TMD DENTAL RECONSTRUCTION PATIENT
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A Case Study

ABSTRACT
Ruth was seen as a new patient looking for cosmetic work to improve her smile and overall oral health. She had no idea that her current dental occlusion was the cause of many symptoms. She had severe dental anxiety and was upset with herself for avoiding the dentist for several years. After trying to seek dental help a few times during this time period away, she could not find a doctor that she was happy with or felt comfortable with. Ruth had gotten to the point where she wanted to improve herself aesthetically and was ready to do what she needed to do to get healthy. Ruth was given options for restoring her smile and overall oral health. Ultimately, Ruth declined the option of restoring the posterior teeth and undergoing Invisalign treatment to align her front teeth, and decided to proceed with full mouth reconstruction.   The dental treatment rendered utilizing neuromuscular dental concepts and procedures affected a resolution of her TMD symptoms and achieved the cosmetic results for which she sought treatment.

1. *Chief Complaints*

   Ruth was seen as a new patient looking for cosmetic work to improve her smile and overall oral health. She has dental anxiety and had not been undergoing routine dental care for five years. She had tried two other dental offices prior but never returned due to bad experiences at both offices.

2. *History of Illness/Trauma*

   Upon discussion, Ruth reported experiencing headaches five times per week, with pounding pain while lying down. She has noise in her TMJ and ringing in both ears. She stated that she is constantly clenching her teeth. She said for the past few months she

has been experiencing constant neck pain on the left side and tingling in her fingers.

Symptoms		Adjustments (Dates)						Signs
		1	2	3	4	5		SIGNS (extra-oral)
Palpation								___ Facial Asymmetry Bilateral
m. masseter r.								___ Short Lower Third of Face
m. masseter l.								___ Chilitis
m. pteryg. med. r.								___ Abnormal Lip Posture
m. pteryg. med. l.								___ Deep Mentalis Crease
m. digastric. med. r.								___ Dished-Outer Flat Labial Profile
m. digastric. med. l.								___ Facial Edema
Symptoms								___ Mandibular Toirticollis
Headaches	5xwk frontal/night pounding when lay dy	V	No	none				___ Speech Problems
TMJ Pain								**SIGNS (intra-oral)**
TMJ Noise	slight	V	no					✓ Crowded Lower Anteriors
Tinnitus (Ringing in the ears)	Both	V	No	none	mat she			___ Wear of Lower Anterior Teeth
Ear Congestion								___ Lingual Inclination of Lower Anterior Teeth
Vertigo (Dizziness)								✓ Lingual Inclination of Upper Anterior Teeth
Limited Opening								✓ Bicuspid Drop Off
Dysphagia (Difficulty Swallowing)								___ Depressed Curve of Spee
Clenching/Bruxing	Clenching constant	V	better	better				___ Lingually Tipped Lower Position
Loose Teeth								✓ Narrow Mandibular Arch
Tender, Sensitive Teeth (Percussion)								✓ Narrow Maxillary Arch (High Palatal Vault)
Neck Pain	left side constant past few mo.	V	better					✓ Midline Discrepancy
Postural Problems								___ Malrelated Dental Arches
Trigeminal Neuralgia								___ Tooth Mobility
Facial Pain (Nonspecific)								✓ Flared Upper Anterior Teeth
Bells Palsy								___ Facets
Paresthesia of Fingertips (Tingling)	left w/ neck pain	V	V					✓ Cervical Erosion (Notching or Gingival)
Nervousness/Insomnia								___ Locked Upper Buccal Cusps
Difficulty Chewing								___ Fractured Cusps -Particularly Cl 1 + 2 Non-Functional
Thermal Sensitivity (Hot & Cold)								___ Chipped Anterior Teeth

Signs column (continued):

___ Facial Asymmetry Bilateral
___ Short Lower Third of Face
___ Chilitis
___ Abnormal Lip Posture
___ Deep Mentalis Crease
___ Dished-Outer Flat Labial Profile
___ Facial Edema
___ Mandibular Toirticollis
___ Speech Problems
SIGNS (intra-oral)
✓ Crowded Lower Anteriors
___ Wear of Lower Anterior Teeth
___ Lingual Inclination of Lower Anterior Teeth
✓ Lingual Inclination of Upper Anterior Teeth
✓ Bicuspid Drop Off
___ Depressed Curve of Spee
___ Lingually Tipped Lower Position
✓ Narrow Mandibular Arch
✓ Narrow Maxillary Arch (High Palatal Vault)
✓ Midline Discrepancy
___ Malrelated Dental Arches
___ Tooth Mobility
✓ Flared Upper Anterior Teeth
___ Facets
✓ Cervical Erosion (Notching or Gingival)
___ Locked Upper Buccal Cusps
___ Fractured Cusps -Particularly Cl 1 + 2 Non-Functional
___ Chipped Anterior Teeth
✓ Loss of Molars
___ Open Interproximal Contacts
___ Unexplained Gingival Inflammation & Hypertrophy
___ Crossbite
___ Anterior Tongue Thrust
___ Anterior Open Bite
___ Lateral Tongue Thrust
___ Scalloping of Lateral Border of Tongue

Where do you feel the tip your tongue against the roof of your mouth
✓ toching your upper front teeth
✓ touching your lower front teeth
___ not touching anything

3. *Clinical Evaluation*

   a. As a new patient to the practice, a full series of x-rays and comprehensive exam was performed. Dental exam revealed several large multi-surface amalgam fillings that were failing. She had two broken teeth on the upper left one requiring extraction of root tip and the other requiring root canal therapy, cast post and core, and a crown. Ruth had crowded anteriors, narrow maxillary and mandibular arches, midline discrepancy, and eight teeth with abfractions. Ruth had her wisdom teeth extracted in her teens. Her first and second molars and second bicuspid on the lower left were extracted years ago as a result of decay. Her lower right second molar had previously undergone root canal therapy was restored with a post and a crown that was still healthy and did not require any additional treatment at this time.

b. Soft tissue exam revealed generalized deep probing depths, generalized moderate to severe recession with multiple areas of inadequate keratinized tissue. Ruth was referred to the Periodontist on sight for complete periodontal evaluation and implant consult.
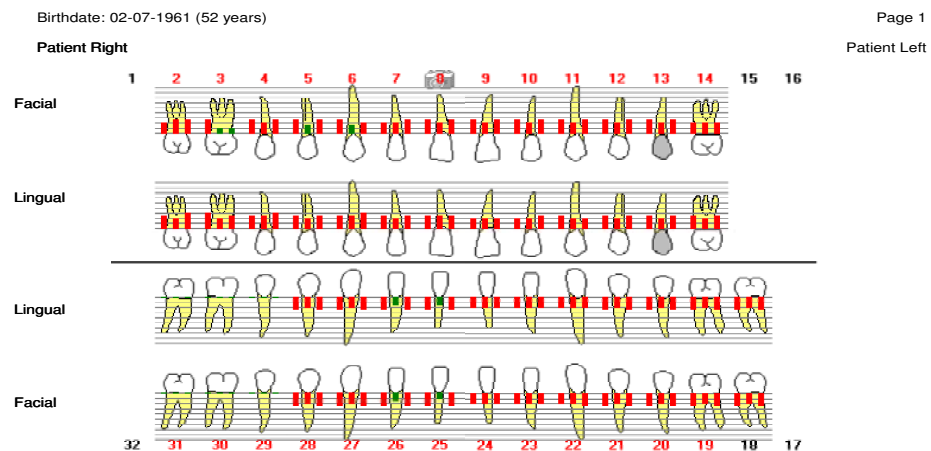
c. Her occlusal exam revealed generalized slight to moderate occlusal wear resulting in an over closed bite with a Shimbashi of 23.4mm (including 5mm of recession on #24), Shimbashi of 18.1 from CEJ of #9 to #24.

d. Postural analysis showed her left shoulder higher than her right shoulder. Her left eye and left corner of the mouth were higher than the right as well. Patients head was shifted towards the right.

      a. -----   Palpation of muscles extra-orally and intra-orally and joints were within normal limits.

4. **Diagnostic Procedures**

Radiographic exam included both intraoral films and a panoramic film. Intra-oral exam included hard and soft tissue cancer screening. Soft tissue probing was done at later date during scaling and root planning appointments and full periodontal evaluation was done by the periodontist during consultation. Intra-oral and extra-oral muscle palpation, were completed. Diagnostic models were created and mounted using Stratus articulator to the HIP plane. Intra-oral and extra-oral photos were taken. Computerized jaw tracking, electromyography and sonography data were collected.

5. **Diagnostic Data Analysis**

    a. Radiographic exam revealed generalized bone loss and calculus build-up, particularly on the right side, and was referred to hygienist for full scaling and root planing.

    b. Head and neck cancer screening was preformed following office protocol and oral cancer screening was performed by hygienist using VELscope oral cancer screening technology. All screenings were negative.

    c. Periodontal evaluation with periodontist revealed generalized deep probing depths, 18 teeth with recession, 11 of which were greater than 2mm.

Recession resulted in 13 teeth with less than 3mm of keratinized tissue.
Class I mobility #'s 24 and 25.

d. Intra-oral and extra-oral muscle palpations were within normal limits.

e. Diagnostic models and intra-oral photographs show crowded lower anteriors, lingual inclination of upper teeth, bicuspid drop off, narrow arches, midline discrepancy, flared upper anterior teeth, occlusal wear, cervical erosion, and super-eruption of #'s 2 and 3 due to loss of #'s 29, 30, and 31.

f. The objective evaluation of the physiologic and anatomical status of Ruth's stomatognathic system was performed by using K7 evaluation system. The initial diagnostics were performed utilizing scans 9, 11, 2, 3, 6, 13, and 15.

g. The initial EMG scan #9 was performed in patient's rest position. As shown in the scan, the muscles are relatively relaxed at the rest position. Anterior temporalis muscle tone is quite low and symmetrical if we disregard the left temporalis muscle EMG pikes during patient's wink. Insignificant increase of the right digastric muscle can be related to a lateral tongue thrust.

LTA 2.8	1.2	1.1	11.2	1.2	4.7	4.5	5.1	1.3	1.5	4.1	1.2	1.5	9.9	1.7	3.5
RTA 2.8	1.2	1.4	1.0	1.2	1.1	1.1	1.7	1.7	1.3	1.3	1.4	0.9	1.0	1.5	1.3
LMM 2.0	1.0	0.8	1.2	0.9	1.1	0.9	1.1	0.7	0.8	0.8	0.6	0.5	0.7	0.5	0.8
RMM 2.0	1.8	2.3	1.8	1.8	2.1	2.1	2.6	1.9	1.8	2.6	1.9	2.1	1.9	2.2	2.1
LTP 2.2	1.8	1.8	1.9	1.8	1.9	1.7	2.2	1.7	2.2	2.0	1.7	1.8	1.9	1.6	1.9
RTP 2.2	1.0	1.0	1.0	1.1	1.1	1.2	1.1	1.1	1.2	1.2	1.1	1.2	1.2	1.1	1.1
LDA 1.7	1.5	1.5	1.7	1.6	1.7	1.4	1.5	1.3	1.4	1.5	1.5	1.4	1.5	1.5	1.5
RDA 1.7	2.7	2.8	2.9	2.6	2.3	2.4	2.6	2.5	3.1	2.4	2.5	2.4	2.7	2.2	2.6

Time	0:01	0:02	0:03	0:04	0:05	0:06	0:07	0:08	0:09	0:10	0:11	0:12	0:13	0:14
								EMG= 30			Set AB		Speed= 1.0	

h. Scan #11 showed that the bite on cotton rolls was significantly better than on the natural teeth, especially on the left side. The first two clench scores are on natural teeth and the low values indicate that the patient is not able to create a solid gearing on her teeth and has a poor home. Additionally, missing lower right premolar and molars are causing not only low scan values but also the lack of symmetrical response compared to the left side and to the right side when biting on the cotton rolls.
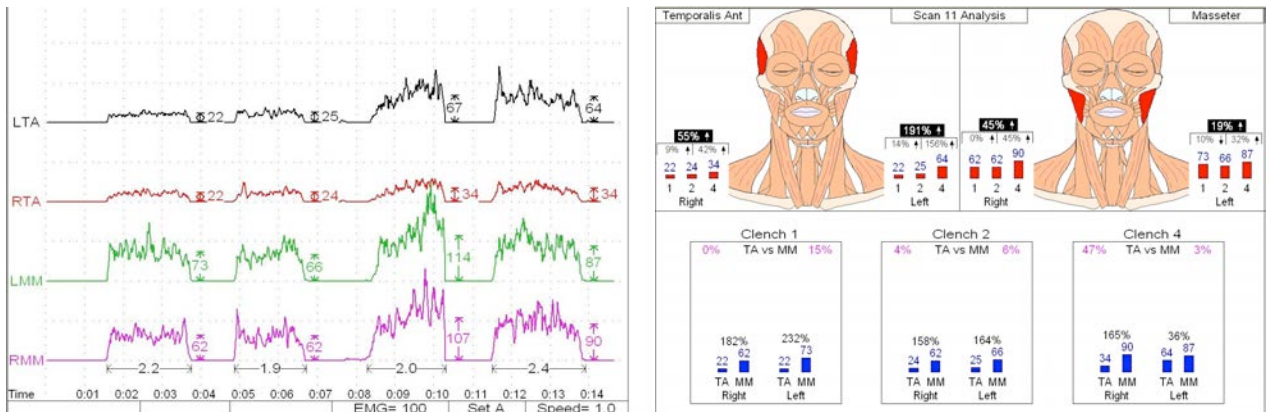
i. Scan #2 shows good opening and closing in terms of both velocity and trajectory. The maximum velocity is 426 mm/sec when opening and 380 mm/sec when closing. Closing has a pronounced plateau at the terminal point. A slight decrease in velocity when opening and closing may indicate the presence of a reciprocal click. This change velocity corresponds to the

crossover in the lower third of the opening/closing trajectory, which could indicate rotation of C2, C3 and C4 and forward head posture.
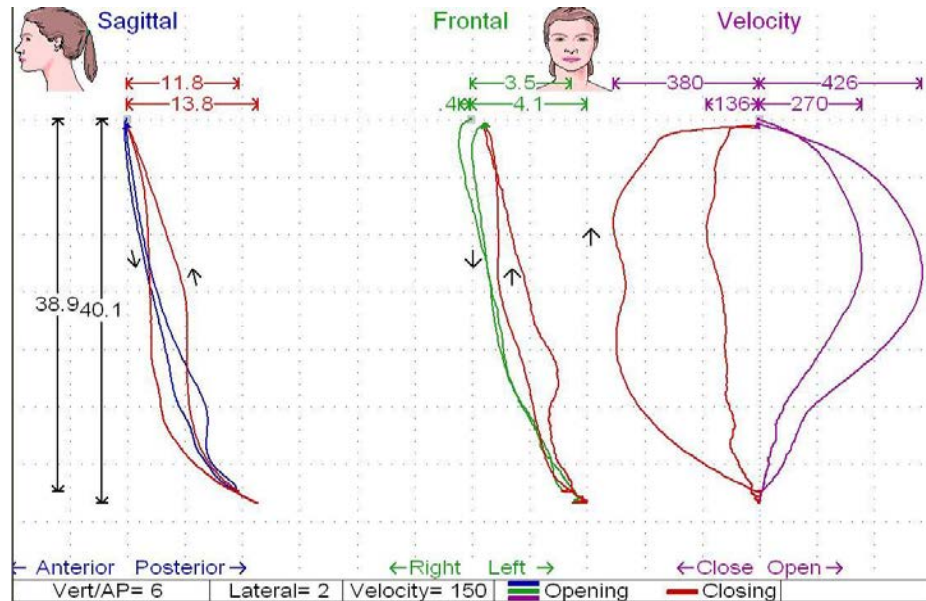

j. Freeway space according to scan #3 equals 1.9 mm. At the same time scan #3 shows prominent pike of the vertical line and increase in freeway space up to 3.6 mm after tapping the teeth. This indicates lateral tongue thrust - patient is using her tongue to support rest position. This conclusion is also confirmed by scan #6. Patient has a lateral tongue thrust during swallowing because she swallows at the point, which is 4.3 mm below the closed position. The scan provides a specific depiction typical for lateral tongue thrust, not frontal. Thus, according to the data provided by scans #9, 3, 6 the patient has a lateral tongue thrust at rest position and when swallowing.
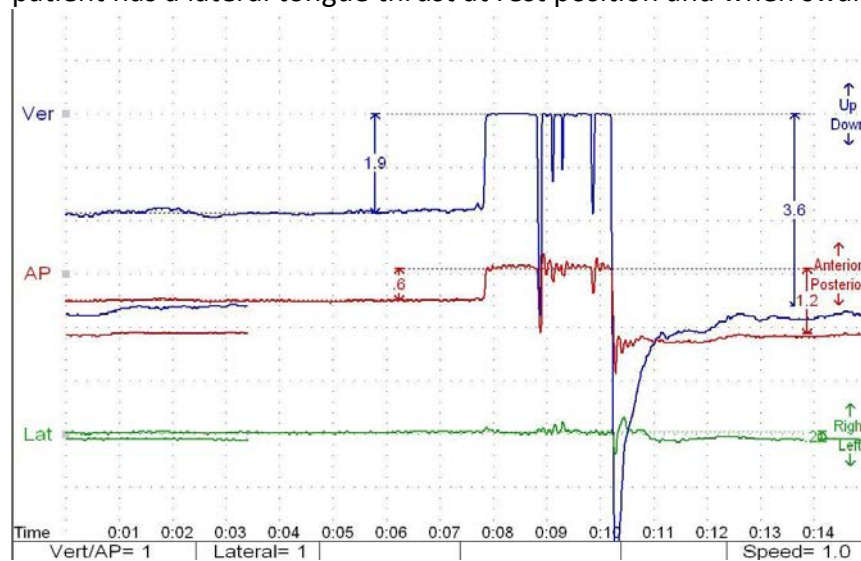
k. Range of motion of the lower jaw at the lowest point is in the normal range, the magnitude of opening is 43 mm and moving to the left and to the right is symmetrical, 12 mm and 14 mm respectively. The distal deviation trajectory of the lower jaw movement in sagittal plane corresponds to the maximum forward movement as 1:1.6, which deviates from the norm significantly and also indicates vertical direction of the trajectory. This is connected with the issues in cervical vertebrae group. Additionally, the proportion between maximum jaw deviation to the right and to the left and maximum opening is 1:3.3 (the normal ratio is 1:4).
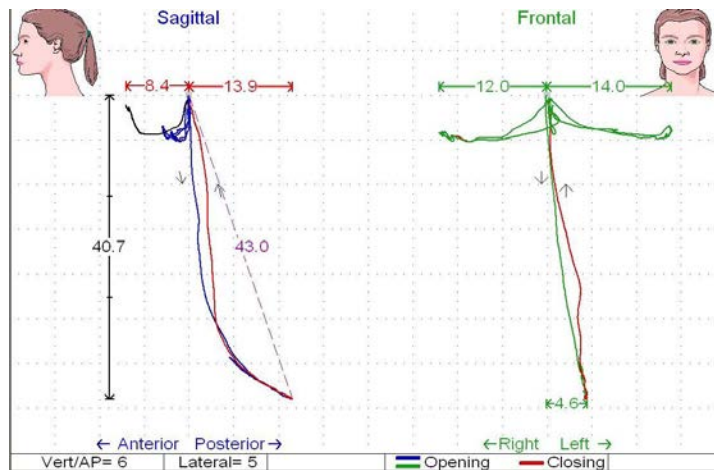
I. ESG (scan 15) did not confirm the presence of the reciprocal click although the velocity change shows its presence identical to scan 2. There does appear to be significant guarding in the closing stroke to protect against colliding with dentition that is on the path of close.
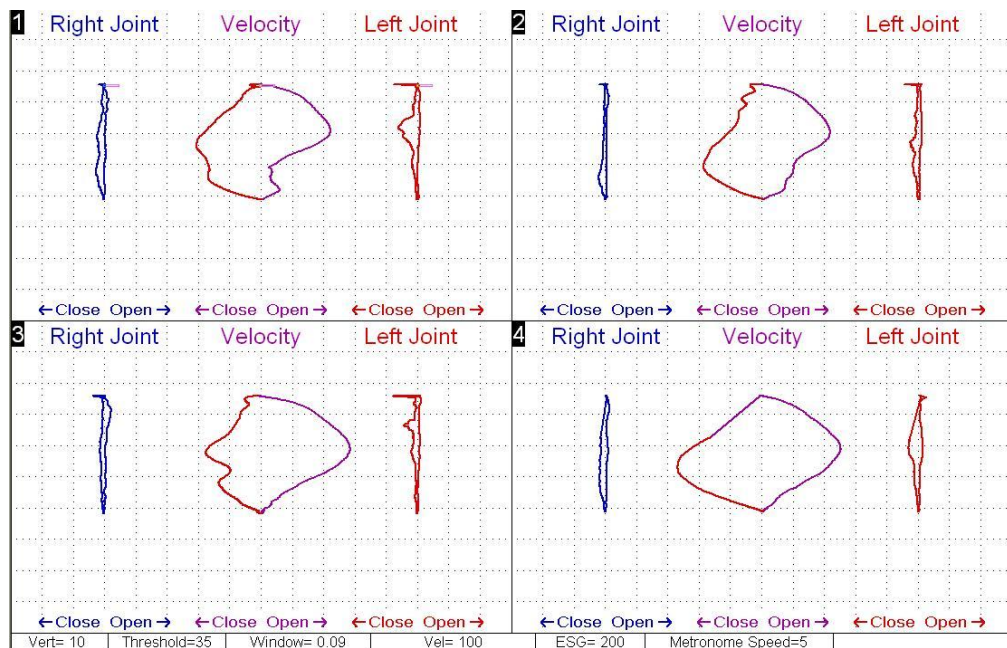
l. Analysis of frequencies by filtering the sounds was performed. It shows high frequency sounds with average amplitude of 74 and 35 microvolts. It could be sign of degenerative left joint disease with thinned retrodiscal ligament.
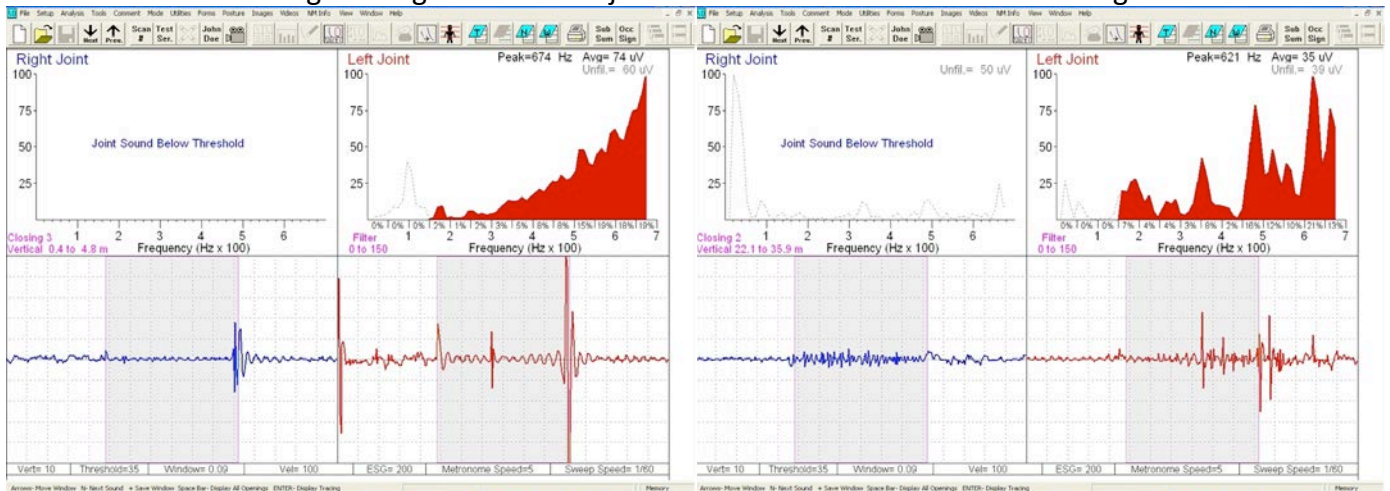

m. Electrical neural stimulation of 5th, 7th and 11thcelebrocranical nerves was performed using J5 myomonitor. After about an hour of TENS at threshold, Scan 10 was recorded and showed significantly lower readings, which gives us great promise that we may be able to help address at least the headaches and neck issues.
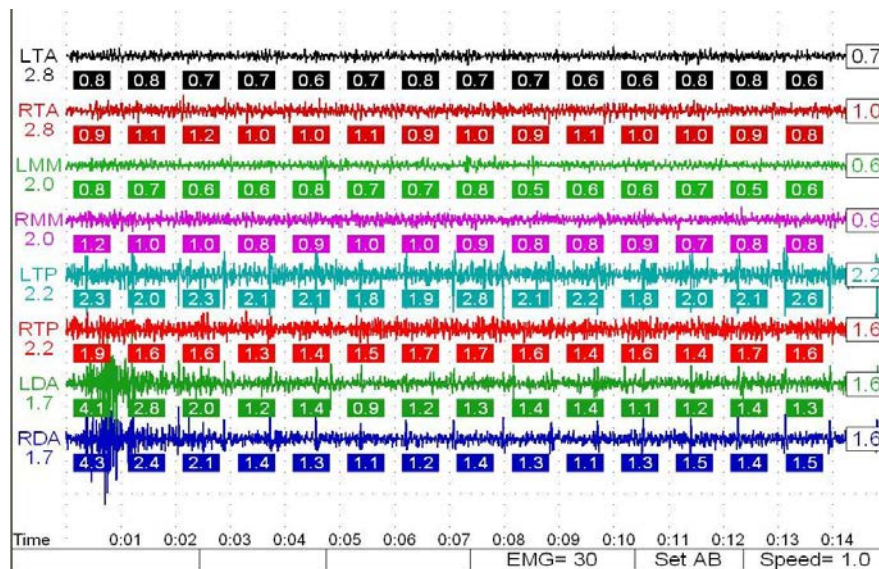
    n. The 4/5 bite scan was taken and a bite was recorded on NM trajectory at the point 1.5 mm up from rest position. (position #1) The data supports the presumption that putting Ruth into a more balanced and comfortable muscle posture will likely result in a decrease in discomfort of

the muscles and likely a dramatic decrease in headaches as well as neck pain.
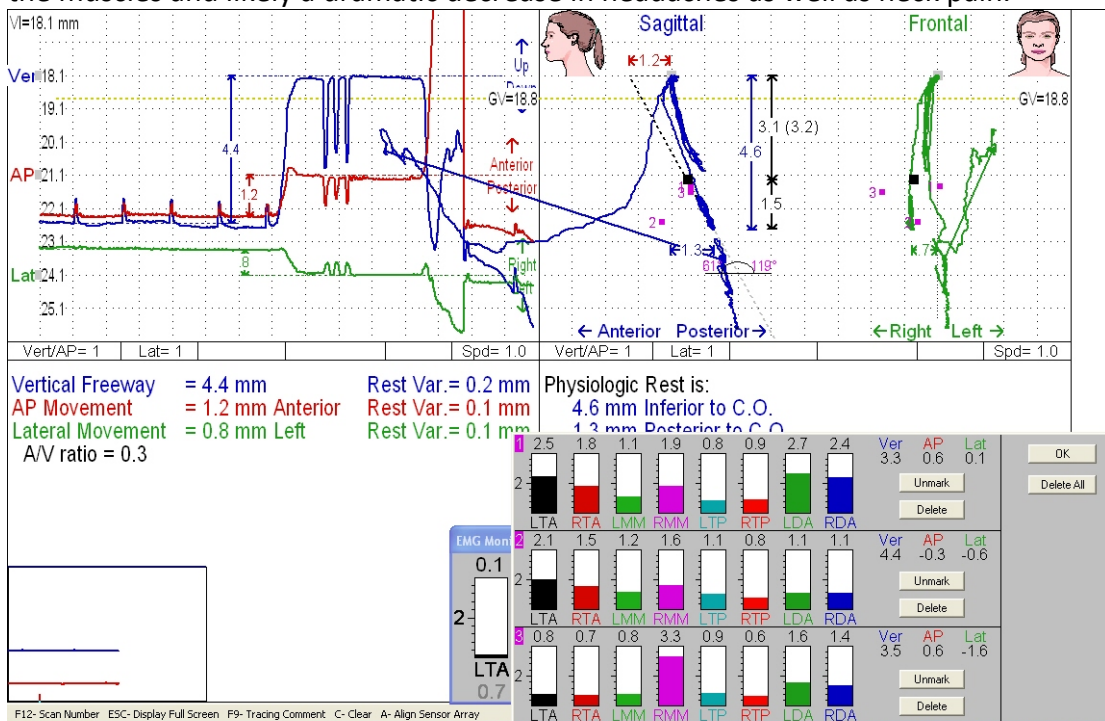
6. *Diagnosis*

Ruth suffered with a malocclusion (class II div II). She has partially edentulous upper and lower jaws, generalized advanced periodontal disease with generalized moderate gingival recession. Ruth has TMD associated with malocclusion, neck problem and forward head posture.

7. *Treatment Objectives*

Ruth's primary concern was to achieve a healthy mouth that is both comfortable and aesthetically pleasing. She wanted to replace the missing teeth for better function as well. In order to achieve optimum comfort level for her, we determined that first we need to identify a more physiological bite position and then stabilize her habitual bite into the new neuromuscular position. Once her bite is stabilized and comfortable, we will proceed with restoring the teeth with full mouth reconstruction giving her a comfortable, healthy, and aesthetic smile. Simultaneously, Ruth will have 3 implants placed on the lower left where teeth have previously been extracted.

Ruth had multiple symptoms of TMD in addition to several intra-oral signs so the initial focus is to treat the malocclusion and over-closed relationship with the anticipation of relieving Ruth's symptoms. Initial scans were recorded as a baseline and to verify that her muscles and jaw position were indeed causing her symptoms. This data was then used to capture a neuromuscular bite for the fabrication of a lower removable orthotic. Ruth will undergo orthosis therapy for approximately four months allowing for muscle accommodation and adaptation in the new neuromuscular position to ensure symptoms have been greatly improved or eliminated completely prior to placing permanent restorations.

8. Treatment Rendered

a. First phase of treatment was finding a neuromuscular bite that was comfortable for Ruth prior to preparing and placing permanent restorations. Being that the majority of Ruth's symptoms were related to her malocclusion, comfort and symptom relief was of the utmost importance during this initial phase. Ruth was seen periodically to check the orthotic and to adjust the orthotic when necessary. This was done over a period of time to ensure the symptoms indeed were eliminated or improved as much as possible prior to reconstruction.

a. During first phase of treatment, Ruth had three implants placed #'s 29, 30, 31. Orthotic was adjusted accordingly.

b. Also during the first phase of treatment, Ruth had undergone scaling and root planing to control her periodontal disease. Ruth was instructed on proper homecare and brushing and flossing techniques. After scaling and root planing visits, Ruth was then put on a three-month periodontal maintenance program.

c. After stabilization period, the adjusted neuromuscular bite was transferred back to the models for the lab to fabricate upper and lower wax-ups in the proper neuromuscular position.

d. Upper and lower arches were prepared at the same appointment. Upper and lower posterior teeth were prepared for e.Max restorations, upper and lower anterior teeth were prepared for Empress Restorations. This was done while maintaining the bite by preserving a posterior stop on both sides and prepping segments mesial to the stop. During the preparation, the neuromuscular bite stent was relined and measured multiple times ensuring that the vertical dimension was remaining at the proper height. Upper and lower prepared arches were scanned using iTero digital impressions.

e. After Ruth's teeth were temporized, her occlusion was checked and adjusted with TENS to ensure optimum relationship between the upper and lower

arch while in temporaries. Ruth reported no complications or discomfort while in temporaries.

f. The case was delivered following standard adhesion protocols. Proper vertical measurements were maintained through this process indicating no bite change had occurred.

g. According to typical post-delivery procedure, Ruth was seen for a K7 evaluation. First, her general comfort level, function, and aesthetics were re-evaluated. The trajectory was then evaluated and confirmed by Scan 5 to be correct. Electromyography proved that her muscles were more comfortable. Chewing cycles were evaluated and interferences were eliminated. This was done with articulating paper coated with Vaseline and having the patient chew gum.

9. **Treatment Outcome Data**

Although Ruth's main concerns were aesthetics and treating any teeth requiring treatment, she was initially unaware that the symptoms she was experiencing were related to her bite. Her main symptoms were headaches, TMJ noise, ringing in her ears, and neck pain. Through educating Ruth about TMD and pointing out the signs she exhibited in the mouth in addition to the symptoms she had mentioned, she then considered the improvement and possible elimination of these symptoms as an added benefit to the aesthetic result she was initially looking for.

a. One month after the insertion of the orthotic Ruth reported that she no longer had headaches, TMJ noise, or tinnitus at all. She also reported that her clenching, neck pain, and tingling in her fingers were greatly improved.
b. Implants were successfully placed and restored with no complications, which established better every day chewing functions.
c. Probing depths and periodontal status greatly improved after initial scaling and root planning appointment and homecare had significantly improved after proper instructions. Probing depths after scaling and root planing, delivery of permanent restorations, and proper homecare were all within normal limits.

Patient Right   Patient Left
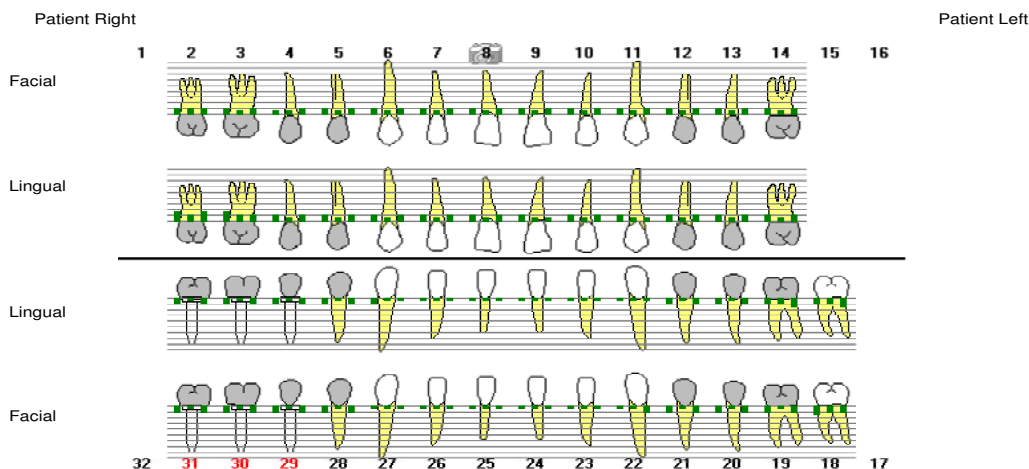
05-23-12   SM   Entire mouth   Perio Exam

Facial	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Pckt:		2 2 2	2 1 2	1 1	2 2 1	2 2 1	2 2 1	2 2 1	2 2 1	2 2 1	2 2 1	2 2 1	2 2 1	2 2 1 2		
Rec:	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Ping:		3 2 3	3 2 2	1 2	2 1 2	2 1 2	2 1 2	2 1 2	2 1 1	2 1 2	2 1 1	2 1 2	2 1 2	2 1 2		

Lingual	32	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17
Sup:		2 1 2	2 1 2	2 1	2 2 1	2 2 1	1 1 1	1 1 1	1 1 1	1 1 1	1 1 2	1 2 2	1 2 2	3 2 2 3		
Plaq:	32	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17
		2 1 2	2 1 2	2 1	2 2 1	2 1 1	1 1 1	1 1 1	1 1 1	1 1 1	1 2 2	1 2 2	1 2 2	1 2 3 2 2		

Possible sites: 162

0 sites (0%) had pocket depths of 4 mm or more	58 sites (100%) improved
0 sites (0%) had recession of 2 mm or more	6 sites (100%) improved
0 sites (0%) had total tissue loss of 6 mm or more	9 sites (100%) improved
0 sites (0%) had bleeding	No change
0 sites (0%) had suppuration	No change
0 sites (0%) had plaque	No change
0 sites (0%) had calculus	No change
0 sites (0%) had furcation out of 21 possible sites	No change
0 sites (0%) had mobility out of 27 possible sites	No change
0 sites (0%) had total loss of attached gingiva out of 27 possible sites	No change

d. Ruth reported no symptoms, issues, or concerns while in temporaries and after delivery of final restorations. Ruth was extremely pleased with the aesthetic outcome of her new smile and the relief of symptoms.
e. Follow up appointments revealed that the neuromuscular bite remained stable and consistent throughout the entire length of treatment and after. Ruth had reported no issues or problems in the time after the delivery.
f. Ruth's posture became better.

**10. Analysis of Outcome Data**

a. Post-treatment scans conducted after full mouth reconstruction, confirm the positive results of the performed treatment. Macro occlusion is characterized by a stable jaw position on neuromuscular trajectory. Scan 5 shows that both the habitual trajectory and the terminal occlusion point are consistent with the TENS neuromuscular trajectory.
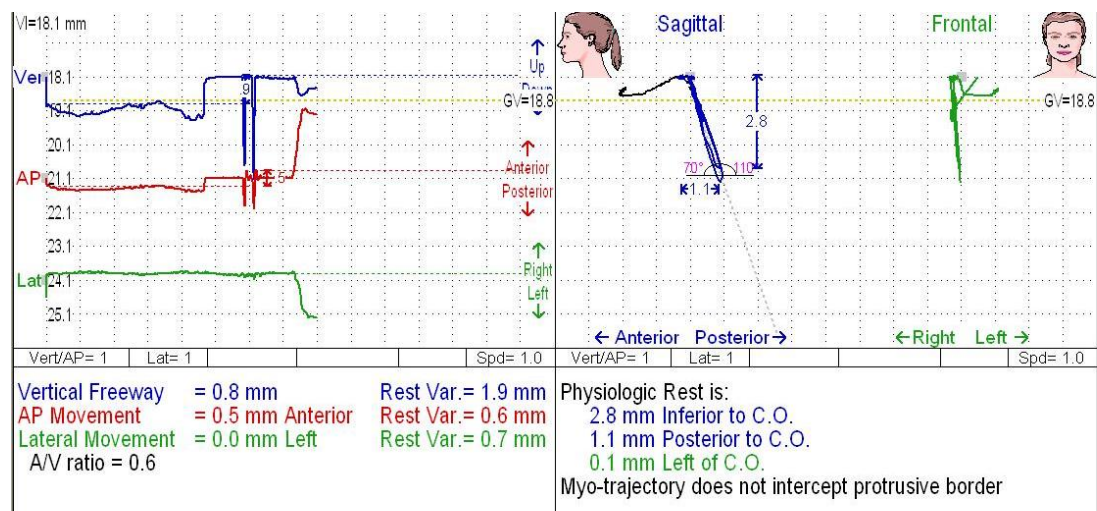

b. Clench test (Scan #11) shows significant increase in muscle engagement when clenching in reconstructed teeth bite compared to the initial scans which confirms improvements in both macro occlusion and micro occlusion. However, the temporalis muscles EMG values taken when biting on cotton rolls have increased by 49%. This means that micro occlusion should be further improved by using coronoplasty.
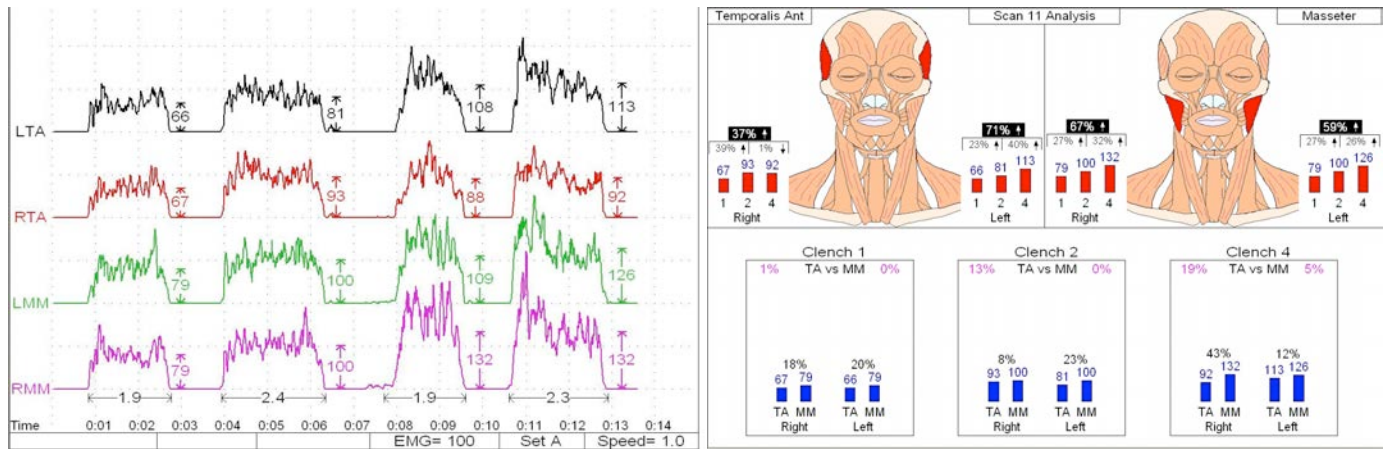
c. Chewing cycle (scan #8) on the left and on the right shows pointed terminal position in closing which confirms lack of functional premature contacts.
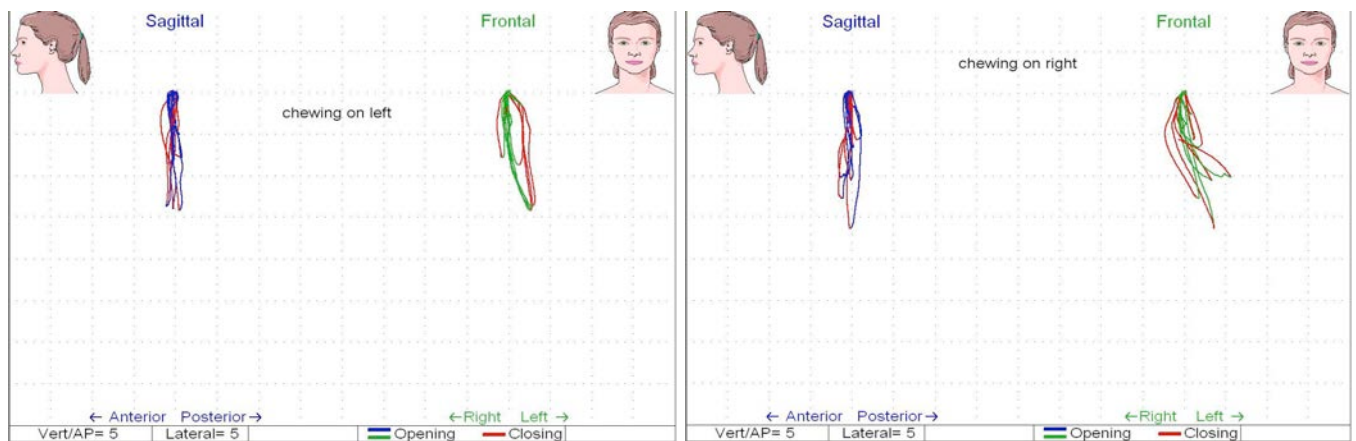
d. Uniformity and symmetry of the occlusal contacts were checked using scan #12. This scan shows two positions where muscles simultaneously react to the symmetrical initial central contacts when Ruth brings her teeth together.
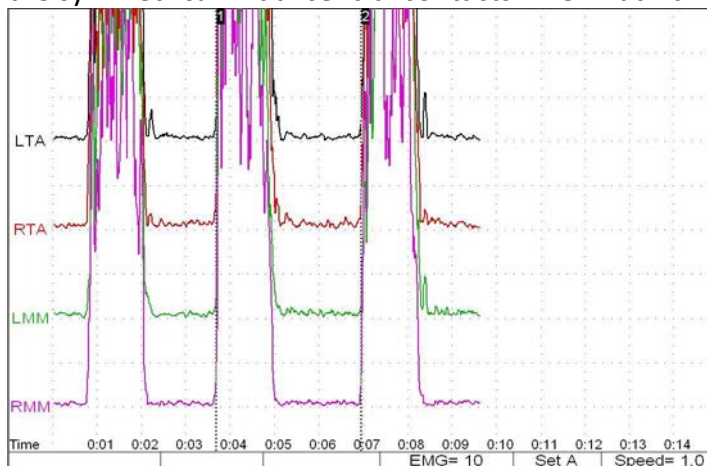
e. EMG (scan 10) analysis of the rest and light CO showed calm and balanced muscles in both rest and light CO position and lack of accommodation function of the muscles when bringing teeth together.
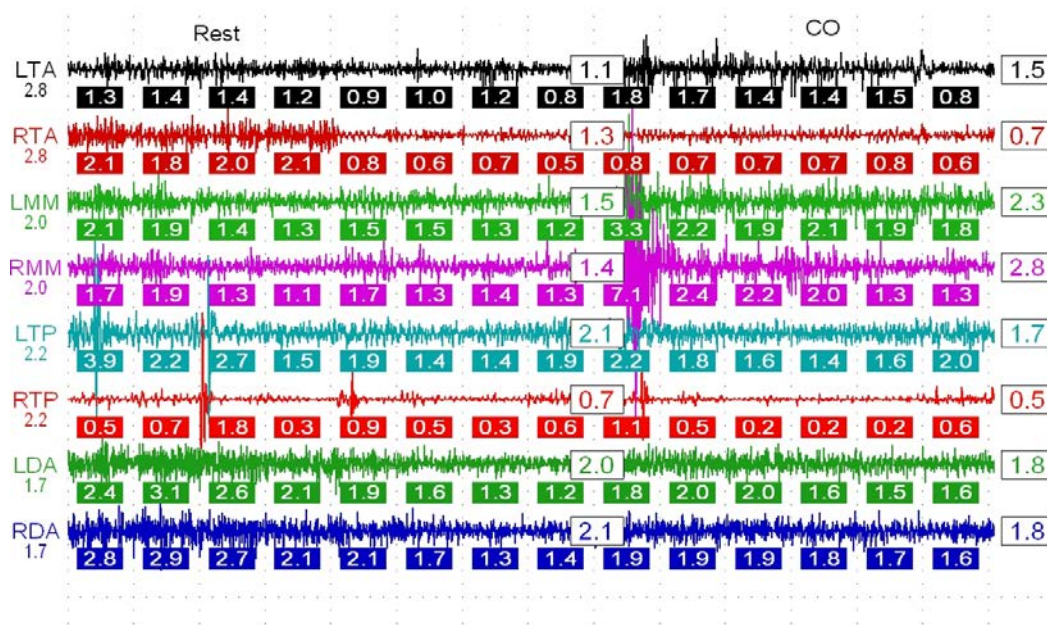
12. Narrative Abstract of Case

Ruth had severe dental anxiety and was upset with herself for avoiding the dentist for several years. After trying to seek dental help a few times during this time period away, she could not find a doctor that she was happy with or felt comfortable with. Ruth had gotten to the point where she wanted to improve herself aesthetically and was ready to do what she needed to do to get healthy. Ruth was given options for restoring her smile and overall oral health. Ultimately, Ruth declined the option of restoring the posterior teeth and undergoing Invisalign treatment to align her front teeth, and decided to proceed with full mouth reconstruction.

After her initial consult and discussion regarding TMD, Ruth was eager to start and proceed with the work she needed with a practice she felt comfortable at. Within one month of wearing her orthotic, Ruth was amazed that her symptoms were either eliminated or greatly improved. The NM bite was comfortable confirming that the NM bite would be the one we would restore her in.

Before the preparation appointment we sat down with Ruth and decided with her what she wanted her new smile to look like. After the preparation appointment Ruth was extremely happy with the temporaries. Although she was happy, we still gave Ruth ample time to get used to them and determine whether or not she would like to make any changes in shape and smile design. Given that there was nothing she wished to

change, the delivery was scheduled shortly after and Ruth was ecstatic with the final results. After some coronoplasty, all scans showed improvements and she was comfortable. Not only was she now comfortable, she now had a smile that she was happy with.

13. *Future Treatment Recommendations*

At the beginning of treatment Ruth informed us that she was moving cross country. Once our work was completed, we advised Ruth to find a doctor in her area as soon as possible. We gave her recommendations for NM doctors in that area. We explained to Ruth that we felt it would be best for her to seek routine care with one of the providers we gave her, as they are familiar with cases like hers. I recommended Ruth to continue with her perio maintenance every three months, and to please contact us if she is ever back in our area as we would love to see her and check to make sure all is well with the work we completed.