Face Design and Orthodontics

Concept, Mechanics and Clinical cases

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Contents

Chapter 7

Face and TMJ Pain

Modern orthodontics practiced throughout the world today is ineffective in treating adolescents with TMJ pain caused by disc displacement (DD), because it is not equipped to assess the progression of DD, which often is the primary cause of joint pain.[1-4] Why do adolescents complain of TMJ pain or discomfort? Objective assessment of the TMJ is not part of orthodontic diagnosis, which precludes an accurate diagnosis of DD progression in daily practice. This is why we are puzzled by such cases as the one discussed in this chapter. A visual examination of the dentition shows that this patient has straight teeth and good bite (Fig. 7-1). In her case, to put it harshly, conventional orthodontics is useless,

現在世界中で行われている矯正治療では、円板転位（disc displacement, DD）を原因とするTMJの痛みを訴える思春期の患者に対して無力である。何故なら痛みの主な原因であるDDの進行状態を把握することができないからである[1-4]。なぜ思春期の患者がTMJの痛みまたは違和感を訴えるのか。そのTMJを客観的に見ることが診断の中に入っていない。そのDDの進行状態を的確に診断することを日常の臨床で行っていない。だから本章で見ていくこの患者のように一見口の中では上下の歯がきれいに並び、口の中でみる限りよく咬んでいるような場合『？』となる（Fig. 7-1）。強い表現ではあるが、この症例の場合伝統的矯正治療の出番はない。ましてやいわゆるアラ

Fig. 7-1 **Face and TMJ pain**

A 14-year-1-month old girl presented with TMJ pain (A). Her history and chairside examination revealed not only TMJ pain, but also trismus, muscle strain and headaches. There appeared to be no problem with her bite. Her older sister had been treated in our office, because of advanced DD. Splint therapy was initiated to see if her TMJ pain and other symptoms were related to her occlusion. Her TMJ symptoms improved as splint therapy progressed. While these symptoms were eliminated, her occlusion changed significantly post-splint. She developed an open bite, and the lower facial height was increased (B). A functional occlusion was obtained with the extraction of four premolars and careful vertical control during orthodontic treatment. Facial esthetics was improved with a reduction in lower facial height (C).

14歳1ヶ月の女子でTMJの痛みを主訴として来院した（A）。既往歴、そしてチェアサイドの診査でTMJの痛み以外に開口障害、筋緊張、頭痛があったが、歯の咬み合せには大きな問題がないように見えた。姉も進行したDDで当院で治療している。まずスプリント療法を行い、TMJの痛みなどの症状が咬合と関連するか観察した。スプリント療法が進むにつれ、TMJの症状は改善、スプリント療法後は消退した。咬合は大きく変化し安定したがオープンバイトになり、顔貌は下顔面高が増大した（B）。小臼歯4本を抜歯し、注意深くバーティカルコントロールを行い機能的咬合を達成した。顔貌は下顔面高を縮小し改善した（C）。

let alone orthodontic appliances designed only to align teeth such as clear aligners, because her teeth are already straight.

Then, how can we treat patients like this? The following questions should be asked during the patient interview: Do you have anyone who has experienced similar symptoms in your family? What symptoms (e.g., sounds, catching, discomfort) have you experienced on which side of the jaw or both sides, and since when? Children are vulnerable to injury. The patient should also be asked about a history of trauma in childhood. A trauma to the chin may damage the TMJ and trigger DD. Attention should be paid to bruxism as well.[5] Limited-CBCT and MRI are available today, and initial records should be taken using these imaging modalities. Because TMJ pain is one of the signs of DD progression, tooth movement should not be initiated without further investigation. The severity of DD should be evaluated carefully before starting orthodontic treatment. One should gain experience in treating patients with incipient and moderate DD before embarking on the treatment of advanced DD. TMJ pain in adolescence is treatable when the principal cause is DD. Splint therapy combined with orthodontic treatment performed is effective in treating the condition if done with utmost caution.

イナー矯正のような歯を並べるだけの矯正では、そもそも歯がある程度並んでいるのだから役に立たないのである。

それでは、どう治療するのか？問診で以下のことを確認する。まず家族に似た症状を経験した人がいるか。彼女自身過去にTMJエリアでどのような症状、例えば音、引っかかり、違和感などをいつ頃、左右どちらまたは両側で経験したのか聞いていく必要がある。外傷も小児の時期多いので、そのことも確認していく。オトガイを打つとTMJへの外傷となり、DDのきっかけの一つとなる。歯ぎしりも要注意である[5]。現在ではlimited-CBCT、MRIが利用可能であるから、資料として採取する。TMJでの痛みはDDが進行している1つのサインなので、安易に歯の移動を開始してはいけない。細心の注意のもとDDの程度を把握してから処置を行うべきであるし、初期そして中期のDDの治療の経験を積んでから行うべきである。しかし思春期のTMJの痛みはDDをその主因とするなら治療可能であり、十分に注意しながら行えばスプリント療法そしてそれに伴って行われる矯正治療は有効である。

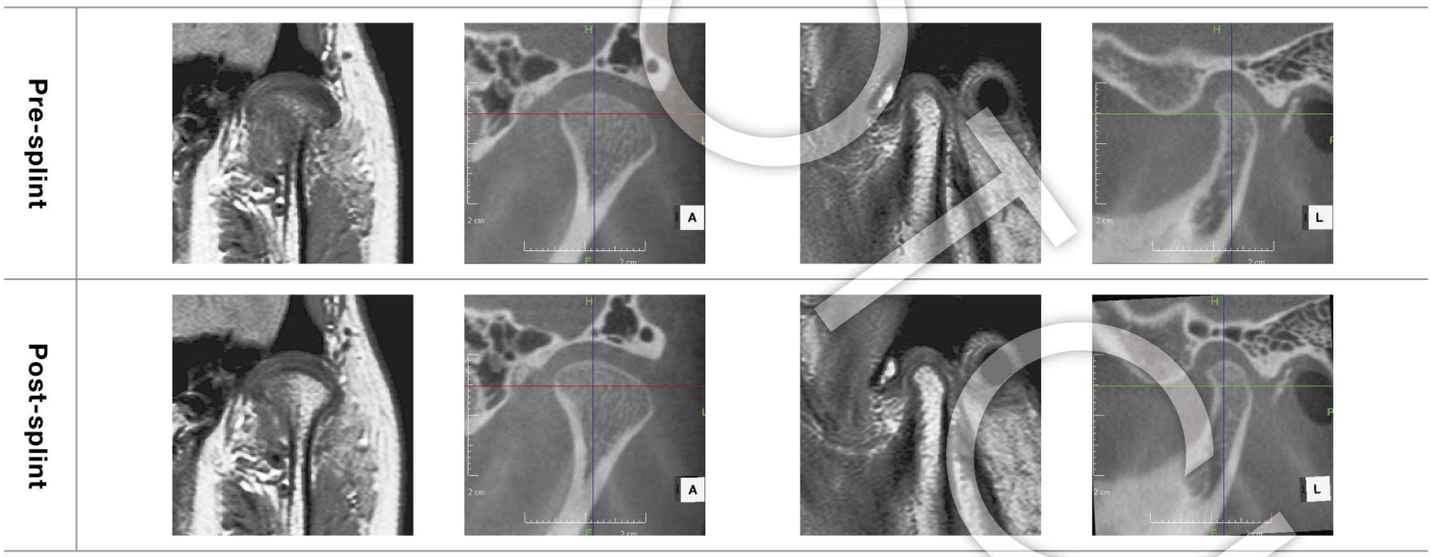


Fig. 7-2 Face and TMJ pain

Comparison of limited-CBCT and MRI images of the left TMJ before and after splint therapy. Her disc position was improved with mandibular stabilization in both sagittal and coronal planes. Her TMJ pain was eliminated, demonstrating that there was an association between her bite and chief complaint. Although the condition of DD is said to deteriorate over time, the morphology and position of the disc can be improved in incipient or moderate DD in my experience.

スプリント療法前後の左側TMJのlimited-CBCT画像とMRI画像の比較である。顎位安定と共にこの症例の場合も円板の位置は矢状面、冠状面両方向で改善している。彼女のTMJの痛みはなくなり、咬み合せと主訴の関連性がわかった。DDの状態は経時的に悪くなると言われているが、スプリント療法により円板の形態や位置の改善は、比較的初期、中等度のDDでは起こるのを経験している。

located at the tip of the mandible, but also an anterior open bite. When the condition occurs unilaterally, the chin often deviates to the affected side,[10,11] producing significant changes in occlusion and seriously affecting facial esthetics. Naturally, the longevity of the teeth will be greatly compromised. For adolescent patients, it is still possible to try and prevent DD from progressing to an advanced stage, and then to achieve a functional occlusion and a pleasing smile with orthodontic treatment, as demonstrated in this case.

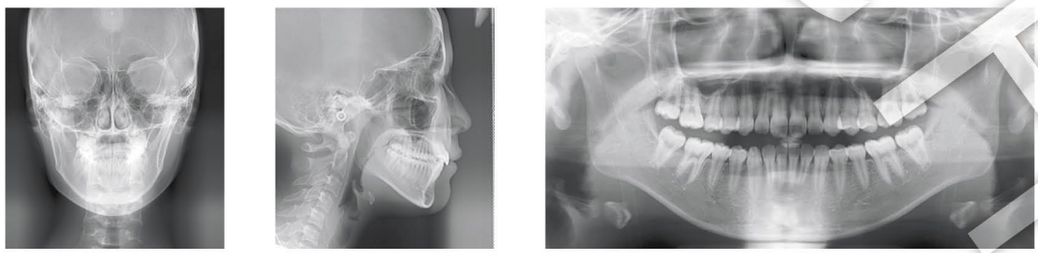
Case summary

A 14-year-1-month girl presented with TMJ pain. History taking and chairside examination revealed not only TMJ pain, but also trismus, muscle strain and headache. There appeared to be no problem with her bite. Splint therapy was necessary to see if there was a causal relationship between the occlusion of the teeth and the TMJ problem. This is a process to provide the patient with a correct bite and check if the problem will be reduced or eliminated. Her occlusion changed as splint therapy progressed. However, her TMJ problem disappeared, and a stable mandibular position was obtained. Post-splint imaging confirmed that disc position was improved (Fig. 7-2). The teeth were then aligned orthodontically in the stabilized mandibular position. The TMJ remained stable throughout orthodontic treatment, and facial and occlusal improvements were achieved at the end of treatment.

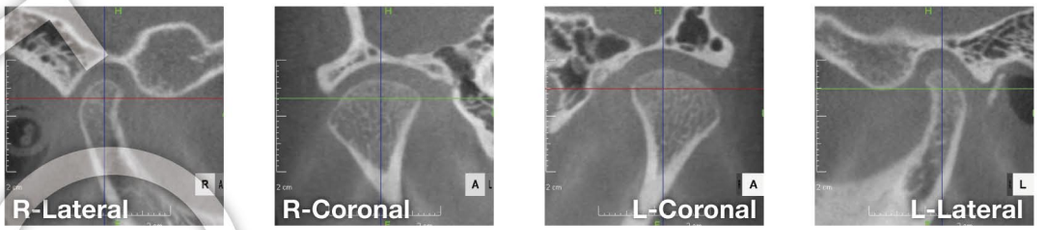
14歳1ヶ月の女子でTMJの痛みを主訴として来院した。既往歴、そしてチェアサイドの診査でTMJの痛み以外に開口障害、筋緊張、頭痛があったが、歯の咬み合せには大きな問題がないように見えた。まず歯の咬み合せとTMJの問題との因果関係をスプリント療法を行い確認したい。歯を動かす前にまずスプリント療法で正しい咬み合せを与え、彼女の訴えているTMJの問題が減少するか、または消退するかを確認し、さらにTMJの安定化が得られるか確認する。スプリント療法が進むにつれ咬合は変化したが、TMJの問題は消失し、安定した下顎位が得られた。スプリント療法後の診査で変位していた関節円板の位置の改善も確認できた（Fig. 7-2）。その後に歯の移動を用いて安定化した顎位において歯の配列を行った。矯正治療中もTMJは安定を保ち、矯正治療終了後顔貌、そして咬み合せも改善することが出来た。

Initial records

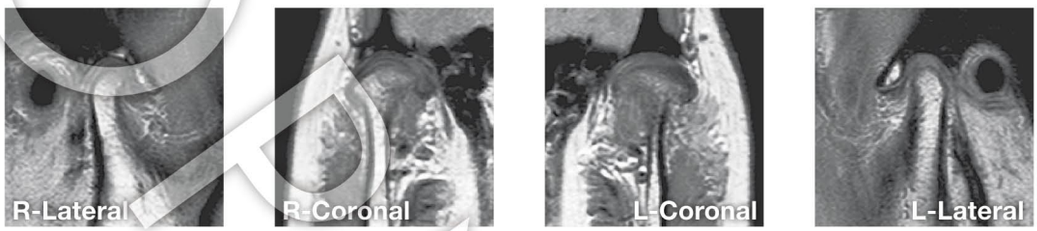
Initial facial photographs (14y1m)



Initial PA and lateral cephalograms and panoramic radiograph



Initial limited-CBCT images of TMJ



Initial MRI images of TMJ

TMJ status

Family history

- Her older sister also had TMJ symptoms and was previously treated in my office

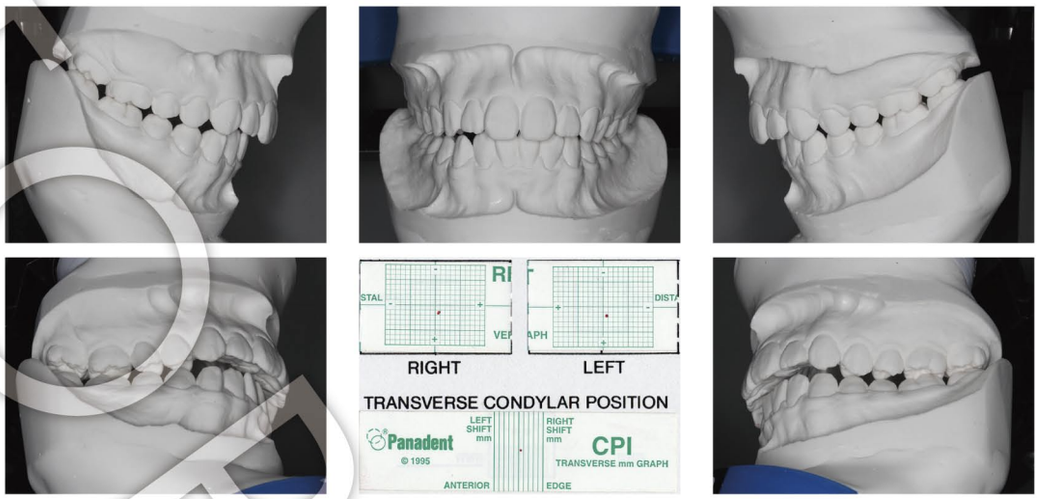
History

- Started to feel pain in the right joint 6 months ago; pain on both sides later

Current clinical findings

- Pain in the left joint on palpation, shifting the jaw to the right
- Limited movement in the left joint, maximum opening of 41.5 mm
- No symptoms in the right joint
- Tight musculature on both sides
- Frequent headaches
- Moderate and advanced DD (MRI)


Initial intraoral photographs



Initial models mounted in CR and condylar position indicator (CPI) data

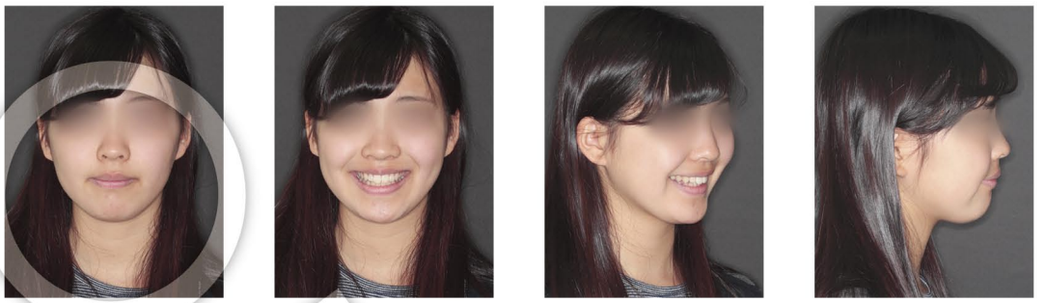
Intraoral views during splint therapy

Intraoral views during splint therapy

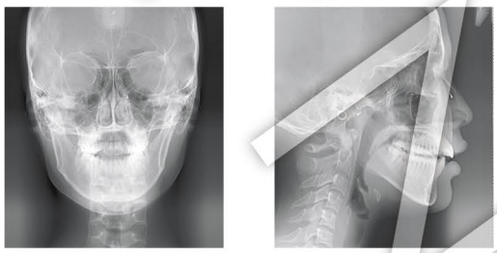
A maxillary stabilization splint was used for the first 8.5 months, and then switched to a mandibular splint to prevent flaring of the maxillary arch forward. TMJ pain, which was her chief complaint, disappeared. Splint therapy was continued to see if she would remain pain-free.

8.5ヶ月まで上顎に顎位安定型スプリントを用い、それ以降は上顎歯列全体が前方傾斜する傾向を防ぐため、下顎にスプリントを用いた。彼女の主訴であるTMJでの痛みは消失したその後、その状態を維持できるかスプリント療法を継続した。

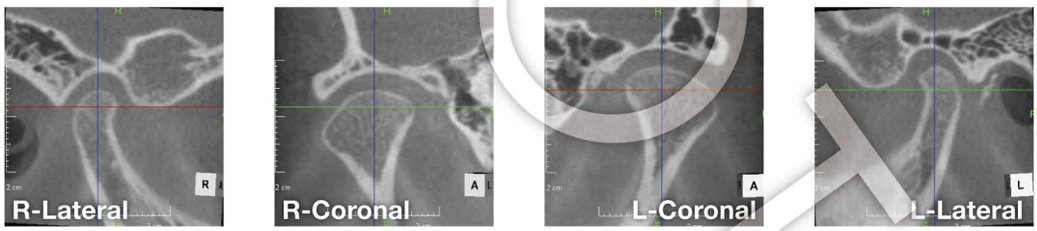
Post-splint records



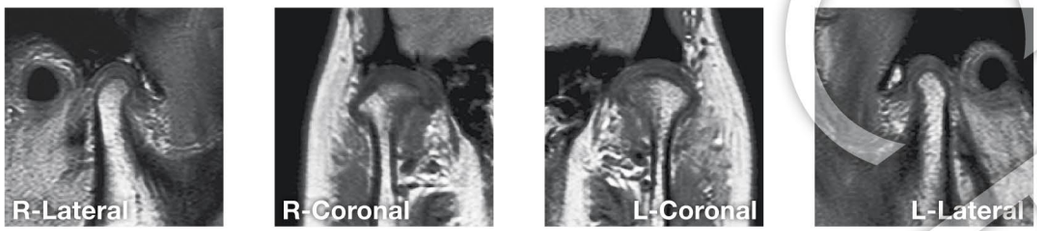
Post-splint facial photographs (15y1m)



Post-splint PA and lateral cephalograms

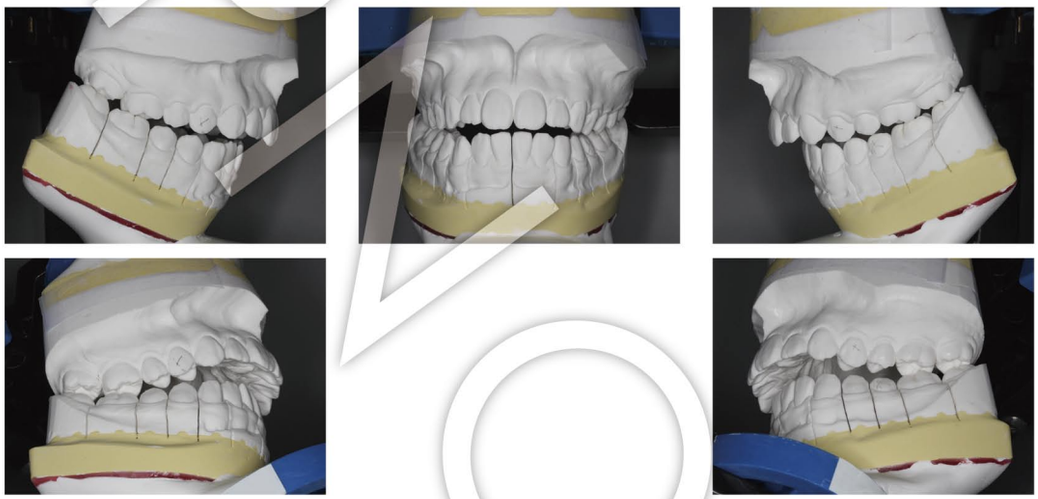


Post-splint limited-CBCT images of TMJ

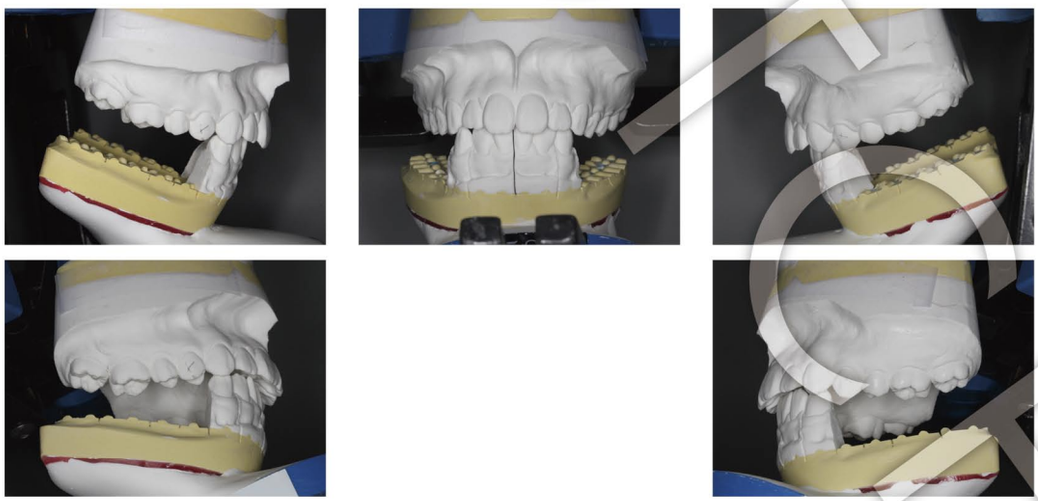


Post-splint MRI images of TMJ

Post-splint intraoral photographs



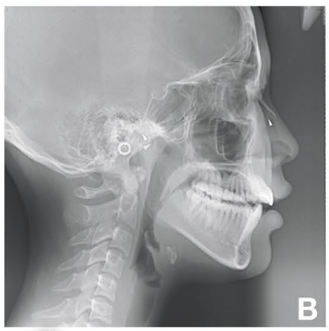
Post-splint hinge-axis mounting

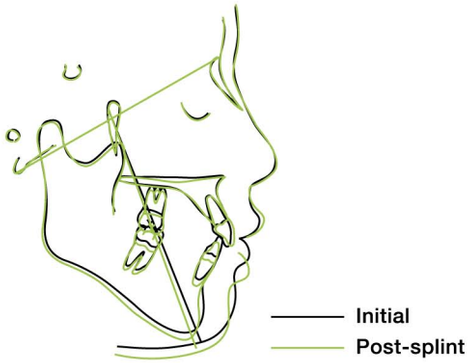


3D check

After removing posterior teeth to simulate vertical control, AP problems still existed, and no transverse problem was noted.

臼歯部を取り除いてバーティカルコントロールを行った状況をつくると、前後的問題はまだ存在しているが、正中のずれはない。





Pre- (A) and post-splint (B) lateral cephalograms and superimposition of pre- and post-splint tracings

The maxillary arch flared forward slightly.

わずかにスプリント療法中に上顎の歯列が前方傾斜した。

Problem list

Facial

- Large lower facial height
- Lip strain on closure
- Short throat length
- Chin deviation to the right

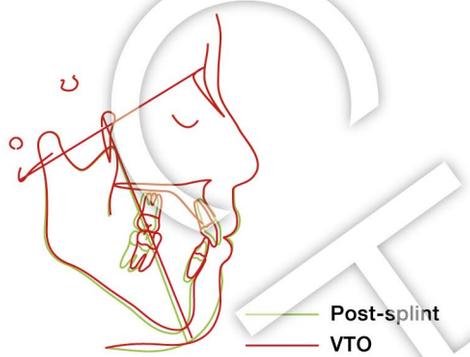
Skeletal

- Open bite
- Large lower face height
- Steep mandibular plane 36°
- Slight mandibular deviation to the right

Dental

- Open bite
- Class II molar and canine relationship
- Midline shift to the right
- Edge to edge tendency on the right molars

Treatment planning



Prediction of post-treatment profile based on VTO and superimposition of post-splint tracing and VTO

The prediction shows normal counterclockwise growth rotation of the mandible.

下顎は反時計回りの回転の正常な成長を示す。

Treatment plan

Vertical control

- Reduce the lower facial height
- Prevent molar extrusion, intrude molars if possible
- Move molars mesially

AP control

- Retract maxillary incisors
- Move mandibular molars mesially
- Control maxillary molar anchorage

Transverse control

- Protect catch-up growth of right condyle
- Correct buccolingual molar deviation with TPA hooks and palatal mini-implants
- Correct midline deviation using extraction spaces

Tooth alignment

- With vertical control, correct open bite and establish anterior guidance
- Place mini-implants in extraction sites to correct midline and class II molar relationship on the right

Treatment mechanics

Vertical control

- Move molars mesially with closing coils and elastic threads from mini-implants
- Intrude maxillary molars with elastic threads from palatal mini-implants to TPAs
- Extract maxillary first and mandibular second premolars

AP control

- Control molars and anterior teeth with elastic threads from mini-implants in extraction sites
- Extract maxillary first and mandibular second premolars
- Control maxillary molars with TPAs and palatal mini-implants

Transverse control

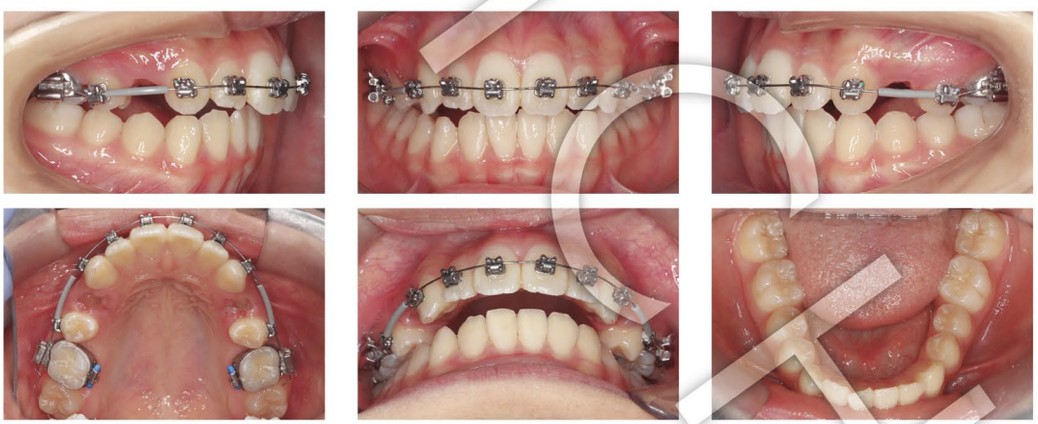
- Elastic threads from palatal mini-implants to TPA hooks
- Diagonal elastics later in treatment after vertical correction

Course of treatment with SWA

Appliances placed

↑.014" nickel titanium (NiTi)

Continued mandibular splint wear at night



Orthodontic tooth movement was initiated in the maxillary arch along with 6 months of continued mandibular splint wear because of advanced DD and TMJ pain. The maxillary initial wire was a light round .014" NiTi wire placed in an .022-inch slot appliance.

TMJに進行した痛みを伴う症例なので、さらに6ヶ月ほど下顎にスプリントの装着を続けながら上顎から歯の移動を開始した。上顎の初めのワイヤーは.022"スロット装置に弱いラウンドの.014" NiTiを用いた。

6 months

Appliance placed in the mandibular arch

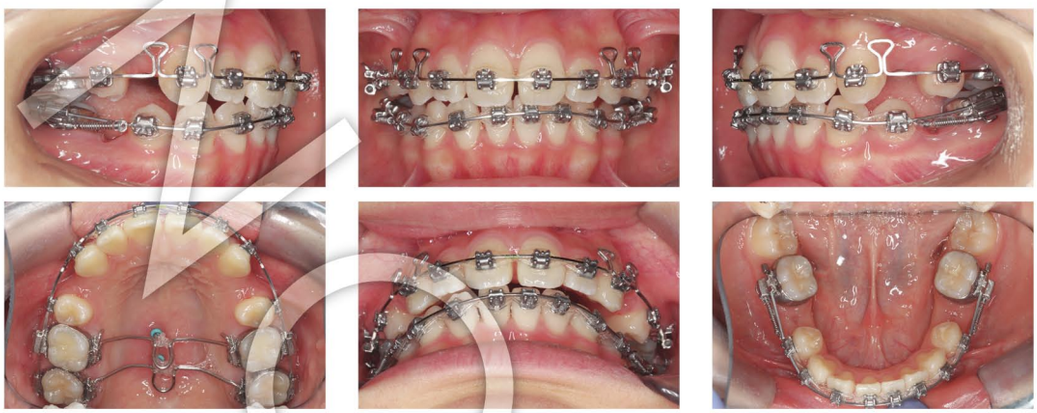
↓ .014” NiTi

The splint was discontinued to start tooth movement in the mandibular arch. The second premolars were extracted to facilitate molar anchorage loss in the mandibular arch for vertical control by wedge effect (reduction of occlusal vertical dimension by mesial movement of the posterior teeth).
下顎の歯の移動を開始、スプリントは休止。クサビ効果によるバーティカルコントロールを行うため、下顎の臼歯の速やかな近心移動を考え、第二小臼歯抜歯を選択。

7.5 months

↑ .019”×.025” DKL (Nickeloy)

↓ .018”×.025” superelastic NiTi with closing coils (7m)



The first molars were moved mesially with a maxillary .019”×.025” DKL (Nickeloy) wire and a mandibular .018”×.025” superelastic NiTi wire with superelastic NiTi closing coils.
上顎に.019”×.025” DKL (Nickeloy)、下顎は.018”×.025” superelastic NiTiとsuperelastic NiTiのクロージングコイルで第一大臼歯を近心へ移動。

8.5 months

$\overline{7}$ banded

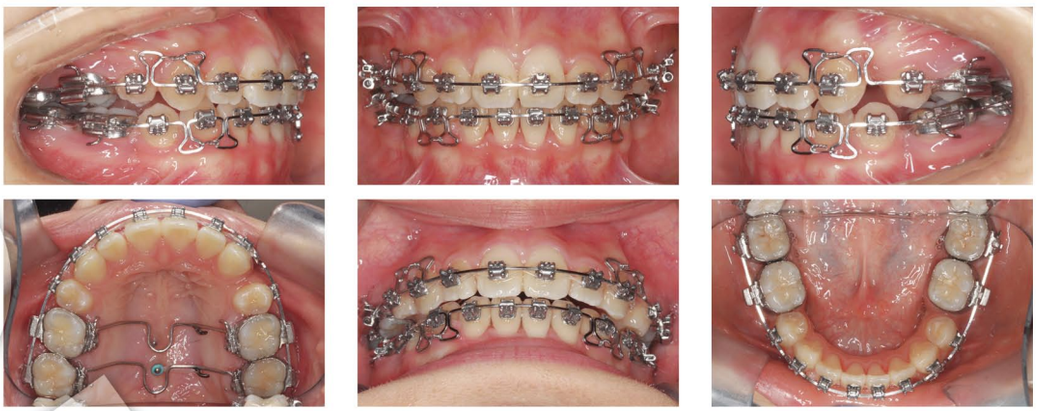
↓ .022”×.028” superelastic NiTi with closing coils

↑ .019”×.025” DKL (Nickeloy) activation

The wire size was further increased to .022”×.028” superelastic NiTi in the mandibular arch and closing coils to the first molars were continued for molar anchorage loss. The second molars were quickly incorporated into the archwire. The maxillary .019”×.025” DKL (Nickeloy) wire was activated from the second molars.
さらに下顎のワイヤーをレベルアップ、.022”×.028” superelastic NiTiそして下顎臼歯のアンカレッジロスのため第一大臼歯へのクロージングコイルは継続。第二大臼歯も速やかにengageされた。上顎の.019”×.025” DKL (Nickeloy)は第二大臼歯よりアクティベートしている。

1 year 10 months

↑↓ .019”×.025” DKL (Nickeloy) activation

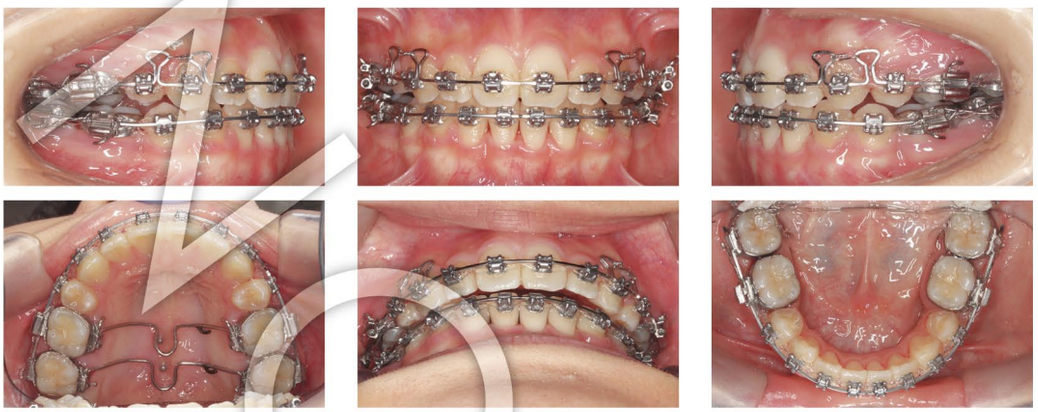


The mandibular extraction spaces were closing. The mandibular mini-implants were thus removed.
下顎の抜歯スペースは閉じてきているので、下顎のミニスクリューインプラントは除去されている。

2 years 2 months

↑ .019”×.025” DKL (Nickeloy) activation

↓ .022”×.028” superelastic NiTi



The spaces were closed in the mandibular arch, and a full-sized .022”×.028” superelastic NiTi wire was placed.
下顎では抜歯スペースが閉じ、フルサイズの.022”×.028” superelastic NiTiを入れる。

2 years 3.5 months

↑ .022”×.028” superelastic NiTi

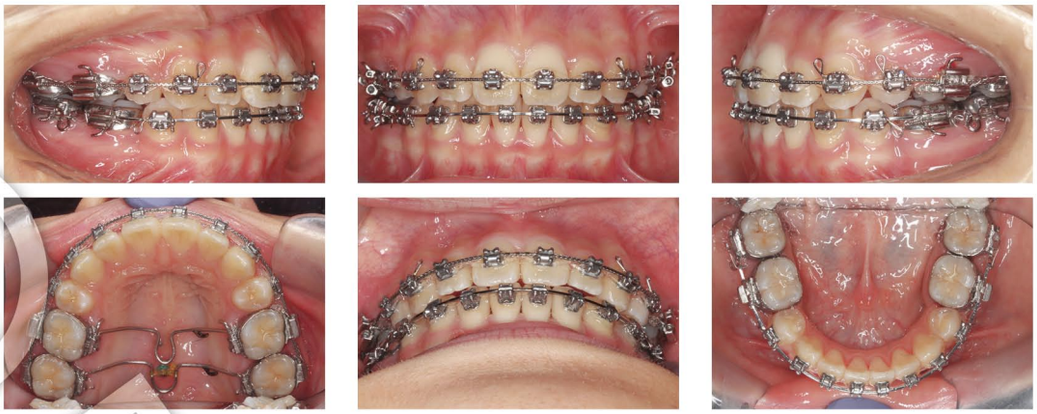
The maxillary extraction spaces were closed, and a full-sized .022”×.028” superelastic NiTi wire was placed. The first and second molars were co-ligated, and the right and left first molars were tied with an elastic thread to keep the spaces from opening.
上顎の抜歯スペースが閉じ、フルサイズの.022”×.028” superelastic NiTiを入れる。第一・二大臼歯はコライゲートし、左右第一大臼歯間をelastic threadで結び、スペースが出来ないように注意する。

2 years 5.5 months

↓ .021”×.025” stainless steel (SS) with omega loops (2y4.5m)

↑.021”×.025” multi-stranded SS

Class II elastics

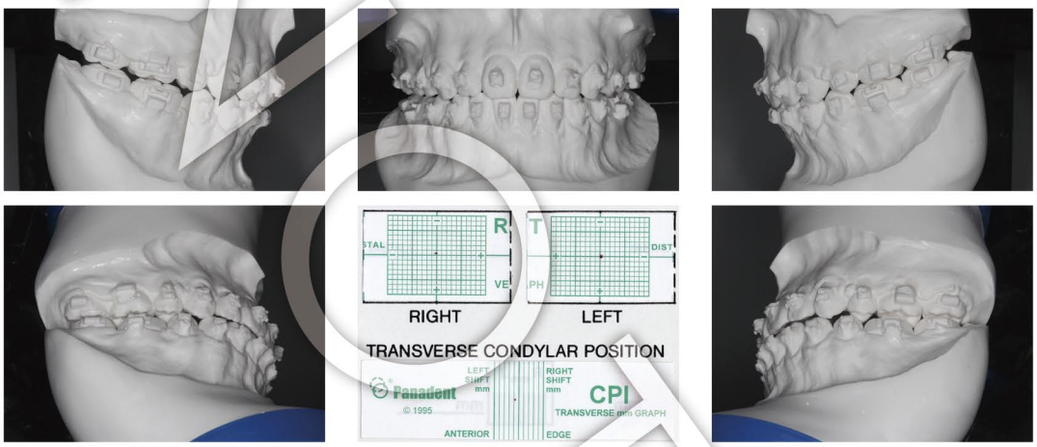


The mandibular archwire was changed to .021”×.025” SS with omega loops, while the maxillary archwire was replaced with an .021”×.025” multi-stranded SS wire and short Class II elastics to settle the occlusion. Short Class II intermaxillary elastics should be used only after resolution of vertical problems and achievement of a good occlusion.

下顎のワイヤーをオメガループ付きの.021”×.025” SS に変えている。上顎は.021”×.025” multi-stranded SSにⅡ級顎間ゴムを用い、上下の歯をお互いに咬みこませている。ここでバーティカルの問題もなく、咬み合せも良好になった時点で初めてⅡ級顎間ゴムを用いる。

2 years 6.5 months

CR mounting for gnathological tooth positioner



Impressions were taken to fabricate a gnathological tooth positioner. The models were mounted in CR to find a true hinge axis. There was little discrepancy in mandibular position.

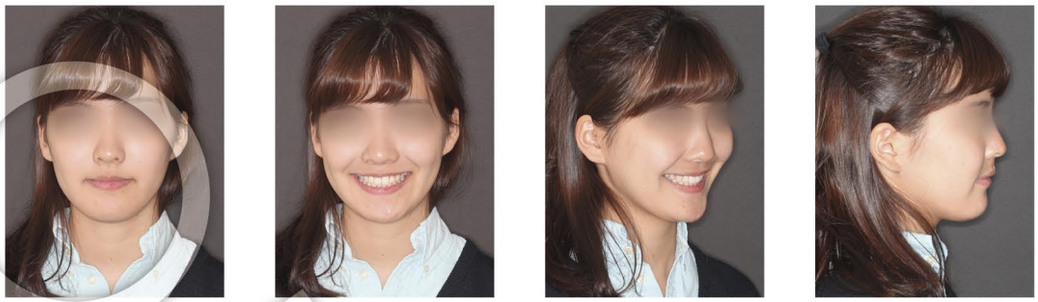
ナソロジカルトゥースポジショナーの作製のため模型を採取、最終蝶番軸を求めCRマウントしてある。顎位のずれはほとんどない。

2 years 7.5 months

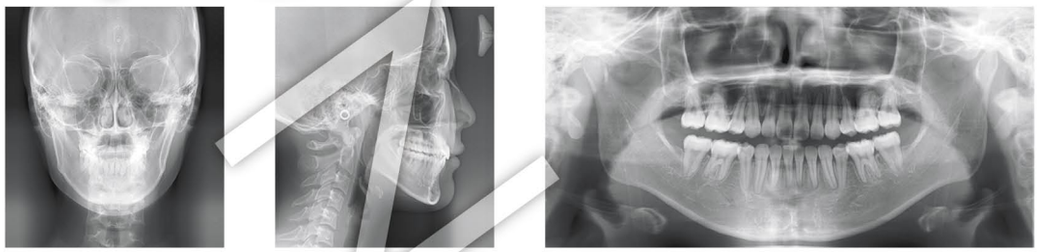
Appliances removed

Gnathological tooth positioner placed

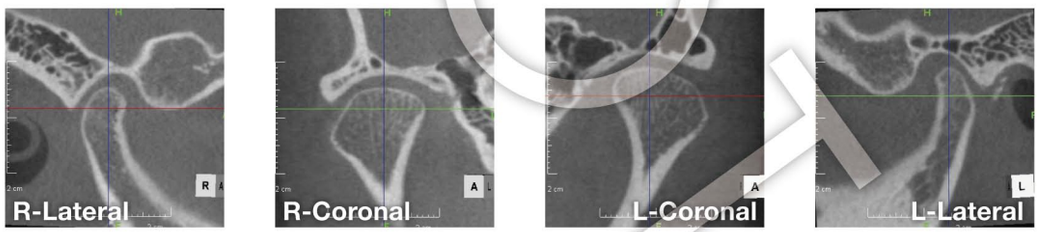
Records at the end of active treatment



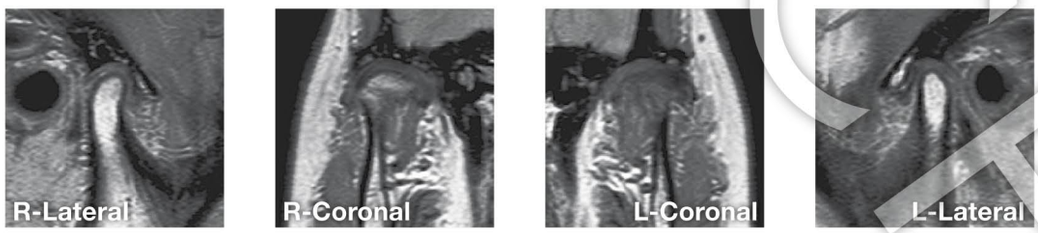
Facial photographs at the end of active treatment (18y0m)



PA and lateral cephalograms and panoramic radiograph at the end of active treatment

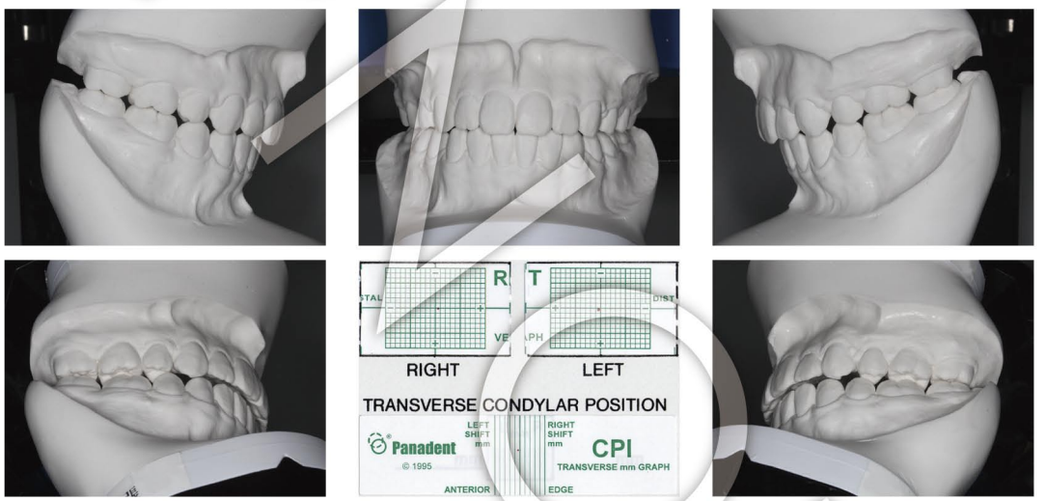


Limited-CBCT images of TMJ at the end of active treatment



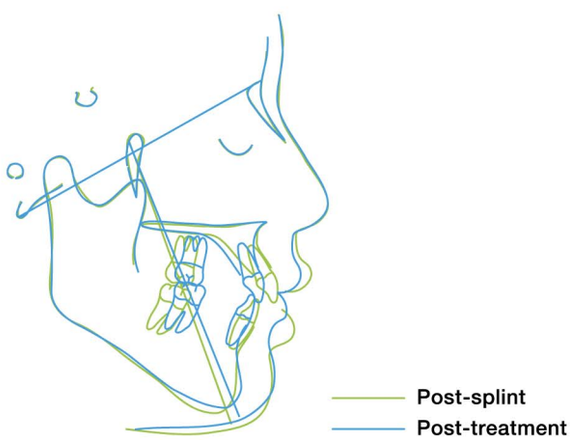
MRI images of TMJ at the end of active treatment

Intraoral photographs after 2 weeks of gnathological tooth positioner wear

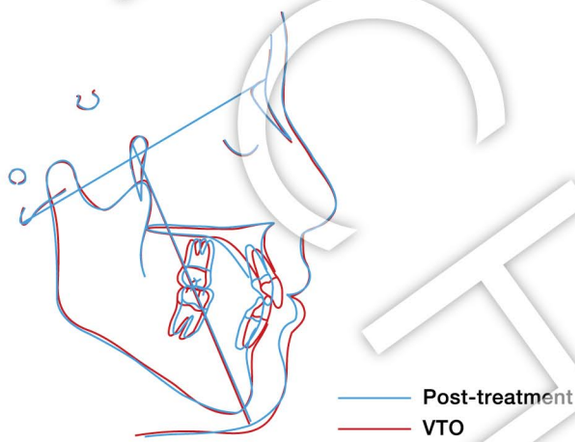


CR mounting and CPI data at the end of active treatment

Superimposition of cephalometric tracings



Superimposition of post-splint and post-treatment tracings



Superimposition of VTO and post-treatment tracing