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Comprehensive orthodontic treatment for Silver–Russell syndrome patient with large overjet and overbite

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ABSTRACT

Purpose: Silver–Russell syndrome (SRS) is a congenital malformation syndrome with a growth disorder characterized by intrauterine and postnatal growth retardation leading to short stature, body asymmetry, characteristic triangular facies and several other anomalies.

Materials and methods: This report describes comprehensive orthodontic treatment of a girl aged 11 years and 1 month with SRS. She showed skeletal class II with asymmetrical facial profile, constricted upper and lower arches, crowding and large overjet and overbite.

Results: In the first phase of orthodontic treatment, the constricted arches, large overjet and skeletal class II showed improvement by functional appliance with expansion screw. At the age of 13 years and 7 months, second phase orthodontic treatment was started in order to improve severe crowding, large overjet and overbite by preadjusted edgewise appliance and temporary anchorage devices with four bicuspids extraction. Favourable facial profile and occlusion were achieved at the end of active treatment.

Conclusion: Long-term follow-up is also essential in order to assess long-term stability of this treatment.

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KEYWORDS
Congenital anomaly; Silver–Russell syndrome; growth disorder; skeletal class II; genetic testing

Introduction

Silver–Russell syndrome (SRS) is a rare congenital malformation syndrome with multiple symptoms including SGA (small for gestational age), postnatal growth failure and body asymmetry, and occurs in approximately 1/30,000–1/100,000 live births [1]. Malocclusion caused by craniofacial anomalies such as secondary palate cleft, high arched palate and micrognathia is also reported and its improvement is considered to be important for the healthcare of patients with SRS [2]. However, there is still limited information about orthodontic treatment in patients with SRS. Here, we describe an orthodontic case of SRS which exhibited large overjet and overbite with retrognathic mandible as well as severe crowding and constricted arches in both upper and lower jaw. Functional appliance followed by conventional edgewise treatment with four bicuspid extractions and temporary anchorage devices (TADs) was performed and resulted in ideal occlusion and favourable facial profile.

History

A girl aged 11 years and 1 month came to our clinic with chief complaint of crowding on both arches, large overjet and asymmetrical facial profile (Figure 1). She had already been diagnosed with SRS at the age of 1 by genetic testing (Figure 2). She exhibited several general symptoms, including low body height, mild leg length discrepancy and poor weight gain, which were controlled by the paediatrician.

A clinical examination showed triangular facial profile with pointed chin, convex soft tissue facial profile, protruded lip and mentalis strain. An intraoral examination showed delayed dental age compared to chronological age. Large overjet and overbite with value of 9.5 and 5.7 mm with distal and vertical step type terminal plane could be seen on the right and left side, respectively (Figure 1 and Table 1). Both maxilla and mandible showed narrowed arch form with severe crowding. High-arched palate could be observed. Incisors in both maxilla and mandible were extruded and resulted in reverse curve of Spee in upper arch and steep curve of Spee in lower arch. The exposure of upper incisors was large in smiling position (Figure 1). A lateral

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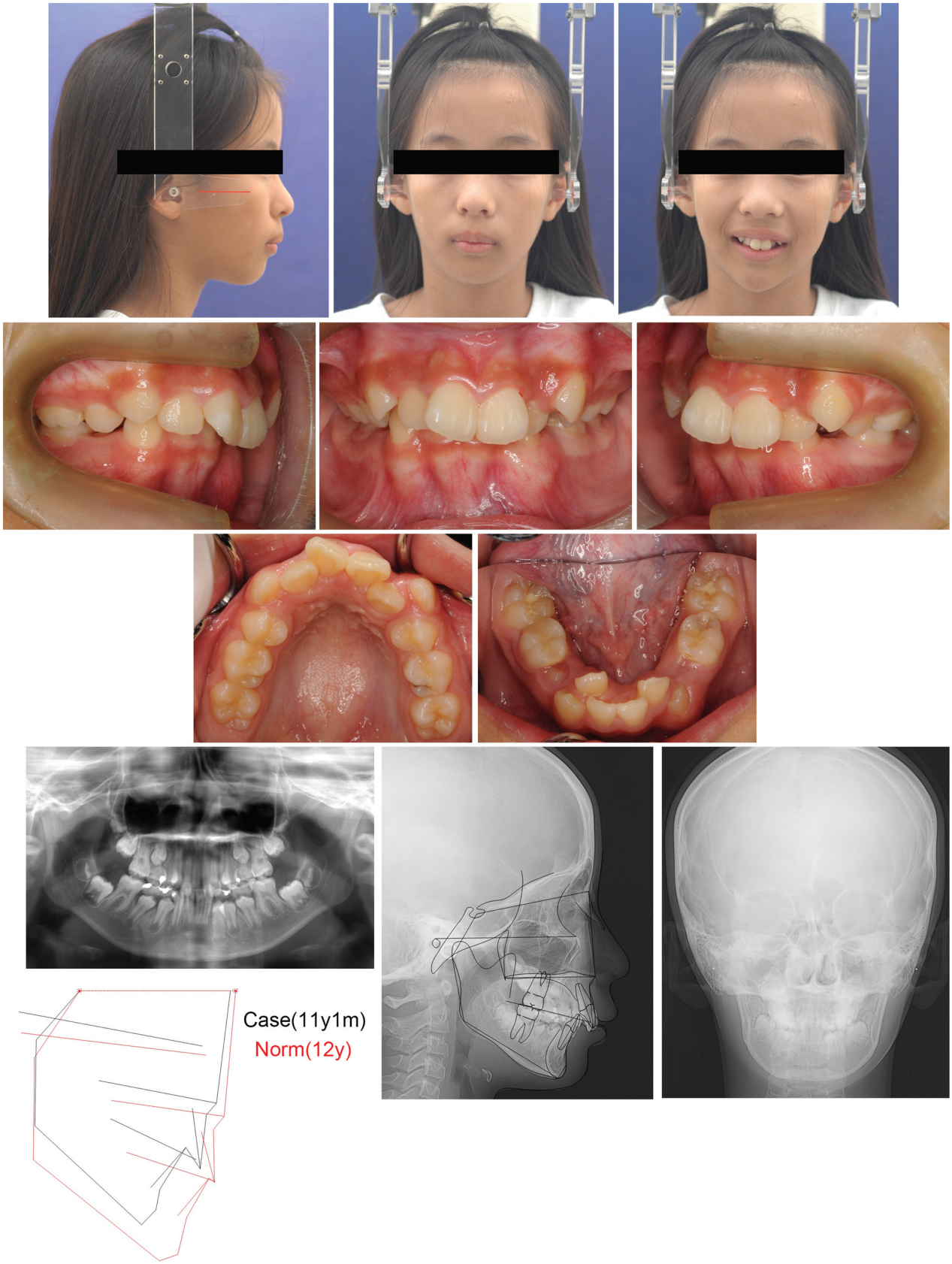

Figure 1. Pre-treatment facial and intraoral photographs, cephalometric and panoramic radiographs and facial diagrams with norms (age: 11 years and 1 month).

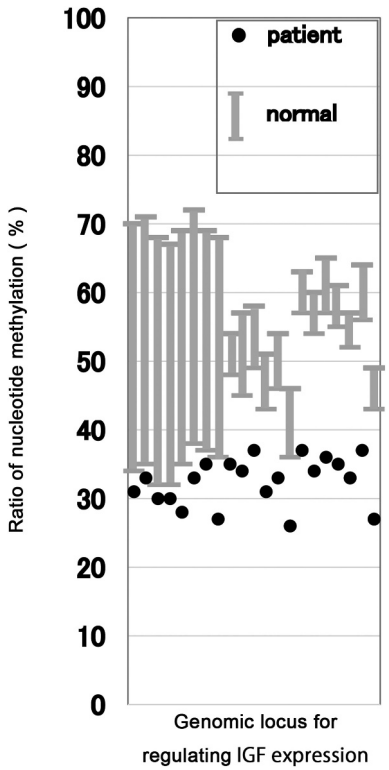

Figure 2. The schematic result of methylation analysis for the *H19*-DMR using pyrosequencing in the patient. Gray scales indicate the range of methylation indices in the control subjects. Black dots indicate the patient's methylation indices in CpGs within the *H19*-DMR. X-axis indicates the region of genes which were analysed methylation. Y-axis indicates degrees of methylation. This graph shows that the patient's methylation indices were lower than the control subjects and this result means hypomethylation at the *H19*-DMR which is known as a responsible genomic locus for causing SRS.

cephalometric analysis revealed skeletal Class II jaw base relationship (ANB = 8.6°) with retrograded mandible (SNB = 70.4°) (Figure 1 and Table 1). The upper incisor showed dental compensation with palatal inclination (U1-SN = 97.4°). The lower facial height was short (57.3 mm). Orthopantomogram did not show any problematic symptom (Figure 1).

Treatment objectives

We planned to treat constricted upper and lower arches with large overjet and skeletal class II by removable, dual arch functional appliance with expansion screw during her pubertal growth. Subsequent edgewise treatment with premolar extraction was planned for correcting severe

Table 1. Initial, Preedgewise, Posttreatment and Retention2y cephalometric summary.

Measurement	Initial	Preedgewise	Posttreatment	Retention2y
SNA angle (°)	79.0	79.8	77.5	77.5
SNB angle (°)	70.4	72.4	73.2	73.2
ANB angle (°)	8.6	7.3	4.3	4.3
Wits appraisal (mm)	4.3	2.4	−0.9	−0.3
U1-SN (°)	97.4	103.1	102.5	106.3
IMPA (L1-Mp) (°)	90.0	91.2	91.2	94.3
Interincisal angle (°)	131.5	125.7	126.3	119.5
Overjet (mm)	9.5	7.8	4.3	4.9
Overbite (mm)	5.7	5.8	3.8	3.1
Facial axis (°)	81.8	84.5	85.2	85.2
FMA (Mp-FH) (°)	30.6	29.4	29.3	29.3
Upper facial height (mm)	48.5	51.8	51.8	51.8
Lower facial height (mm)	57.3	62.7	64.0	64
Mandibular length (mm)	91.4	101.2	103.1	103.1

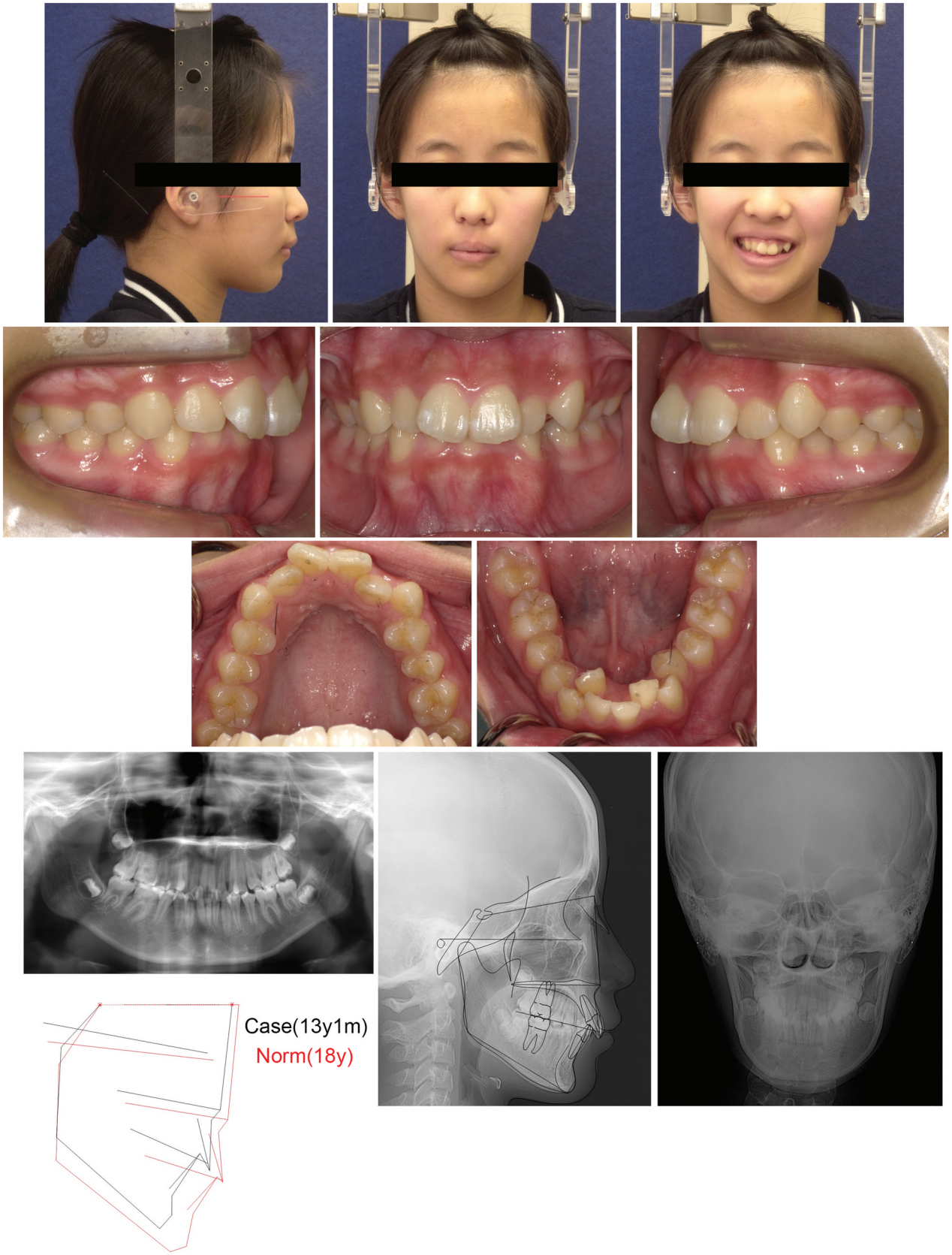

Figure 3. Post-first treatment facial and intraoral photographs, cephalometric and panoramic radiographs and facial diagrams with norms (age: 13 years and 7 months).

crowding in both arches. Upper and lower incisor retraction were also planned to improve her full profile and incompetent lips. Intrusion of upper incisor with TADs was planned to further improve her large overbite and reduce exposure of upper incisors when she smiled.

Treatment progress

From the age of 11 years and 10 months to 13 years and 4 months, first phase orthodontic treatment was performed by functional appliance (bionator) with expansion screw for improving constricted arches, large overjet and skeletal class II. The working bite was recorded to improve the retrognathic and deviated mandible. The duration of expansion was 14 months and the duration of retention was 7 months. Reduction of overjet and overbite could be seen by forward and downward growth of the mandible (Figure 3).

At the age of 13 years and 7 months, we diagnosed her as a case with severe crowding and convex type facial profile, deviation of the mandible to the right, large overjet and overbite for phase II orthodontic treatment (Figure 3). Under this diagnosis, we decided to treat her with preadjusted edgewise appliances with four first premolars extraction and TADs (Figure 4). At the age of 14 years and 1 month, 0.022-inch slot preadjusted edgewise brackets were placed on the upper and lower dental arches. TADs (Dual-Top Anchor System; length, 6.0 mm; diameter, 1.6 mm; Jeil Medical Corporation, Seoul, Korea) were also placed bilaterally in the buccal area between the upper and lower second premolar and the first molar. Following levelling and alignment of both dental arches, large overjet and overbite were corrected by retracting and intruding upper incisors. Lower incisors were also intruded and slightly retracted with accentuated curve of Spee in rectangular stainless steel arch wire. Elastomeric chains were placed between the TADs and the hook attached on the both arch wires in order to perform en masse incisor retraction. After removal of the Edgewise appliances, Begg-type retainers and a bonded wire retainer in lower incisor were used for retention.

Treatment results

The constricted arches were corrected by expansion screw in functional appliances and followed Edgewise appliances (Figure 5). The amount of maxillary expansion was 2.0 mm and the amount of mandibular expansion was 1.5 mm between pre-treatment and post-phase II treatment (Figure 6). Convex type facial profile with skeletal class II was improved with horizontal and vertical growth of the mandible by change of ANB from 8.6° to 4.3° (Figure 7 and Table 1), which also improved her convex type facial profile and small lower facial height at the end of treatment (Figure 5 and Table 1). Severe crowding on both arches was relieved by premolar extraction (Figure 5). The overjet was decreased from 9.5 to 4.3 mm by bodily lingual movement of the upper incisors (Figure 7 and Table 1). Upper lip protrusion and lip incompetency were also improved (Figure 5 and Table 1). The upper and lower incisors were intruded by 1.5 and 1.3 mm, respectively, which resulted in reducing excessive overbite from 5.7 to 3.8 mm (Figure 7 and Table 1). Excessive exposure of upper incisors at smiling position was improved with favourable smile arc (Figure 5). Right deviation of lower dental midline remained because of mandibular deviation (Figure 8). Angle class II molar relationship changed to Class I as a result of the mesial movement of the lower molars by 2.5 mm and mandibular growth (Figure 7 and Table 1). Mutually protected occlusion was achieved at the end of edgewise treatment (Figure 5) and was maintained after 2 years of retention (Figure 9).

Discussion

SRS frequently requires dental management for its characteristic symptoms, including feeding disorders and oral motor problems [3]. Craniofacial dismorphology with SRS includes Pierre Robin sequence, which could subsequently cause cleft palate in some cases [2]. It is also known that SRS exhibits retrognathia, which is associated with large overbite as well as severe crowding [4–6]. However, the orthopaedic response to functional appliance in SRS is largely elusive. In this particular case, effective horizontal and vertical mandibular growth could be attained by the

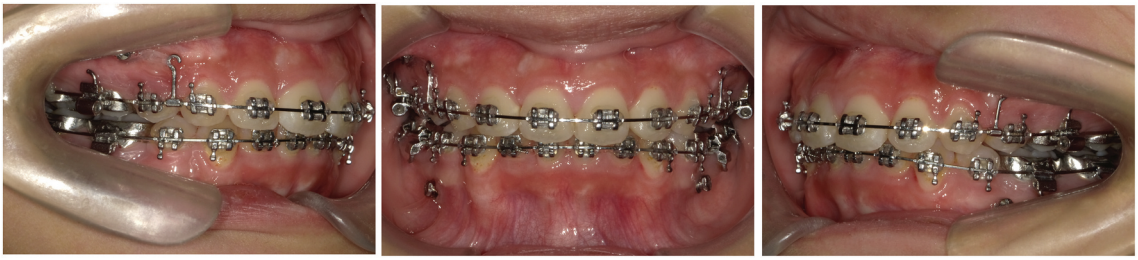

Figure 4. Intraoral photographs during active treatment with preadjusted edgewise appliances and TADs.

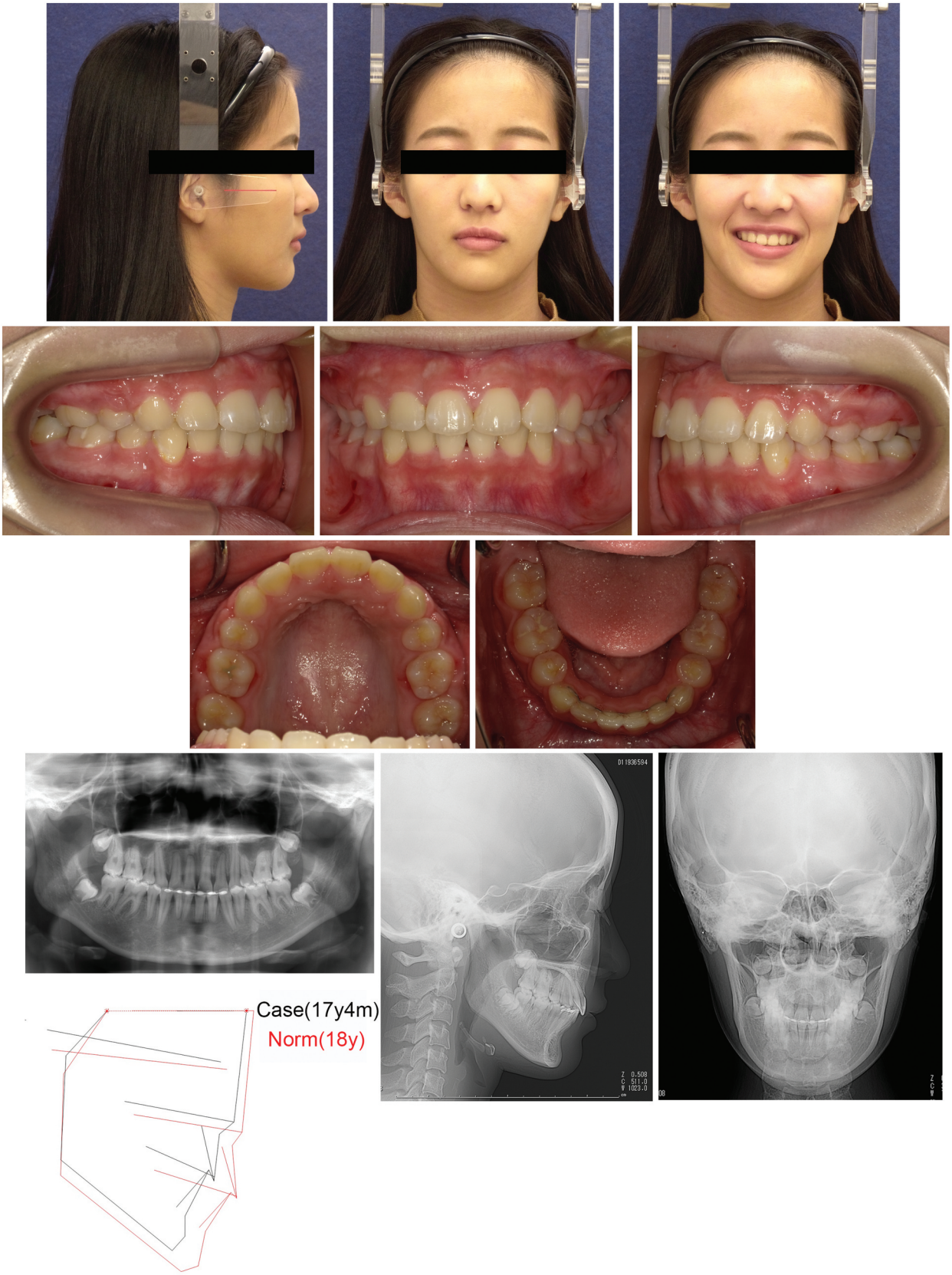

Figure 5. Post-active treatment facial and intraoral photographs, cephalometric and panoramic radiographs and facial diagrams with norms (age: 17 years and 3 months).

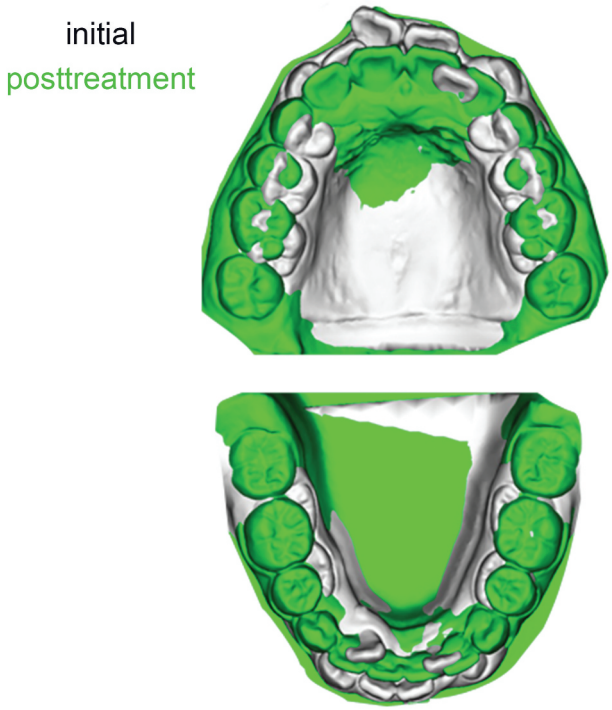

Figure 6. Superimposition of digital dental casts at pre-treatment (age: 11 years and 1 month, white) and post-active treatment (age: 17 years and 3 months, green).

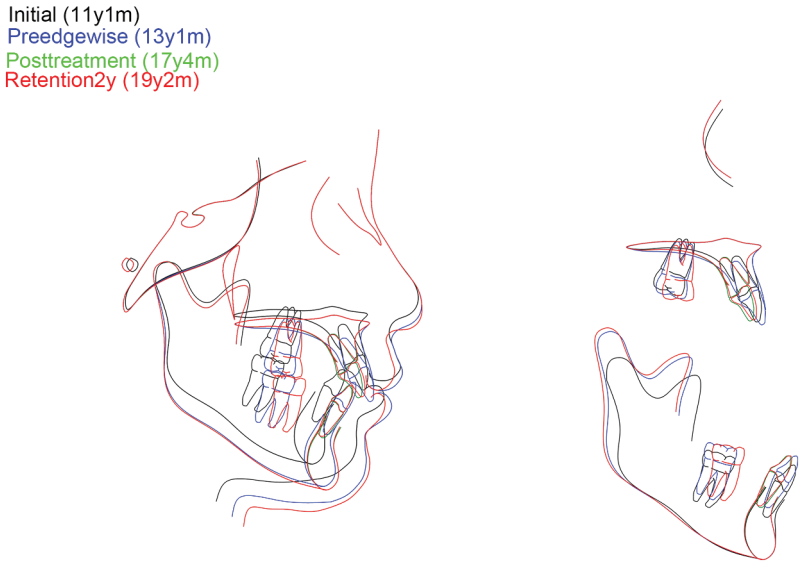

Figure 7. Superimposition of lateral cephalometric tracings at pre-treatment (age: 11 years and 1 month, black line), post-first treatment (age: 13 years and 7 months, blue line), post-active treatment (age: 17 years and 3 months, green line) and post-2 years retention (age: 19 years and 2 months, red line). Superimposition on the SN plane at S, superimposition on the palatal plane at ANS and superimposition on the mandibular plane at Me.

use of functional appliance from the age of 11 years and 10 months to 13 years and 4 months. This indicates that SRS mandible growth could also be modified by conventional functional appliances. Growth hormone (GH) treatment is a growth-promoting therapy for short children born SGA, including children with SRS [1]. GH treatment is known to stimulate craniofacial growth, which could impact the result of orthodontic treatment [7]. For this reason, orthodontists should carefully consult with the paediatrician regarding the schedule of GH therapy in patients with SRS. This patient did not receive GH therapy for her mild growth retardation.

The severity of malocclusion in SRS exhibits certain variation [4]. A case with severe mandibular alveolar constriction with retrognathia was reported to have been treated with distraction osteogenesis and surgical mandibular advancement [8]. On the other hand, camouflage treatment was performed in a case with milder skeletal deformities [9]. As

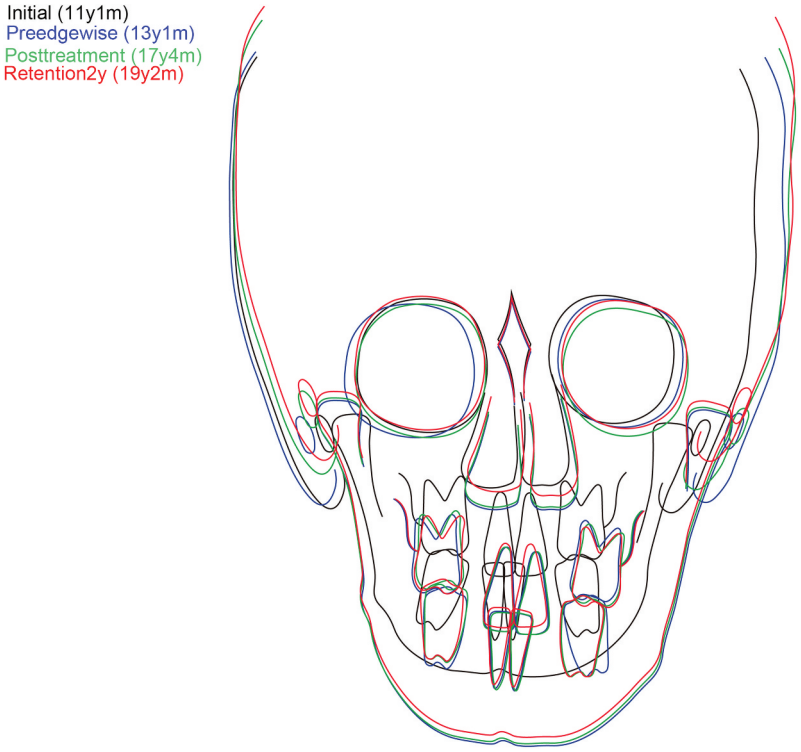

Figure 8. Superimposition of PA cephalometric tracings at pre-treatment (age: 11 years and 1 month, black line), post-first treatment (age: 13 years and 7 months, blue line), post-active treatment (age: 17 years and 3 months, green line) and post-2 years retention (age: 19 years and 2 months, red line). Superimposition on the LO-LO plane at crista galli.

treatment alternatives, constricted arches could be treated by fixed expander, and headgear could be utilized to correct skeletal class II. Double jaw orthognathic surgery could be applied to correct the retrognathic skeletal relationship, large exposure of upper incisors as well as mandibular midline deviation. Arch lengthening and interproximal reduction could also be used for improving the crowding. Extracting lower incisors instead of premolars could be considered for relieving severe crowding. In this case the skeletal problem was not severe enough to warrant orthognathic surgery. The plan for extracting lower incisors instead of premolars was unfavourable because of anterior ratio discrepancies. The plan for extracting second premolars was available in terms of mesial movements of molars. We decided to extract four first premolars because the amount of upper and lower anterior crowding and large overjet. The present case report showed efficient alveolar effect of the functional appliance in first phase treatment. Skeletal mandibular deviation was improved to some extent and there was dental improvement such as molar relationship at the end of active treatment. Remained malocclusion included severe crowding was treated with edgewise appliance and premolar extraction. TADs were successfully used for reinforcing the anchorage to retract upper incisors for improving large overjet and protruded lip instead of using headgear. Displacement of lower incisors into a lingual position is one of the features of the malocclusion of SRS [1]. In orthodontically treated patients, relapse of the mandibular incisors is widely reported and this risk of relapse could possibly increase in the patients with SRS [10]. Therefore, we used a removable retainer with a bonded wire retainer for retention in the lower arch.

In 35–60% of individuals with SRS, hypomethylation of the paternal chromosome at 11p15.5 is detected [1,11]. On the other hand, 5–10% of individuals with SRS exhibit maternal uniparental disomy (upd(7)mat), with both chromosomes derived from the mother [1,12–14]. From genetic testing of the present case, we detected hypomethylation at *H19*-DMR (differentially methylated region) in the 11p15.5 region, which causes reduced expression of *IGF2*. which underlies the aetiology of SRS (Figure 2). The genetic test was an analysis of methylation indices (MIs, the ratio of methylated clones) in CpG dinucleotides, regions of DNA with a high G + C content [15] within the *H19*-DMR, using pyrosequencing. For comparison, 50 control subjects were studied to define the reference ranges of MIs [16]. There are a few case reports of two-phase orthodontic treatment in SRS patients and especially reports including genetic information. Genotype-phenotype correlation of craniofacial deformities in SRS patients is largely elusive [16]. This case report provides one finding

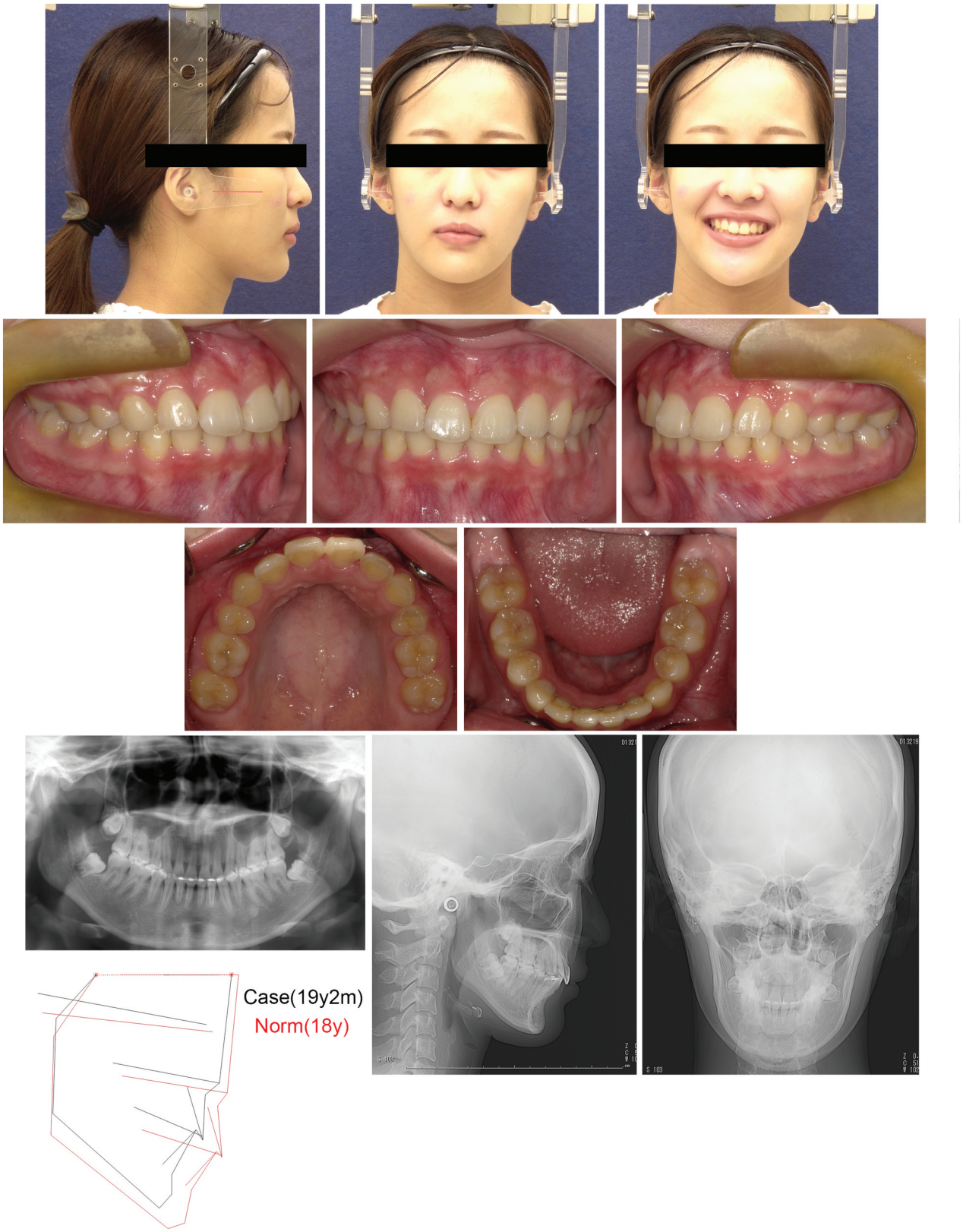

Figure 9. Post-2 years retention facial and intraoral photographs, cephalometric and panoramic radiographs and facial diagrams with norms (age: 19 years and 2 months).

of evidence, which links the genotype and craniofacial phenotype, and includes the clinical result of orthodontic treatment in a patient with SRS. Continuing reports and investigations of genotype and craniofacial phenotype correlation should provide valuable evidence for precise treatment planning for dental management and orthodontic treatment.

Although there have been some reports concerning the orthodontic treatment in SRS patients, the long-term outcome of orthodontic treatment is still unclear. Long-term follow-up is essential in order to assess long-term stability of this treatment.

Conclusions

A case of SRS with typical craniofacial features and malocclusion was successfully treated with two-stage orthodontic treatment. Functional appliance facilitated horizontal and vertical mandibular growth in the first-phase treatment. Second-phase treatment was performed with conventional edgewise appliance with TADs and resulted in favourable facial profile and mutually protected occlusion. Long-term follow-up is also essential in order to evaluate long-term stability of this treatment.

Author contributions

Authors 1, 2, 3 and 9 contributed to conception, drafted and critically revised the manuscript. Authors 4, 5, 6, 7 and 8 contributed to data acquisition and interpretation.

Disclosure statement

No potential conflict of interest was reported by the authors.

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Ethical approval

Written informed consent was obtained from the patient and the parent for publishing this case report.

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