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C-activator treatment for distalization of maxillary molars in Class II anterior deep bite malocclusion

Seong-Hun Kim[1], Kyu-Rhim Chung[2], Yoon-Ah Kook[3]

A modified removable appliance for molar distalization called C-activator was used in a 10-year old male patient with a Class II anterior deep bite malocclusion with upper arch discrepancy. The treatment plan involved correcting the Class II relationship, distalizing both upper first molars, and regaining space for the erupting canines. The C-activator, which was used for 6 months, consisted of a labial framework formed from .036-in stainless steel wire and an acrylic monobloc. Both the closed helices of the labial framework were compressed for reactivation during the C-activator treatment period. C-activator mechanics simultaneously achieved distalization of the upper first molars into their proper positions and repositioning of the mandible. After 21 months of treatment, the correct overbite and overjet was obtained and contributed to an improvement in facial balance. The treatment results were stable 6 months after debonding. Fabrication and placement of the new appliance and clinical procedures are detailed, and the treatment sequence and results of this case are presented as follows.

Key words : C-activator; Cervical pull headgear; Molar distalization, Impacted canine.

Numerous treatment protocols have been advocated for the management of Class II malocclusion.[1-6] One of these methods uses activators to normalize the occlusion and improve the patient's facial profile by modifying mandibular growth during the active growth period.[6] This approach is relevant because the study of Ruf et al demonstrated that effective condylar growth can be increased and the chin position changed by activator treatment.[7]

Molar distalization is needed for the normal eruption of upper canines in Class II cases which show arch-length discrepancy. Although various intra-oral molar distalization techniques have been introduced, they have several drawbacks as suitable appliances for mixed dentition (by causing molar tipping during distalization, applying an equal and opposite mesial force to anchor teeth, flaring the incisors labially, and increasing overjet).[8-10]

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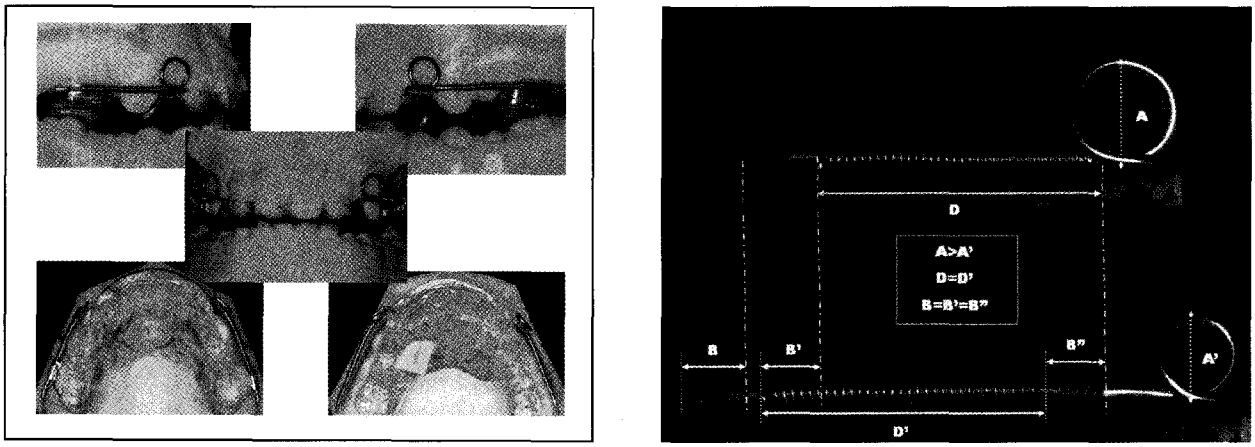

Fig. 1. Class II C-activator
(A) Labial framework with a closed helix and an acrylic monobloc
(B) compression of the closed helix for reactivation of C-activator

Chung et al[11,12] recently developed the C-space regainer, an alternative method for distal movement of the buccal teeth. C-activator mechanics uses a combination of a C-space regainer and an activator to achieve bodily molar movement without significant incisor flaring and repositioning the mandible in the growing subject.

The authors will describe a new treatment approach for a Class II anterior deep bite malocclusion case: C-activator-controlled distalization mechanics.

Fabrication and placement of the C-activator

The C-activator has two major components (Fig. 1); a labial framework, formed from 0.036 inch stainless steel wire, and an acrylic monobloc.

The labial framework consists of a closed helix part and a soldered open-coil spring. The closed helix is bent into the labial framework in each canine region. The helix should be as wide in diameter as comfort will allow. The labial framework is extended distally to lie as close to the buccal molar tubes as possible. The distal ends of the framework should be polished down to allow easy insertion into the headgear tubes. A 0.010 X 0.040 inch stainless steel open-coil spring (Ormco Sybron Dental Specialties, Orange, Calif) is soldered immediately distal to the helix, and .028-in ball clasps are used to retain the appliance. The open-coil spring should be 130% of the length between the solder point and the mesial edge of the headgear tube. When compressed, it exerts 200g of force and moves the molars distally about 1-1.5mm per month.[13] Only squeezing the closed helix with a three-prong plier can reactivate the C-activator. The helix moves the labial wire extension and the coil spring distally, and regains the initial compressive force when the labial wire is reinserted in the headgear tube. Asymmetric distalizing of the molars is possible by eccentric squeezing of the helicies. The change in the vertical position of the molar is possible by adjusting the labial framework occlusally or gingivally.

CASE REPORT

Pretreatment evaluation

An 8-year-old male presented the chief complaint of lip protrusion and deep bite.

There was no history of dental trauma or oral habits and temporomandibular joint function was normal. He

Table 1. Cephalometric survey

	Average(Male)	Pretreatment	FRII+CPHG	C-actovator	Posttreatment	6m Retention
SNA()	82	74	73	74	73	74
SNB()	80	71	71.5	72	72.5	73
ANB()	2	3	1.5	2	0.5	1
PFH/AFH(%)	95/136(70%)	62/108(57%)	68/119(57%)	70/122(57%)	71/123(59%)	73/120(59%)
SN-OP()	15	27	25.5	26	26.5	27
FH-UI()	116	120	118	119	120	120
FMA()	22	28.5	31	31	30	29
IMPA()	97	92	90	90	93	93
FMIA()	61	59.5	59	59	57	58
UL-E plane(mm)	-0.7	3	0.5	3	2	3
LL-E plane(mm)	0.5	2.5	0	1.5	2	2
Interincisal angle()	124	119	122	120	117	119
Mx 1 to NA(mm)	8	8	9	8.5	8.5	9
Mx 1 to NA()	26	32	31	31	32	32
Mn 1 To NB(()	27	26	27	28	28.5	28.5

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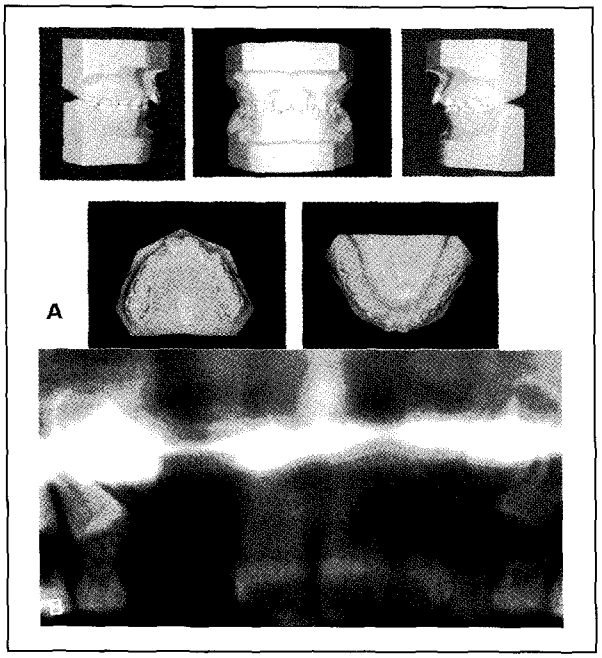

Fig. 2. (A) Pretreatment study models
(B) erupted canine position in the panoramic radiograph.

had been diagnosed a Class II Division 1 malocclusion with 4mm overjet and 50% palatally impinging overbite (Fig. 2, 11A, and Table 1).

The primary skeletal objectives of treatment were to achieve differential mandibular growth and reduce the ANB angle, and correct the overbite with a Fränkel regulator II and cervical pull headgear (CPHG). He had worn a Fränkel regulator II for 1 year and 6 months and cervical pull headgear for 1 year. However, poor coope-ration with the headgear treatment and insufficient eruption space for the upper canines made us reevaluate the progress achieved and change the treatment plan.

At 10 years of age, the extraoral, intraoral and study model examination showed a Class II malocclusion with an anterior deep overbite and a large overjet despite the previous treatment (Fig. 3 and 4).

There was moderate arch length discrepancy in the maxillary arch and minimal crowding in the mandibular

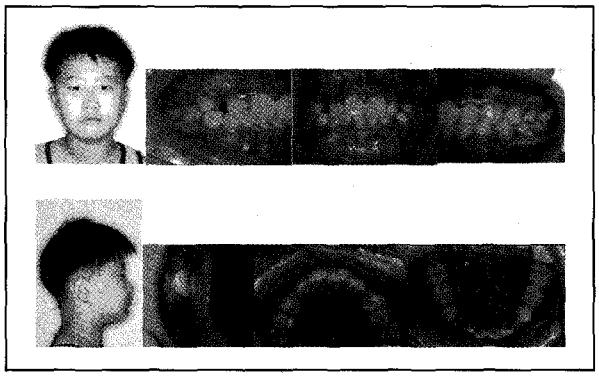

Fig. 3. After Fränkel function regulator II and cervical pull headgear therapy extra and intra oral photographs.

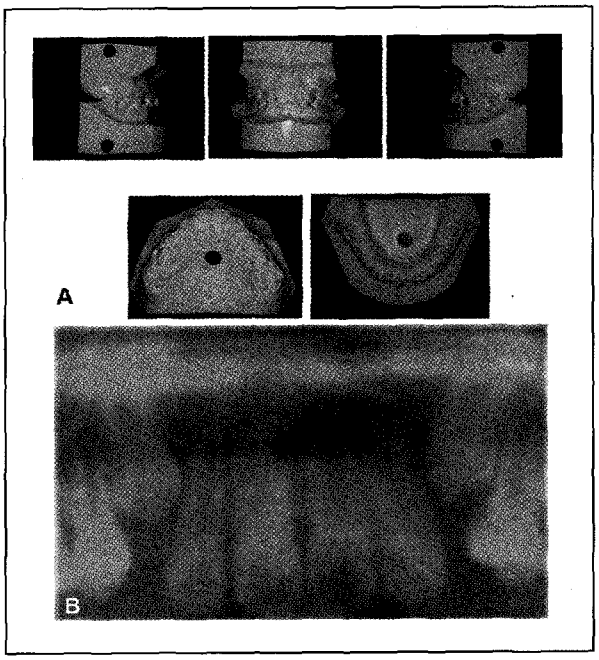

Fig. 4. Study models taken after Fränkel function regulator II and cervical pull headgear therapy.

arch. There was no occlusal centric relationship discre-pancy upon closure. Skeletal and dental characteristics included protruded upper incisors, and slightly procumbent lower incisors. His dental midlines were coincident with the facial midline and a Bolton analysis showed normal anterior proportional relationships.

The radiographic examination revealed that the patient showed an improvement of profile in spite of the limited patient cooperation; with an ANB angle of 1.5 (3 pretreatment) (Fig. 11B and Table 1). The lips were competent in repose (Upper Lip to E-plane 3mm→0.5 mm, Lower Lip to E-plane 2mm→0mm). However, the panoramic radiograph and sequential periapical films illustrate the potential impaction of the upper canines. Both of the upper lateral incisors had migrated mesially and their root areas were very close to the crown of the canines.

Treatment plan

The improvement of skeletal growth and the patient's cooperation were the main issues in deciding on the appropriate treatment. However, the patient did not want any more headgear treatment. In this period, the treatment objectives were to achieve continuous differential mandibular growth, reduce the skeletal overbite tendency, improve the occlusal interdigitation, and achieve a normal Class I occlusion with normal overbite and overjet. In the maxillary dentition, the treatment planning included eliminating arch length deficiency, making room for normal canine eruption, and achieving normal axial inclination of the incisors without any root resorption. It was also important to minimize the protrusion of the incisors relative to the distal movement of the first molars. The mandibular dentition required using leeway space to achieve normal alignment while maintaining arch form and intercanine width. Therefore, the treatment strategy was to use the C-activator for correcting the Class II relationship, distalizing the upper first molars, and regaining space for the erupting canines.

Treatment progress

After registration of the construction bite, the C-activator was fabricated and delivered to the patient (Fig. 5A). The patient was instructed to wear the appliance 18 hours a day. The upper resin part was

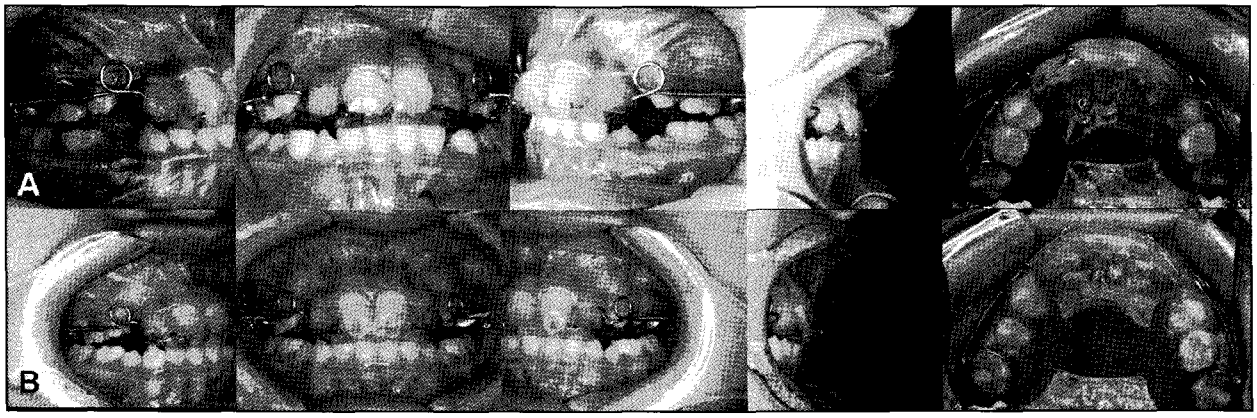

Fig. 5. Intra oral progress photographs after C-activator delivery (A) and during C-activator treatment (B).

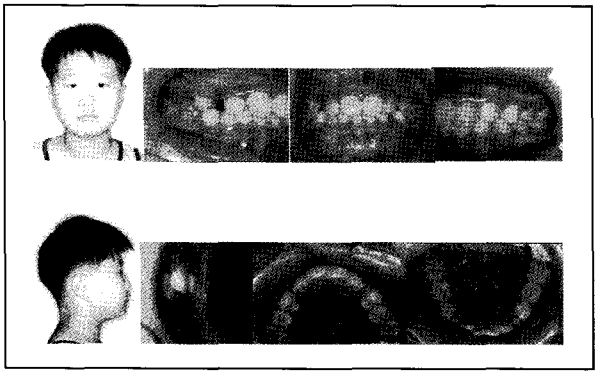

Fig. 6. Extra and intra oral progress photographs after C-activator treatment.

relined when the C-activator was loosened. During C-activator treatment, the distal movement of the upper first molars and drifted upper premolars was observed (Fig. 5B).

After 6 months of C-activator treatment, canine eruption space was sufficiently regained and the lateral incisors were not affected by the erupted canines. At the cessation of C-activator therapy, routine orthodontic mechanics were performed to complete treatment. Extraoral, intraoral, and study model photographs are shown in Fig. 6 and 7.

Fixed orthodontic treatment was initiated with the leveling and intrusion of the lower anterior dentition, and the anterior bite plate was placed on the upper dentition

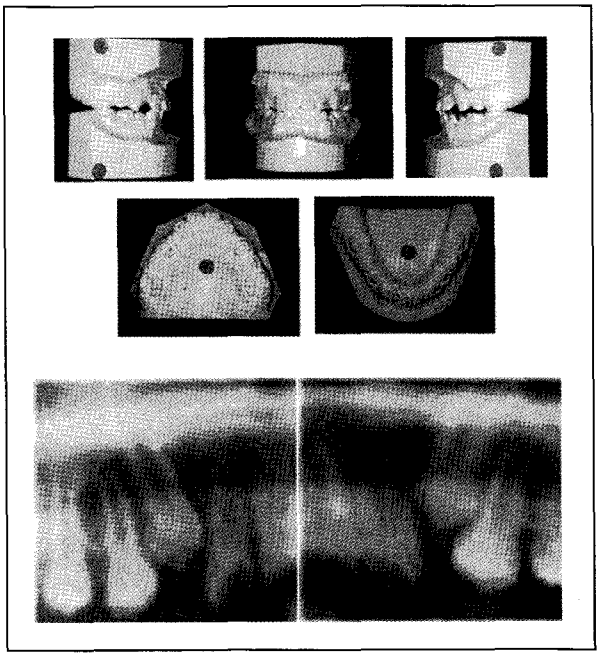

Fig. 7. (A) Study models after C-activator treatment; (B) panoramic radiograph of the erupted canine position.

to allow distal movement of the upper first molars (Fig. 8A). After 2 months of leveling the lower dentition, brackets were placed on all the upper teeth except the erupting canines, followed by the buccally-segmented placement of a 0.022X0.028 inch preadjusted arch wire appliance. The permanent first molars were banded and a Nance button was soldered to the lingual aspects of both

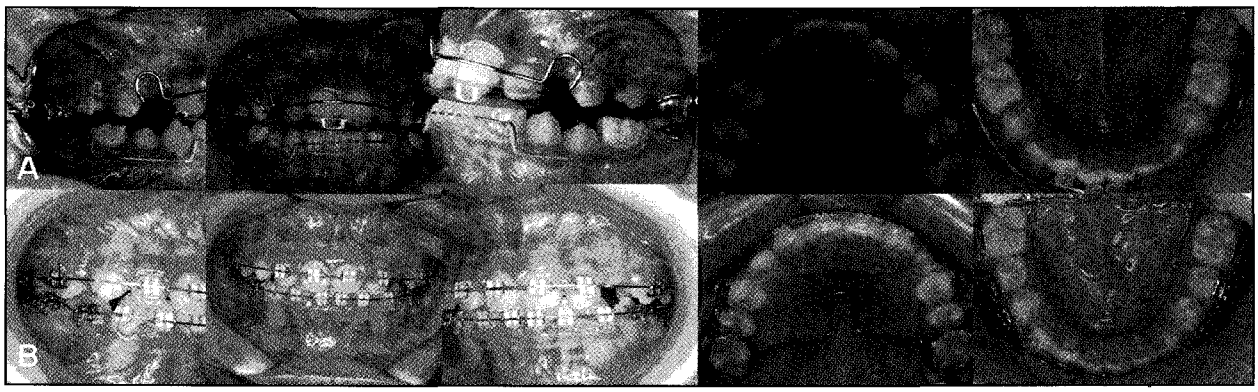

Fig. 8. Progress study models: (A) during lower dentition leveling; (B) during conventional fixed appliance treatment.

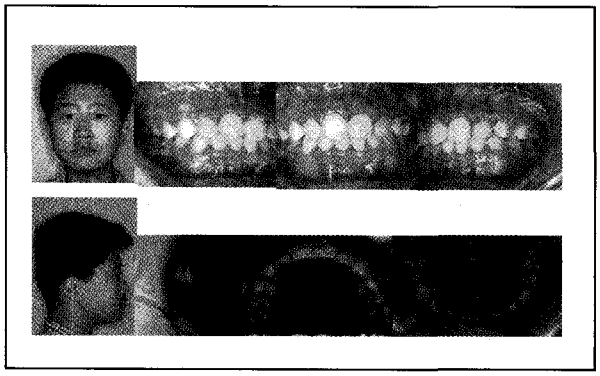

Fig. 9. Posttreatment extra and intra oral photographs.

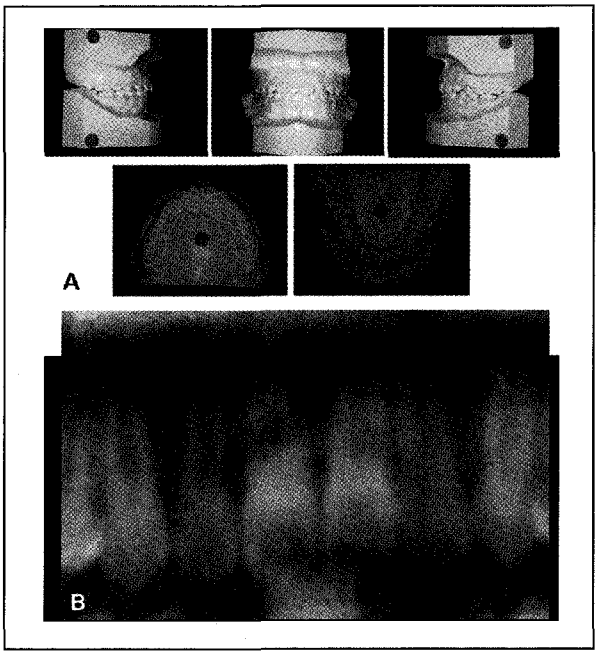

Fig. 10. Posttreatment study models (A) and panoramic radiographs (B).

upper molar bands. After 12 months of leveling (Fig. 8B), the fixed appliances were all removed and a tooth positioner for finishing was used for a month. The retention was provided by upper and lower Hawley retainers.

Treatment results and discussion

We compared the treatment results between the pre-C-activator period (after the patient had used a Fränkel regulator II and CPHG), post-C-activator period, and posttreatment. After 6 months of C-activator treatment, the maxillary arch length deficiency was eliminated due to both a 3.5mm distal movement of the maxillary molars and a 2mm increase in intermolar width. The sequential panoramic radiographs show that the upper lateral incisors were not damaged by the erupted canines, and the upper premolars had moved distally. Cephalometric analysis did not reveal the rotation of the mandible during distalization of the maxillary first molars (Fig. 11C, 12, and Table 1). FMA was not changed (31°). The backup of mandibular growth might prevent a change of the mandibular plane although the occlusal

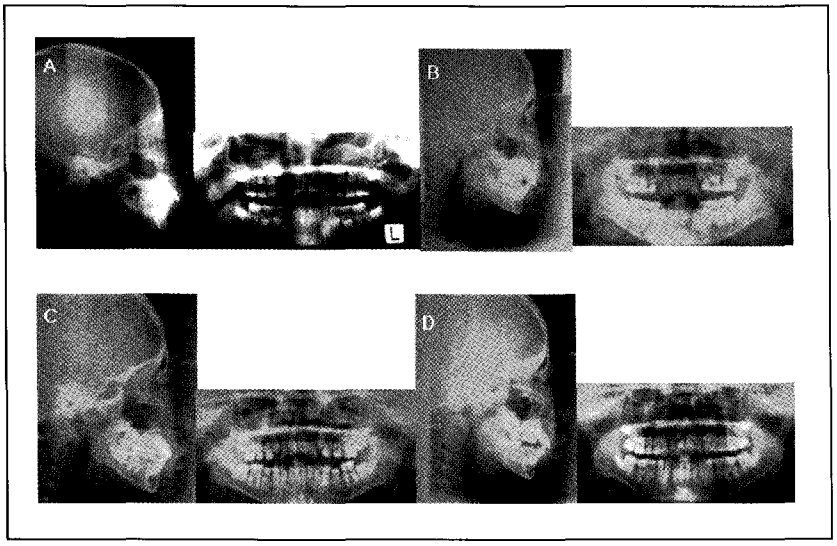

Fig. 11. Cephalometric and panoramic radiographs: (A) Pretreatment; (B) after Fränkel appliance and cervical pull headgear therapy; (C) after C-activator treatment; (D) posttreatment.

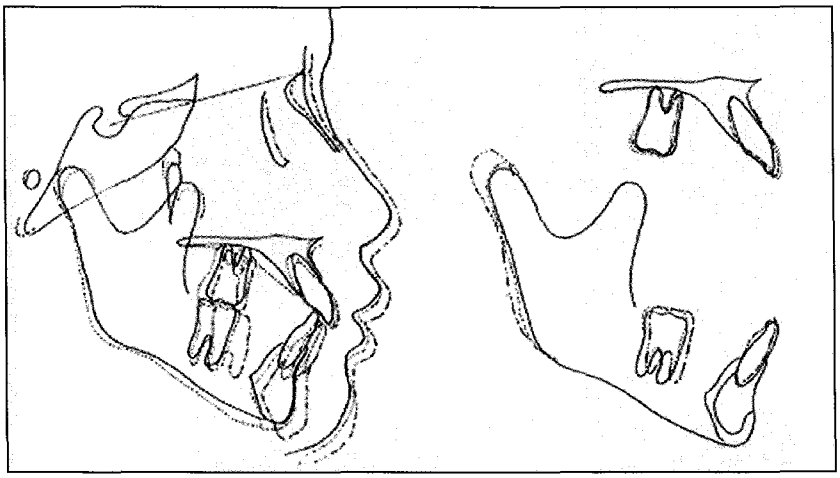

Fig. 12. Superimpositions of lateral cephalograms; After Fränkel function regulator II and cervical pull headgear therapy (solid line), after C-activator treatment (dotted line), and posttreatment (double dotted line).

plane angle slightly increased (SN to OP angle25.5°→ 26°). The distal extension of the C-activator can be also assumed to have produced bodily movement in the upper molars, which minimized any steepening of the mandibular plane.

After fixed orthodontic treatment, the Class I canine and molar relationship with a midline coincidence, correct tooth position, proper alignment, and facial balance were obtained even though a slightly large overjet and overbite remained (Fig. 9, 10). The posttreatment facial photographs showed an improvement of facial esthetics because the well-aligned canines exhibited appreciable facial change. The incisors were not procumbent.

Cephalometric analysis showed favorable growth of the retrognathic mandible as well as an increase of the posterior/anterior facial height ratio (pre-C-activator treatment 57%→ posttreatment 59%) (Fig. 11D, 12, and Table 1).

The occlusal plane changed a little after fixed orthodontic treatment due to the lower anterior teeth intrusion and posterior teeth extrusion (SN to OP angle 26°→26.5°). The upper and lower incisors were slightly protruded from the pre-C-activator period to

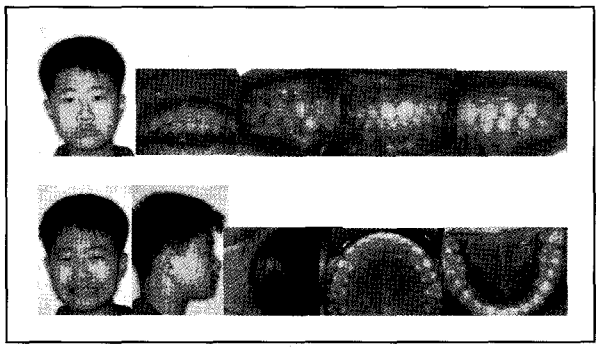

Fig. 13. 6 months postretention extra and intra oral photographs.

posttreatment (FH-U1 angle 118°→120°, Maxillary incisor to NA angle 31°→32°, IMPA 90°→93°, FMIA 59°→57°, Mandibular incisor to NB distance 5.5mm→6mm, Mandibular incisor to NB angle 27°→28.5°). The interincisal angle was decreased 122°→116° and the ANB changed slightly during treatment (SNA 73°→73°, SNB 71.5°→72.5°). The treatment result was acceptable and the patient was pleased with the final treatment result despite the slightly protruded upper and lower lips. Though lip protrusion remained, treatment results were maintained for 6 months of postretention (Fig. 13).

Impacted canines might lead to untoward effects such as migration of the neighboring teeth and loss of arch length, dentigerous cyst formation, external and internal root resorption, infection, and referred pain.[14] Especially, the risk of external root resorption of the permanent lateral incisors is an important indication for orthodontically erupting impacted maxillary canines.[15] However, the patient in this case had mixed dentition, and the upper canines showed continuous eruption. Therefore, we decided to modify the jaw growth and regain the erupting canine spaces simultaneously by using the C-activator. The bonding and engaging of the archwire to the maxillary lateral incisors was delayed considerably to avoid root interference with the erupting canines.[16] Even though the molars were moved distally during C-activator treatment, facial growth continued throughout treatment as the maxilla carries the molars mesially. Bowman suggested that these final molar positions were expected to arise from a typical pattern of facial growth and not due to molar anchorage loss.[17] If patients are followed long enough, the maxillary molars should be significantly more mesial than their pretreatment position.

However, the upper anterior incisors were protruded slightly after C-activator treatment (FH-UI angle 118° → 119°). The rugae area and palatal vault of this patient were too shallow to provide a suitable anchorage. And the resin parts of the upper lateral incisors were ground to enable loose contact and to avoid damaging the roots of the lateral incisors during distalization of the molars. Therefore, the reactive force might have been the reason the upper incisors flared. We had planned to J- hook headgear traction, and if anterior protrusion is to be avoided, then 0.028 inch ball clasps should be added between the lateral incisors and canines to serve as hooks for Class II elastics or J-hook head gear traction. However, the patient in this case requested only intraoral appliances.

CONCLUSION

C-activator mechanics seem to be an effective tool for distalizing the first molars and repositioning the mandible in a growing subject with Class II deep-bite malocclusion.

In this report, the fabrication and placement of the new appliance and clinical procedure were detailed. The treatment sequence and results of C-activator mechanics were described. Further research and studies are required to evaluate the long-term treatment effects of the C-activator.

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국문초록

C-activator를 이용한 성장기 II급 부정교합환자의 구치부 원심이동 치험례

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혼합 치열기의 교정치료 증례 중에서 경도의 총생을 가진 경우 상악 대구치를 원심 이동함으로서 양호한 치료의 결과를 얻는 경우가 많다. 주로 악외 견인장치를 적용하여 원심이동을 시행하지만 환자의 협조도에 따라 구치의 원심이동이 결정되는 단점을 가지고 있다. 구강내 고정원 사용시 생길 수 있는 반작용을 최소화하기 위해 정에 의해 개발된 C-space regainer는 후방이동 시키고자 하는 치아를 제외한 거의 모든 치아들을 완벽하게 묶음으로서 효과적인 후방이동을 가능케 하는 장치이다.

후속영구치의 맹출 공간 부족으로 매복 치에 의한 인접치의 치근손상이 예상되는 성장기 II급 부정교합 환자에서 악기능 교정장치에 c-space regainer의 개념을 적용한 변형된 C-space regainer, 즉 C-activator가 사용되어 양호한 치료결과를 얻었기에 이에 보고하는 바이다.

주요 단어 : 구치원심이동, 악기능교정장치, 매복견치