

CHAPTER 6

Rigid fixed functional appliances

Peter Miles

Class II treatment may be managed in either a one- or two-phased approach. Apart from the more invasive option of surgery, non-extraction options include the use of headgear, removable functional appliances (e.g. Twin Block, activator) or fixed functional appliances (e.g. Herbst; MARA – Allesee Orthodontic Appliances, Sturtevant, WI), often prior to comprehensive treatment with brackets in a two-phase approach. Alternatively, a single-phased approach is becoming increasingly popular in comprehensive treatment with brackets combined with headgear and/or elastics, which requires more cooperation from the patient, or to reduce the onus on compliance a fixed Class II corrector (e.g. Forsus FRD – 3M Unitek, Monrovia, CA; Jasper Jumper – American Orthodontics, Sheboygan, WI) may be used. Rigid fixed functional appliances including the Herbst and MARA will be discussed in this chapter, while flexible fixed variants (often termed Class II correctors) will be covered in Chapter 7.

A functional appliance is usually one that engages both dental arches and acts principally by holding the mandible away from its normal resting position.¹ This description would therefore best fit rigid appliances such as the Herbst and MARA. However, with non-rigid appliances such as the Forsus or even elastics, some forward posturing of the mandible may occur. A functional appliance may also be described as one aimed at modifying growth, but given that prospective clinical trials^{2–4} have found that initial growth acceleration dissipates over time, perhaps the more appropriate description is fixed Class II correctors. However, the current convention is to term these fixed functional appliances (FFA).

Herbst

The Herbst appliance is by far the most researched of the fixed functional appliances, with the bite jumping phase of treatment usually completed within 6 to 8 months.⁵ It was named after its developer, Emil Herbst, who according to Pancherz first described it in 1905.⁶ The Herbst appliance (Figure 6.1) comes in various forms and may be cemented in place with crowns, bands or cast metal splints. Additionally, there is a bonded acrylic splint variant and a removable type.

The feature common to all designs is the rigid telescoping buccal tubes and rods, which keep the mandible in continuous protrusion both at rest and in function. A lingual arch is usually included in the lower arch and a trans-palatal arch (TPA) is often incorporated in the upper element, helping to maintain arch form while limiting potential unwanted movements such as the mesial tipping of the lower anchor teeth or buccal rolling of maxillary molars. As with other functional appliances, certain cases may require upper arch expansion, since a transverse discrepancy may be introduced when the mandible is advanced. It is usually best to carry out the expansion phase prior to addition of the telescopic arms. The possible requirement for expansion can be assessed by having the patient posture forward into an edge-to-edge bite and re-assessing the transverse relationships (Figure 6.1).

For maximal treatment effect, it has been proposed that the appliance should be constructed with an edge-to-edge incisal position.⁷ However, other researchers have suggested that step-wise advancement may result in a greater change in the skeletal base relationship.^{8,9} Step-wise advancement with the use of pre-formed spacers of known dimensions incrementally advances the mandible during treatment. In a retrospective comparison of step-wise and maximal advancement, a larger improvement in the sagittal jaw base relationship of 2.9 mm was recorded using step-wise advancement.⁸ However, there were important differences between the groups, with, for example, step-wise advancement was used with a Herbst in combination with headgear for 12 months, compared with a standard Herbst appliance used for 10 months with maximal advancement. A large component of the recorded difference was due to a 1–1.5 mm distalizing/'headgear' effect on the maxilla, which may also relate to the additional 2 months of treatment allied to the use of headgear. Another study concluded that the amount of skeletal change was higher with step-wise advancement of the Herbst.¹⁰ However, again this study was retrospective and involved comparison of step-wise advancement in adult Chinese subjects over 12 months, versus mandibular advancement to an incisal edge-to-edge position in German adult subjects over a shorter period (7–9 months). Outcomes may have been confounded by differences in centres, ethnic groups and treatment times. In contrast, a higher