



Comparative Evaluation of two new non-compliance devices for the treatment of skeletal classes II and III malocclusions (second and third class resolver-S&TCR) and Herbst Appliance

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Abstract

The correction of Class II and Class III malocclusions is often hampered by the use of appliances that require the collaboration of the patient (headgear, Delaire mask, elastics or the wearing of a removable appliance). Non-compliance therapy involves the use of appliances which minimize the need for such co-operation and attempt to maximize the predictability of results. The aim of this article is to describe the characteristics, indications, advantages and mechanism of action of two innovative appliances and compare them to a device widely used as the Herbst appliance, based on currently available data.

Introduction

A successful orthodontic treatment mainly relies on patient compliance. Unfortunately, such collaboration decreases progressively, from generation to generation, therefore orthodontists are increasingly turning to non-compliance devices.

The S&TCR device (Second & Third Class Resolver, Dental World, Molfetta, Italy) are orthopedic, fixed, non-compliance appliances for the resolution of the second (SCR) and third (TCR) skeletal class during developmental period. S&TCR's action device mechanism is new and revolutionary and have been designed, engineered and manufactured by Professor Michele D'Attilio and dental technician Ugo Comparelli. These devices functionalize the stomatognathic apparatus while it expresses its physiological function such as chewing, swallowing and phonation, and are driven by proprioceptive stimuli based on the same principles of other orthopedic appliances, but, having their function released 24 hours a day, they allow to obtain the expected therapeutic results in average time faster than removable devices, regardless the patient's collaboration .

Advantages of S&TCR devices:

1. Do not require patient cooperation;
2. Acceptable aesthetics;
3. Allow movements of laterality (of about 3 mm);
4. Allow the maintenance of a good oral hygiene;
5. One size available;
6. 24 hours action mechanism based on proprioceptive stimuli especially during physiological stomatognathic functions (chewing, swallowing, phonation) therefore release light forces
7. Easy to activate, with the possibility to perform progressive millimetric activations;
8. Easy to insert into the oral cavity;
9. Employable in combination with other components and orthodontic devices;
10. Short treatment time procedures compared to removable devices.

Materials and methods

Two non-compliance functional appliances have been considered: the S&TCR device (which have been recently developed and represents a revolutionary alternative to other currently available devices) and the Herbst appliance (that has been introduced at the beginning of the twentieth century, although widely spread after 1979 thanks to Pancherz).

Several features have been considered: materials, components, ease of construction, cost, mechanism of action, advantages and disadvantages.

The **Second Class Resolver (SCR)** is a new and alternative fixed system able to correct Class II malocclusion through the anterior reposition of the mandible. It can be used both in developmental age and in patients at the end of growth even though the most propitious moment to treat these patients with such device is during the pubertal growth peak. This device was developed to create an alternative to Herbst and to other similar orthodontic devices.

SCR consists of two main components: the upper Skibar (distally positioned) and the lower Blockrun,

that both interface, thanks to a slide plane of 70 °, during the masticatory, phonetic and swallowing activities, as well as during the rest position. Thus leads the mandible to a progressive and calibrated advanced position. The Skibar and the Blockrun can be assembled both on sectional wires and on ferrules (welded to molars and/or premolars bands), as well as directly on stainless steel archwires of maximal thickness size according to the specific slot diameter used in multibrackets appliances.

Fig. 1. Second Class Resolver (SCR).

SCR devices ensure each dental arches to be independent and consequently the mandible, instead of Herbst's mechanism system device, is not "blocked" in the same position. Moreover, since the proprioceptive stimulus induced on the mandible by the contact between the two slide planes of upper Skibar and lower Blockrun and the distraction of about 2 mm of the condyle and masseter muscles thus allows to reorient both muscular and condylar growth vectors. The therapeutic results consist of a length growth increase of the mandibular ramus and of an anterotation growth vector of the mandible.

Table I. Advantages, disadvantages and mechanism of action of the SCR (Second Class Resolver).

The SCR in its three variants (on steel archwires of multibrackets appliances; on four sectional archwires from first molar to first premolar; on vestibular ferrule from first molar to first molar, both upper and lower) is placed in the vestibule, leaving free the oral cavity. This is advantageous both for the function (chewing, swallowing and phonation) and in case of association with speech therapy or physiotherapy: the association between an orthopedic device for the correction of the relationship of skeletal class and myofunctional therapy and/or speech therapy is one of the absolute novelties of the device.

The SCR can be activated progressively and, in cases of mandibular laterodeviation, also in an asymmetrical manner. Its activation is simple, having to act exclusively on a tightening screw, screw to mobilize the Blockrun. The sliding in the distal direction of the Blockrun (or mesial if it acts on the Skibar) allows the activation of the device: the new way of interfacing of Blockrun and Skibar determines the gradual advancement of the position of the mandible.

Fig 2. Treatment with Second Class Resolver (SCR).

A clinical research conducted on a group of 40 patients (mean age 8 years) with a skeletal Class II malocclusion showed the following results:

- a statistically significant reduction of ANB angle

- (average of about 2°), maxillo-mandibular angle (MM, about 1°), SNA angle (3°), total goniac angle (1.8°);
- a statistically significant increase in the length of the mandibular ramus (average of 5 mm) and of the mandibular body (2.9 mm).

The analysis of these results highlights that the SCR is able to act on the vertical dimension, reducing it.

The **Third Class Resolver (TCR)** is the first fixed device capable of resolving the skeletal third Classes in growing patients and uses the same principles of other orthopedic appliances employed for the same purpose such as the stimulation of the circum-maxillary sutures in order to promote the advancement of the maxilla.

The main components of the TCR are the upper Skibar which must not have any inclination, but must be in vertical position, the lower Blockrun that is placed distally to the Skibar and should not be tight on the archwire, but left free to slide, an open Ni-Ti coil-spring placed distally to the Blockrun and a stop set on the archwire, behind the coil-spring.

Fig 3. Third Class Resolver (TCR) and its components.

Fig 4. Treatment with Third Class Resolver (TCR).

Table II. Peculiarities and advantages of the TCR (Third Class Resolver).

The interfacing between the Skibar and the Blockrun during functions allows the latter to slide distally and to activate the spring which represents the "engine" of the appliance. The activation of the Ni-Ti coil-spring manage to transfer the distracting input originally by the circum-maxillary sutures.

A clinical research conducted on growing patients with a skeletal Class III malocclusion showed the following results:

- a statistically significant increase of ANB angle (average of about 1°), index of Witts (3.5 mm), upper incisor relative to the bispinal plane (about 10°), length of the mandibular ramus (4.8 mm) and body (3.3 mm);
- a statistically significant reduction of maxillo-mandibular angle (MM, about 1.7°), total (2°) and upper (2.5 °) goniac angles.

The analysis of these results highlights that TCR device is able to act on the lower vertical dimension reducing it.

The **Herbst appliance** (Dentaurum) was introduced in 1905 and underwent numerous changes over years: it is a fixed functional appliance (but it can sometimes be removable) and today is widely used in orthodontics for the resolution of Class II. It works like an artificial joint between the maxilla and the mandible.

Fig. 5. Herbst appliance.

A bilateral telescopic mechanism (on orthodontic bands, acrylic splint, cast chromium cobalt or in the variant "cantilever bite jumper, CBJ) maintains the mandible in a protruded position. The cast appliance and bite jumper design are cemented and worn full time excluding the need of cooperation.

Table III. Main features of the Herbst appliance.

The Herbst appliance is indicated in Class II division 1 growing patients (with well-aligned arches). Pancherz (1995) also recommends its use in post-adolescent patients, mouth-breathers, uncooperative patients, and those that do not respond to removable functional appliances.

In addition it has been shown to be a most effective treatment option for Class II division 2 malocclusions, correcting both the Class II molar relationship and the deep bite simultaneously.

It determines dental and skeletal effects (Table III), which vary according to sex, age and duration of therapy.

Table IV. Skeletal and dental effects of Herbst appliance.

Sagittal growth may be increased whereas the vertical growth is unaffected by treatment.

Vertically, the overbite is reduced: this occurs by intrusion of lower incisors and enhanced eruption of lower molars (Panchers, 1995). Hansen et al. (1990) found that the appliance did not have any adverse effects on the temporomandibular joint.

Results and conclusions

The patient compliance is often the most limiting factor in determining the duration of treatment and the quality of achieved results. Non-compliance therapy aims to remove some of these patient variable factors. Therefore this new innovative type of devices is useful not only in non-compliant patients but may be advantageous in all patients.

As previously mentioned, the SCR represents an alternative to the Herbst appliance, thanks to its innovative design has some advantages over the latter one. Infact, unlike the Herbst appliance, the SCR allows the dental arches to remain independent to each other and, consequently, the mandible is not bind to the same position. Furthermore, SCR is less prone to breakage, allows the maintenance of a good oral hygiene and, being less bulky, is more comfortable for the patient.

SCR's structure morphology allows to better associate,

if necessary, a myofunctional and speech therapy: this is one of the absolute innovations of the device. Biologically SCR device reduces the vertical skeletal growth dimension, whereas the Herbst appliance stimulates the sagittal growth vectors.

The introduction of these innovative designed devices provides ideally satisfactory results, which have to be better validated and improved by a larger number of clinical study case reports, both for the patient and the orthodontist.

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Illustrations

Illustration 1

Fig. 1 A. Second Class Resolver (SCR).



Illustration 2

Fig. 1 B. SCR consists of two main components: the upper Skibar (distally positioned) and the lower Blockrun.



Illustration 3

Table 1 Advantages, disadvantages and mechanism of action of the SCR (Second Class Resolver).

<i>Advantages</i>	The main components (Skibar and Blockrun) are mounted buccally: they don't encumber the lingual area and this allows a simultaneous speech therapy.	It is very comfortable (thanks to its reduced dimensions and the ability of progressive reactivation, which allow the patient a fast adaptation to the appliance).	Simple activation.	It works also during the night, since the length of the Skibar changes autonomously according to the depth of the fornix, ensuring control of the anteposition of the mandible.	Not easy to fracture.	It does not require patient cooperation (it is a fixed device).	The time taken to obtain the correction of Class II is reduced if compared to the other removable devices.
<i>Disadvantages</i>	Initially, the buccal mucosa can be traumatized.	The patient may initially have difficulty in closing the mouth (especially in the laterodeviation) but, after 4-7 days, he adapts to that device. It is advisable, therefore, to let the system passive for 15 days, so as to allow the patient to become familiar with it.					
<i>Mechanism of action</i>	The presence of the SCR in the oral cavity determines changes in the masseter muscle and the condyle. In fact, when the patient closes his mouth, the condyle and the masseter are distracted by about 2 mm, thanks to the contact between the metal structures of the SCR (upper and lower). This action induces a stimulus to the vertical growth of the mandibular ramus and a reaction of the superficial and deep masseter to oppose this elongation with an increase in the contractile ability of its fibers.						

Illustration 4

Fig 2 A. Treatment with Second Class Resolver (SCR): before.



Illustration 5

Fig 2 B. Treatment with Second Class Resolver (SCR): after.



Illustration 6

Fig 2 C. Treatment with Second Class Resolver (SCR): before and after.

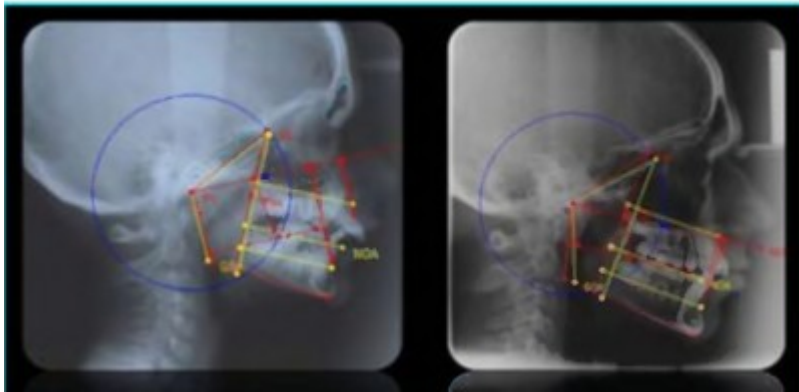


Illustration 7

Fig 3 A. Third Class Resolver (TCR) and its components.



Illustration 8

Fig 3 B. Third Class Resolver (TCR) and its components.



Illustration 9

Fig 4 A. Treatment with Third Class Resolver (TCR): before.



Illustration 10

Fig 4 B. Treatment with Third Class Resolver (TCR): after.



Illustration 11

Table 2 Peculiarities and advantages of the TCR (Third Class Resolver)

<i>Peculiarities and advantages</i>	It lets you therapeutic outcome regardless of the patient's cooperation and in average times faster (since it functions 24 hours/day).
	The stimuli to promote the advancement of the maxilla, thanks to the design that characterizes the TCR, are not induced by forces that have anterior support points either extraoral (Delaire mask) or intraoral (Class III elastics). These stimuli start from the masticatory and swallowing acts; all the mechanics of the device is positioned posteriorly (permanent first molar-premolar area), avoiding the generation of reaction forces with oblique vector with direct action on the condyle.
	The force of action (and reaction) is confined, for the most part, inside the device. The latter develops according to a preordained and controlled horizontal axis through the "track" structure of the appliance and the presence of an open coil-spring in Ni-Ti (which absorbs part of the reaction force that is generated inside the device). This, associated with the distraction of the condyle of about 2 mm, determines a minimum transfer of the reaction force on the condyle.
	Its activation is simple: it acts only on a tightening screw to mobilize the stop behind the open coil-spring (located distally to the lower Blockrun). The sliding in mesial direction of the stop determines the advancement of the whole system (coil-spring and Blockrun), allowing the activation of the device.

Illustration 12

Fig. 5 A. Herbst appliance.



Illustration 13

Fig. 5 B. Herbst appliance.



Illustration 14

Table 3 Main features of the Herbst appliance

<i>Indications</i>	Dental Class II malocclusion	Skeletal Class II mandibular deficiency	Deep bite with retroclined mandibular incisors	Upper molar distalization	Lower incisors advancement
<i>Contra-indications</i>	Cases predisposed to root resorption	Dental and skeletal open bites	Vertical growth with high maxillomandibular plane angle and excess lower facial height		
<i>Advantages</i>	It works 24 hours a day	It does not require patient cooperation	The active treatment time is short (about 6-8 months)		
<i>Disadvantages</i>	Proclination of the lower incisors (due to the force exerted on them by the telescopic structure), which can be reduced by associating the miniscrew. It contributes to a decrease in the interincisal angle during treatment. This proclination has been suggested to contribute to overbite stability after Class II division 2 Herbst treatment.	Gingival lesions	Difficulty in maintaining of a good oral hygiene	Prone to breakage	Is limited to use in patients who can tolerate proclination of mandibular incisors
<i>Mechanism</i>	Bilateral telescoping mechanism advancing the mandible into new position				
<i>Anchorage</i>	Lower lingual arch or lower acrylic splint				

Illustration 15

Table 4 Skeletal and dental effects of the Herbst appliance

<i>Dental effects</i>	<i>Skeletal effects</i>
Maxillary molar distalization and intrusion	Has a restraining effect on maxillary growth
Lower molars mesialization	Has a stimulating effect on mandibular growth
Lower incisor proclination	Increase in the condylar growth (Pancherz, 1979, 1982; Paulsen, 1997 ; Paulsen et al. , 1998; Manfredi et al. , 2001)
	Remodeling of the glenoid cavity (Woodside et al. ,1987 ; Ruf and Pancherz, 1999 ; Voudouris et al. , 2003)
	Increasing the SNB angle and lowering the SNA angle, which are significant in the case of IHA (Integrated Herbst Appliance)