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The method of Root Canal Treatment before Extraction technique in an orthodontic extraction case with Labial Braces

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ABSTRACT

In the previous article on the method, we studied how to systematically close the extraction gap to resolve constricted alveolar bone malocclusion, which is common in orthodontics and may require several months or years to resolve. The main study pertains to orthodontic cases with a substantial arch-length discrepancy that require extractions; Class II Division 1 and 2 cases typically favor first bicuspid extractions. The study showed that root canal treatment of the indicated extraction bicuspids facilitates interproximal reduction of the mesial and distal areas, thereby providing space. This method provides an option to reduce the Arch Length Discrepancy and delay extraction timing during the initial alignment stage. The orthodontist's initial treatment aims to align the crowded area and correct the Curve of Spee. The treatment could begin with bracket placement, either Lingual or Labial orthodontic method, before reaching a stage at which it is ready to close the space created without extraction. This paper presents case studies to demonstrate the advantages and disadvantages of delaying extraction using the Root Canal First Before Extraction method. The sample cases are used to demonstrate the method's effectiveness and to highlight potential disadvantages in complex cases.

Keywords: regional acceleration phenomena (RAP) , bone density, delayed tooth extraction timing, root canal treatment (RCT), time to close the extraction site in orthodontics, arch length discrepancy (ALD), interproximal reduction (IPR), tooth movement, labial brackets, lingual brackets, Root Canal First Before Extraction method.

Introduction

Closing the extraction gap is more difficult after alveolar resorption. It is essential to close the extraction gap promptly and reliably to prevent relapses[1].

Initiating a study to close the extraction gap immediately after extraction is advisable[2]. Utilizing the regional acceleratory phenomenon (RAP)[3,4] and leveraging the decreased bone density during orthodontic treatment[5,6,7] can also be advantageous.

The use of delayed extraction after aligning the first stage of orthodontic treatment, followed by root canal treatment, has been published[8]. The study has shown that this method prevents the later problem of closure of the extraction site, as demonstrated by these cases.

However, we need to be careful because the delayed extraction method using Root Canal Treatment, interproximal reduction, and then extracting afterward may not work very well in complex, difficult cases. This is because the average value of the study includes both easy and normal cases on one end and difficult cases on the other.

The following two cases will illustrate a typical, relatively simple orthodontic case, followed by a more complex case involving skeletal and condyle deformities. In these cases, treatment priorities and flow may differ, which can also affect treatment duration, as the time needed to close the extraction spaces is longer.

THE PREPARATION.

Before orthodontic treatment, root canal procedures were performed on all bicuspids that needed to be extracted. Extraction is performed after aligning the maxillary and mandibular arches, followed by placement of closing arch wires to close the extraction gap.

The closing process started immediately after the teeth were extracted. The study measured the time needed to close extraction sites in typical clinical situations. This is because severe crowding and a posterior or anterior crossbite require longer alignment periods; therefore, the timing applies only to these cases, not all cases. Crowding cases with a 9 mm or greater arch length discrepancy, without severe skeletal issues, are considered routine clinical cases.

The method assumes that RAP and decreased bone density will reliably seal the extraction site within a designated time frame.

The need for bicuspid extraction varies among clinicians. An arch length discrepancy of 5–9 mm may be necessary and usually requires extraction; for an ALD exceeding 10 mm, extraction is definitely necessary[9].

Below are two cases using the Root Canal First Before Extraction method. The first case demonstrates how the Root Canal Treatment before Extraction method can fully benefit from the technique, while the second case shows a cautious application of the same method.

The first case.

The first case involves a Class I to Class II tendency, with crowding and an arch length discrepancy (ALD) of 3mm in the upper arch and 9mm in the lower arch. It is a labial fixed appliance case with the extraction of the upper and lower first bicuspids. The labial fixed appliances utilize a self-ligating mechanism. The patient is a 20-year-old female concerned about her protrusive profile.

The case is characterized by a right-shifted upper midline and a left-shifted lower midline, separated by a 5 mm distance. Overjet and overbite are about 3 mm, and the mandible is slightly retrusive. SNA is 79.8°, SNB is 74.7°, and ANB is 5.1°. FMA is 28.8°, indicating a moderate mandibular plane angle. The E-line extends from the tip of the nose to the chin, with both upper and lower lip protrusion, suggesting an extraction case. Age 14 years, female, with no growth expected. Facial height is 145.4 mm, which is average.

Palatal Pl-FH is 3°, which perhaps makes the bite of the anterior upper and lower teeth seem deeper than average.

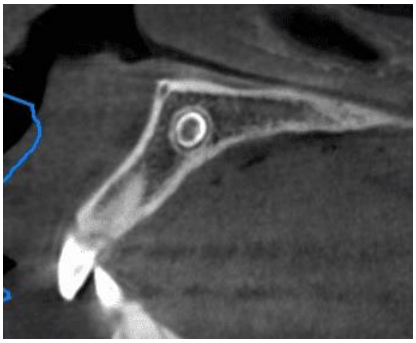

Fig. 1 The supernumerary impacted teeth

A supernumerary impacted tooth was found on the maxillary alveolar bone side of the foramen incisivus. The patient was referred to an oral surgeon for the removal of the impacted tooth.

Below is the initial Cephalometric tracing comparing the blue line representing the average and the red line representing the patient.

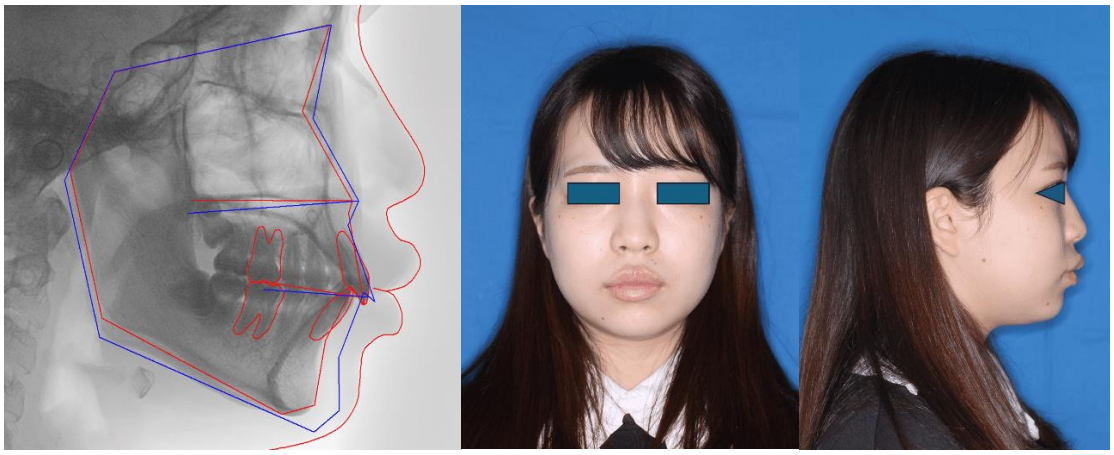

Fig. 2. The initial cephalometric. Fig. 3 and 4. Initial facial photographs.

Fig. 5, 6, and 7. Right view, front view, and left view.

Fig. 8 Maxillary occlusal view. Fig. 9. Mandible occlusal view.

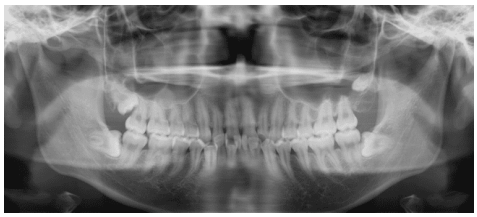

Fig. 10. The panoramic view of the initial stage.

The crowding of the lower teeth was obvious; the bone structure, as well as the condyle and articulation structures, were healthy. The four impacted wisdom teeth will affect the treatment; 3 were extracted immediately, except for the upper left side, as there is a risk to the maxillary sinus when attempting to extract it.

Root canal treatment was performed on the intended tooth extractions before bracket placement, and IPR was performed as needed to align the crowded arch. Routinely, 2mm or more of enamel and dentin are removed from the mesial and distal sides. The IPR creates at least 4mm of space on each side, increasing the arch length by 8mm. The IPR can be increased at each stage of the alignment procedure. Straight wire brackets were then placed, and alignment began with a .012 Titanium straight wire. The alignment of the upper and lower teeth can be progressed quickly. Once a titanium wire size of .016 x .022 was reached, it was

replaced with Multiple Loops Edgewise (MEAW) wire in preparation for the extraction procedure. The MEAW wire is a stainless-steel wire (S.S. wire) with a .016 x .022. In both the upper and lower arches, the MEAW[10,11,12] technique was applied. MEAW, which stands for Multiloop Edgewise Arch Wire, is a specialized orthodontic technique that uses a custom arch wire with loops to deliver precise, low-force corrections. An arch wire originally developed by Young-Ho Kim. This technique reduces friction between brackets and provides a continuous, adjustable force without changing the wire. The force range is 150-200 g, moving adjacent teeth mesially and distally of the extraction site. MEAW was set before the extraction of the bicuspids.

Fig. 11. The upper MEAW wire. Fig. 12. The lower MEAW arch wire.

The MEAW wires are used to finalize the alignment and serve as the closing loop wire. The timing of extraction was when the adjacent teeth would touch the mesial and distal of the RCT bicuspids; the remaining tooth structure of the RCT teeth could be removed as much as possible, depending on the need to accommodate the ALD in the initial stage. MEAW wire was immediately activated after extraction to close the interproximal reduction gap. During closing extraction spaces, a .017 x .022 S.S. wire could be more effective, although a .016 x .022 S.S. wire could be used as well. The extraction of the RCT's teeth usually is not difficult, as the teeth and surrounding bone have already been biologically affected by the mechanics of tooth movement and RAP involvement, as explained before. Reduced bone density and increased remodeling: Orthodontic forces induce continuous bone resorption on the pressure side and apposition on the tension side, temporarily lowering bone density and making the alveolar bone around moved teeth less rigid. This can reduce resistance during elevation and luxation[13].

The decreased bone density, combined with the increased periodontal ligament width due to prolonged orthodontic loading, can widen the periodontal ligament (PDL) space in areas of tooth movement, decreasing the mechanical interlock between the root and bone, which helps instruments separate the tooth from its socket more easily[14,15,16].

The next step is to close the extraction side as soon as possible. This is where the MEAW wire can be very useful, as not only will the extraction space be closed, but the arch form will also be controlled, and each tooth within the arch will receive 3D directional movement. The upper and lower arches use inter-arch vertical elastics, which coordinate them.

After closing the extraction space, we can take a Cone-Beam Computed Tomography (CBCT) scan to confirm the parallelism of the roots of the adjacent space. Then we plan to place the TADs to move the entire arch distally. At that time, the previous CBCT was used to determine TAD placement and verify correct implantation.

In orthodontics, achieving root parallelism is essential to prevent relapses after treatment[17].

The treatment sequence could be explained as follows, based on the intraoral photographs.

Fig. 13. Left side of the maxilla, right side of the mandible.

The first bicuspids were gradually trimmed to achieve the desired amount of Arch Length Discrepancy, making alignment easier as the wire progressed to a stiffer one.

Fig. 14. Left side of the maxilla after extraction and right side of the mandible after extraction.

The extraction was performed the same day, and the photographs were taken a week later, when the threads from the sutured extraction sites were removed.

Fig. 15. Left side of the maxilla and right side of the mandible during closure of the extraction spaces.

The photograph was taken 128 days after the extraction of the four bicuspids. The upper and lower right extraction sites were closed, leaving the left upper side with less than 1 mm of opening and the mandibular left side with about 2 mm of open space.

The time to close the extraction sites on the upper right and lower right was 128 days, whereas the upper left took 151 days and the lower left took 176 days. This may be due to differences in alveolar bone structure and bone density; the time required for post-extraction space closure in the previous study was 218 days in the mandible and 235-240 days in the maxilla.[18] In this case, closing extraction spaces took less time than the average for this kind of method.

The extraction sites were closed using the conventional posterior teeth as anchorage to move the anterior teeth proportionally; no TADs were used to determine how the extraction sites would close without additional devices, and the time required was measured.

The overjet and overbite have been controlled 3-dimensionally by the MEAW wire, and the relationship between the upper and lower molars remains Class I. However, it is evident that we now have bimaxillary protrusion and a gummy smile that the patient would like to improve. We prepared to move the upper and lower teeth distally using TADs.

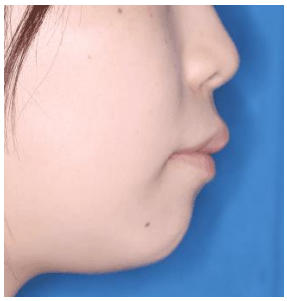

Fig. 16. The bi-maxillary protrusive profile. Fig. 17. The Gummy smile.

Before TAD insertion, density was measured to likely represent the point of highest resistance[19].

The upper mid-palate suture area was chosen because the bone density is high and there are no teeth present. A Trans Palatal Arch (TPA) was constructed, and a Benefit plate[20] with hooks in the middle was used to retract the entire upper teeth distally. On the lower mandibular ridge, between the first and second molars, the TADs can be placed vertically to provide en-masse distal movement of the entire mandibular teeth[21].

Fig. 18. On the left side is the maxilla with a Trans Palatal Arch with a Benefit plate, on the right side is the mandible with 2 TADs on the ridge of the mandible between the 1st Molar and the 2nd Molar.

Fig. 19. On the far right, the placement of the TADs in the ridge of the mandible is shown.

Fig. 20. The TADs on the labial of the laterals and the canines.

The gummy smiles will be addressed through labial insertion of TADs between the roots of the lateral incisors and canines[22]. The combination of distalization and intrusion of the upper teeth, along with distalization of the lower teeth, was used to treat bimaxillary protrusion[23]. The Cephalometric measurements of the lateral cephalogram and the Panoramic determined the finalization of the case, combined with oral function test and soft tissue improvement[23].

Fig. 21. The occlusal view at the completion of fixed appliances treatment. The maxilla is on the left, and the mandible is on the right.

Fig. 22. The left side shows the lateral facial photographs, from left to right, depicting the initial, the end of fixed appliance treatment, and 2 years after retention.

Fig. 23. The right side shows intraoral occlusal views of a 2-year post-retention intraoral photograph.

Fig. 24. The Gummy Smile improvement.

The time from the initial bracket placement to the final alignment with the MEAW and readiness for extraction was one full year of treatment. Extraction and closure of all four quadrants took 176 days; the last area to be addressed was the lower left first bicuspids. The use of TADs to correct the remaining bimaxillary protrusion and the Gummy Smile took another 9 months, after which all the brackets could be removed. During this time, the patient received oral myofunctional therapy and exercises to recover from the TMD they had suffered before treatment[25]. At the end of treatment, the patient maintained good masticatory function with no pain or jaw clicking. The total treatment time was 721 days, or about 2 years. During the two-year retention period, there were no relapses, and we kept records comparing pre- and post-treatment outcomes and retention.

Fig. 25 shows the cephalogram of the initial (red), the retention (blue), and the records after 2 years (green).

The second case.

The case involves a 22-year-old female with a Class II skeletal high-angle open bite. The patient presents with TMD, including clicking and pain. Her upper and lower arches are constricted, showing severe crowding of both the upper and lower teeth. A deviated swallowing pattern and a short tongue frenulum suggest she is a mouth breather[26]. The mandible deviates to the right, and there is an obvious slanting of the occlusal plane, which affects her speech[27]. Achieving an improved facial image and function without surgery is a significant challenge solely through orthodontics, as skeletal issues often require surgical intervention. However, treatment options vary depending on severity, patient age, and goals[28].

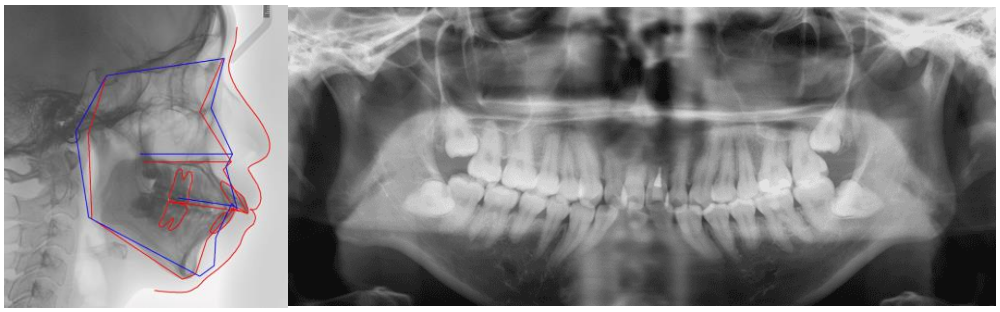

Fig. 26. The left side shows the patient's initial Cephalogram (red line) compared to the average (blue line). Fig. 27. On the right side is the initial panoramic radiograph.

The four impacted third molars were referred to the oral surgeon for removal. The panoramic radiograph showed that some of the anterior incisor roots were very short due to a tongue-thrust habit; the tongue's chronic pressure jiggles the anterior teeth, causing mobility each time during speaking and eating[29].

The cephalogram revealed a bimaxillary protrusion of an underdeveloped maxilla and mandible, with a Class II skeletal pattern—high-angle case with FMA 34.4°. The downward movement of the maxilla mainly caused the facial vertical height, and the mandible rotated clockwise by 115.5 mm. The condyle was deformed, and erosion occurred on the mesial side of the right condyle, making opening and closing of the jaw difficult. The bent condyle may be due to trauma the patient was unaware of at the time[30]. The masticatory muscles also contributed to the deformation of the skeletal pattern. The rather low position of the hyoid bone reveals the importance of the problem in swallowing function.

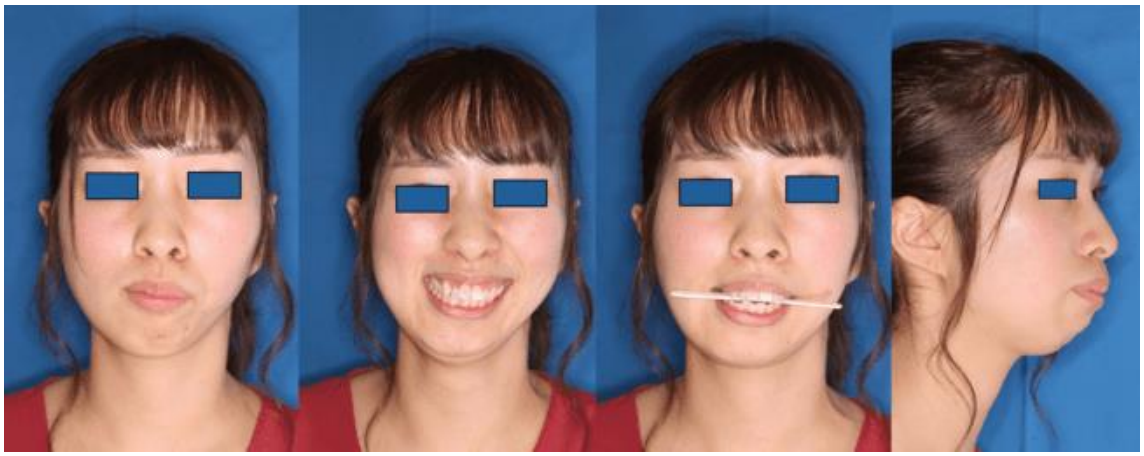

Fig. 28. Facial frontal and lateral photograph.

The difficulty in closing the lips together makes the gonial muscles contract against her will, causing the Gummy Smile, a deviated occlusal plane, and a rightward deviation of the jaw. Showing a long lower third of the face is disturbing to the patient[31].

Fig. 29. Intraoral photograph of the initial stage.

An open bite of the anterior teeth and a tongue thrust, along with a short tongue frenulum, might exacerbate condylar pathology and worsen TMD.[32] Nasal obstruction may contribute to a constricted upper arch, leading to unequal molar widths and a crossbite in the first molar region[33,34].

The orthodontic treatment involving premolar extractions will be challenging, as the upper ALD was as much as 11 mm, and the lower was 9 mm. Achieving the necessary space after removing only two bicuspids can be very difficult, and it is important to move the upper and lower teeth distally.

A root canal treatment was performed before the patient's brackets were placed. After tooth alignment, she will have the first bicuspid extracted as required by the treatment plan. The bracket placement without TADs was done to align the upper and lower teeth.

Fig. 30. The occlusal view of the upper and lower arch during the alignment stage.

Take advantage of the IPR of the first bicuspids as much as possible. The teeth were trimmed to their limits, and extraction was performed when no additional space could be gained with IPR.

Fig. 31. The occlusal view one week after the extraction of the first four bicuspids.

The upper arch utilizes the Trans Palatal Arch and Benefit plate to distalize both arches and intrude the posterior molars, especially on the left side, to correct the slanting occlusal plane as much as possible.

Fig. 32. The left picture shows the placement of the labial TADs, and the lower shows the "Propeller" for the correction of the lower midline. On the right side, the Trans Palatal Arch is shown with the Benefit plate intruding into the molars on the left side.

The correction of the Gummy Smile was performed using TADs placed on the labial side of the incisors: the right labial between the lateral and central, and on the left between the lateral and canine. This was chosen because of the root proximity of the anterior upper teeth. The upper and lower midlines were driven toward the original placements for correction. The "Propeller" is a device used to drive the teeth of the whole arch in one direction[35]. The TADs were placed between the roots of teeth 45 and 43, engaging the propellers with the heads of the TADs, and on the other side, the pins drive the incisors in the intended direction. The upper arch is mostly intrusion of the left posterior region using the Trans Palatal Arch and the Benefit Plate as anchorage[36]. The second molars were extracted to distalize the upper arch more effectively and use the third molars as replacements. The decision to extract the upper second molars was related to the TMD symptoms that, after the extraction of the four bicuspids, pain occurred during opening and closing, and during mastication. Bite plates were added to the occlusal surface of the posterior teeth, and the orthodontic force to move the teeth was halted[37]. The open and close jaw exercise was given to lessen the pain and relieve the patient from pain[38]. The effect gave a good response, and the pain was relieved, but the clicking symptoms were worrying, so we decided to continue for 4 months before starting the orthodontic tooth movement again.

In correcting the cant of the occlusal plane, combined with the shifted mandible to the left direction, the existing bite plane was used to couple the plane to the left direction as well as to rotate the occlusal plane counterclockwise[39].

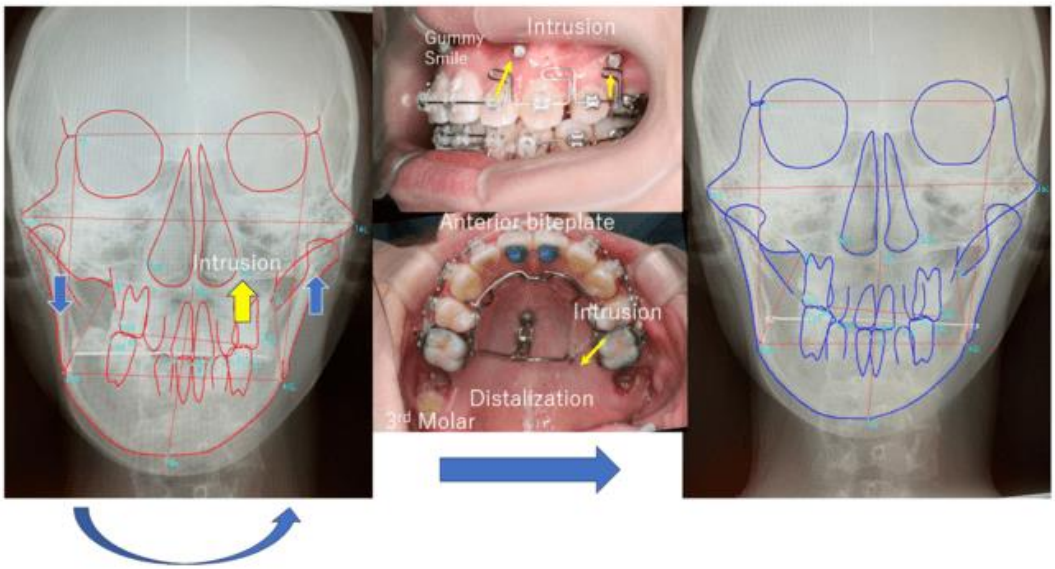

Fig. 33 The series of moving the shifted mandible with its occlusal plane from right to left.

In the left frontal image, the upper left molars demonstrate intrusion into the alveolar bone, with a measured depth of 3 mm[40]. In the central lower image, an anterior bite plane is shown, to which forces were applied using an anterior cross elastic. The effect of which might not only shift the mandible to the left, but also may distract the right condyle, and compress the left condyle; therefore, the use of very light force was necessary. In the image, the Trans Palatal Arch was used in combination with the midpalatal Benefit plate to retract the whole upper arch distally and intrude the left posterior side of the arch. The intrusion of the left posterior upper molars was reinforced with buccal placement of TADs, and the Gummy Smile correction was achieved using anterior labial placement of TADs, as shown in the middle upper image[41].

In high-angle cases with joint symptoms, it is recommended to extract the maxillary second molar to control vertical height[42]. The third molar, as it erupts, can be aligned with the rest of the upper teeth.

The right image is the frontal view of the Frontal Cephalo x-ray at the end of the treatment. A slightly better proportion between the maxilla and mandible was observed.

The difficulty is that after the mandible shifted to the left, the muscles and the condyle with the disc may take some time to adapt. Therefore, we wait for some time while continuing light-force cross-elastic maintenance.

What we see is not very promising in terms of how long it takes to finish correcting the mandible to the left, especially when compared to the final result, once we stop using the elastic and have to remove all fixed appliances at the finishing stage.

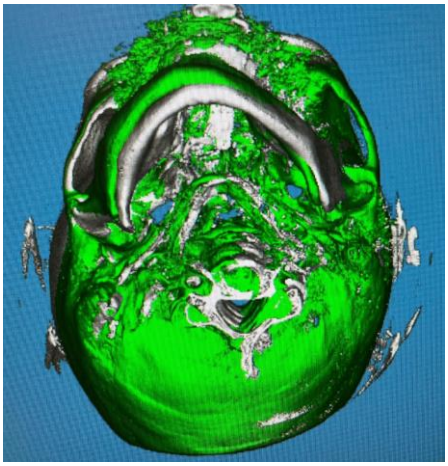

Fig. 34 The CBCT overlay showing the initial and shifted mandible after molars intrusion and cross elastic maneuver.

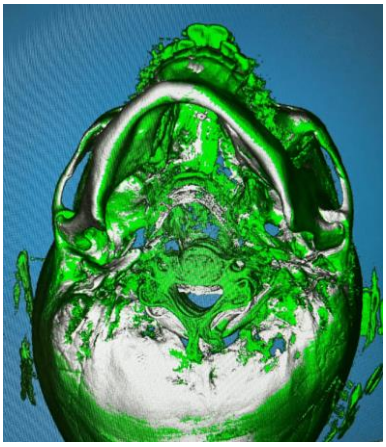

Fig. 35. The same overlay of the initial and the time we are ready to remove the fixed appliances.

In figures 34 and 35 above, the mandible did return to its initial position. The difference may be in the occlusion of both the maxilla and mandible, resulting in a much better relationship. This may reduce some degree of relapse, and some of the mastication apparatus will also adapt to the new, improved relationship between the upper and lower teeth.

Fig. 33. The time at which all the brackets were taken off at the end of fixed appliance treatment.

It took 10 months to align the upper and lower arches. The first bicuspids were then extracted. It took 130 days to close the extraction spaces for the right upper and lower bicuspids.

The upper left bicuspid took 251 days to close the extraction side, so the opposite side, where the lower left bicuspid took a further 260 days to close. The closure of the extraction sites was disrupted by the occlusal plane corrections and the midline correction, which should be handled first. The total treatment time was 34 months. During the treatment, expansion of the upper arch was performed to correct the right crossbite, and depressed the upper left occlusal plane and the lower occlusal plane. Allow time for the condyle to adapt to the new occlusal plane. Myofunctional therapy, open-close exercises for the correction of TMD, and referral to an otorhinolaryngologist (ENT) for nasal breathing adaptation to correct facial expression.

After the brackets are taken off, the relapse of the bite follows, as the correction may not be immediately followed by function and adaptation. Instruction could be given, but some relapses should also be accepted. The relapse mainly relates to the adaptation of the slanted occlusal plane and the jaw.

Fig. 34. The intraoral photograph at the time of the removal of the brackets.

It was obvious that the jaw was trying to shift to the right again; we maintained the upper and lower arches using the Bio Star clear aligner to stabilize the tooth formation and the relationship between the upper and lower arches. The mandible immediately shifted in the photo. 34, lower left. One year has passed. Ironically, there were no changes, like in the first week of the end of fixed appliance removal. We have stressed that myofunctional exercises should be performed daily and that the left and right sides of the jaw should be used equally when eating. The ENT visit should also be continued until the symptoms are resolved. The patient moved to another prefecture and promised to come when she goes nearby.

Fig. 35. Facial photographs at the time of the finished fixed appliance treatment.

The canted occlusal plane was slightly better than before, the Gummy Smile looked better, the lower third dimension of the face looked better, and the lateral view looked much better, as the Hyoid bone went up with the Myofunctional Therapy. She is prettier than before. Her visit to the office again will be very exciting, as it will reveal the outcome of the case. The mandibular plane rotated upward from 34.4° to 30°, which is closer to the average and will provide stability of the post-treatment condition[43].

Fig. 36. The cephalogram of the initial stage (red) and the retention (blue).

The change in the profile was obvious. The patient was happy with the result; she moved to another prefecture and hoped she could come again for the 2 years after the retention observation and records.

Discussion

The time required to close the maxillary or mandibular extraction gap varies by case. Some cases can be completed quickly because the RAP helps close the gap as bone density decreases over time. This raises the question: how do we determine the treatment timeline for an orthodontic case in advance? Assessing the complexity of orthodontic treatment is very challenging from the start. The case should be defined and evaluated in terms of effort and skill, but then it depends on individual analysis; perhaps a questionnaire could assist, after which we can categorize the severity[44]. While severity indicates how much a malocclusion deviates from ideal alignment, it still remains difficult to predict whether the RCT-first-before-extraction method will result in a faster finish. Although high bone density is a concern, it doesn't mean we cannot estimate how long it will take to close the

extraction case. Sometimes, repositioning the relationship between the upper and lower teeth for better interdigitation to stabilize the occlusion and correct the midline requires more tooth movement on one side. There will be an occlusal plane that needs correction, along with intrusion and distalization of the posterior and anterior teeth; attention to the Gummy Smile is also routine. Often, additional anchorage and more TADs need to be inserted mid-treatment, which isn't apparent at the beginning because 3D movements cannot be performed simultaneously. The adaptation of the condyle should also be considered, and normalizing oral function is essential to achieve stability in the end. Therefore, at present, we know that severe crowding, deep overbite, crossbites, and open bites top the list of difficult issues. High-angle anterior open bites with TMJ dysfunction rank among the toughest due to extrusion resistance and joint complications. Cases with extensive arch-length deficiency or missing teeth also prolong treatment and increase the risk of poor outcomes. Patient-related factors: adult patients pose unique challenges, including reduced compliance, poor hygiene, and psychological barriers to visible appliances. It is obvious that poor cooperation leads to hygiene crises and extended treatment time. While the treatment should be finalized, monitor any changes and additional plans during the process, and inform the patient beforehand.

Conclusion.

The maxillary teeth were then moved to consolidate the mandibular teeth, a process that may take time. Therefore, the Root Canal First Before Extraction method will help in many cases, but not all, especially when complex maneuvering is required, which is another priority at every step of orthodontic treatment. By understanding the limitations and advantages of this Root Canal First Before Extraction method, the orthodontist can wisely treat both easy and difficult, as well as complex, cases.

A comparison with other orthodontic treatment options, like lingual orthodontics and aligners, is also important. However, a randomized controlled trial (RCT) should be done first, not on the appliance itself. Still, in cases requiring extraction, this method could help determine the best timing for removing teeth. It will yield the same result as delaying extraction, allowing time to prepare the arches—both upper and lower—before closing the extraction gap. Extraction can occur once all preparations, such as aligning, leveling the Curve of Spee, and setting up for gap closure, are completed. After extraction, the process can continue. Take advantage of the RAP once the tooth is removed. Before extraction, brackets are placed on the tooth to prevent bowing. Applying Root Canal Treatment before Extraction (RBE) is practical across all areas of orthodontics.

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