

Treatment of Prognathic Maxilla with Dento-alveolar Protrusion in Adult with the Assistance of TADs: A Case Study

By Adrian J. Palencar, MUDr, MAGD, IBO, FADI, FPFA, FICD

Abstract: There are numerous challenges the orthodontic clinician faces in his/her everyday practice. One of them is a combination of prognathic maxilla, procumbent anterior teeth, crowding, and incompetent lips. This article presents the case of a 35-year-old Caucasian man with prognathic maxilla, severe maxillary dento-alveolar protrusion, anterior crowding, incompetent lips, and hyper-divergent tendency. The case was treated with the assistance of TADs and was successfully finished in 39 months.

Key words: TAD (Temporary Anchorage Device – Mini-screw), Translation, Moment of the force, Moment of the force ratio, Crowding, Prognathic, Dento-alveolar protrusion, IPR (Inter-proximal reduction – Slenderizing) Off-center bend (tip back, gable bend), Third Newton Law

Introduction
Prognathism is a positional relationship of the mandible and maxilla to the skeletal base, where either jaw protrudes beyond the predetermined imaginary line in the coronal plane (frontal plane) of the skull. Prognathism in humans can be due to normal variation among phenotypes. In the human population where it is not the norm, it may be a malformation, the result of an injury, a disease state, or a hereditary condition.¹ In disease states, maxillary prognathism is associated with Crouzon syndrome, Down syndrome, and Cornelia de Lange syndrome.²

Treatment of the mild and moderate maxillary prognathism is orthodontics in combination with surgical plates and TADs. However, the severe true maxillary prognathism requires orthodontic therapy and orthognathic surgery.

Dento-alveolar protrusion is a positional relationship of the alveolar process and anterior teeth to the skeletal base. Not all dento-alveolar protrusions are anomalous, and significant differences can be observed between different ethnic groups.³ Harmful habits such as thumb sucking, tongue thrusting, and lip biting can result in or exaggerate dento-alveolar protrusion, which causes teeth to misalign. The combination of oro-facial myofunctional therapy, habit breaker, functional appliances, fixed orthodontic treatment, and lifetime retention is required for a successful outcome.

The Case

G. G., a young Caucasian man aged 34 years and 8 months presented to our office with his chief complaint: “I do not like my smile and the appearance of my front teeth. They are too crowded and I cannot close my lips comfortably. Therefore, I am forced to sleep with my mouth open. I also have a speech impediment.”

Anamnesis

The patient’s medical history reveals only an intermittent hypoglycemia, for which he has not been treated. It is controlled by a judicious food intake. The patient’s dental history reveals a speech impediment and a previous consultation with the orthodontist concerning orthodontic treatment.

Examination

Clinical Macro-esthetic appraisal revealed normal facial symmetry, slightly longer lower face height and convex - maxillary prognathic profile. The patient’s upper (+2.5 mm) and lower (+1.0 mm) lips are convex in relation to the “S” (Steiner) line, and they are incompetent (Figure 1-A, B, C). Clinical Mini-esthetic appraisal revealed full upper and lower lips, an approximately 6.0 mm of incisor display (Incision to Stomion, Norm is 3.0 – 5.0 mm), with his lips reposed, and incongruent Incisal line to the lower lip. The patient’s posed smile revealed minimal buccal corridors. (Figure 1-D, E, F). Clinical Micro-esthetic appraisal revealed a full step (8.0 mm) Angle Class II occlusion, a narrow maxillary arch, an ovoid mandibular arch, and 9.0 mm over-jet and 7.0 mm overbite. The lower airway was slightly narrow, and the tongue mobility was within the norm (Figure 1-G, H, I, J).

Clinical Nano-esthetic appraisal revealed no signs of erosion, abfraction, abrasion, and minimal attrition only on the mandibular anterior teeth. Periodontal health was excellent. Plus, there were very few restorations, and he was devoid of tooth decay.

Clinical Appraisal of the patient’s posture was significant: the frontal view revealed head and shoulders leveled; however, the lateral view revealed the head forward position (Figure 1-K, L).

Peri-apical and Panoramic radiograms revealed a complete permanent dentition except the wisdom teeth, which are missing. There is excellent bone support and no sign of periodontal or peri-apical pathology. (Figure 2-A, B).

Lateral Cephalometric radiogram and tracing revealed narrow airway in area of tonsils, prognathic maxilla (SNA - 87°, SNB - 82°), protrusive maxillary incisors (U1/SN - 120°), Class



Figure 1: A) Pre-treatment, frontal view; B) Pre-treatment, lateral view; C) Pre-treatment, posed (dynamic) smile; D) Pre-treatment, lips reposed; E) Pre-treatment, posed (dynamic) smile, lips reposed; F) Pre-treatment, frontal view; G) Pre-treatment, right lateral view; H) Pre-treatment, left lateral view; I) Pre-treatment, maxilla, occlusal view; J) Pre-treatment, mandible, occlusal view; K) Pre-treatment, posture, frontal view; L) Pre-treatment, posture, lateral view

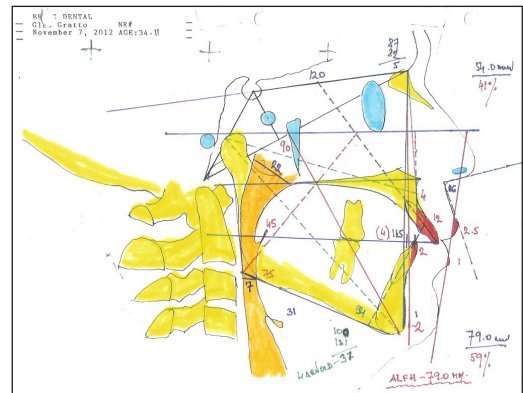
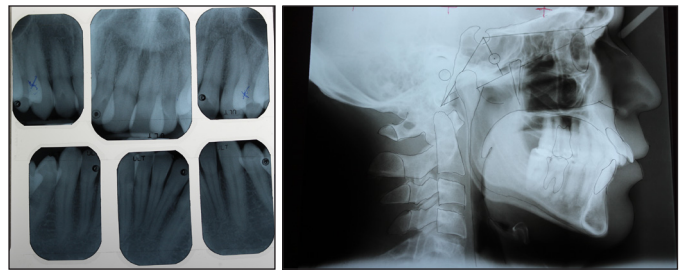


Figure 2: A) Pre-treatment PA radiograms; B) Pre-treatment panoramic radiogram; C) Pre-treatment lateral cephalometric radiogram; D) Pre-treatment cephalometric tracing

II skeletal (ANB +5°, Wits +4 mm), hyper-divergent tendency (ALFH - 79 mm) and an acute naso-labial angle (NLA - 86°). The patient was in CVMS 6 (cervical Vertebrae Maturation Stage) (Figure 2-C, D).

Bolton tooth size discrepancy analysis revealed 2.5 mm excess tooth mass in the maxillary arch.

TMJ appraisal; Symptoms: headaches, snoring at night, and teeth grinding Signs: Normal range of motion and deviation on closing to the left. Muscle palpation was negative.

Diagnosis

The patient exhibits a skeletal Class II, prognathic maxilla, orthognathic mandible and hyper-divergent facial type. An Angle dental Class II (8.0 mm) with maxillary dento-alveolar protrusion, narrow maxillary arch with 9.0 mm over-jet, and 7.0 mm overbite. The patient had a severe crowding, particularly in the maxilla, slightly narrow lower airway, and minimal signs and symptoms of TM dysfunction.

Treatment Plan

The author proposed odontectomy of #14(5) and #24(12), bonded power arms to #13(6) and #23(11), TADs to retract #13(6) and #23(11), Straight Wire Appliance, ARS (IPR – slenderizing) of the maxillary anterior teeth 2.5 mm, and life-time retention.

Treatment

Prior to commencement of the orthodontic treatment, orthodontic set up in a dental stone and the removal of teeth #14(5) and #24(12) were done in the commercial laboratory, and then presented to the patient. Upon approval by him, we placed separators mesially and distally to #16(3) and #26(14) (Figure 3-A).

Bands were cemented on teeth #16(3) and #26(14) and also bonded self-ligating brackets on teeth #17(2), #15(4), #13(6), #23(11), and #25(13), #27(15) (Carrière a .022" slot, OrthoOrganizers). Power arms were constructed from a .018 x .025 SS and bonded to the facial surface of teeth #13(6) and #23(11) (Unietch, Bond 1, Tetric Evo, Ivoclar).⁴ An odontectomy of the teeth #14(5) and #24(12) was executed at the same appointment (Regional acceleratory phenomenon), as well as placement of TADs (1.6 x 8.0 mm AncorPro, Ortho Organizers) into the attached gingiva just mesially to #15(4) and #25(13).⁵ Two links of power chain were stretched from the TADs to the power arms of #13(6) and #23(11) (buccal intra). The cuspids are active, and the TADs are reactive (Third Newton's Law). The line of action was horizontal, close to the center of resistance of the cuspids. (Figure 3-B, C, D).



Figure 3: A) Orthodontic set-up of the maxillary arch; B) The power arm and the TAD in situ, right side; C) The power arm and the TAD in situ, left side; D) PA radiograms of the TADs in situ

Only a small piece of a .018 NiTi leveling wire was inserted between the second bicuspids and molars. Cuspids were not engaged at this stage; therefore, they were allowed to move freely. Distalization of the cuspids with the power chain to TADs creates disto-lingual moment. This lingual component is neutralized by a power chain from the lingual button from the cuspids to the cleat on the first molars (lingual intra) (Figure 4). After some spaces had developed between the incisors, a .018 SS sectional arch wire was placed into the brackets from the ipsilateral and contralateral cuspids to the second molars. A 30° off-center bend (tip-back, gable bend) was placed with Tweed loop forming pliers (OrthoOrganizers), just mesially to #15(4) and #25(13). The purpose for this off-center bend is to produce 10:1 Moment to Force ratio for bodily translation of the cuspids (Figure 5-A, B).⁶



Figure 4: Occlusal view of lingual intra



Figure 5-A: Off-center bend mesially to #15(4); B) Off-center bend mesially to #25(13)

It is paramount not to bracket or engage the arch wire into the maxillary incisors, in order to prevent undesirable Moments of the couple and labial moment (flaring) of the incisors. The inherent properties of the Straight Wire Appliance are: distal moment on the molars, leveling the curve of Spee, curve of Monson, and "dumping" the incisors labially. These undesirable moments may cause gingival recession, dehiscence, and bone resorption.⁷

Because the force of the power chain placed from the TAD to the power arm (buccal intra) on the cuspids was close to the center of resistance, an additional undesirable buccal moment (flaring) happened. In order to control this buccal moment an in-bend (30° off-center bend – tip back in the horizontal plane), was placed just mesially to the second bicuspids. This in-bend was bent intra-orally with the Tweed loop-forming pliers and



Figure 6: A) Off-center bend mesially to #15(4) in the horizontal plane; B) Off-center bend mesially to #25(13) in the horizontal plane; C) Off-center bends mesially to #15(4) and #25(13) in the horizontal plane

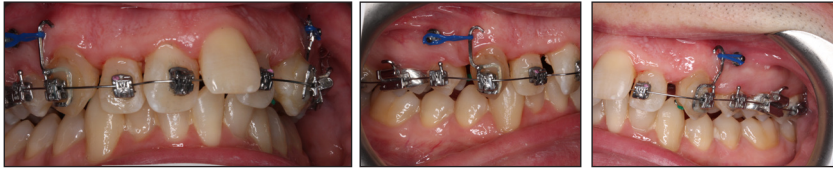


Figure 7: A) A .016 NiTi arch wire was placed in the maxilla; B) A .016 NiTi arch wire was placed in the maxilla, right lateral view; C) A .016 NiTi arch wire was placed in the maxilla, left lateral view

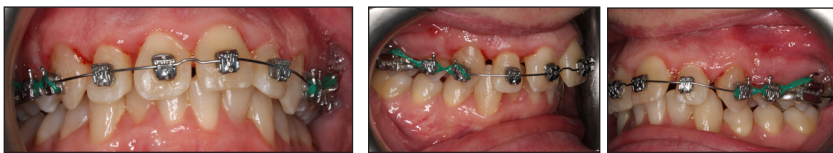


Figure 8: A) A .018 SS arch wire engaged to all maxillary teeth; B) The TAD was removed, PC from #16(3) to #13(6); C) The TAD was removed, PC from #23(11) to #26(14)



Figure 9: A) A .018 SS maxilla and a .016 NiTi mandible; B) A .018 SS and step-up maxilla, a .018 x .025 SS step-down and RC in the mandible; C) A .018 SS step-up maxilla and a .018 x .025 step-down and RC in the mandible

produced the lingual moment on the cuspid, which neutralized the flaring. (Figure 6-A, B, C).

Spaces had developed between the incisors. Thus a full .016 NiTi leveling arch wire was inserted. The most procumbent left central incisor was under-passed to prevent an undesirable moment of the couple and further flaring. In nine months, we have achieved a solid Angle Class I cuspid occlusion (full 8.0 mm correction) with the assistance of: a TAD, off-center bend in sagittal plane, off-center bend in horizontal plane, buccal intra, and lingual intra. One has to engage all these available modalities to achieve a pure translation of an extremely long cuspid (33.0 mm) in an adult patient (Figure 7-A, B, C).

The TADs were removed and the leveling arch wire a .016 NiTi and a .018 NiTi were placed, followed by a .018 SS arch wire. A power chain was placed from #13(6) to #16(3) and #23(11) to #26(14) to condense the spaces in the posterior sextants. Please note the amount of space created in the anterior region (Figure 8-A, B, C).

After bracketing the mandible, we placed a .018 SS arch wire in the maxilla and a .016 NiTi arch wire in the mandible (Figure 9-A).

A .018 SS arch wire with the step-up was placed in the maxilla and a succession of arch wires a .018 NiTi, a .018 SS, and finally a .018 x .025 SS with a step-down and a reverse curve in the mandible. In order to close the residual space, two links of a power chain were stretched between #13(6) and #12(7). This power chain had to be changed at least every two weeks, because of the fast degradation of the elastic material (Figure 9-B, C).⁸

Pre de-bracketing appraisal⁹

The pre-debracketing appraisal records comprise the facial photographs, intra-oral photographs, panoramic radiogram, and study casts. After prudent appraisal of the bracket position, root angulation, occlusion, posed smile, and maxillary incisor display (Incision to Stomion), seven teeth were re-bracketed (Figure 10-A, B, C, D, E, F, G, H, I)

The misaligned maxillary anterior teeth were re-bracketed and the incisal edges were re-shaped (Figure 11-A).

A .018 NiTi arch wire was placed in the maxilla to relevel the teeth. There was a .018 SS arch wire in the mandible (Figure 11-B).

The 1st order artistic wire bend (distal step-out) was placed on a .016 x .022 SS arch wire in order to precipitate a labial moment on the distal aspect of the rotated tooth #31(25). Even the Carrière self-ligating bracket was used, the latch had to be left open and the arch wire was ligated tightly with a .010 ligature tie (Figure 12-A, B).

A .018 SS, a .018 x .025 SS arch wire – flat, was placed in the maxilla and the same arch wire with a 1.0 mm step-down distally to the cuspids was inserted in the mandible. In addition, lace backs and power chains were placed as required to close the spaces and refine the occlusion. These final arch wires were left in for three months. After this time, the esthetics, TMJ, airway, and alignment were evaluated. The patient reported that he was satisfied and that he was happy with the result (Figure 13-A, B, C).

Count down on retention¹⁰

One month before de-bracketing, when everyone was satisfied and the patient had a .018 x .025 SS arch wire in the maxilla and the mandible, we appointed the patient for “Count down on retention.” The full arch wire was left in the maxilla; however, in the mandible, it was cut and bent-in, just distally cuspids. Also, 3/8” – 2.5 oz., letter “N” elastics (from the maxillary cuspid to the mandibular second bicuspid to the maxillary second bicuspid to the mandibular first molar) were placed for one month. After that time, the patient was booked for de-bracketing (Figure 14-A, B).

Retention¹¹

The retainers comprised of a maxillary QCM wrap around retainer, a maxillary bonded retainer, from #12(7) to #22(10), plus a bonded retainer from tooth #43(27)

Lateral Cephalometric Analysis

Description	Pre-treatment	Post-treatment
CVMS	6	6
SNA	87°	86°
SNB	82°	82°
ANB	5°	4°
Wits	4 mm	3.5 mm
NS/GoM	31°	33°
ALFH	79 mm	81 mm
U1/SN	120°	100°
L1/GoM	94°	93°
U1/L1	115°	134°
Facial axis	90°	91°
Harvold Δ	31 mm	32 mm
Nasio-labial angle	86°	103°

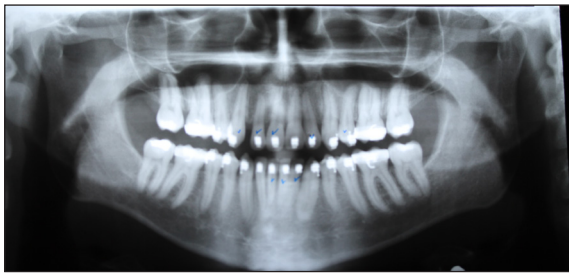


Figure 10: A) Pre de-bracketing, frontal view; B) Pre de-bracketing, lateral view; C) Pre de-bracketing, posed smile; D) Pre de-bracketing, panoramic radiogram; E) Pre de-bracketing, lips reposed; F) Pre de-bracketing, posed smile; G) Pre de-bracketing, right lateral view; H) Pre de-bracketing, frontal view; I) Pre de-bracketing, left lateral view

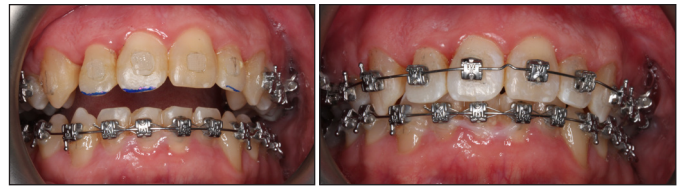


Figure 11: A) The misaligned maxillary anterior teeth were re-bracketed and the incisal edges were reshaped; B) A .018 NiTi arch wire was placed in the maxilla for the re-leveling

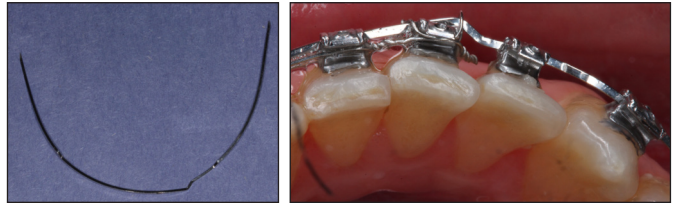


Figure 12: A) First order wire bend (distal step-out) on a .016 x .022 SS arch wire; B) First order wire bends (distal step-out) on a .016 x .025 SS arch wire tooth #31 (25)

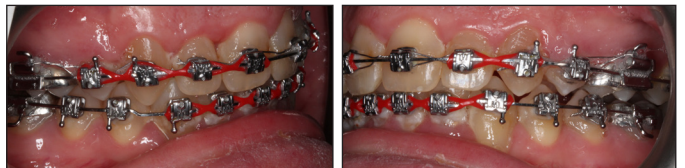


Figure 13: A) A .018 x .025 SS final arch wires, frontal view; B) A .018 x .025 SS final arch wires, right lateral view; C) A .018 x .025 SS final arch wires, left lateral view



Figure 14: A) A 3/8" - 2.5 oz. letter "N" elastic, right lateral view; B) A 3/8" - 2.5 oz. letter "N" elastic, left lateral view

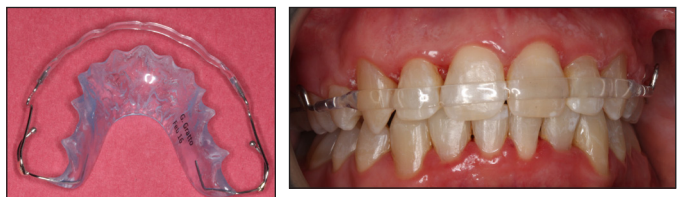


Figure 15: A) Maxillary QCM wrap around retainer; B) Maxillary QCM wrap around retainer in situ

to #33(22) in the mandible. These bonded retainers were made of a .0215 SS flexible spiral (braded) wire and bonded with Unietch, Bond 1, and Tetric Evo (Ivoclar). The patient was instructed to wear his QCM retainer 24/7 (except meals, brushing his teeth, and sports) for 12 months and after this time only at night. The bonded maxillary and mandibular retainers should stay in place indefinitely (Figure 15-A, B).

Please view the post-treatment images at the time of the insertion of the retainers (Figure 16-A, B, C, D, E, F, G, H, I, J, K, L, M, N, O, P).

Discussion

In this article, the author presented a challenging orthodontic case involving prognathic maxilla in combination with maxillary dento-alveolar protrusion. The patient was hyper-divergent, with crowding and excessive maxillary anterior teeth display. He was Class II skeletal and a full step Angle Class II dental. His lips were convex as related to “S” (Steiner) line and incompetent. The patient had 9.0 mm over-jet and 7.0 mm over bite and signs and symptoms of TM dysfunction. The lower airway was only 7.0 mm.

The outcome of the treatment was successful; even though it took a little too long. The patient had an Angle Class II molar and Class I cuspid relationship, SNA, ANB, and Wits have improved and decreased by 1.0° and 1.0 mm respectively. NS/GoM and ALFH became worse and increased by 2.0° and 2.0 mm respectively. The patient’s TMD and the airway have improved. There was a minimal overjet and overbite. The position of the anterior teeth was more favorable, whereas the nasio-labial

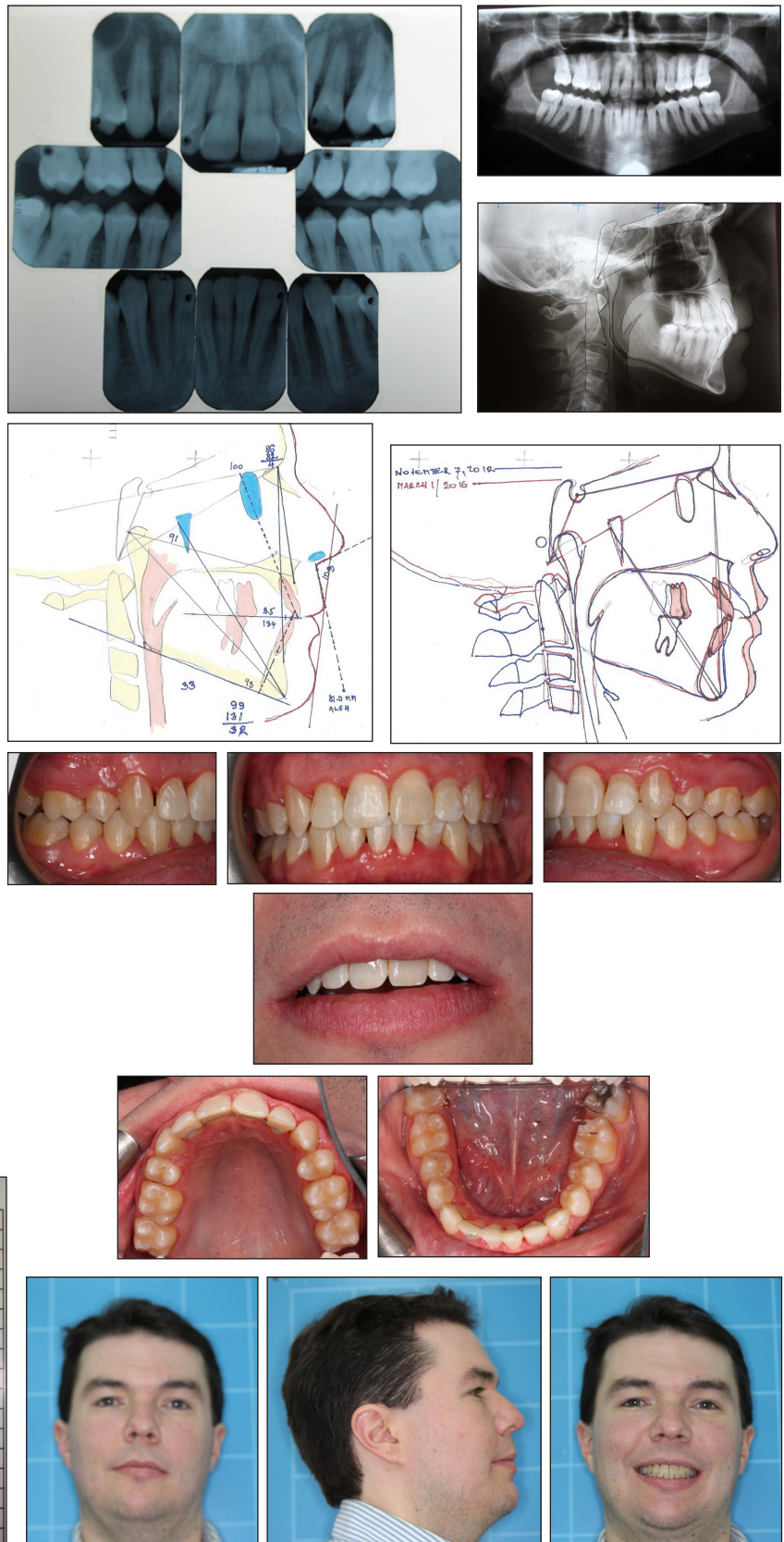


Figure 16: A) Post-treatment PA radiograms and bite wings; B) Post-treatment panoramic radiogram; C) Post-treatment lateral cephalometric radiogram; D) Post-treatment cephalometric tracing; E) Pre- and post-treatment cephalometric superimposition on Sella – Nasion; F) Post-treatment, right lateral view; G) Post-treatment, frontal view; H) Post-treatment, left lateral view; I) Post-treatment, lips reposed; J) Post-treatment, maxilla, occlusal view; K) Post-treatment, mandible, occlusal view; L) Post-treatment, posture, frontal view; M) Post-treatment, posture, lateral view; N) Post-treatment, frontal view; O) Post-treatment, lateral view; P) Post-treatment, posed smile

angle was almost ideal. The maxillary anterior tooth display was excellent with a positive buccal corridor. His lips were competent and they were right on the "S" (Steiner) line. On the lateral photograph of the patient's posture, there is still a slight head forward position. The patient did not sleep with an open mouth any more, his speech has improved, and his profile was pleasing. All in all, the patient was very happy.

Conclusion

The author presented an interesting orthodontic case of an adult Caucasian male with a true maxillary prognathism. He had a Class II malocclusion, maxillary dento-alveolar protrusion, hyper-divergent, severe crowding, and incompetent lips. The author pondered three distinct alternatives before the commencement of the orthodontic treatment:

1. Distalization of maxillary posterior sextants 8.0 mm in order to obtain Angle Class I molar, and Class I cuspid relationship. This can be accomplished with the aid of distalization appliances, i.e. Greenfield appliance, DMJ 2000, 3D Motion appliance, or TADs. Unfortunately, this option would precipitate the clockwise rotation of the mandible and increase the anterior lower face height on an already hyper-divergent patient. Plus, the treatment would take much longer.
2. Odontectomy of the maxillary second bicuspid, as these are smaller and less valuable than the first bicuspid. This option is a maximum anchorage case; his maxillary molars would have to be stabilized with a colligation of molars and placement of a TP arch/Nance button combination in order to preserve the anchorage. A better option would require the assistance of TADs and more complex mechanics.
3. Odontectomy of the maxillary first bicuspid and bodily translation of the cuspid with the assistance of TADs. The moment-to-force ratio has to be kept at 10:1 during the entire distalization movement of the cuspid.

The author chose the last alternative, because he believed that this option would give the patient the best function, esthetics, TMJ health, and shortest treatment time.

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