

# Clinical Effects of Fixed Functional Herbst Appliance in the Treatment of Class II/1 Malocclusion

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## SUMMARY

**Introduction** Sagittal mandible deficiency is the most common cause of skeletal Class II malocclusion. Treatment objective is to stimulate sagittal mandible growth. Fixed functional Herbst appliance use is beneficial for shortening the time required for treatment and does not depend on patient compliance.

**Case outline** A 13-year-old girl was referred to the Clinic of Orthodontics, School of Dentistry in Belgrade following previous unsuccessful treatment of her skeletal Class II malocclusion using an activator. The patient's poor cooperation had led to failure of the treatment. Patient was subjected to the Herbst treatment for 6 months followed by fixed appliance for another 8 months. Lateral cephalograms before and after the treatment was performed. The remodeling of condylar and fossal articulation was assessed by superimposition of pre- and post-treatment temporomandibular joint tomograms. The promotion of oral hygiene and fluoride use was performed because orthodontic treatment carries a high caries risk and risk for periodontal disease. Skeletal and dental changes were observed after treatment (correction [Max+Mand]: molar relation 7 mm, overjet 8 mm, skeletal relation 5 mm, molars 2 mm, incisors 3 mm). Combination of Herbst and fixed appliances was effective in the treatment of dental and skeletal irregularities for a short period of time.

**Conclusion** In the retention period, 14 months after treatment, occlusal stability exists. Follow-up care in oral prevention is based on regular recalls at the dental office and supervision at home by the parents.

**Keywords:** malocclusion; fixed appliances; prophylaxis

## INTRODUCTION

Skeletal Class II/1 malocclusions are common orthodontic irregularities [1]. With successful treatment traumatic injuries of upper incisors, hard palate injuries of lower incisors, as well as temporomandibular joint (TMJ) dysfunctions can be prevented. If breathing and speech functions are normally developed, a better psycho-social adaptation of the child during personality development is accomplished [2].

The treatment objective for skeletal Class II malocclusions is to stimulate sagittal mandibular growth and establish a correct occlusal relationship. Since Kingsley in 1877 introduced an appliance that affects mandibular position and growth, promoting the "jumping the bite" effect and the development of removable functional appliances was commenced (activator by Andersen etc.) [3, 4].

Some researchers claim that mandibular condylar growth can be stimulated by removable functional appliance treatment, while others state that changes in occlusion result in dento-alveolar remodelling processes [5-8]. Disagreements between clinicians were due to difficulties in the evaluation of therapy, as the activator was used for only during a part of the day, meaning that for some patients the threshold for condylar growth adaptation to forward mandibular movement could never be reached. In the cases of insufficient appliance use that pass undetected, the interpretation of treatment outcome could be biased. Treatment time is relatively long (2-4 years) and it is hard to find a suitable control group in order to differentiate between physiological growth changes and therapy changes [3]. Fixed functional appliance therapy aims to overcome the shortcomings of remov-

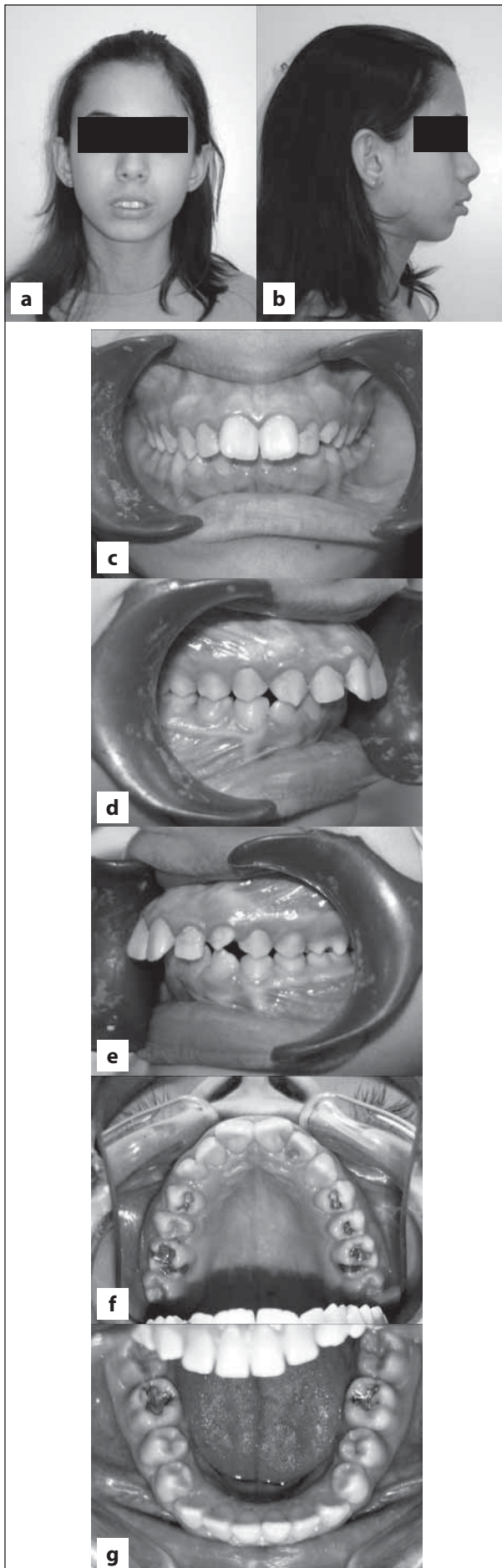
able functional appliances. The Herbst appliance is frequently used for the treatment of Class II malocclusions. The time needed for the therapy is relatively short (6-8 months) and does not depend on patient's compliance as it is fixed to the teeth and acts 24 hours a day [9]. It is also indicated in older patients with completed skeletal growth.

## CASE REPORT

A 13-year-old girl was referred to the Clinic of Orthodontics, School of Dentistry in Belgrade following the unsuccessful treatment of her skeletal Class II/1 malocclusion using an activator (Figure 1). The patient's poor cooperation led to treatment failure after 18 months, and therefore the patient commenced Herbst appliance therapy which was acceptable to both the patient and the parents (Figure 2).

At initial examination her malocclusion was diagnosed as Class II/1 (Figure 1), with an overjet of 8.5 mm and crowding in both dental arches. Extraoral analysis revealed convexity, an extruded upper lip, a mentolabial sulcus and potentially competent lips. A lateral cephalogram analysis (Figure 3) confirmed the Class II sagittal skeletal relationship between the upper and lower jaws as a result of mandibular retrognathism. The protrusion of the upper incisors was identified (Figure 4). The analysis of lateral cephalograms and photographs were performed using Nemotec Dental Studio NX software [10]. Radiographs were digitized, calibrated and assessed with the software program.

Dental examination revealed a restored permanent dentition without active caries lesions but with poor oral hygiene. Teenagers are high caries-risk patients

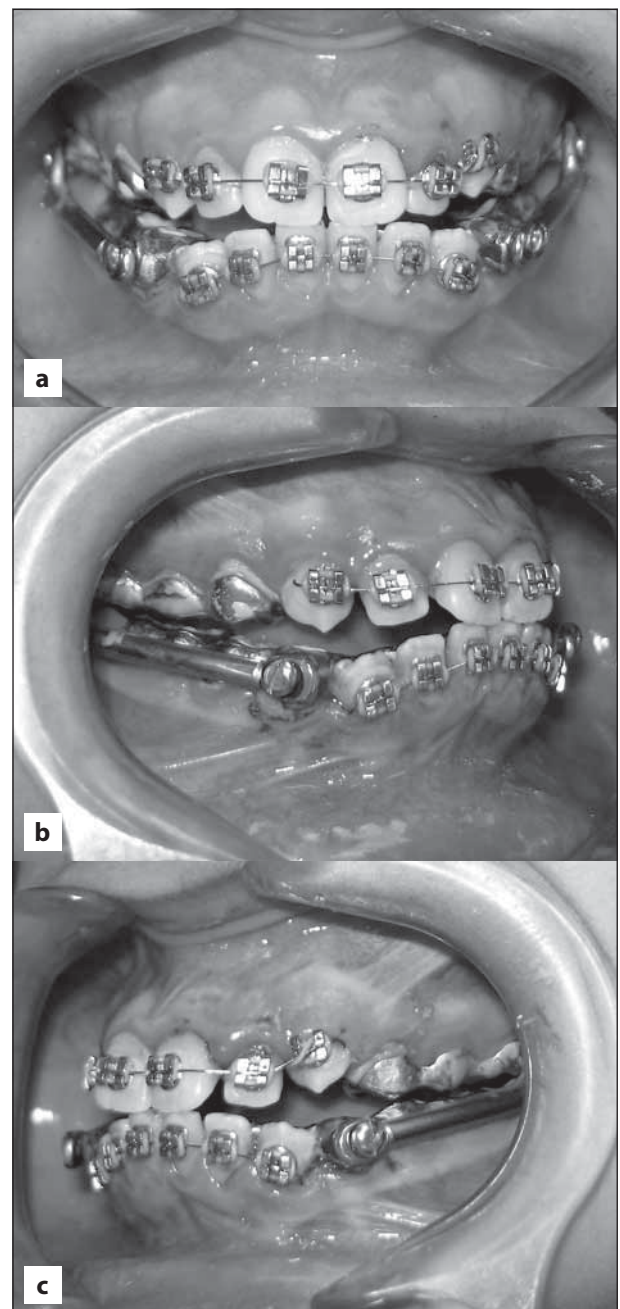


**Figure 1.** Before treatment

and are advised to brush the teeth regularly with fluoride toothpaste and to use a daily fluoride rinse [11]. Regular recall visits aimed at re-motivating patients oral hygiene practices is a protocol applied at the Orthodontic Clinic.

Constructive wax bite impressions were taken with an edge-to-edge incisal relationship. During Herbst appliance treatment segmental fixed appliances were used in the frontal regions of both upper and lower jaws [3]. The patient wore the Herbst appliance for 6 months (Figure 2), followed by multibracket appliances for another 8 months in order to attain a regular inter-occlusal relationship (Figure 5).

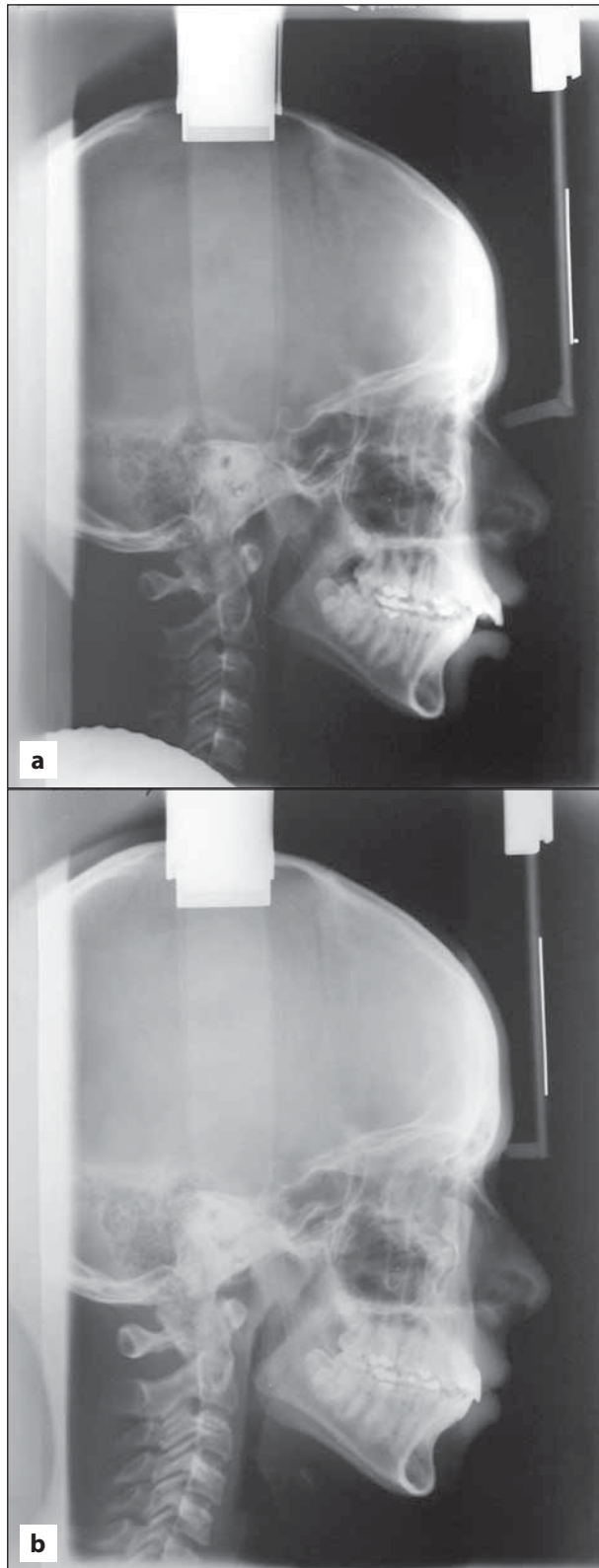
During the treatment, moderate gingival inflammation was recorded, probably as a result of the orthodontic brackets. Therefore, the patient was subjected to weekly prophylactic plaque removal until a good level of oral hygiene and gingival status were attained. After two months



**Figure 2.** Herbst appliance and segmented frontal multibracket appliance

of intensive prophylactic measures, the gingival inflammation reduced from moderate to mild. Regular check-ups were performed until the end of the orthodontic treatment in order to motivate the patient's oral hygiene.

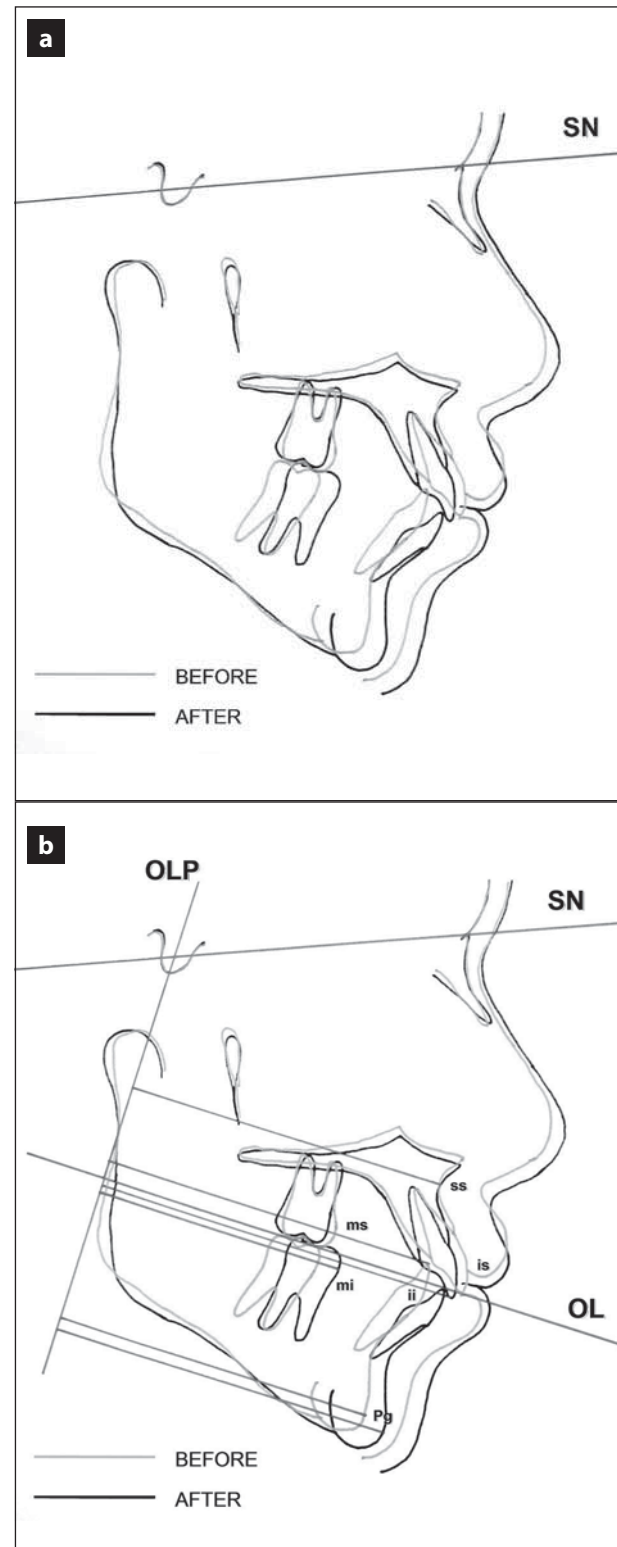
On completion of the treatment, lateral cephalograms indicated correction of the mandibular position (Figures 3 and 4). The molars and incisors, as well as the skeletal inter-jaw relationship were corrected and confirmed by the



**Figure 3.** Profile cephalogram before (a) and after (b)

computerised superimposition (Figure 4) and lateral cephalograms analysis according to Pancherz before and after Herbst appliance therapy (Table 1). Aesthetic improvements were observed with correction of the convex profile, retrusion of the upper lip and the reduction of the mentolabial sulcus (Figure 5). The lips became competent.

A tomography analysis of the TMJ pre- and post-therapy (Figure 6) indicated that the remodelling of the fossal and



**Figure 4.** Superimposition of profile cephalograms: a) before (gray), after (black) treatment; b) traced parameters for treatment changes measurements (Pancherz method)

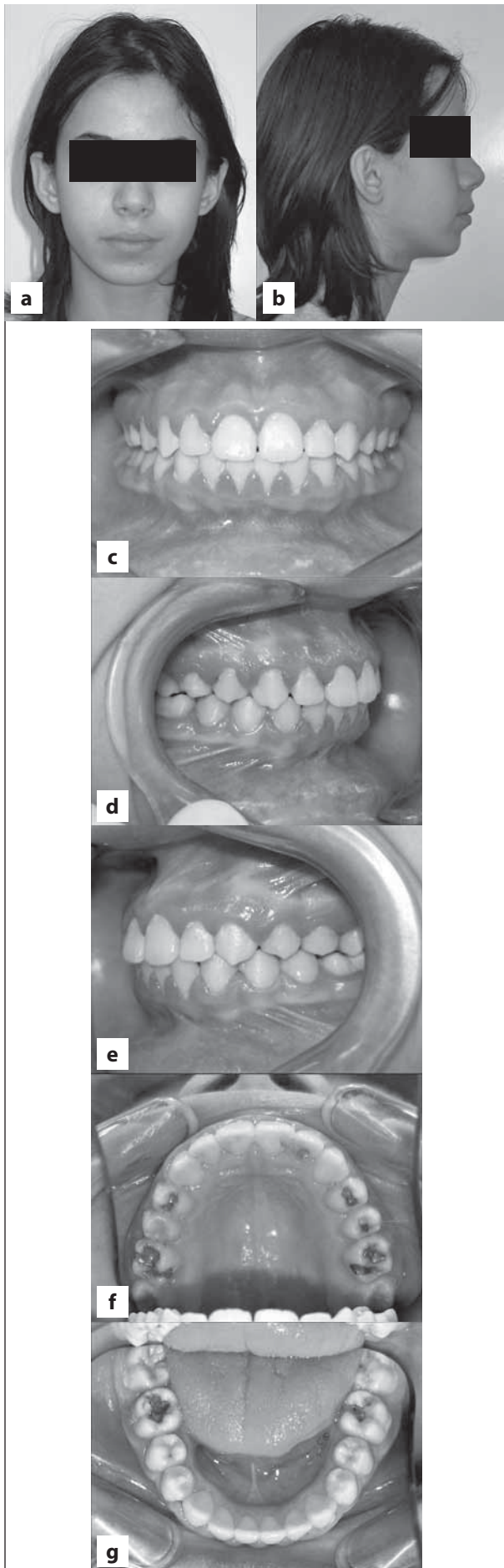


Figure 5. After treatment

condylar articulation occurred resulting from resorption of the anterior aspect, while apposition took place on the posterior aspects, which had been previously reported as well [9, 12, 13].

A healthy gingiva and restored sound dentition without new caries lesions was observed on completion of orthodontic treatment and the patient's oral health status was preserved during 14 months follow-up (Figure 7).

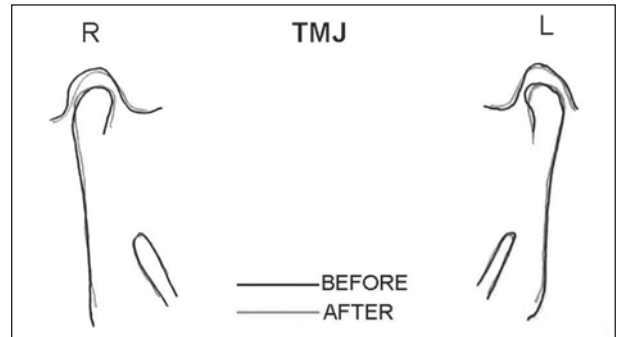


Figure 6. Superimposition of profile TMJ cephalograms tracings (black – before, gray – after treatment)

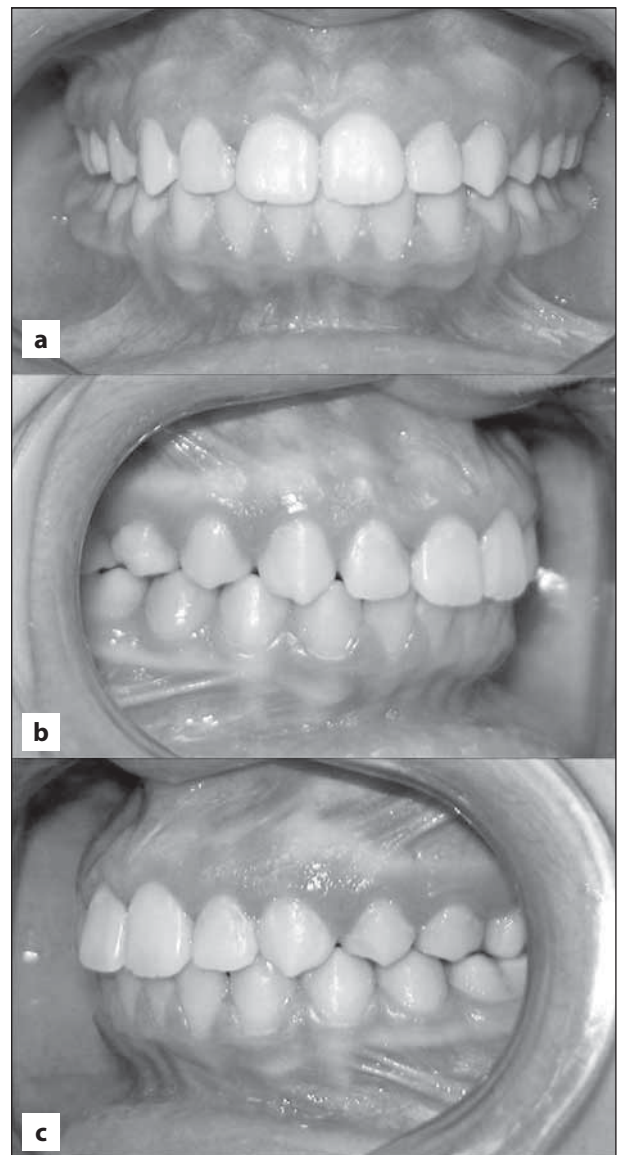


Figure 7. Oral health status after treatment

**Table 1.** Pancherz analysis of sagittal, dental and occlusal changes

Analysis	Variable (measurements to OLP)	Before	After	Difference	Correction (Max.+Mand.)
Skeletal + Dental	ms	56.0	54.0	2.0	Molar relation 7.0
	mi	53.0	58.0	5.0	
Skeletal + Dental	is	90.0	86.0	4.0	Overjet 8.0
	ii	79.0	83.0	4.0	
Skeletal	ss	76.0	75.0	1.0	Skeletal 5.0
	Pg	76.0	80.0	4.0	
Dental (molars)	ms(D)-ss(D)	-	-	1.0	Molars 2.0
	mi(D)-Pg(D)	-	-	1.0	
Dental (incisors)	is(D)-ss(D)	-	-	3.0	Incisors 3.0
	ii(D)-Pg(D)	-	-	0	

OLP – occlusal line perpendicular; ms – the most mesial point of the approximal surface of the upper first molar; mi – the most mesial point of the approximal surface of the lower first molar; is – incisal edge of the upper incisor; ii – incisal edge of the lower incisor; ss – the most recessed point of the anterior side of the maxilla; Pg – the most prominent point of the chin profile; D – difference

## DISCUSSION

In our orthodontic practice the most frequently used appliance for the therapy of Class II malocclusions is Andersen's activator. Most clinicians try to overcome the shortcomings of this activator; dimensions, long-term therapy (1.5-2 years), a reduced tongue space and speech difficulties. The ideal time for the use of this appliance is between 8-12 years of age if children are not very motivated for orthodontic therapy, are poorly compliant and reject wearing the appliance 16 hours a day. The question is: how to carry out orthodontic treatment in patients with such a diagnosis if they are in the final phase of growing or have already completed growth?

The Herbst appliance is indicated in the therapy of maxillary prognathism, mandibular retrognathism (or combinations), enlarged sagittal inter-maxillary ANB angle, the retrusion of lower or protrusion of upper incisors (or combinations), and mild to moderate crowding of the upper dental arch [4, 13]. Therapy with this appliance could be a good choice instead of camouflage orthodontics, growth adaptation with removable appliances or orthognathic surgery.

In this case the successful treatment outcome resulted in both skeletal and dentoalveolar changes. The forward displacement of the mandible with remodelling of the TMJ and distalisation of the upper molars resulted in an Angle I Class dentolaveolar relationship, the correction of incisal

overjet and aesthetic improvement of the patient's profile (Figures 3, 4, 5 and 6).

An important phase in constructing the appliance is to take good bite impressions with an edge-to-edge incisal relationship which can be the explanation for the therapeutic outcome (correction of the sagittal skeletal relationship by stimulation of mandibular and inhibition of maxillary growth joined by TMJ remodelling – Herbst effect). The position of the appliance in the buccal region and the areas of fixation contribute to the distalisation and intrusion of the upper molars (Headgear effect), as well as the mesial movements and intrusion of the lower molars (correction of vertical inter-maxillary angle). As the forces in the lower jaw are directly transmitted to the anterior teeth, the lower incisors become protruded (Table 1, Figure 4).

The individual effort every patient makes to maintain regular oral hygiene measures with fluoridated toothpaste and fluoride mouth rinsing is of great importance in oral health prevention. Regular check-ups, patient remotivation and prophylactic measures (plaque removal, high fluoride concentration supplements – rinses, gels, varnishes) all contribute to good oral health care [14, 15]. Good co-operation with patients is paramount, because only motivated patients have good compliance.

It can be concluded that Herbst appliance therapy is effective in the treatment of dental and skeletal irregularities (Class II/1) after a short treatment period.

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## Клинички утицај примене фиксног функционалног *Herbst* апарата у лечењу малоклузија класе II/1

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### КРАТАК САДРЖАЈ

**Увод** Сагитална мандибуларна неразвијеност је најчешћи узрок скелетне малоклузије II класе. Циљ лечења је да се подстакне сагитални раст доње вилице. Примена фиксног функционалног *Herbst* апарата скрађује време лечења и не зависи од сарадње пацијента.

**Приказ случаја** Тринаестогодишња девојчица примљена је на Клинику за ортопедију вилица Стоматолошког факултета у Београду после неуспешног лечења скелетне малоклузије II класе активатором. Подвргнута је лечењу *Herbst* апаратом током шест месеци, након чега је терапија настављена фиксним ортодонтским апаратом још осам месеци. Латерални цефалограми урађени су пре и после лечења. Ремоделација кондила и фосе артикуларис оцењивана је суперпозицијом томо-

грама темпоромандибуларног зглоба пре и после лечења. Пацијенткињи је посебно скренута пажња на адекватну оралну хигијену и примену флуорида због ризика од развоја каријеса и периодонталног обољења. Скелетне и денталне промене уочене су после лечења (корекција [Max+Mand]: однос молара 7 mm, инцизални степеник 8 mm, скелетни однос 5 mm, молари 2 mm, инцизиви 3 mm). Комбинација *Herbst* апарата и фиксног ортодонтског апарата била је ефикасна у лечењу денталне и скелетне неправилности за кратак временски период.

**Закључак** Четрнаест месеци након лечења и даље је заступљена оклузивна стабилност. Контрола оралне превенције заснива се на редовним прегледима у стоматолошкој амбуланти и надгледању пацијента у одржавању оралне хигијене.

**Кључне речи:** малоклузије; фиксни апарати; профилакса