Extrusion-based leveling with segmented arch mechanics

Leveling of the dental arch may be accomplished through anterior intrusion, posterior extrusion, or a combination. Posterior extrusion is usually preferred in vertically balanced adolescents and in surgical-orthodontic treatment of adults suffering from deep bite and mandibular deficiency. A major disadvantage of posterior extrusion, when accomplished by continuous archwires, is incisor flaring. Here a segmented arch arrangement is proposed for posterior extrusion that combines the clinical simplicity of continuous mechanics with better control of incisor position. (Int J Adult Orthod Orthognath Surg 2002;17;47–49)

Leveling of the curve of Spee is one of the important aspects of comprehensive orthodontic treatment. It is usually accomplished by anterior intrusion or posterior extrusion. Each method has advantages and disadvantages. Segmented arch mechanics is an efficient way to achieve anterior intrusion. With this approach, forces and moments can be accurately adjusted to prevent incisor flaring or downward and backward mandibular rotation. Therefore, in an adult patient with less vertical growth potential, anterior intrusion—within the physiologic limits—seems the likely choice to level the dental arch because any posterior extrusion in such a patient is prone to relapse. But anterior intrusion has its own disadvantages. Compared with posterior extrusion, it is more complex mechanically and needs more chair time. From a periodontal perspective, it is more hazardous than posterior extrusion. Anterior intrusion may cause apical root resorption, the amount of which is greater than the whole root resorption that has been reported in comprehensive orthodontic treatment. Therefore, in an adolescent patient with a horizontal or normal vertical growth pattern, posterior extrusion may be a better choice. In surgical-orthodontic treatment of a deep bite mandibular deficient adult, it is also preferred to level the dental arch by posterior extrusion. Since posterior extrusion is usually accomplished with continuous archwires, which may cause incisor flaring, it is suggested to leave some space in the dental arch in presurgical orthodontics to compensate for this side effect in postsurgical leveling.

Cervical headgear, anterior bite plate, intermaxillary elastics, and a continuous archwire (into which a curve may be incorporated) all can cause posterior extrusion. The continuous archwire does not need patient cooperation and does not have any unwanted effects on the opposing arch. However, its main disadvantage is the flaring of incisors. It is widely accepted that leveling the dental arch, when there is an excessive curve of Spee, increases arch length requirements and results in incisor protrusion. It has been suggested that 1 mm of space is needed to level each 1 mm of the curve of Spee. Dale proposed the addition of 0.5 mm to the mean depth of the curve of Spee in the left and right sides of the mandible to determine the needed
but according to calculations of Erskine, Germance et al., and Kirschen et al., they may be overestimations.

When a curve flattens, its length will be greater than its planar projection. This characteristic has been considered the cause of incisor protrusion when a continuous archwire levels the dental arch. But Woods and Braun et al. showed that this is not the major cause. Rather, the mechanics involved in a continuous archwire become the most important factor. Since the continuous archwire delivers the force to the incisors anterior to their center of resistance, they flare forward. Many techniques have been proposed to minimize the unwanted effects of leveling with continuous archwires. In the original Tweed technique, for instance, Class III elastics were used in conjunction with second-order molar tip-back bends to drive the mandibular arch posteriorly while leveling the curve of Spee. The Class III elastics were supported by high-pull facebows to prevent extrusion of the upper molars. But we can use segmented mechanics to level the arch by posterior extrusion without incisor flaring.

### Biomechanical considerations

Segmented arch mechanics have previously been used for anterior intrusion. It can also be used for posterior extrusion. This method is especially useful in those patients for whom posterior extrusion is preferred but incisor flaring is not desirable. In this method, there are 1 anterior and 2 posterior segments (Fig 1). During the leveling, the wires of the posterior segments slide over the anterior segment wire without increasing the incisor protrusion. Since the contacts of the anterior and posterior wires are distal to the lateral incisors (close to the center of resistance of the anterior segment), anterior flaring is eliminated or diminished. The force is not very light because of the small interbracket spans; thus, posterior extrusion dominates anterior intrusion. The ends of the wires can be bent to prevent tissue irritation. In this technique, the canine teeth can be incorporated to the anterior segment to increase the posterior extrusion/anterior intrusion ratio. One of the disadvantages of this method is that the extrusive force is not evenly distributed among the posterior teeth. The same problem also exists when a continuous archwire is used. To solve this problem, Braun et al. have suggested a more complex segmented arrangement.

In fact, the method described in our article is somewhere between pure continuous technique and pure segmented technique. It combines the clinical ease of continuous mechanics with the control of incisor position, though it is not as well defined as pure segmented mechanics in terms of forces and moments and is less elegant from an engineering perspective.

Proffit and Fields warn against the use of a rectangular archwire with an exaggerated curve of Spee, because the curve creates torque to move the incisor roots linguually. On the other hand, Ferguson believes that introducing a reverse curve in a rectangular archwire does not necessarily have any adverse effects on final mandibular incisor inclination. Anyway, both round and rectangular continuous archwires cause incisor protrusion when they level the curve of Spee and there is no difference between them in this regard. But in segmented mechanics, both round and rectangular wires (with or without a reverse or accentuated curve) can be used for posterior extrusion without worry because single-point contacts between the anterior and posterior wires prevent any adverse effects on incisor torque.

Clinically one can follow the following steps:

**Fig 1** Left intraoral view of segmented arch mechanics to level the mandibular dental arch by posterior extrusion.
1. Insert the ends of the continuous archwire into the molar tubes and tie the wire to the incisor brackets.
2. Cut the wire just mesial to the canine brackets.
3. Pull the posterior segments of the wire a bit forward over the anterior wire.
4. Tie the posterior wires to the brackets of the canines and premolars.
5. Bend the ends of the wires if they bother the patient.

**Conclusion**

Segmented arch mechanics can be used for both anterior intrusion and posterior extrusion to level the dental arch without causing incisor protrusion. The choice depends on the patient's orthodontic conditions. Leveling the dental arch does not necessarily increase arch length requirements. On the contrary, with sectional mechanics, about 3 mm to 4 mm of total arch length may be gained by leveling a deep curve of Spee through molar uprighting. Therefore, when clinicians want to treat more borderline cases without extractions, the use of segmented mechanics may allow the curve of Spee to be of less importance when deciding how much arch perimeter is actually required.

**References**