



JVA

Bridging the Gap
Between
Exam and Imaging

JOINT VIBRATION ANALYSIS (JVA) CAN BRIDGE THE GAP BETWEEN HISTORY, CLINICAL EXAM, AND TMJ IMAGING



In a private practice it may not be practical to obtain CBCT or MR imaging on every new patient, but it would be good to have a reliable indication of any present mal-conditions of the TMJs. The patient medical history report and clinical examination, while necessary and valuable, are often insufficient to provide an accurate indication of TMJ status¹⁻¹⁰ And situations occur where it is necessary for economic reasons to limit imaging to either CBCT or MR, choosing the one that may contribute the most information to the diagnostic process with due consideration.

Joint Vibration Analysis (JVA) is a computerized process of recording vibrations bilaterally from the TMJs and processing the vibrations in software to arrive at a reliable indication of whether the TMJs are normal or damaged. The recording step involves placing a pair of accelerometers directly over the TMJs and instructing the patient to open maximally and close to a light tooth contact 6 or more times. This simple movement requires the condyles to translate to their full extent, revealing any limitation in the range of motion, deviation, deflection or joint noises.

HOW DOES JVA EXCEED AUSCULTATION AND PALPATION OF THE TMJ?

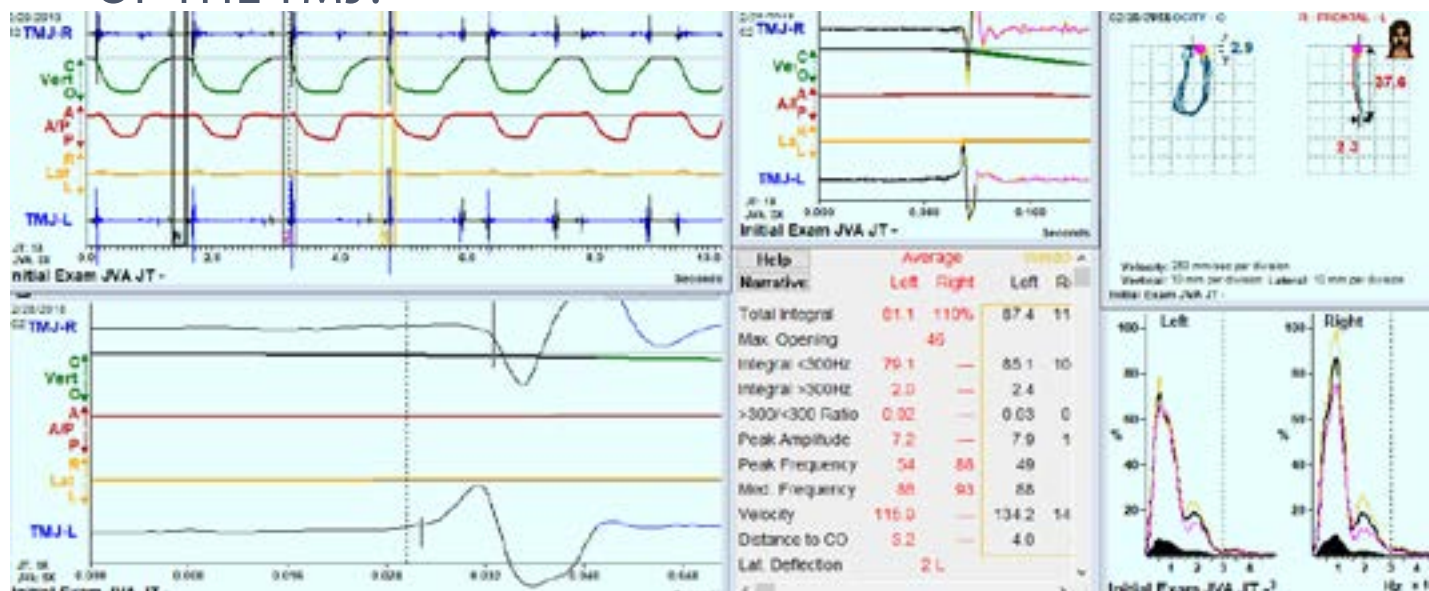


Figure 1 is the JVA from a patient with a chronic left TMJ reducing displaced disk. Both TMJs show large vibrations at around 80 KPaHz. Palpation suggested a bilateral Piper 4a disk displacement with reduction. However, the intensity of the vibration, the timing of the vibrations and the mirror image relationship between sides in the JVA ZOOM view indicated a left disk reduction from a chronic medial displacement. No reduction for the right TMJ. Why is that?

- The left vibration starts 6 milliseconds before the right vibration. The originating side always starts first.
- The contralateral equal intensity, mirror image vibration is evidence of a reduction from a medial displacement
- The large early opening vibration has only 1 cycle, which may be evidence of long-term chronicity
- The pattern of frequency distribution (FFT Window) is the same from both joints (meaning it's the same vibration)

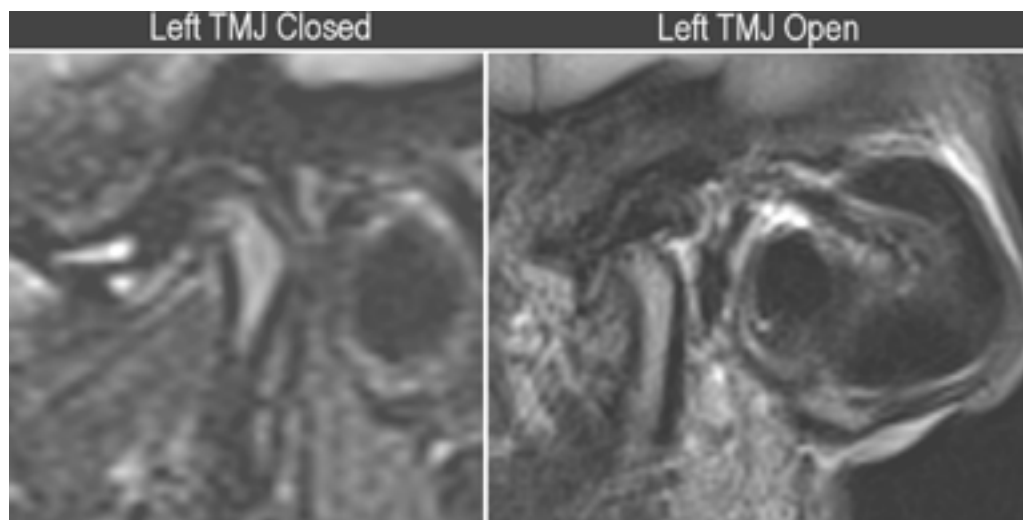


Figure 2. MRI of Left TMJ in closed position and open position. The disk appears to be missing in the closed position in this sagittal view and unfortunately not coronal view was taken. A lesser internal derangement is the partial disk displacement with reduction (PDDR, Piper 3a). In this case the disk slips off of the lateral pole during closure and the reduces during opening. This produces a single vibration of the ipsilateral side with about 50 % transfer to the contralateral side because the disk moves antero-medially when it displaces, posterolaterally when it reduces. This PDDR can be easily missed in MRIs, depending on how thoroughly the images are reviewed. It is very convenient and cost effective to have the JVA right in the practice for a quick indication of TM joint function.

JOINT NOISE MIGHT SOUND THE SAME TO THE EAR, HOWEVER, JVA PROVIDES YOU SOUNDLESS ADVICE AS TO WHAT THE JOINT IS ACTUALLY DOING

When palpating the TMJ and finding an indication of a disk internal derangement it is often considered necessary to obtain an MRI as the so-called "Gold Standard." Figure 2. In this case, the MRI confirms the status of the left TMJ disk as being displaced, but it is not as clear whether it fully reduces or not. However, both the MRI and the JVA detected that the left TMJ is damaged (not normal), but the right TMJ is not. Note that the condyle is distalized in the closed position, sometimes considered an indication of DD or DDR, but not always a very reliable one¹¹.

Figure 3 is the JVA recording of a right TMJ (PDDR) Piper 3a condition.

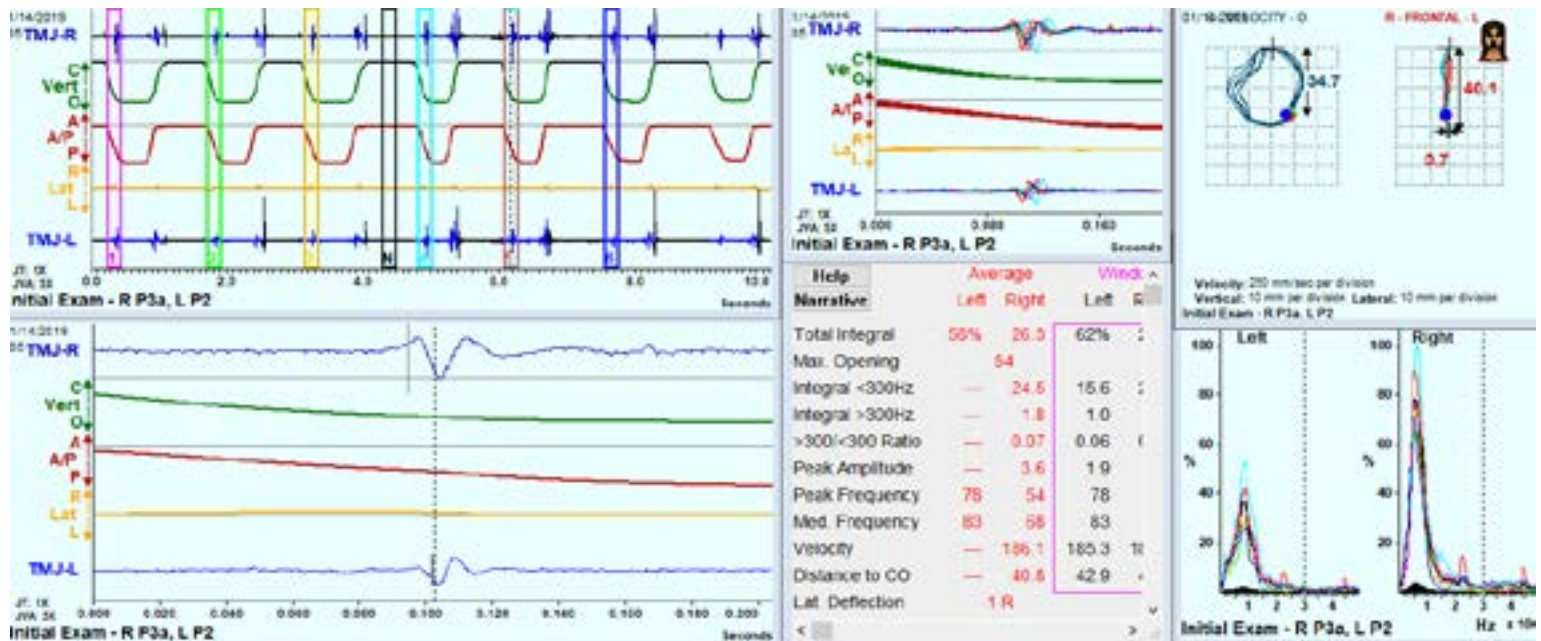


Figure 3. JVA recording from a patient with a Piper 3a (PDDR) condition in the right TMJ.

In the case of the long-term chronic internal derangement, the disks are often permanently displaced bilaterally. Clinically, the TMJs may be quiet if the condition is acute or if both TMJs have successfully adapted, but the range of motion (ROM) will be somewhat restricted. When JVA is used to record the TMJ vibrations, a ROM in the 20 – 30 mm range is usually indicative of a relatively acute Piper 4b or closed lock condition. Chronic adapted Piper 4b conditions usually exhibit a ROM of 30 – 40 mm. The significance of any vibrations present is mainly predicated upon the frequency distribution present. A high Integral of frequencies > 300 Hz, high values of the peak and the median frequency generally indicate the presence and the degree of degeneration, which does not suggest an optimistic prognosis¹².

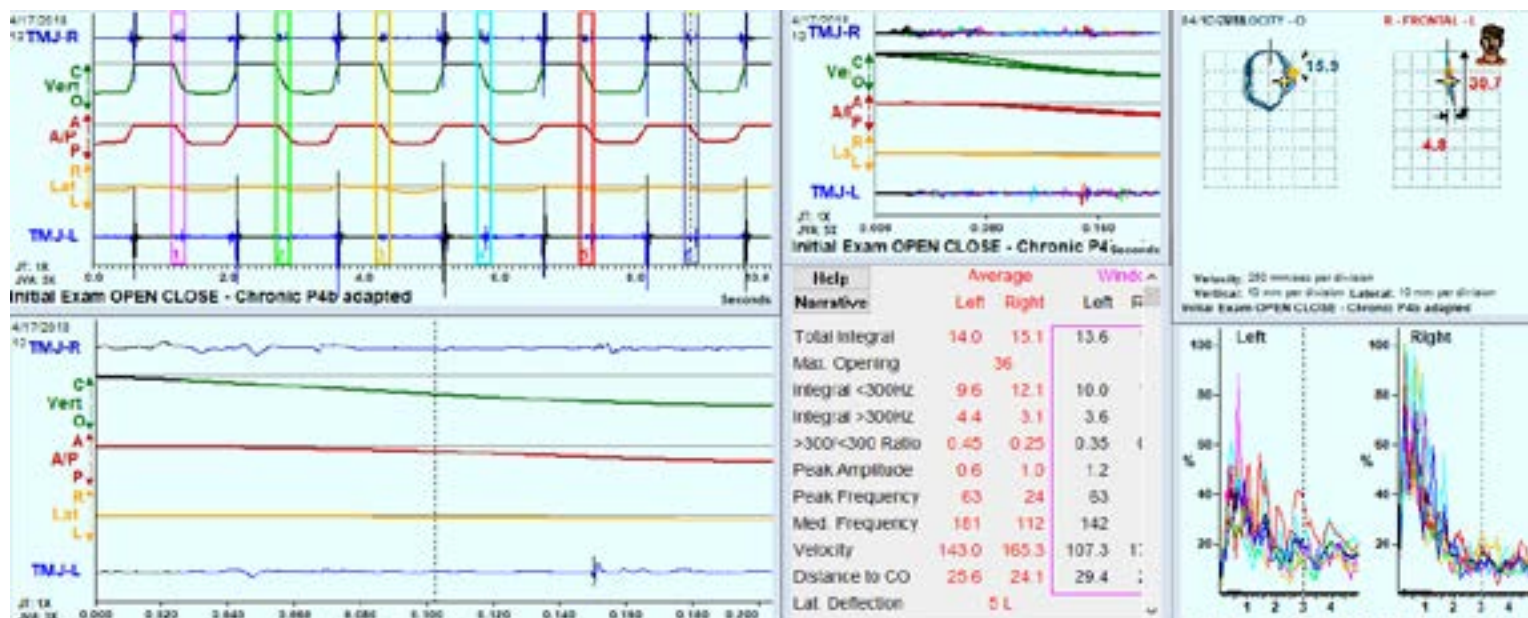


Figure 4. JVA of patient with bilateral Piper 4b chronic closed lock. TMJs are quiet, but ROM = 36 mm, typical of a chronic adapted limitation. The Integral > 300 Hz is above the threshold of 3.0 in both TMJs indicating a slightly rougher tissue interface than normal, but not by much.

The MRIs on the same patient reveal that there is still some tissue between the condyle and the eminence, which suggests successful adaptation, but does not reveal anything about dynamic function. The JVA indicates both TMJs are quiet during opening and closing, an indication of good adaptation. The MRIs do confirm that both of the disks are permanently displaced and it appears that the right condyle is translating somewhat more than the left condyle. This is quantified by the JVA record revealing the mandible deflects toward the left 5 mm at the widest opening.

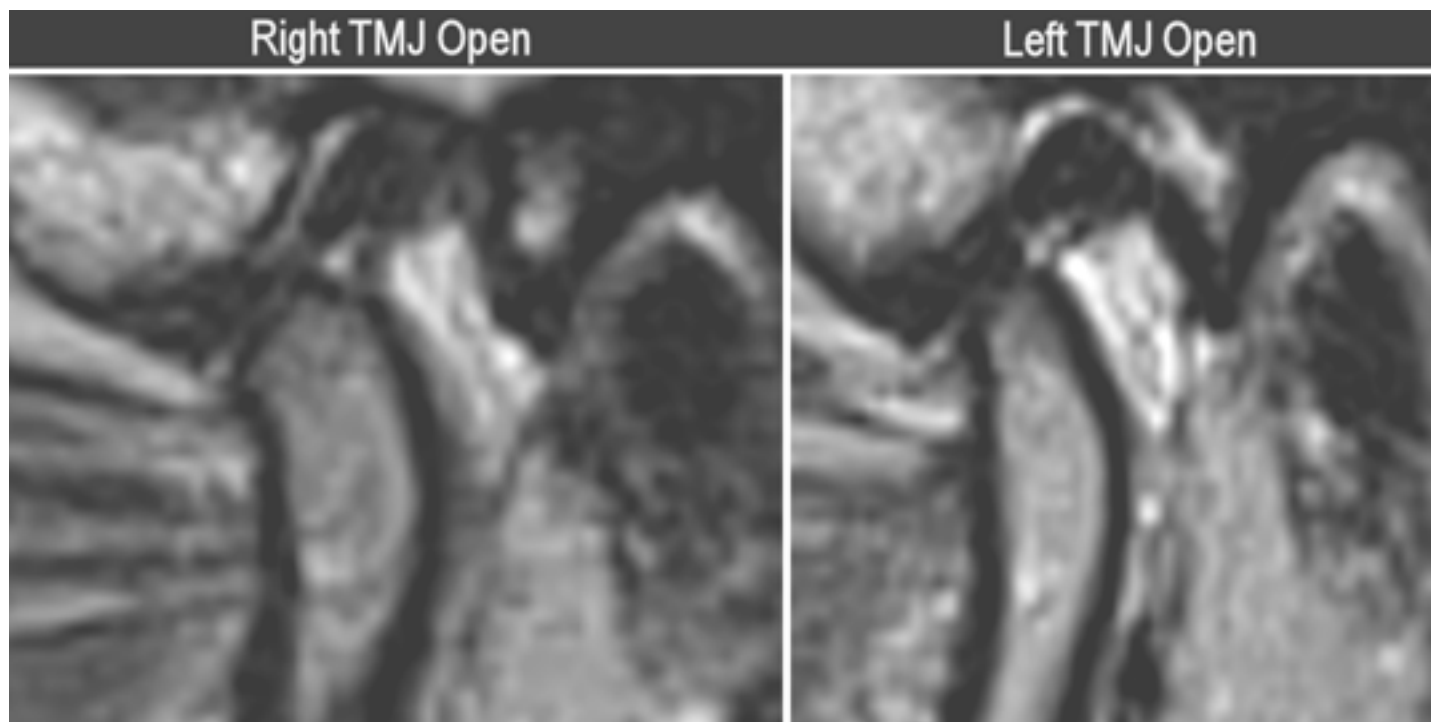


Figure 5. MRIs of the same patient in figure 4, with open TMJs showing that some tissue is still between the condyle and eminence, but not the disk. The right condyle seems to be translating somewhat more than the left one at maximum opening. It usually takes years for a closed lock condition to fully adapt, even when the adaptation is ultimately successful. A ROM in the low 30s with a moderate intensity that does not include high frequencies is indicative of conditions that are still adapting and have not yet commenced a degenerative process. This suggests that good adaptation is progressing.

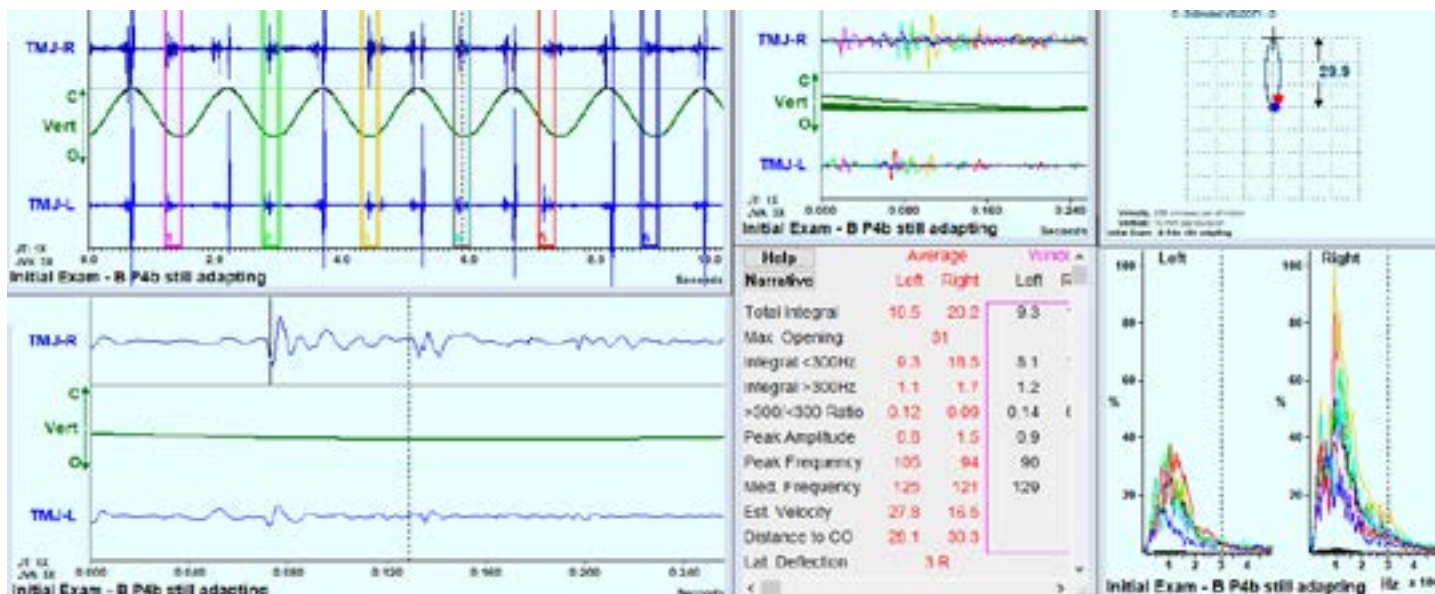


Figure 6. Bilateral Piper 4b non-reducing displaced disks still adapting. The low values of the > 300 Hz Integral and the very low ratios indicate good adaptation dynamically.

MRIs reveal any changes in the morphology of the TMJs as a disk displacement progresses, but cannot indicate the quality of the dynamic interface of the remaining tissues. In this case the condyle shape is very flattened with a “bird beak” appearance, which is associated with degenerative joint disease. However, the relatively quiet JVA record with minimal high frequency content (normal values) indicates that the tissue interface is adapting well to the condition.

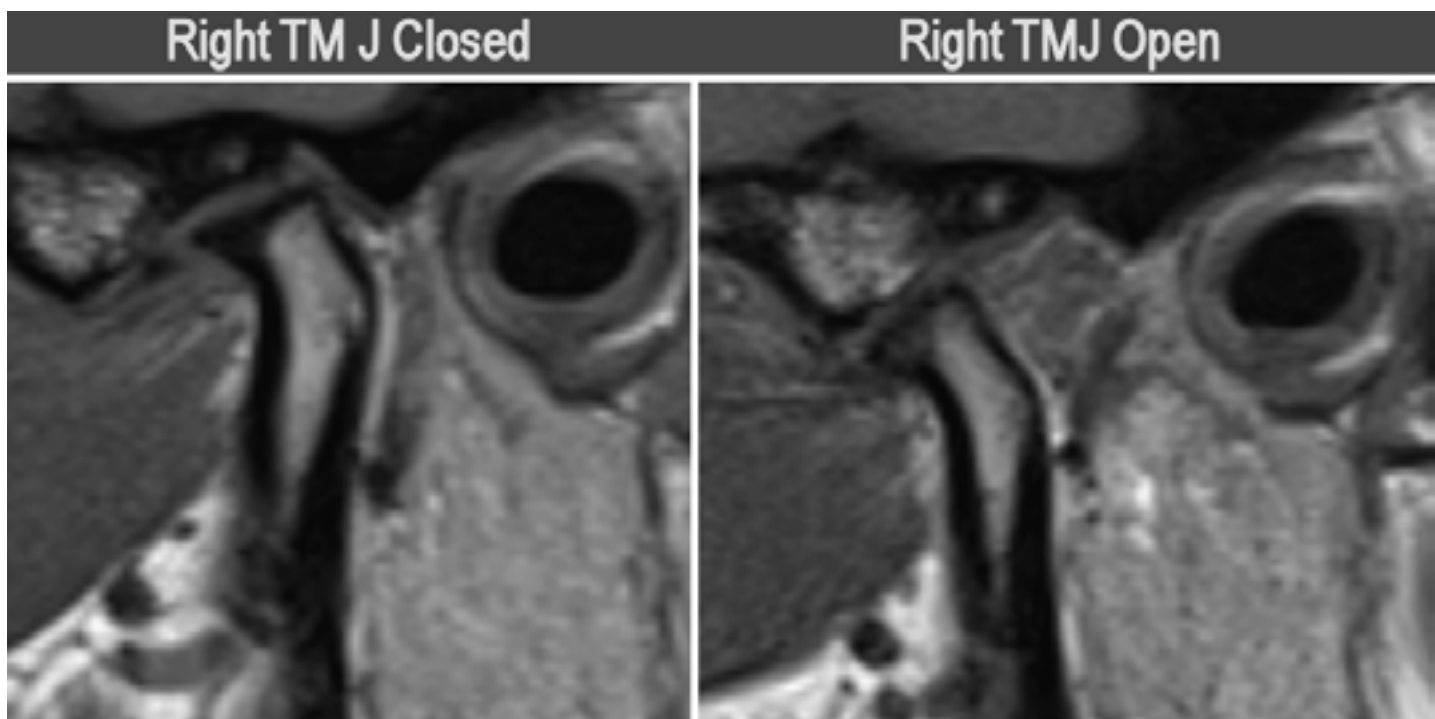


Figure 7. MRIs from the right TMJ of a patient with Piper 4b permanent bilateral disk displacement without reduction. Although the condyle appears flattened, there is tissue between the condyle and the eminence.

When the JVA record indicates that some degenerative changes are present in the left TMJ based upon the increased value of the > 300 Hz Integral (6.6) compared to a nominal value < 3.0. This is an example when it may be preferable to obtain a CBCT image set rather than an MRI.

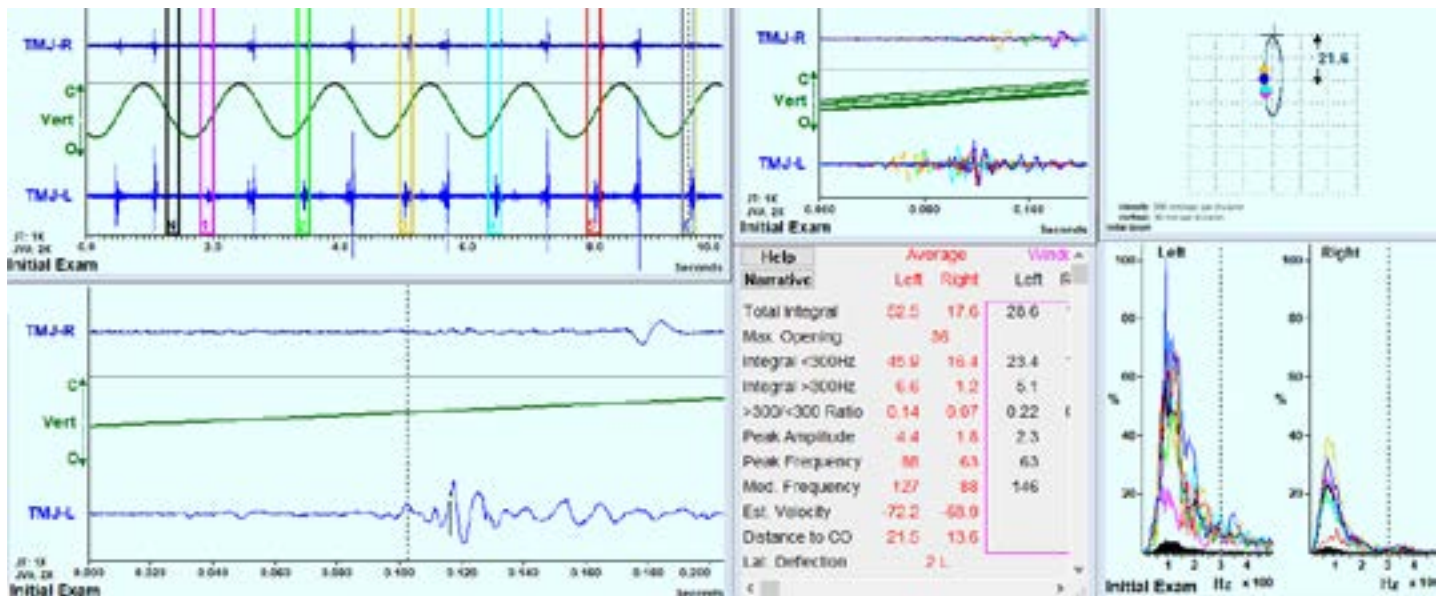


Figure 8. This chronic DD Piper 4b patient's JVA record measured 6.6 KPaHz in the > 300 Hz Integral (< 3.0 is considered low) from the left TMJ, but revealed a low value from the right TMJ. The ROM of 36 mm suggests a rather long-term Piper 4b condition where adaptation has restored 70 % of a normal range of motion.

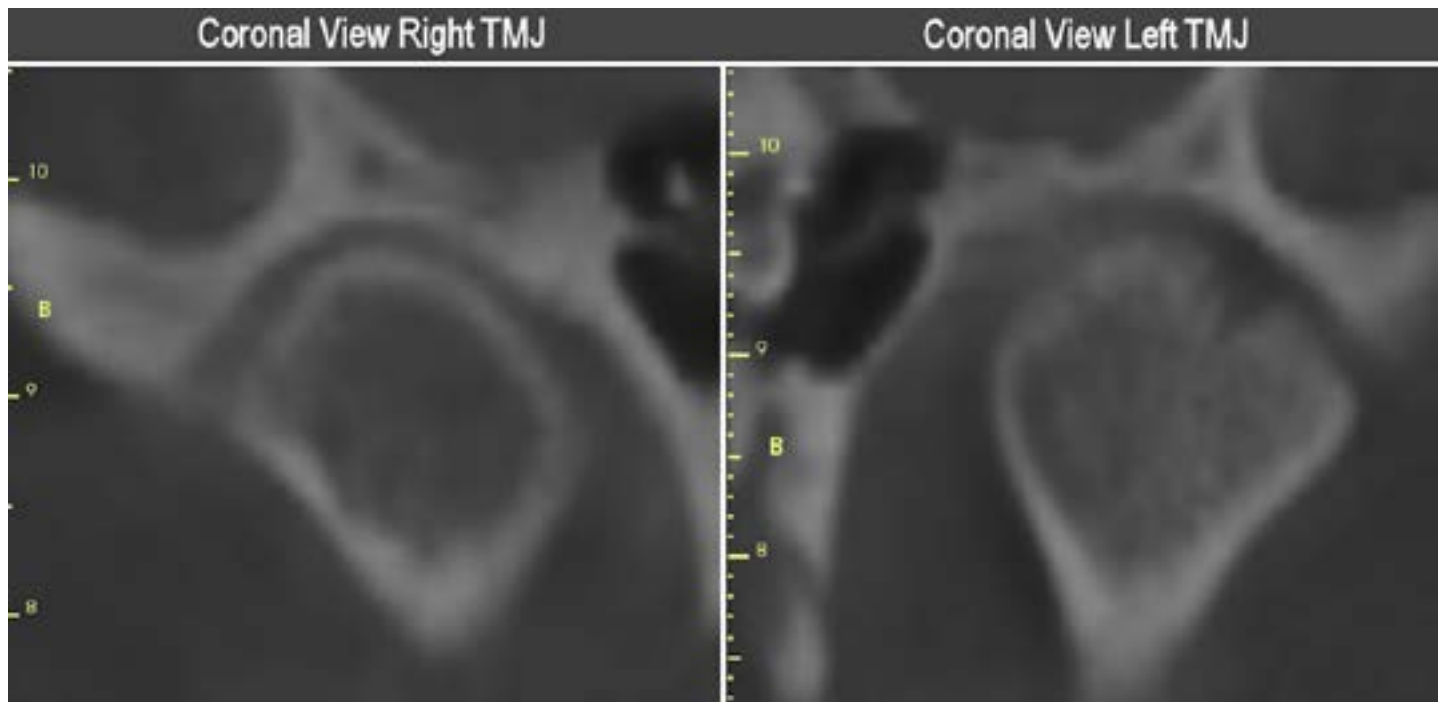


Figure 9. The left condyle as seen in the coronal view has lost some of the cortical bone and is displaced laterally, suggesting a permanent medial displacement of the disk. However, the right condyle is more centered and has more cortical bone intact.

In some cases, adaptation can be very good even though the Internal derangement does distort the structures. In figure 9 the loss of cortical bone may be damaging to the integrity of the TMJ long-term. In other cases, the joint adapts to the displaced disk condition, adjusts to it and maintains a stable relationship.

The 40 mm ROM in the female patient record (Figure 10) represents an eighty percent recovery of a mean normal ROM. The quiet TMJs without vibrations in the > 300 Hz Integral values (< 3.0) bodes well for her TMJ adaptation. Although previous active osteoarthritis was likely, the current status is more likely a stable osteoarthritis.

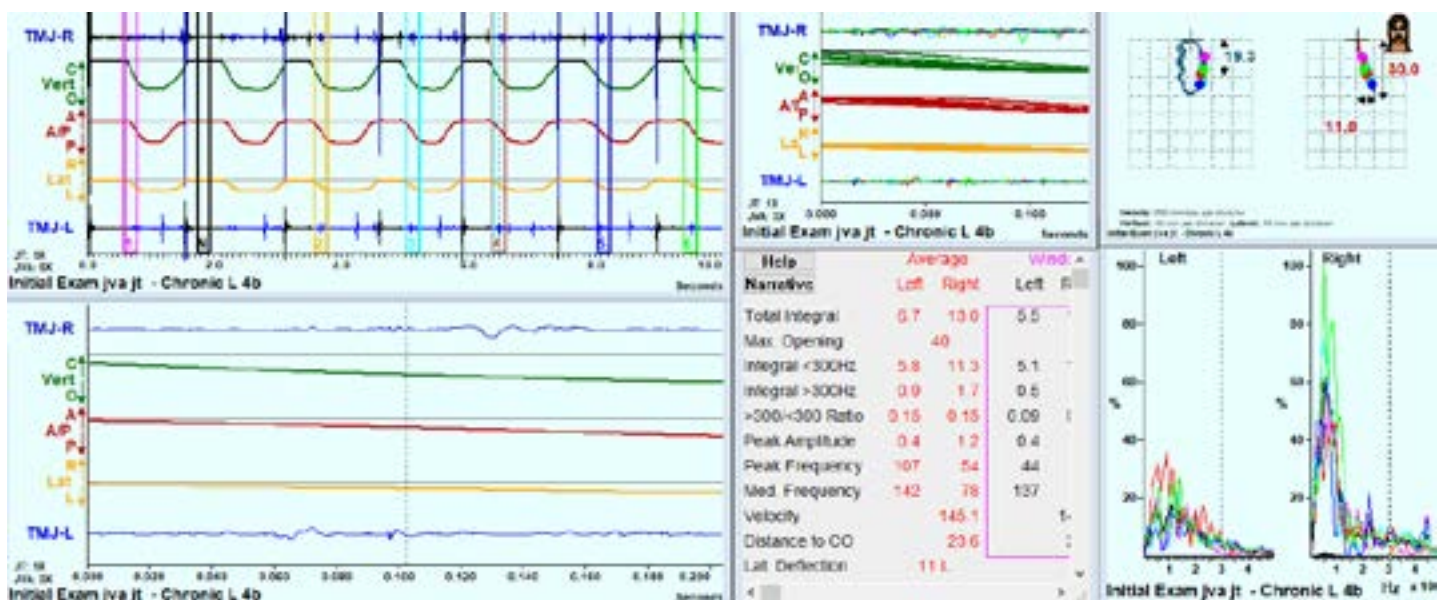


Figure 10. This is a typical well adapted Piper 4b non-reducing disk displacement condition. The 40 mm ROM is enough for good function and the bilaterally quiet TMJs suggests good tissue interfaces within both of the TMJs.

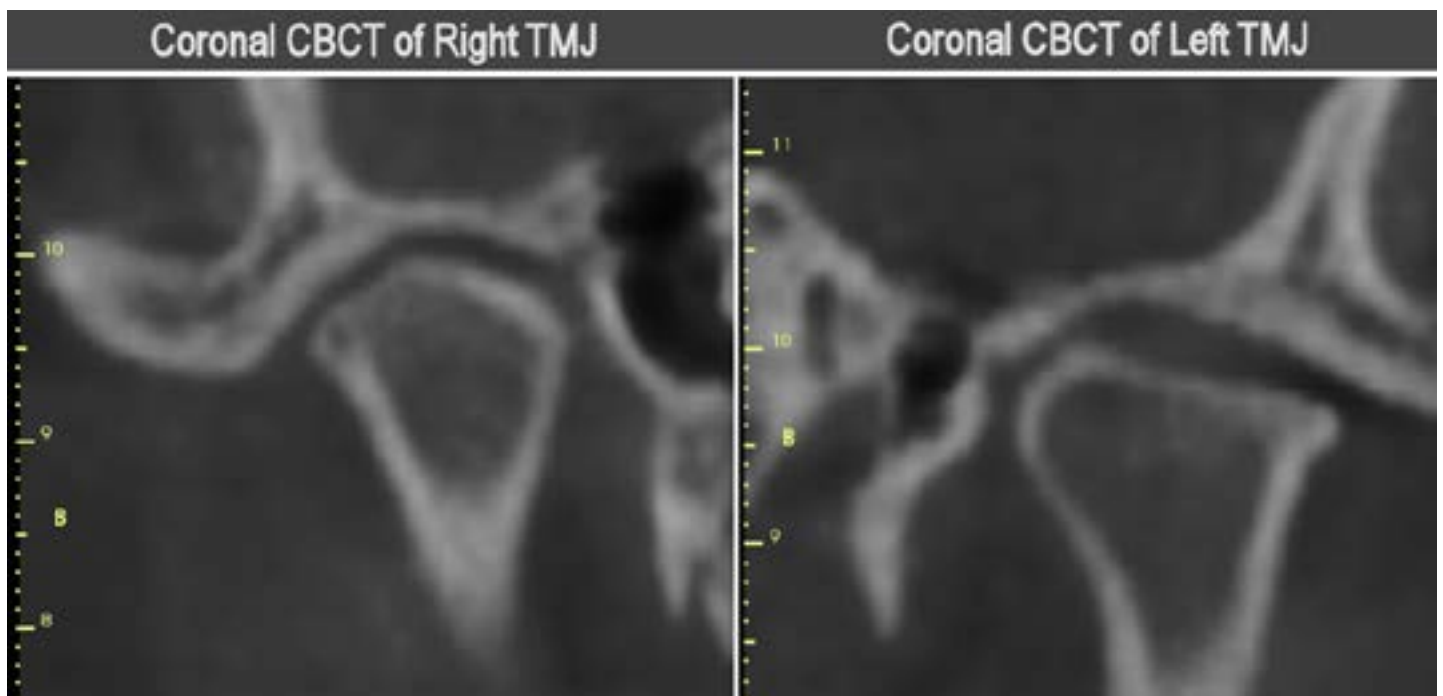


Figure 11. Although both condyles are distorted, the cortical bone is still present. The structures look well adapted to the conditions in both TMJs.

JVA often complements the information available from imaging, but more importantly, it provides an in-office, quick and easy record of every new patient's starting point with respect to their TMJs. JVA is also a great tool for measuring function during and post treatment. As valuable as MRI and Radiography is to the diagnostic process, it is not feasible for them to be performed at every follow up visit. This is data that can be derived with the JVA in a matter of seconds. Furthermore, dentists can use the JVA to test function at various jaw and/or splint positions prior to building the splint. Radiography and MRI is more expensive, more invasive, and can be a challenge to schedule, make JVA even more valuable.

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