

Corticotomy-Assisted Orthodontics

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Corticotomy has been used in difficult adult cases as an alternative to conventional orthodontic treatment or orthognathic surgery.¹ Because the primary resistance to tooth movement is encountered in the cortical layer, corticotomy makes it possible to move teeth faster without undesirable side effects.^{2,3} As Suya described it, the tooth plays the role of a handle by which the bands of less dense medullary bone are moved block by block; thus, orthodontic tooth movement after corticotomy is a process of moving blocks of bone rather than moving only individual teeth.⁴

Corticotomy can be used in the treatment of ankylosed teeth, teeth surrounded by narrow cortical bone, significant arch-length discrepancies, and transversely constricted maxillae.⁴⁻⁸ It can also be combined with orthopedic therapy, as several authors have demonstrated.^{9,10} The present article shows how corticotomy procedures can promote efficient posterior intrusion and rapid anterior retraction with maximum anchorage.

Corticotomy-Assisted Posterior Intrusion

In cases with vertical problems and anterior open bite, there are many treatment approaches, depending on the severity of the problem: habit control, adenoidectomy, interarch vertical elastics, high-pull headgear, extraction of wedging teeth, MEAW archwires, orthognathic surgery, and others.¹¹⁻¹⁵ In mild-to-moderate adolescent cases, it is preferable to intrude the posterior teeth with high-pull headgear traction. Of course, in adult patients who have completed bone maturity, this approach will be ineffective, and a corticotomy-assisted technique should be considered.

Dental and Skeletal Evaluation

Occlusal equilibration should first be performed to decide whether corticotomy is indicated. The maxillary and mandibular casts are mounted on the articulator, and the posterior teeth on the maxillary cast are ground until a normal anterior overbite is achieved or the maxillary and mandibular canines are in contact. If there is only a vertical discrepancy, a treatment involving corticotomy and orthopedic traction can be planned to intrude the posterior segment. If the vertical discrepancy is accompanied by a dental or transverse discrepancy, however, corticotomy is contraindicated. Because posterior impaction can occur at the corticotomy site between the palatal bone and the root tip of a buccal tooth, this procedure should be avoided in cases with short posterior alveolar height.

Surgical Procedure

A full-size stainless steel stabilizing archwire segment is placed passively to stabilize the maxillary posterior segment.^{16,17} The corticotomy is carried out first on the palatal side and two weeks later on the buccal side. A horizontal bone cut is made at least 2mm above the apices of the teeth to be moved (Figs. 1 and 2). A connecting vertical bone cut begins 2-3mm above the interdental alveolar margin between the canine and first premolar and extends through the interdental bone to 2mm above the apices. The cant of this vertical bone cut should coincide with the desired direction of intrusion of the posterior segment. The horizontal cut is extended to the maxillary tuberosity, and the

pterygomaxillary junction is then separated with an osteotome or cut with a round bur. The depth of bone cut should be limited to cortical bone, as evidenced by bleeding in the osteotomy site.

Case 1

A 24-year-old female presented with the chief complaint of chewing problems. She had a tendency toward anterior open bite and a mild dolichofacial pattern with a retrusive mandible (Fig. 3, Table 1). Model analysis showed an anterior open bite, severe attrition of the posterior teeth, mild Class II canine and molar relationships, and mild crowding in both arches. The highest priority among the treatment objectives was vertical control of the maxillary posterior segment.

Corticotomies were performed as described above. It is critical to begin the orthodontic movement immediately after surgery, before bony healing occurs.¹⁷ High-pull headgear with a short outer bow was used to apply a force of 400- 450g per side through the center of resistance of the maxilla. The headgear was worn for about 12 hours per night for three months.

At this point, the maxillary and mandibular canines were in contact, the anterior overbite was within normal limits, and a Class I molar relationship was present (Fig. 4). Cephalometric analysis showed that a 2.5° counterclockwise rotation of the mandible and a positive anterior overbite were obtained, and that the perpendicular distance from the buccal cusp tip of the maxillary first molar to the palatal plane was reduced by 2mm (Table 1). After the removal of orthodontic appliances, 11 months later, the mandibular plane remained in the closed position (Fig. 5).

Corticotomy-Assisted Anterior Retraction

Patients with severe anterior protrusion need maximum retraction of the anterior teeth into the premolar extraction sites. Conventional methods of reinforcing posterior anchorage—such as extraoral force, stabilizing lingual arches, interarch elastics, "friction-free" sliding mechanics, tipping of the incisors before uprighting, and separate retraction of the canines¹⁸⁻²⁰—demand patient compliance and can be time-consuming and complicated. Corticotomy-assisted anterior retraction with maximum anchorage has the advantages of producing less undesirable tooth movements and requiring less patient cooperation.

Surgical Procedure

The corticotomy is performed first on the palatal side and two weeks later on the buccal side (Fig. 6). In the palatal surgery, cortical bone is removed across both premolar extraction sites, similar to anterior segmental surgery. The buccal corticotomy involves a vertical bony cut beginning at the extraction site and extending parallel to the long axis of the canine. A connecting horizontal bony cut is then made with a round bur at the level of a Le Fort I osteotomy (at least 5mm above the root apices). The depth of the bony cut should be limited to cortical bone, as identified by bleeding in the osteotomy site.

Orthodontic Procedure

Bodily movement of the anterior teeth is obtained by directing the retraction force through the center of resistance of the anterior segment (Fig. 7). Since any movement of the point of force application away from the center of resistance will result in excessive uprighting of the incisors, it is important to carefully monitor the axial inclination of the anterior teeth during retraction. One way to do this is to use a lingual appliance with extension arms ending in hooks at the estimated centers of resistance of

the anterior segment. This appliance consists of lingually bonded mesh bracket bases soldered to an .036" stainless steel wire with power-arm extensions (Fig. 8). It can be combined with a conventional labial appliance to provide the most effective retraction of the anterior teeth and to prevent bony bending.

Case 2

A 35-year-old-female presented with the chief complaint of lip protrusion (Fig. 9). She was diagnosed as a Class I bimaxillary protrusion (Table 2). The treatment plan was to remove four bicuspids and retract the anterior teeth as much as possible. Corticotomies were performed in both arches, followed immediately by space closure with a labiolingual appliance. The retraction force of 400-450g per side was delivered with nickel titanium closed-coil springs (Fig. 10).

Complete space closure took less than three and a half months with no complications (Fig. 11). The total treatment time was 10 months (Figs. 12A, 12B).

Conclusion

Corticotomy reduces cortical resistance to allow more rapid tooth movement, especially in non-growing patients. When combined with conventional orthodontic mechanics, it can avoid undesirable side effects without the need for orthognathic surgery, thus enhancing the stability of results and shortening treatment time.^{21,22} The cases shown in this article demonstrate that the combined use of orthopedic traction and corticotomy procedures can be effective for anterior retraction as well as posterior intrusion, as long as anchorage is reinforced with simple orthodontic devices. □

FIGURES

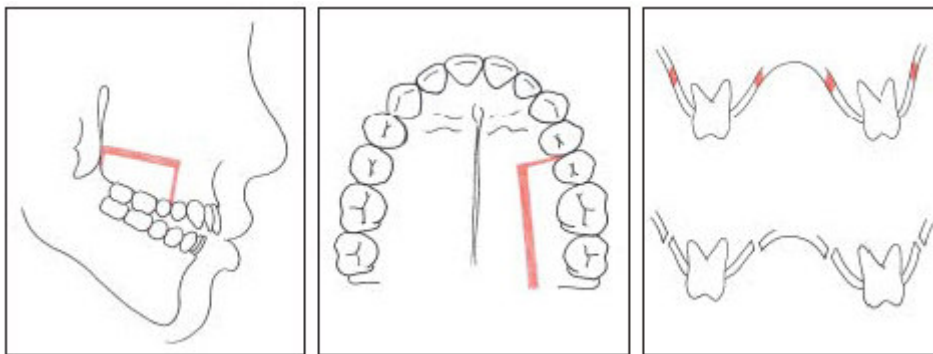


Fig. 1 Diagram of intrusion corticotomy.



Fig. 2 Surgical procedure for intrusion corticotomy.



TABLE 1
CASE 1:
CEPHALOMETRIC MEASUREMENTS

	Initial	After Intrusion	Final
<i>Skeletal</i>			
SN-PP (°)	9.9	9.9	9.9
FH-MP (°)	33.5	32.7	32.7
Y-axis (°)	66.5	65.8	65.8
ANS-Xi-Pm (°)	51.6	49.8	49.8
ANB (°)	6.4	5.6	5.6
<i>Dental</i>			
PP- \bar{E} (mm)	52.0	50.0	50.0
FMIA (°)	55.8	56.6	56.5
Overbite (mm)	-2.2	0	2.0
Overjet (mm)	5.9	4.4	4.0



Fig. 3 24-year-old female with anterior open bite before treatment.



Fig. 4 Case 1. After three months of orthopedic traction following intrusion corticotomies.

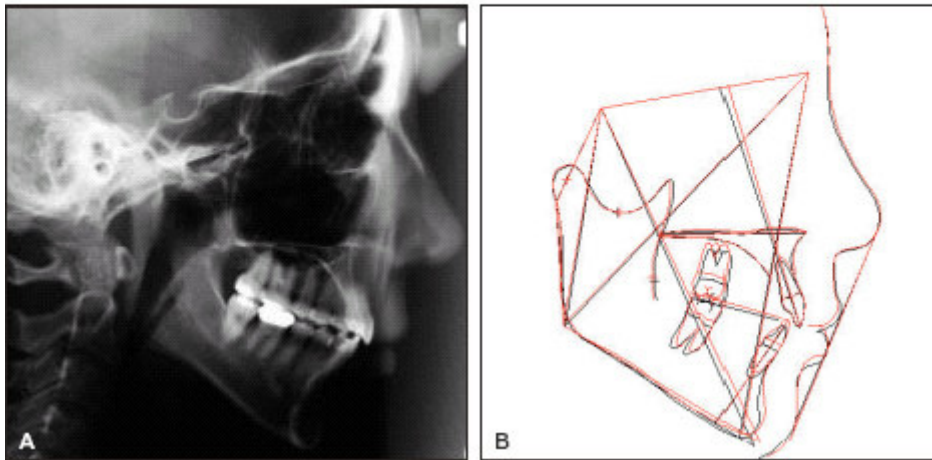


Fig. 5 Case 1. A. Patient after 14 months of treatment. B. Superimposition of cephalometric tracings before and after treatment.

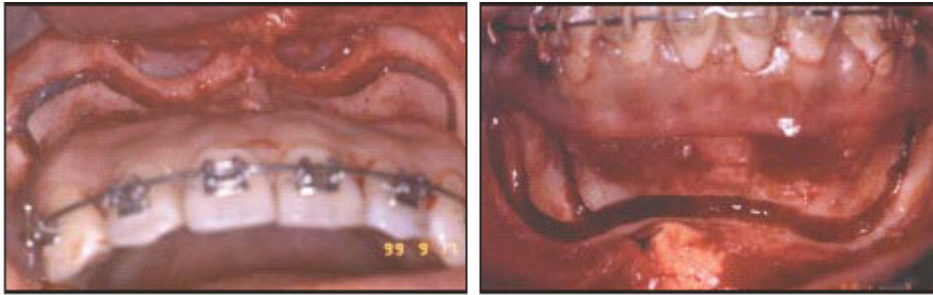


Fig. 6 Surgical procedure for retraction corticotomy.

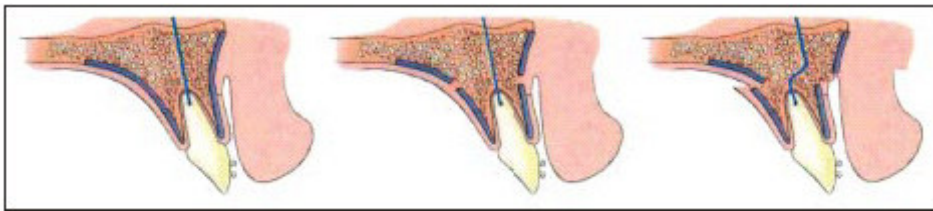


Fig. 7 Sequence of anterior retraction after corticotomy.

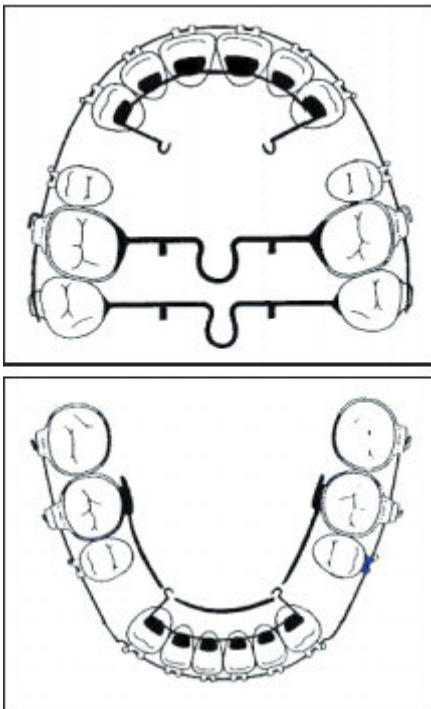


Fig. 8 Labiolingual orthodontic appliance for space closure.



Fig. 9 Case 2. 35 year-old-female with Class I bimaxillary protrusion.



Fig. 10 Case 2. Labiolingual appliance used for space closure after corticotomies and removal of four bicuspids.

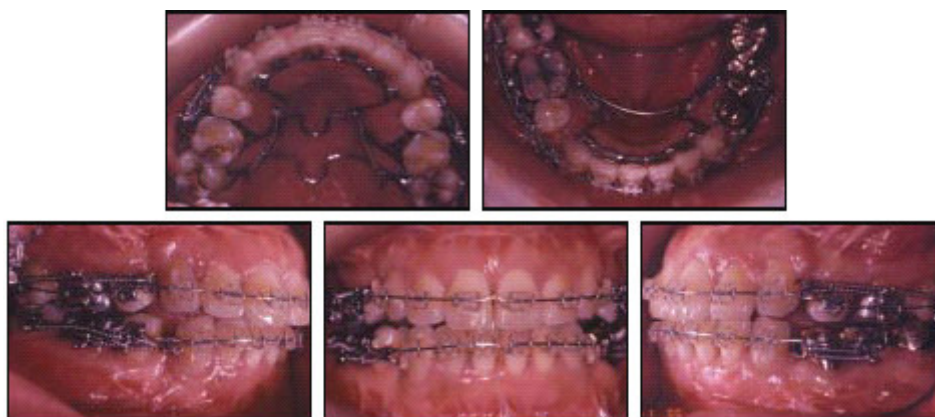


Fig. 11 Case 2. After three and a half months of space closure.



Fig. 12A Case 2. A. Patient after 10 months of treatment.

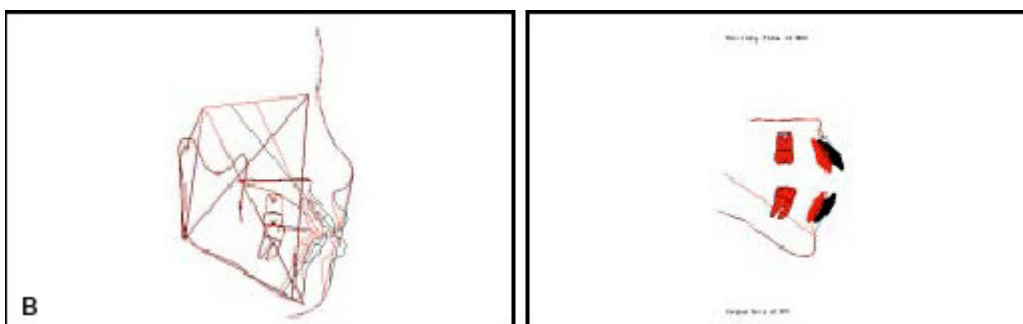


Fig. 12B Case 2. B. Superimposition of cephalometric tracings before (black) and after (red) treatment.

TABLES

**TABLE 1
CASE 1:
CEPHALOMETRIC MEASUREMENTS**

	Initial	After Intrusion	Final
<i>Skeletal</i>			
SN-PP (°)	9.9	9.9	9.9
FH-MP (°)	33.5	32.7	32.7
Y-axis (°)	66.5	65.8	65.8
ANS-Xi-Pm (°)	51.6	49.8	49.8
ANB (°)	6.4	5.6	5.6
<i>Dental</i>			
PP- $\bar{6}$ (mm)	52.0	50.0	50.0
FMIA (°)	55.8	56.6	56.5
Overbite (mm)	-2.2	0	2.0
Overjet (mm)	5.9	4.4	4.0

Table. 1

TABLE 2
CASE 2:
CEPHALOMETRIC MEASUREMENTS

	Initial	Final	Norm
SN-MP (°)	35.4	35.8	32.0
SN-PP (°)	6.5	6.5	7.3
SNA (°)	86.2	84.1	82.0
SNB (°)	84.1	81.0	80.0
ANB (°)	2.1	2.6	2.0
Facial angle (°)	88.9	88.5	83.7
∠-FH (°)	129.0	115.0	111.0
∠-APo (mm)	13.6	7.6	3.5
IMPA (°)	96.2	89.9	90.0
∠-APo (mm)	8.6	3.5	1.0
Interincisal angle (°)	106.2	125.7	130.0
Lower lip-E plane (mm)	3.9	0.2	-2.0
Overbite (mm)	0.2	2.9	2.3
Overjet (mm)	5.0	3.9	3.2

Table. 2

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FOOTNOTES

1 Nickel titanium closed-coil springs: Ormco/"A" Company, 1717 W. Collins Ave., Orange, CA 92867.