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Cone Beam Imaging and Condyles From Rorschach Tests to Reality?

INTRODUCTION

It's not like I haven't written on this subject before.[1-5] The Imaging of the temporomandibular joint complex using dentistry's newest modality cone beam "CT" is actually now, pretty "old news." We now have exquisite thin slice, detailed images with which to view the condyle in three anatomic planes of section - axial, sagittal, and coronal. Thus, we can see subchondral cyst formation, osteophytes and condylar surface morphology in better detail than ever before. We don't have to guess at small opacities or even large ones that represent loose bodies in the temporomandibular joint space. However, even dentists who have adopted this technology still seem to be stuck in a two-dimensional grayscale paradigm. The dental profession is still stuck in the old paradigm of radiographic interpretation. What we need now is to move our colleagues forward to visualization in the 3-D color world. Hopefully this brief article will help you understand the power of using all of the tools in the cone beam toolbox in your software to improve your clinical decision-making and assessment of the TMJ complex. Currently, only cone beam imaging allows us to do that.

Common changes TMJ condyles and adjacent bony structures: Osteophytes, Subchondral Cysts and Surface Erosions

There is no doubt that the thin slice (0.1 mm) grayscale slices allow dentists, who want to evaluate the temporomandibular joint precisely, to find these osteoarthritic changes, much earlier than they could before. The temporomandibular joint, like any other loaded joint, is prone to osteoarthritic changes. When you lose synovial fluid, and the surface cartilage osteoblasts are stimulated to lay down bone to protect the joint. We see substantial bony changes and truly ugly condyles which can be totally asymptomatic. After all, the temporomandibular joint is very, very adaptable. So the goal may be to find these changes much earlier, especially if the patient is symptomatic. Thin slice 2-D grayscale and 3-D color reconstructed images help the dentist do this easily. **Figures 1 to 3** illustrate early changes in the condylar head and adjacent bony structures.

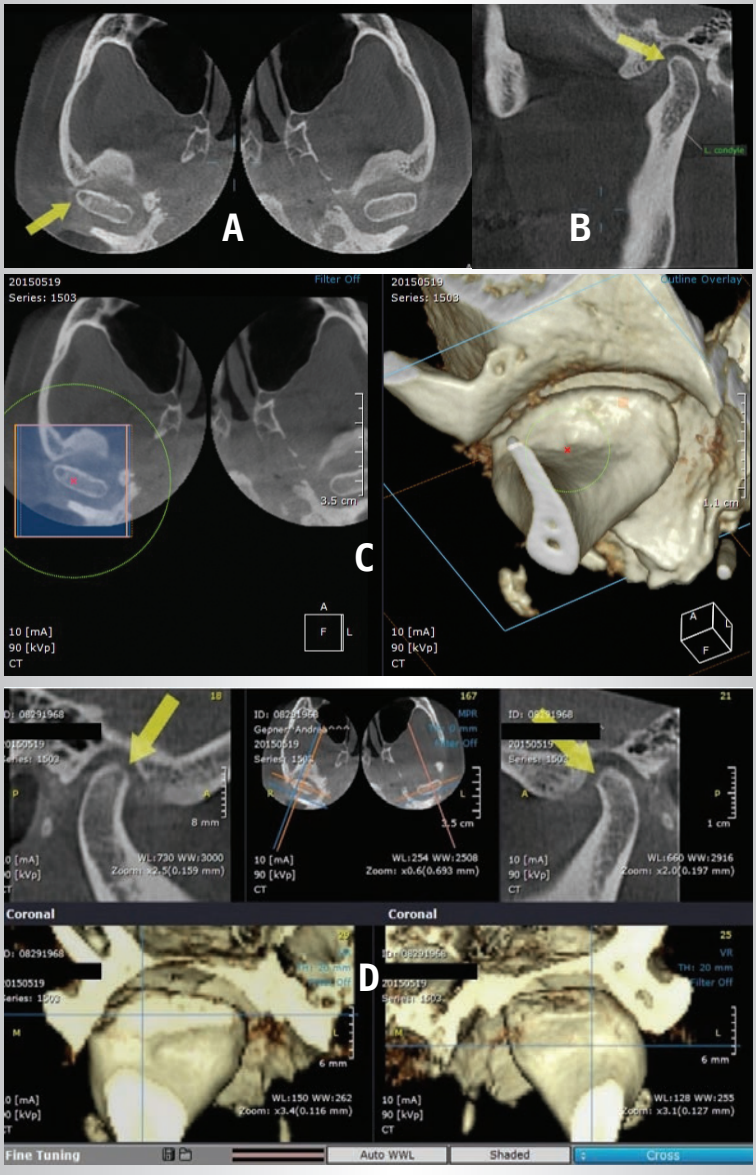
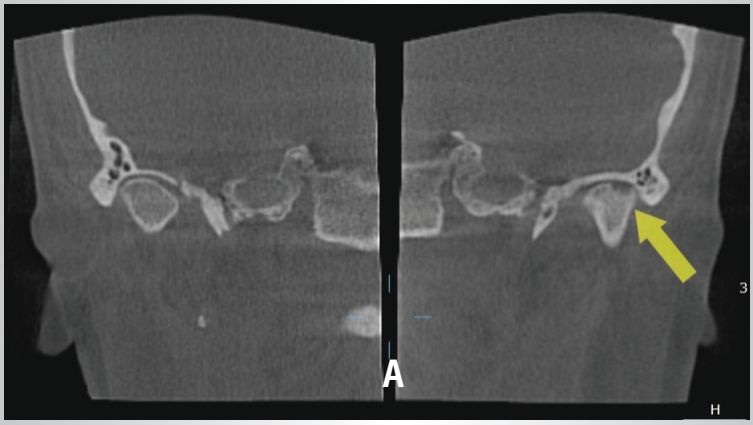


Figure 1A Axial views through the mid-condyle showing a small subchondral cyst on the lateral aspect of the right condylar head. **Figure 1B** Sagittal view of the cyst. **Figure 1C** 3-D reconstructed view viewed from the foot end of the patient failing to show cystic changes. **Figure 1D** Yellow and orange arrows show the subchondral cyst and surface erosions which they caused into D, grayscale and 3-D color.



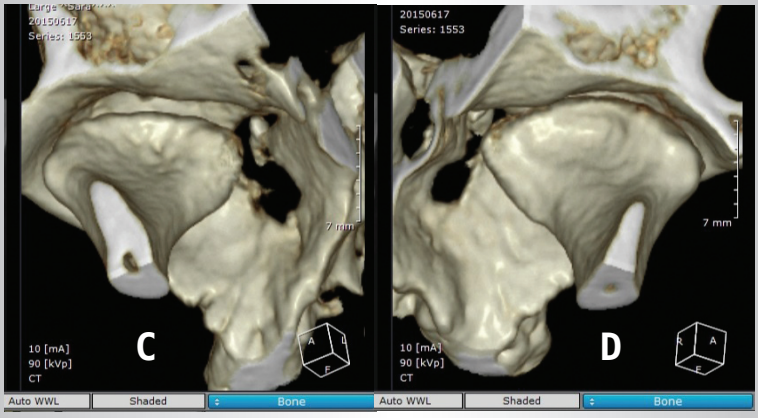
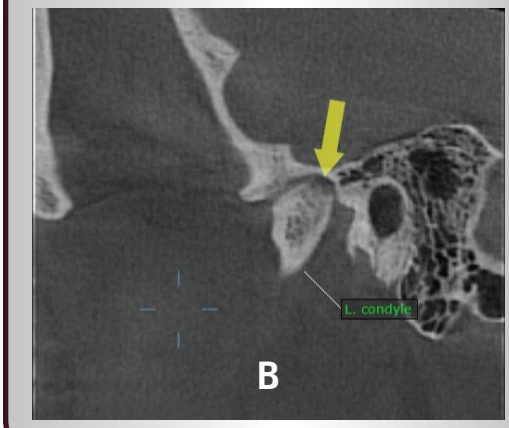


Figure 2 Larger subchondral cyst on left condylar head; **Figure 2A** Coronal slice, **Figure 2B** Sagittal slice. **Figures 2C and 2D** show 3-D reconstructed views with no evidence of the subchondral cyst/erosion.



While there is true osteophyte formation, it is uncommon to see on TMJ condyles. For years we've been looking at thin slice, grayscale views of condyles from the sagittal direction and in slicing the condylar head into sections the osteophytes took on the appearance of "bird beaks." In fact this term was used commonly to describe the osteophytic change. In actuality, the process which occurs on the anterior surface of the condylar head is more akin to that seen on the hip and is termed lipping in medicine.

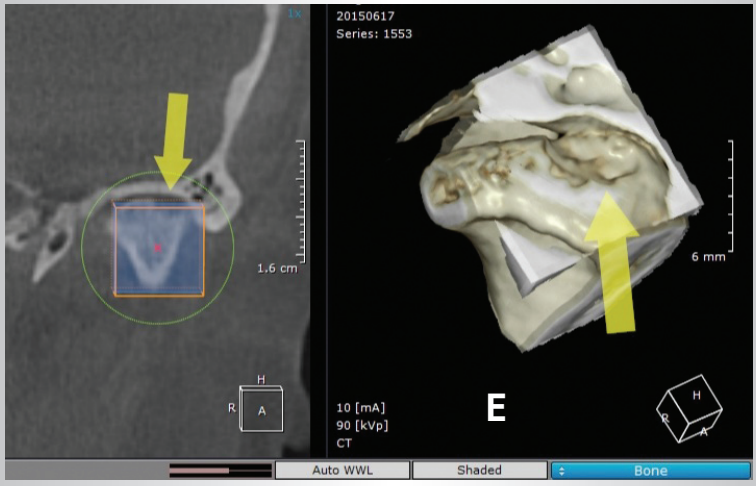
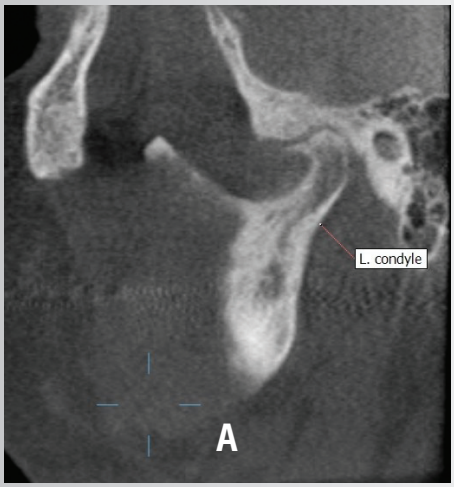
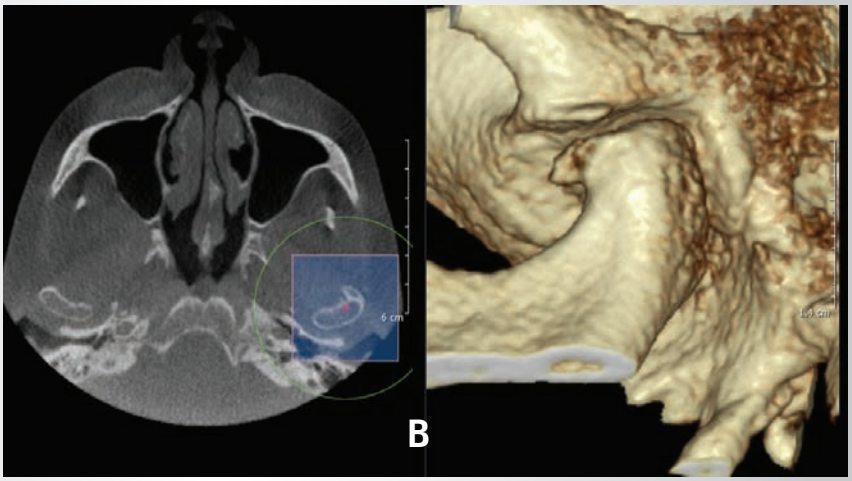


Figure 2E By making a 3-D reconstructed view and rotating it as well is stripping away the roof of the glenoid fossa we see the surface erosion very plainly.





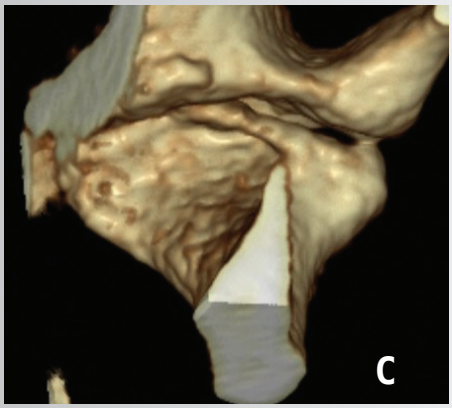


Figure 3A – 3C In the thin slice, grayscale sagittal view above **Figure 3A**. There is a radiopaque projection from the anterior surface of the condylar head which looks like a "bird's beak." In **Figure 3B** above both views show some osteophytic activity on the lateral pole of the condylar head. These appearances are consistent with osteophytes. However, in **Figure 3C** you can see significant projection along the anterior surface of the condyle, consistent with lipping. This is the more usual osteoarthritic change to be seen on condyles.

Uncommon, but Frequently Painful Changes in the TM Joint Complex: Loose Bodies

Figures 3A and 3B shows osteophytic change. **Figure 3C** shows lipping.

"Intra-articular loose bodies are chondral, osseous, or osteochondral fragments located in the articular cavity. They derive from the internal surfaces of synovial joints including bone surfaces covered by hyaline cartilage and capsule lined by the synovial membrane. Loose bodies that move freely in the joint cavity are predisposed to be entrapped between the articular surfaces causing intermittent joint locking, limitation of motion, pain, and intra-articular effusion. On the contrary, fragments stably located either in a synovial recess or in a bursa are usually asymptomatic. Repetitive internal derangement of a joint results in damage to the joint surfaces, and leads to chronic symptoms and early osteoarthritis. The diagnosis of loose bodies is essentially based on imaging findings because clinical findings lack specificity." [6]

In my experience of interpreting over 18,000 cone beam scans, it is my opinion that loose bodies are more common in the TMJ complex than clinicians realize. Previously because of our inadequate imaging techniques I am convinced that many loose bodies may have been overlooked as a source of pain and intermittent locking of the temporomandibular joint. The description from the journal "Radiology Clinics" above gives testimony to this opinion. The author stated this in 1999 prior to the advent in common use of cone beam CT imaging. Plain film radiology including panoramic, linear tomography and sometimes conventional CT were all that was available for the authors to come to this conclusion. Changes probably had to be large to be identifiable. Today, this is not the case with cone beam "CT."

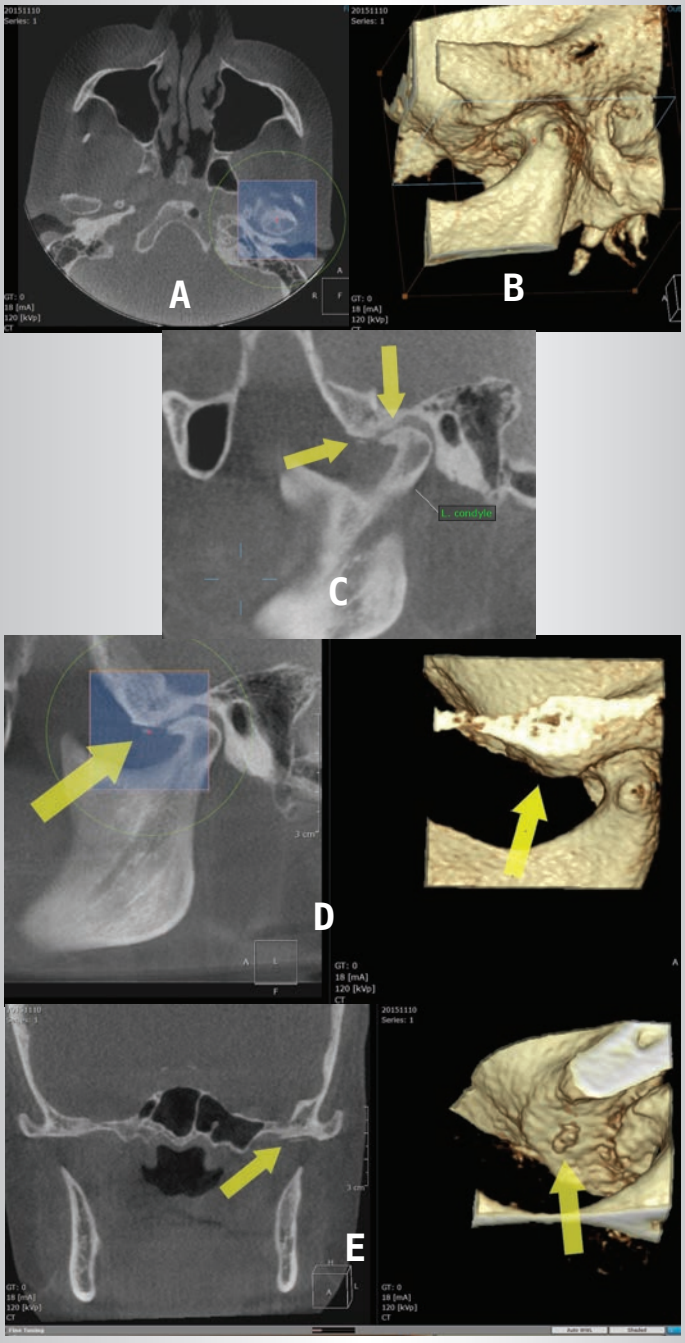


Figure 4A-4E. Figures show significant change on the left condylar head in both the thin slice to D, grayscale, coronal view and the 3-D color reconstructed view seen from a lateral or sagittal aspect. There is significant lipping on this condyle. **Figure 4C**, representing a thicker set of slices (approximately 5 mm) shows a possible loose body (lower yellow arrow). The grayscale image at 10 mm thickness shown on the left in **Figure 4D** makes the small loose body, more apparent. However, it is not visible in **Figure 4D** on the right in the 3-D color reconstructed view. In **Figure 4E** simple image processing using a Fine Tuning tool in OnDemand 3D software (CyberMed, Seoul, Korea and Irvine, California) allows us to alter color, transparency and opacity to make a loose body visible (large yellow arrow on right side of figure).

SUMMARY

Most dentists are just coming to understand the power of cone beam "CT" imaging. Early adopters have been amazed at the level of detail and quality of the images from this imaging modality. However, because dentists have not been taught or even shown tools for performing image processing that can make their images more detailed and understandable, they persist in trying to "interpret" all of the information from their 2-D grayscale paradigm. This is only natural. However, once they grasp the concept of visualization and start to use 3-D color reconstruction to examine their data, they soon realize that the imaging modality they purchased is even more powerful than they thought or understood. 3-D imaging using cone beam "CT" is currently the most powerful form of imaging for diagnosis. Research it, adopt it, and seek out as much education as you can about this modality. You and your patients will benefit enormously from using cone beam 3D imaging. Better diagnosis leads to better treatment - a situation in which everyone wins.

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SOMETIMES YOU WILL NEVER KNOW THE VALUE OF A MOMENT UNTIL IT BECOMES A MEMORY.
DR. SEUSS