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CLINICAL CASES OF NON-SURGICAL PALATAL EXPANSION ON ADULT PATIENTS

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It is generally agreed that the maxillary arch must be wider than the mandibular arch in a normal, stable occlusion. Thus, orthodontic correction to produce a stable, functional and TMJ-biocompatible occlusion sometimes involves true maxillary palatal expansion[2]. For the treatment of relatively narrow maxilla, there are generally two treatment methods. One is to expand the dentition and the other is to expand the maxillary bone itself. In the expansion of narrow maxilla, it is best to minimize the dental effects while maximizing the skeletal effects. In the treatment method which mainly rely on the tooth movement, occlusal interferences due to tipping, periodontal breakdowns and limited range of movement which results in insufficient amount of space gains are among the limitations of that particular type of treatment. Therefore, in growing children, rapid palatal expansion(RPE) which separates the midpalatal suture thereby attaining the expansion of the basal bone is widely used. In adults, it is difficult to separate the midpalatal suture, and if the constriction is mild, a compromising approach through tipping of the teeth may be used. In severe constriction cases, a surgical expansion through corticotomy may be used, although the surgical intervention may result in psychological and financial burdens for the patient.

Recently, successful non-surgical treatment results using RPE alone on adults below 25 years of age have been reported. This study presents review of the literatures and several clinical cases where the palatal expansion treatment without surgery was successfully applied to adult patients.

LITERATURE REVIEW

Like extraoral force to the maxilla, the method of maxillary expansion was known in the late 1800s[1], but was abandoned as unnecessary and potentially damaging. After demonstration of its potential in experimental animals, the method was reintroduced by Haas in the United States in the early 1960s[8], and has been widely used ever since. Biederman[3] expanded on Haas' ideas, using a tooth borne appliance for maxillary expansion in conjunction with the correction of Class III problems. Wertz[28] and Timms[27] reported the advantage of RPE in improving nasal air flow in patients with stenosis of the nasal airway.

The expansion of the suture can be done in two ways : rapid expansion, the original method ; and slow expansion, the method advocated more recently [23]. In the application of RPE, jack screw across the palate is opened at the rate of 0.5mm/day, a commonly recommended rate, and 10mm of expansion will be produced in 20 days. At that point, 75% to 80% of the total expansion will be skeletal change due to opening of the suture, whereas only 20% to 25% will be tooth movements[16]. When the suture is opened rapidly, histologic studies in animals have shown that the tissues are torn apart, with cell death and hemorrhage into the tissue space[25]. Microfractures and other evidences of disruption of the suture could be seen in humans[19]. Isaacson and Ingram[13], and Zimring and Isaacson[30] have suggested that slower rates of expansion would allow for a physiologic adjustment at the maxillary articulations and would prevent the accumulation of large residual loads within the maxillary complex. Storey[25] and Hicks[11] reported that slow expansion might be more

physiologic compared to rapid expansion. Recent histologic studies suggest that expansion at the rate of 1mm/week, which is slower than RPE, should be possible without tissue damage. Expansion at this slower rate may produce about equal dental and skeletal changes[5]. With expansion at this rate, the skeletal and dental effect at the completion of active expansion is approximately analogous to RPE 2 to 3 months after expansion is completed.

The age of the patient appears to be a factor in a successful separation of the suture. Non-surgical rapid palatal expansion has been, for the most part, limited to growing patients. Generally, it has been believed that females 16 or older and males 19 or older with maxillary width deficiency require either a surgical palatal expansion or must be compromised with buccal or labial flaring.

On the basis of morphology, the development of the median suture could be divided into three stages. In infantile stage, the suture is short, broad, and Y shaped ; in juvenile stage the course is more sinuous, and in the adolescent stage the interdigitation is so heavy that a separation of the two halves of the maxilla would not be possible without fracturing the interdigitated processes(Fig 1)[20]. By then, a jack screw is increasingly likely to produce pain and, if the patient can tolerate that, only tooth movement without sutural separation can be attempted. The problem is not an absolute fusion of the sutures but an increasing interdigitation at both the midpalatal and lateral maxillary sutures that causes higher and higher resistance to lateral expansion of the bony shelves. Epker and Fish[6] reported that in patients over the age of 16 years, attempted orthopedic rapid maxillary expansion was frequently associated with significant difficulties, and this was usually the result of fusion of the various craniofacial sutures, which resulted in a lack of suture opening on expansion. Tipping of the teeth, bending of the alveolar bone, and movement of the teeth through the buccal cortical plates were common consequences of orthopedic rapid maxillary expansion in adults. Krebs[17] showed that in children in the 8 to 12 years age group, the net result following expansion was approximately a half and half combination of dental and skeletal expansion ; in the 12 to 18 years age range, the expansion was about two-thirds dental, one-third skeletal. Wertz[29] stated that

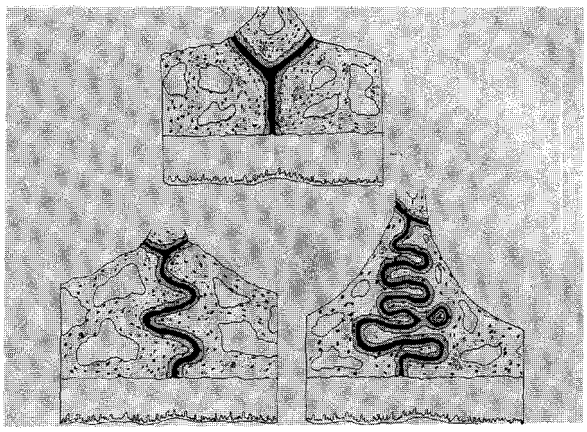


Fig 1. The midpalatal suture becomes increasingly tortuous and interdigitated with increasing age : infancy, juvenile, adolescence

rapid maxillary expansion was definitely accomplished but, with advancing maturity, rigidity of the skeletal components limited the degree of orthopedic correction in older patients.

According to Timms[26], rapid palatal expansion faces a poor prognosis in adults when the midpalatal suture is ossified. However, there have been conflicting reports concerning the degree of ossification in the suture according to the age of the patient. Hansman[9] reported that, judging from roentgenograms, sutures in a few cases started to close as early as 6 years of age. Björk had previously pointed out that growth activity in the midpalatal suture continued for a considerably longer period than formerly believed, and his data consequently demonstrated a range in boys between 14 and 20 years of age as regards the end of the growth of sutures[4]. Melsen[20] stated that the transverse growth of the midpalatal suture continued up to the age of 16 in girls and 18 in boys. Persson and Thilander[22] stated that palatal sutures might show obliteration during the juvenile period, but a marked degree of closure was rarely found until the third decade of life. There was a great activity in the sutural closure of the palate between 20 and 25 years of age. In four of seven specimens from persons younger than 20 years of age, synostosis could not be found ; nor could it be found in two of the remaining seventeen specimens from persons up to 35 years of age. The oldest person without any observed union of the suture margins was a 27-year-old woman. It was logical to presume that skeletal age

also influenced the start of closure, thus partly explaining the interindividual variation observed[4].

Initially, the midpalatal suture was identified as a significant area of osseous resistance to palatal expansion in patients beyond their late teens[20,22]. More recently, important contributions to the problem of palatal expansion have indicated that the zygomaticomaxillary buttress and the pterygomaxillary junction are critical areas of resistance to palatal expansion[7,18]. According to Sicher[24], the circummaxillary sutures remain open at least up to the middle of adult life. Herring[10] and Kokich[15] assumed that the age at which synostosis occurred in a suture was directly determined by extrinsic functional demands affecting the specific suture area. Kokich, employing histologic methods on autopsy material, found that the frontozygomatic suture did not undergo synostosis until the eighth decade of life.

Some problems have been attributed to the increased rigidity of the facial bones and articulations, more specifically, to the zygomatic buttresses[21]. Kennedy[14] stressed in their findings that true movement of the basal bone of the maxilla by rapid palatal expansion might be accomplished by reducing the resistance to lateral movement by osteotomies through the zygomatic buttress, nasomaxillary and pterygomaxillary areas. Lines[18] stated that the zygomatic buttress was the cause of most of the resistance to maxillary expansion in adult. Alpern and Yurosko[2] reported successful maxillary expansion cases without surgery on 82 patients under the age of 25, 12 were females above the age of 15, with an average age of 16.5. The oldest female in the non-surgical group was a 20 year old, and the oldest male to be expanded without surgery was a 25 year old. Inoue et al[12] studied rapid palatal expansion radiographically, including a report of successful expansion in a 50 years old.

From the review of these findings, it seems reasonable to expect successful palatal expansion through suture opening even in patients in the early 20's.

CASES

Case 1

1. Patient : 20Y 9M, Famale

2. Intraoral Findings(Fig 2, A-E)

The patient complained of mandibular prognathism. The examination revealed Angle's Class III malocclusion, bilateral buccal crossbites and facial asymmetry with midline shift to left side.

3. Cephalometric Analysis(Fig 2, G)

ANB : -2.8°
Wits : -9.2 mm
SN to Go-Me : 43.1°
$\underline{1}$ to SN : 120.2°
IMPA : 78.2°

4. Treatment

Twenty years 9 months old female whose growth completion was confirmed by hand and wrist x-rays (Fig 3, D), was planned to have surgery due to skeletal Class III malocclusion. Since maxillary arch was relatively narrow to the mandibular arch, palatal expansion was attempted. Expansion of 0.25mm every 5 days and total of 3.75mm at the end of the expansion were attained. Anterior diastema was present without pain or discomfort, and the separation of midpalatal suture was confirmed on the occlusal x-ray(Fig 3, C).

On occlusal x-ray after 18 months of follow-up retention period, bone fill in the suture space can be seen(Fig 5). After the successful palatal expansion, a two-jaw surgery was carried out to enhance the facial profile and the occlusion(Fig 4).

5. Post-Treatment Cephalometric Analysis(Fig 4, G)

ANB : +2.8 °
Wits : -3.8 mm
SN to Go-Me : 43.1 °
$\underline{1}$ to SN : 110.0 °
IMPA : 75.7 °

6. Cast Analysis(Fig 6)

The following results are from pre-treatment, after expansion and retention follow-up at 1 year 6 months post-treatment.

	Intercanine Width	Intermolar Width
Pre-Treatment	36	42
After Expansion	43	48.5
Retention	39	48.5

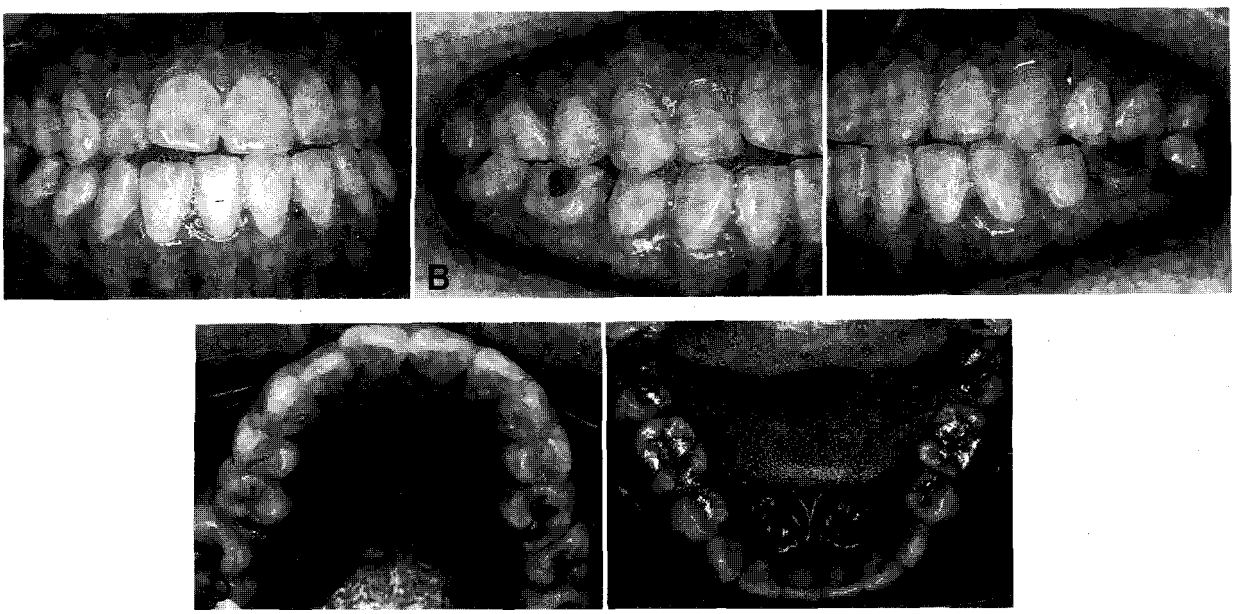


Fig 2. Case 1 initial examination
A-E : Intraoral photos

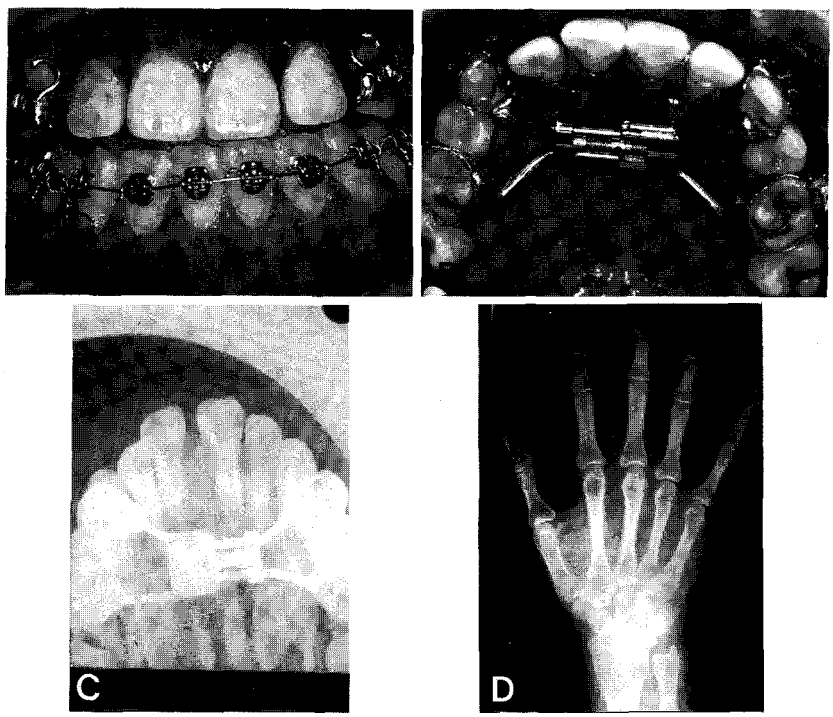


Fig 3. A, B : Intraoral photos after expansion
C : Occlusal x-ray shows the separation of midpalatal suture as a result of palatal expansion.
D : Hand and wrist x-ray shows the evidence of growth completion.

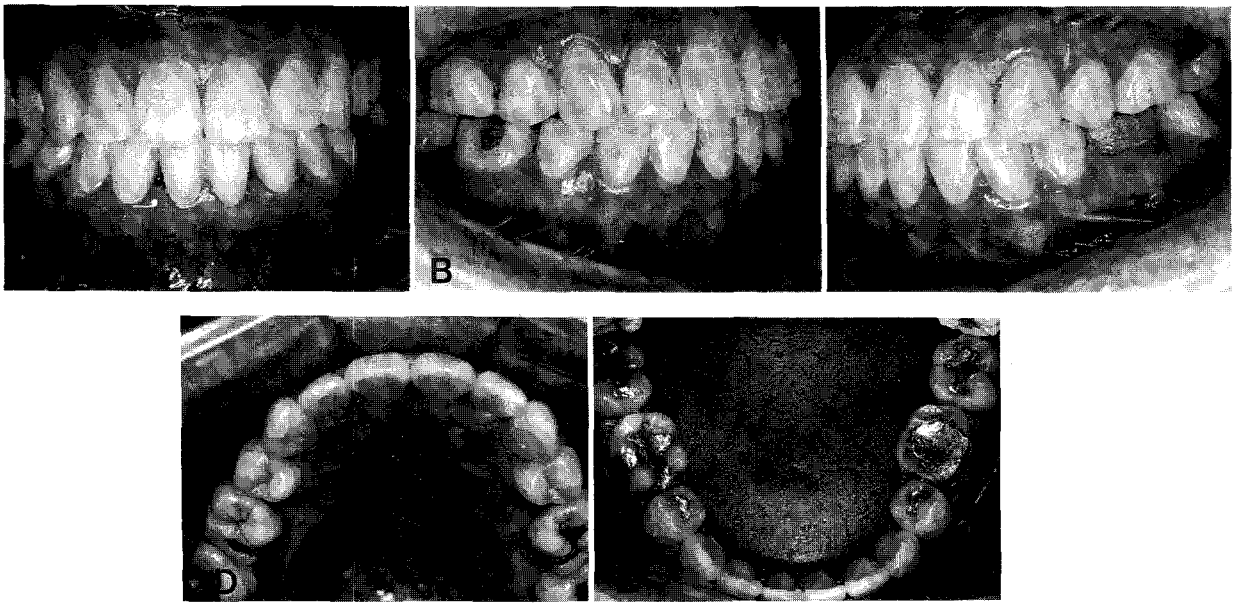


Fig 4. Case 1 after treatment
A-E : Intraoral photos

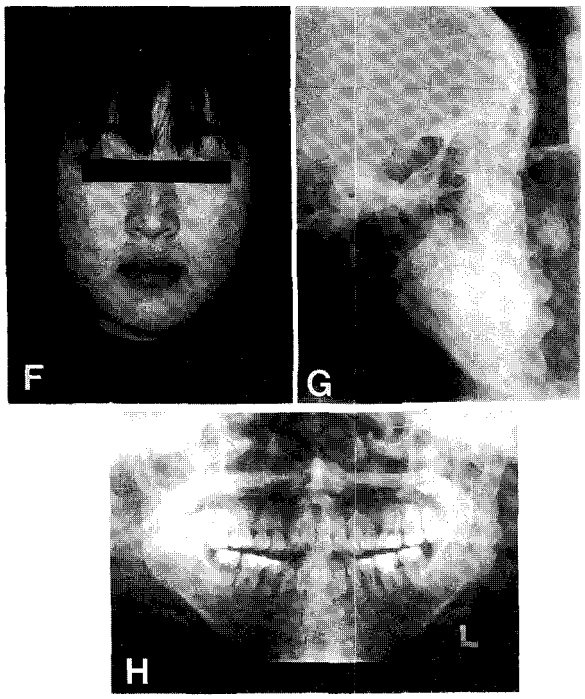


Fig 2. Case 1 initial examination
F : Extraoral photo
G : Lateral cephalogram
H : Orthopantomogram

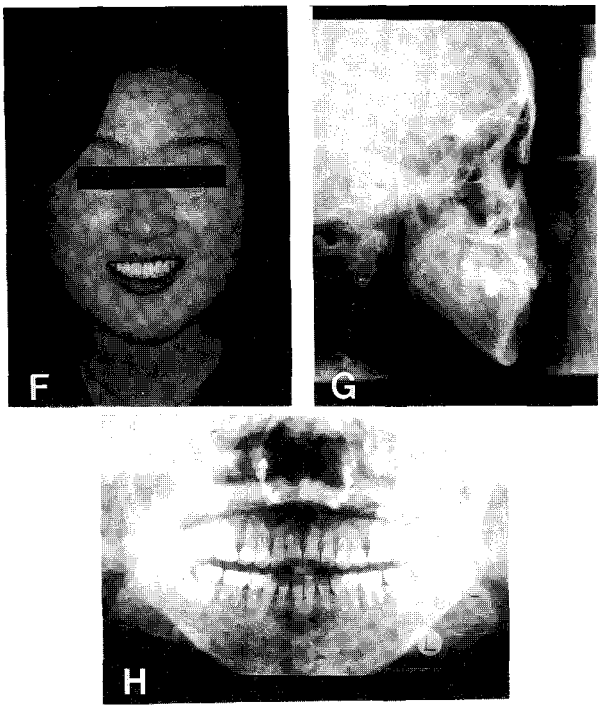


Fig 4. Case 1 after treatment
F : Extraoral photo
G : Lateral cephalogram
H : Orthopantomogram

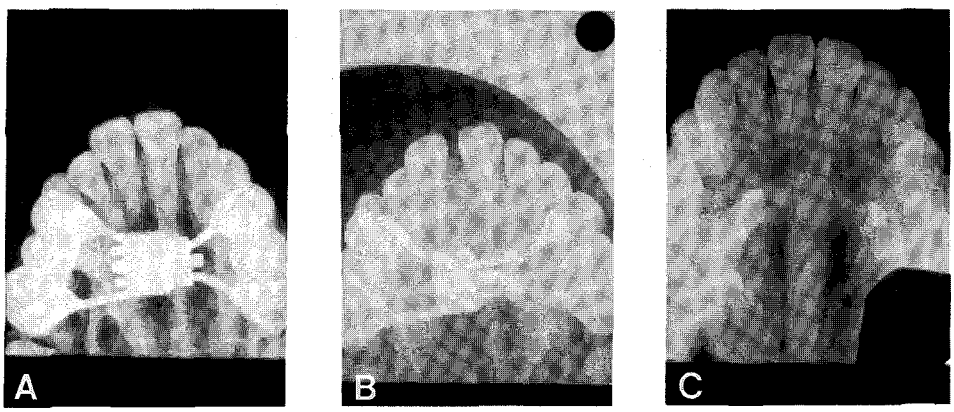


Fig 5. Serial occlusal x-rays before and after expansion, and at the follow-up retention after 18 months

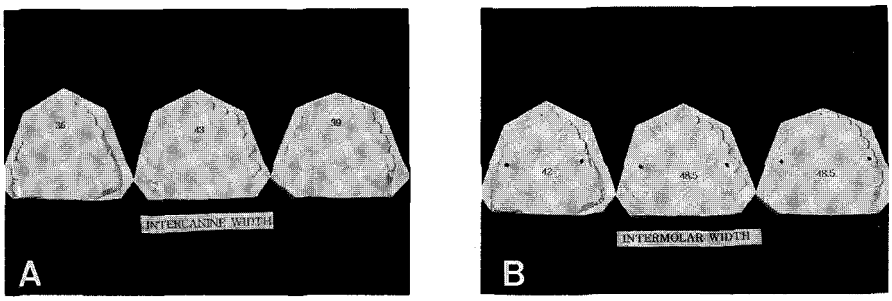


Fig 6. Serial study models before and after expansion, and at the follow-up retention after 18 months

Case 2

1. Patient : 18Y 7M, Female

2. Intraoral Findings(Fig 7, A-E)

The examination revealed crossbite in the left molar side, severe crowding of upper teeth, mild crowding of lower teeth, maxillary arch length discrepancy of 10mm, and mandibular arch length discrepancy of 1.5mm. Anterior teeth occlude in edge to edge bite, and molars show Angle's Class III malocclusion.

3. Cephalometric Analysis(Fig 7, G)

ANB : +1.9°
Wits : -5.1 mm
SN to Go-Me : 30.3°
1 to SN : 113.2°
IMPA : 91.2°

4. Treatment

Eighteen years 7 months old female patient, although her growth was deemed completed due to her age, was successfully treated with RPE. Expansion 0.25 mm a day and a total of 5 mm of expansion were attained. Anterior diastema was produced without pain and discomfort(Fig 8). Ten millimeters of crowding were resolved by the space generated from RPE treatment(Fig 9). Intercanine width increased only 1mm, despite the expansion of 5mm, because of ectopic eruption of canine to labial at the pre-treatment.

5. Post-Treatment Cephalometric Analysis(Fig 9, G)

ANB : +1.6°
Wits : -5.0 mm
SN to Go-Me : 31.2°
1 to SN : 115.1°
IMPA : 91.7°

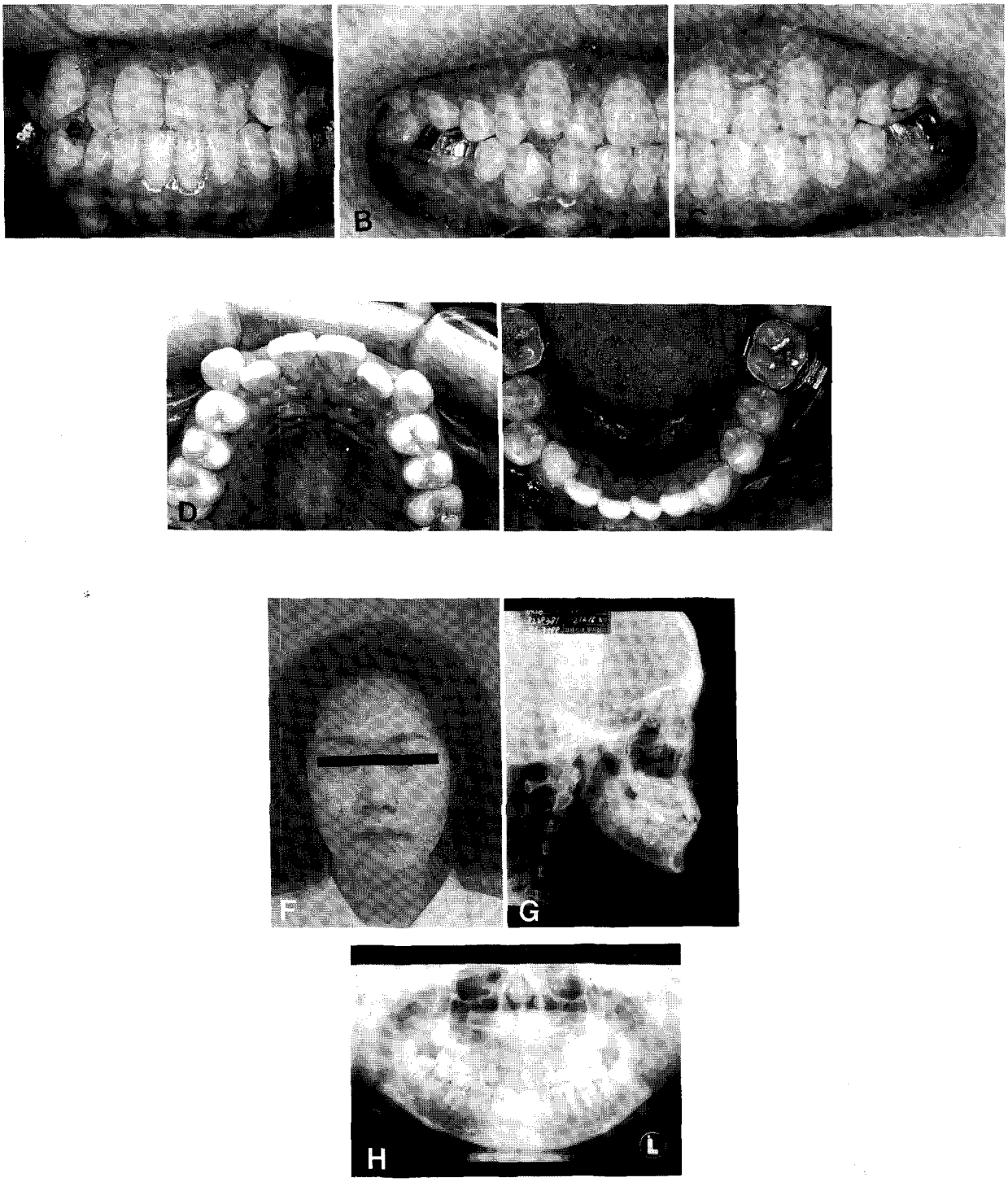


Fig 7. Case 2 initial examination
A-E : Intraoral photos F : Extraoral photo G : Lateral cephalogram H : Orthopantomogram

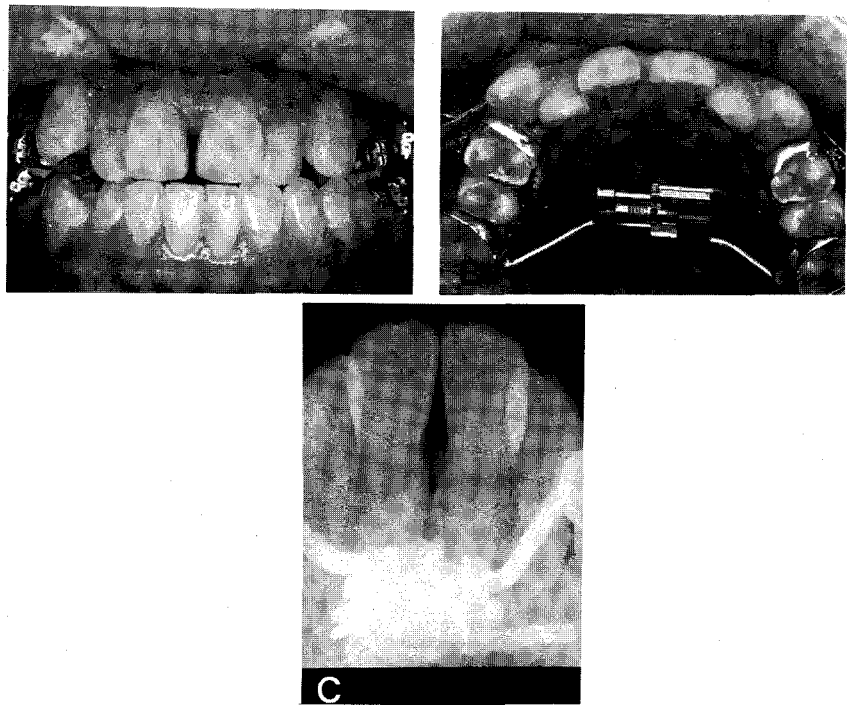


Fig 8. A, B : Intraoral photos after expansion
C : During expansion, the periapical view shows slight suture opening

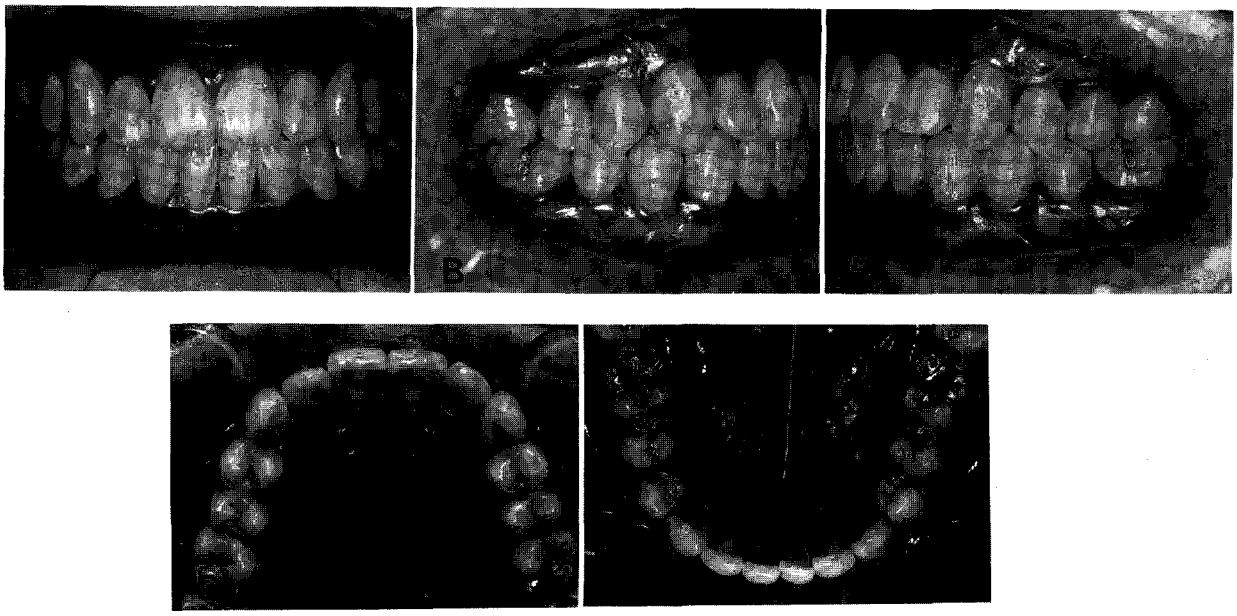


Fig 9. Case 2 after treatment
A-E : Intraoral photos

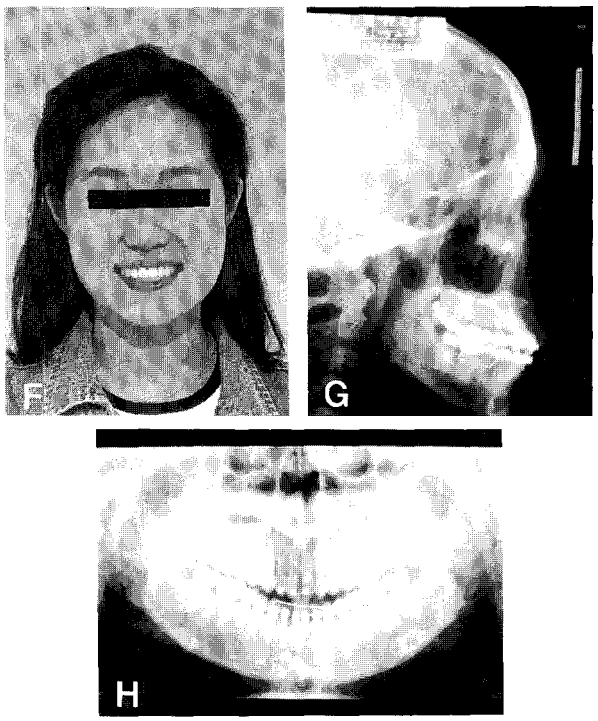


Fig 9. Case 2 after treatment
F : Extraoral photo G : Lateral cephalogram
H : Orthopantomogram

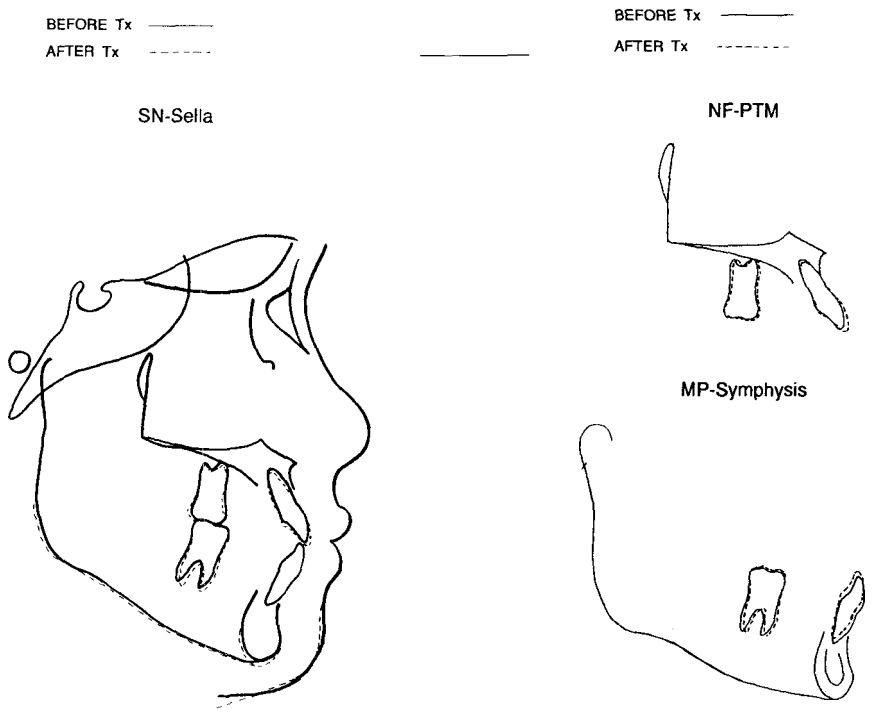


Fig 10. Superimposition of lateral cephalograms : initial and after treatment

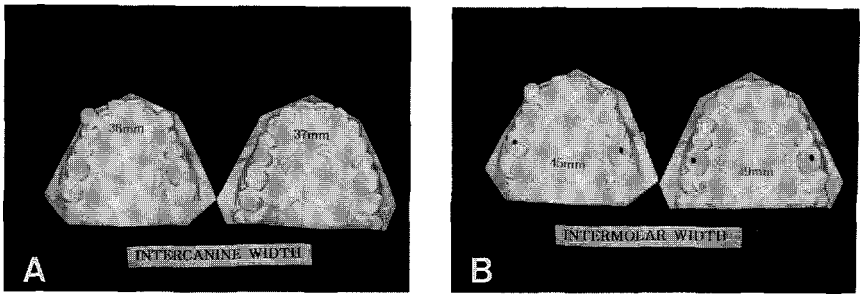
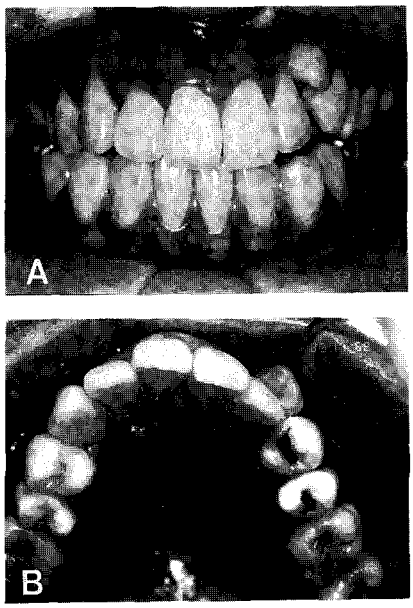


Fig 11. Serial study models : initial and after expansion



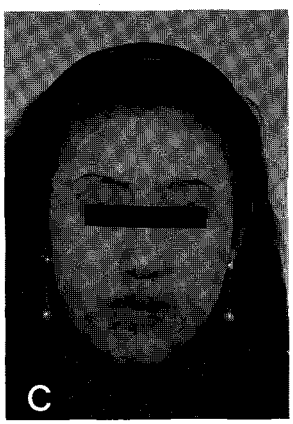
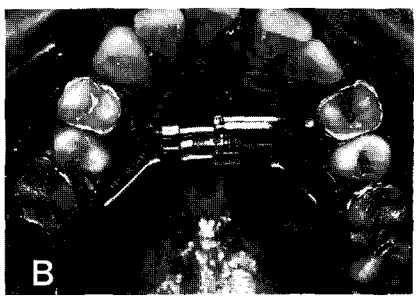


Fig 12. Case 3 initial examination
A, B : Intraoral photos
C : Extraoral photo



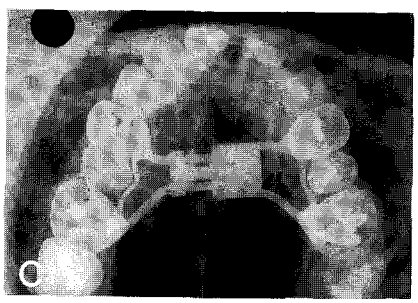


Fig 13. Case 3 after expansion

A, B : Intraoral photos after expansion, C : Occlusal x-ray shows the separation of midpalatal suture as a result of palatal expansion.

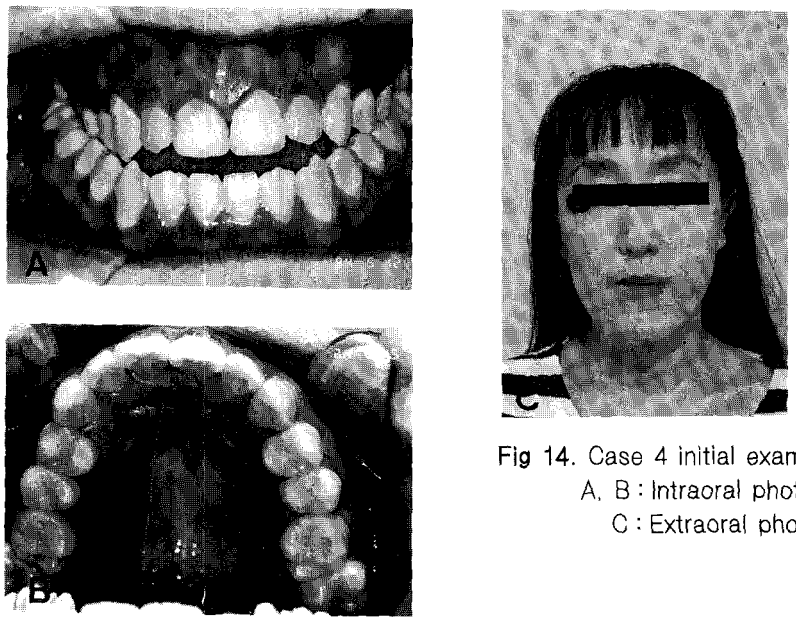


Fig 14. Case 4 initial examination
A, B : Intraoral photos
C : Extraoral photo

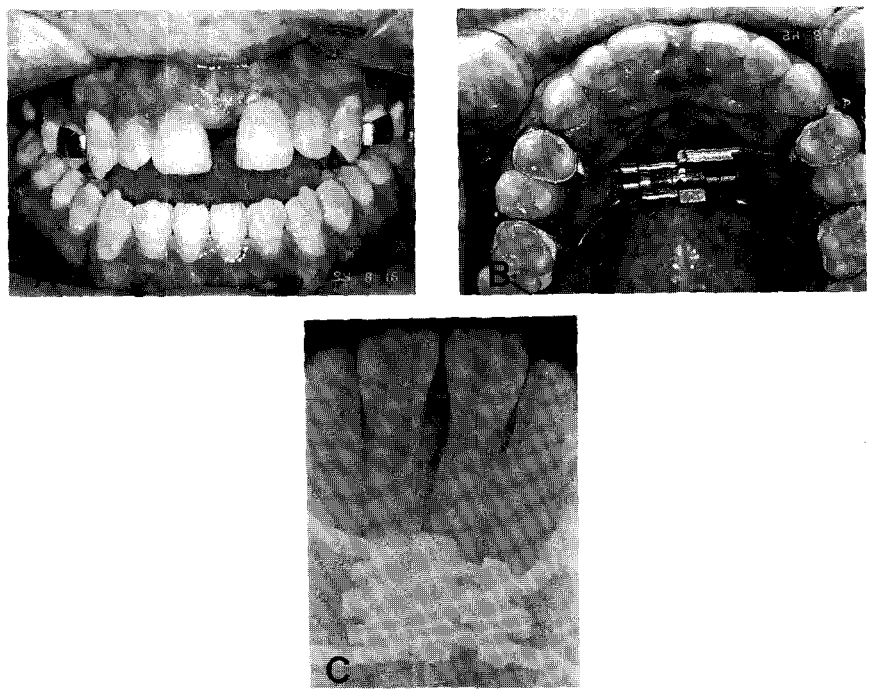


Fig 15. Case 4 after expansion
A, B : Intraoral photos after expansion
C : During expansion, the periapical view shows slight suture opening.

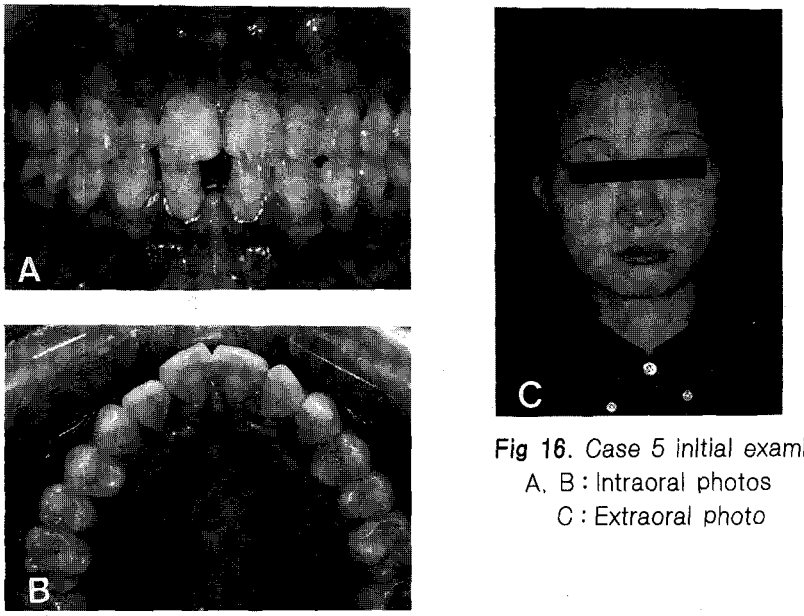


Fig 16. *Case 5 initial examination*
A, B : Intraoral photos
C : Extraoral photo

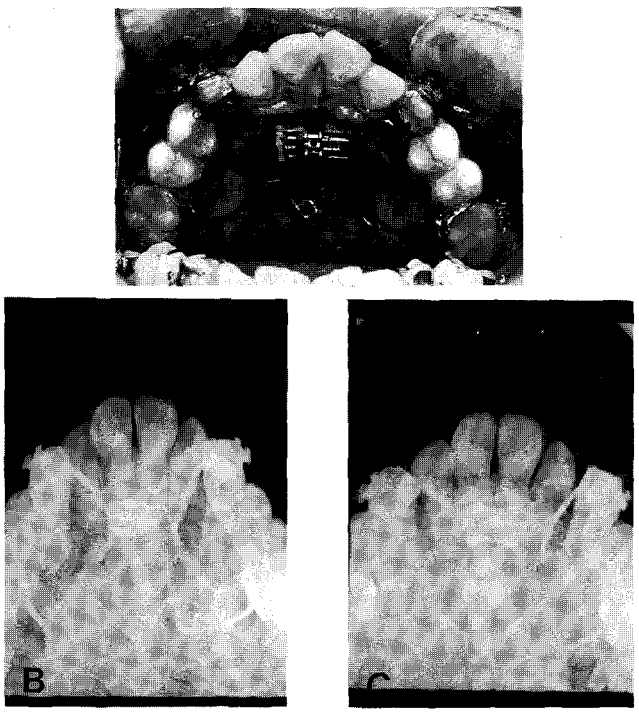


Fig 17. A : Intraoral photo after screw turning
B : Initial occlusal x-ray
C : After screw turning, occlusal x-ray shows no suture opening, and labial flaring of the teeth.

6. Cast Analysis(Fig 11)

The following results are from pre-treatment and after expansion.

	Intercanine Width	Intermolar Width
Pre-Treatment	36	45
After Expansion	37	49

Case 3

1. Patient : 22Y 8M, Female

2. Intraoral Findings(Fig 12, A, B)

The patient showed tapered upper arch form, ectopic eruption of upper left canine, upper arch length discrepancy of 5.5mm, and a cusp-to-cusp bite relationship of the posterior teeth in the transverse dimension.

3. Treatment

A tapered upper arch form and maxillary crowding of 5.5 mm was successfully treated with palatal expansion on a 22 years 8 months old female patient. Expansion of 0.25 mm a day and total of 6 mm at the end of the expansion were attained. Anterior diastema was evident after expansion without any pain or discomfort. Occlusal x-ray confirmed marked palatal suture opening(Fig 13).

Case 4

1. Patient : 20Y 7M, Female

2. Intraoral Findings(Fig 14, A, B)

The patient had skeletal Class III malocclusion, tapered upper arch, anterior openbite, and a crossbite on the right side.

3. Treatment

A twenty years seven months old female patient, whose maxillary arch was narrower than mandibular arch, was planned to try palatal expansion, and in case palatal expansion treatment fails, she agreed to have surgery to correct the problem. The patient was instructed to make 1 turn of the screw per 2 days until she made 9 turns, and then 1 turn per day until 5mm expansion was attained. Anterior diastema was produced without pain and discomfort. During expansion, periapical x-ray confirmed slight suture opening (Fig 15).

Case 5

1. Patient : 19Y 1M, Female

2. Intraoral Findings(Fig 16 A, B)

The patient was presented with excessive overjet, congenital missing of lower lateral incisors, and spacing on lower anterior teeth.

3. Treatment

A 19 year-old female patient with congenital missing of left and right lower lateral incisors, excessive overjet and a tapered upper arch form was planned to be treated with mandibular fixed prosthesis after space regaining. For upper and lower arch coordination, an expansion of intercanine width was attempted, using Haas type RPE. Despite the sufficient effort, no suture opening was evident on occlusal x-ray, and only the labial tipping of both canines resulted(Fig 17).

SUMMARY

In narrow maxillary arch, midpalatal suture can be readily opened in growing children with maxillary palatal expansion. In adult patients, narrow maxilla is generally treated surgically because their growth are deemed completed due to their age. However, in patients under 25, midpalatal suture may not be closed. In addition, maxillary expansion may depend upon the closure of other maxillary sutures, which generally remain open at this stage.

The present study attempted suture openings with palatal expansion on 5 female patients in their early 20's. The opening was successful in 4 patients, while only one patient showed no suture opening. In all 4 subjects, no discomfort or pain was present during expansion, and the successful suture opening was confirmed on occlusal x-rays. Therefore, for those patients with narrow maxilla in their early 20's, rapid palatal expansion or slow palatal expansion may offer

a simple and less complicated option which, if successful, may preclude the need for surgery and thereby circumvent the psychological and financial burdens for the patients.

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KOREA. J. ORTHOD. 1995 ; 25 : 733-746