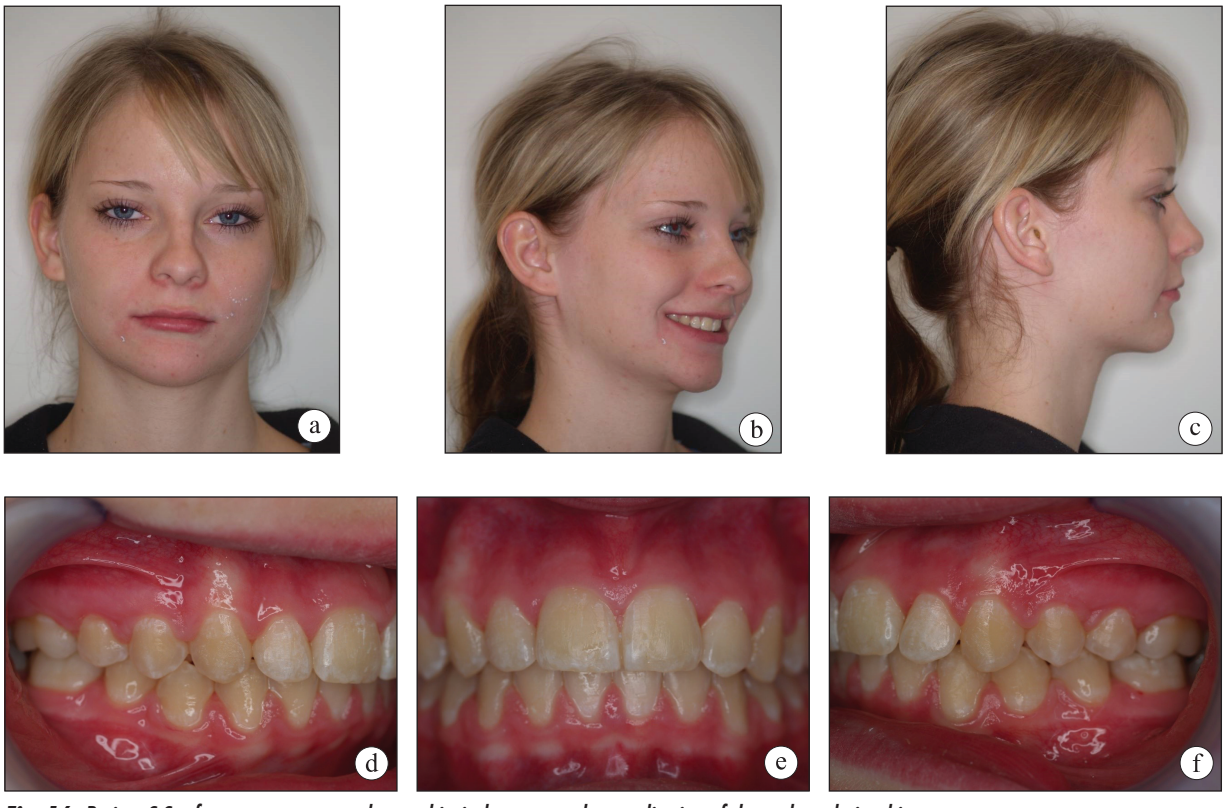

***Fig. 16.** Patient S.S. after treatment: note the good incisal contact and normalisation of the molar relationship.*

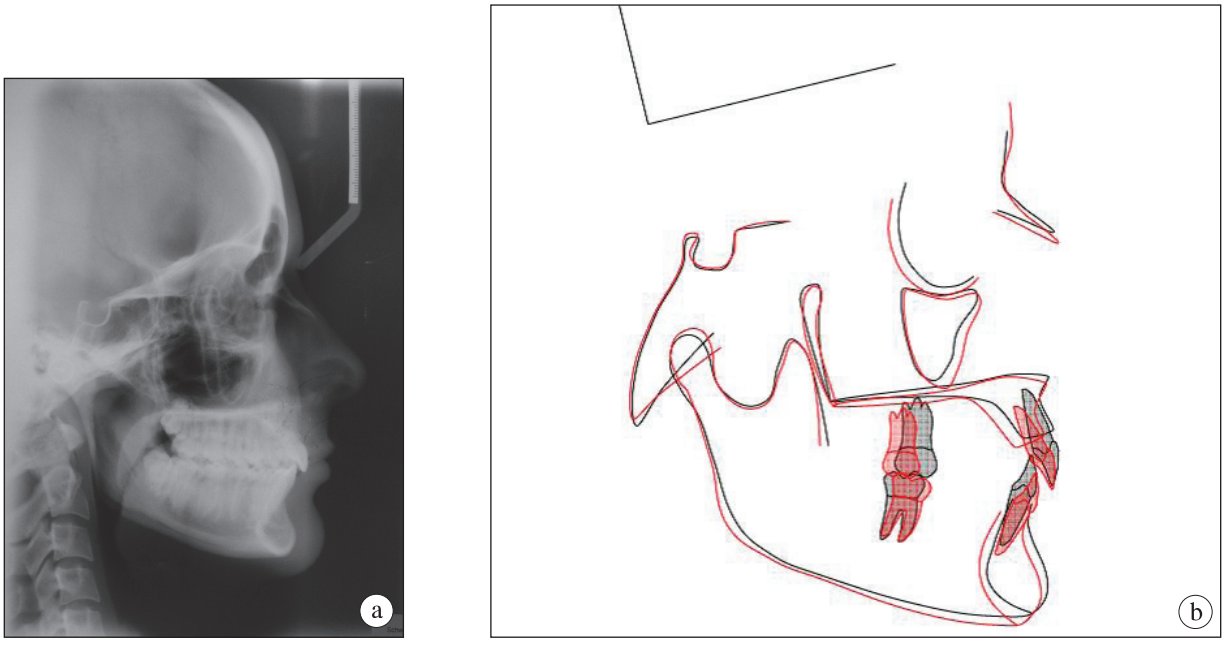

Fig. 17 (a, b). *S.S. post treatment.*

The two-stage cephalometric comparison after superimposition on anterior cranial base reveals a vertical mandibular symphysis development probably as a result of buccal tooth extrusion in connection with bite plate therapy.

The two cases reported here described individualisation of the treatment plan based on the morphology of the deep bite and vertical jaw relationship.

References

1. *Angle EH:* Classification of malocclusion. Dental Cosmos 1899; 41: 248-264.
2. *Hellman M:* Studies on the etiology of Angle's Class II malocclusal manifestations. Int J Orthod 1922; 8: 129-150.
3. *Hitchcock HP:* The cephalometric distinction of class II division 2 malocclusion. Am J Orthod 1976; 69: 447-454.
4. *Björk A, Skieller V:* Facial development and tooth eruption. Am J Orthod 1972; 62: 339-383.
5. *Leighton BC, Adams CP:* Incisor inclination in Class II division 2 malocclusions. Eur J Orthod 1986; 8: 98-105.
6. *Ghafari JG, Haddad RV:* Cephalometric and dental analysis of class II, division 2 reveals various subtypes of the malocclusion and primacy of dentoalveolar components. Semin Orthod 2014; 20: 272-286.
7. *Godiawala RN, Joshi MR:* A cephalometric comparison between Class II division 2 and normal occlusion. Angle Orthod 1974; 44: 262-267.
8. *Arvystats MG:* Non extraction treatment of severe class II division 2 malocclusion. Am J Orthod Dentofac Orthop 1991; 99: 79-84.
9. *Delivanis HP, Kuftinec MM:* Variations in morphology of the maxillary central incisors found in class 2 malocclusions. Am J Orthod 1980; 78: 438-443.
10. *Gorucu-Coskuner H, Ciger S:* Computed tomography assessment of temporomandibular

joint position and dimensions in patients with class II division 1 and division 2 malocclusions. J Clin Exp Dent 2017; 9: e417-e423.

11. *Leighton BC, Adams CP:* Incisor inclination in Class II division 2 malocclusions. Eur J Orthod 1986; 8: 98-105.
12. *Thomsen JR:* Abnormal function of the temporomandibular joints and the related musculature. Angle Orthod 1986; 56: 181-195.
13. *Demisch A, Ingervall B, Thüer U:* Mandibular displacement in Angle class II division 2 malocclusion. Am J Orthod Dentofac Orthop 1992; 102: 509-518.
14. *Grzegocka K, Williams S. Loster J, Wieczorek A, Loster BW:* Relationship between occlusion and dental attrition in a group of young Polish adults. J Stomatol 2016; 69: 285-294.
15. *Schudy F:* The rotation of the mandible resulting from growth: Its implication on orthodontic treatment. Angle Orthod 1965; 35: 36-50.
16. *Williams S, Loster BW:* Presenting the Kracovia system (K.C.S.). J Stoma 2012; 65: 525-542.
17. *Björk A:* The face in profile; an anthropological X ray investigation on Swedish children and conscripts. Svensk Tandl Tidskrift; 1948; 34: 691-699.
18. *Björk A:* Kæbernes relationer til det øvrige kranium. In: Lundström A, editor. Nordisk lärobok i ortodonti. Stockholm: Sveriges Tandläkarforbunds Förlagsförening; 1971.
19. *Demisch A, Ingervall B, Thüer U:* Mandibular displacement in Angle class II division 2 malocclusion. Am J Orthod Dentofac Orthop 1992; 102: 509-518.
20. *Godiawala RN, Joshi MR:* A cephalometric comparison between Class II division 2 and normal occlusion. Angle Orthod 1974; 44: 262- 267.
21. *Hellsing E, Hellsing G, Eliasson S:* Effect of fixed biteplate therapy- a radiographic study. Am J Orthod Dentofac Orthop 1996; 110: 61-68.
22. *Cannon J, Williams S, Loster BW:* The Cannon Ultra System. Krakow: Polish Dental Association, 2014.
23. *Burstone CJ:* Deep Bite correction by intrusion. Am J Orthod; 1977; 72: 1-22
24. *Williams S, Cannon J:* Efficient clinical management of deep bite using a double slotted bracket. J Stoma 2012; 64: 245-259.
25. *Litt RA, Leth Nielsen I:* Interceptive treatment of Class II division 2. Eur J Orthod 1984; 6: 213- 230.
26. *Lapatka BG, Mager AS, Schulte Moenting J, Jonas IE:* The importance of the level of the lipline and resting lip pressure in Class II division 2 Malocclusion. J Dent Res 2002; 81: 323-328.

Address: 31-155 Kraków, ul. Montelupich 4
Tel.: +4812 4245442
e-mail: ahilles@hotmail.com

Received: 23rd January 2017
Accepted: 13th July 2017