One of the most important steps in the design of any restoration is proper functional adjustment during design using the 3Shape virtual articulator. This is especially true for zirconia, as this material ideally should not be ground upon after sintering, or at least ground upon as little as possible to avoid damaging the structure and potentially cause premature failure.

The first thing to understand is exactly where the maxilla should be. Figure 1 shows the anatomically average position of the maxilla according to Bonwil. As you can see, the incisal plane is parallel to the interocular line, the maxilla is positioned midway between the mandible and the Frankfort Plane, and the maxilla leans downward at a 10 degree tilt from posterior to anterior. This position places the maxillary incisal edge between 100 - 110mm from the condyles.

Unfortunately, the initial placement of scanned models into the articulator is not correct in Figure 2.

Figure 1 shows the anatomically average position of the maxilla according to Bonwil.
3Shape DOES offer a system to automatically record the position of the maxilla by using special (and expensive) calibration objects that you mount perfectly and then scan in a special calibration procedure using special scan plates that accept the articulator's mounting plates (Figs. 3-4). Unfortunately, this approach is articulator specific and does not work perfectly beyond the articulator that the calibration objects were mounted on, even with articulators that are supposed to be interchangeable. The final nail in the coffin is the fact that there is NO occlusion scan. This depends solely on the spatial position of each arch, which is derived from the calibration objects and transferred to the articulator during scanning. The teeth never come together correctly this way, so the final occlusion depends on the “Optimize Occlusion” algorithm, which has its own issues. Therefore, I still prefer to take a normal occlusion scan and position the maxilla according to Bonwil.

Four things need to be done to correct the maxillary position.

1. Center the maxillary occlusal plane between the bows by raising it about 12mm (Fig. 3).
2. Tilt the maxilla downward to about 10 degrees (Fig. 4).
3. Move the maxillary central incisal edge to about 110mm from the condyles (Fig. 5).
4. Ensure that the occlusal plane is parallel to the articulator bows (Fig. 6).
Once this is done, you can save and name the placement algorithm by clicking the “Save” icon in the Virtual Articulation dialog box (Fig. 7). In the future, you can automatically perform the placement by clicking the placement icon right next to it. Be aware that this doesn’t always work perfectly and you may need to tweak the resulting maxillary placement.

**Proper Set-up of the 3Shape Virtual Articulator with Quadrant Models**

Cases done on quadrants are particularly problematic since the 3Shape VA offers only full frame articulators which function nothing like tooth guidance on quadrant articulators. This is EXACTLY why these cases almost always require a lot of adjusting at the bench, feeding the seemingly never-ending battle between designers and finishers!

The first step is to realize that we need to try to duplicate the geometry and movements of these situations where at least half the teeth are missing and the condyles are nowhere near a physiologic position.

After a lot of trial and error, it turns out the key to success is using the 3Shape generic articulator and positioning the models so the VA articulator’s condyles are in about the same relative position to the teeth as those of a small plastic “glue-on” articulator (Fig. 10). This is accomplished by moving the models all the way up and back in the
articulator into a totally non-physiologic position just like a quadrant. Note that horizontal positioning is also adjusted as in Figures 11, 12, and 13.

The other thing to realize is that with quadrants, the teeth themselves provide all the “guidance” so it is important that they ride across each other in as close to the same fashion as with the plastic articulators. Tilting the model slightly backward forces the teeth to “run into each other” in a way that is totally wrong, but very similar to what happens with these articulators (Fig. 14).

With the models in this “totally wrong” but similar position relative to the condyles, you will get the correct “markings” that are appropriate for the situation. It’s a good idea to double check that the marks seen in VA actually represent the real situation (Fig. 15). After adjusting the crown(s), the result
It is VERY important to understand that the 3D you think you see on the screen is not real.

The Occlusal Compass button, when enabled, colors the contact areas using different colors for different types of movement. It is VERY important to understand that the 3D you think you see on the screen is not real.

will be very similar if not identical to what the technician will see at the bench; eliminating most, if not all, of the heavy adjusting that is so common in these situations.

Once this is done, you can save and name the placement algorithm by clicking the “Save” icon in the Virtual Articulation dialog box (Fig. 16). In the future, you can automatically perform the placement by clicking the placement icon right next to it. Be aware that this doesn’t always work perfectly and you may need to tweak the resulting maxillary placement.

Figure 17 shows the legend for the Occlusal Compass function of the Virtual Articulator. Many people are unaware that this is available in the help manual from 3Shape. The movements I am mostly concerned with are Red, Blue, and Green. Red is defined as ISS (Immediate Side Shift) and Retrusion. I prefer to look at it as “Broad Centric” in the sense that it seems to represent the centric markings created when the articulator is moved in small circles around centric broadly marking the centric contact area. I generally ignore those and adjust centric via the collision lines using the “Cut to Antagonist” function in Smile Designer. Blue is defined as “Laterotrusive” but is more correctly considered a working movement and represents group function when it appears on multiple teeth. These are generally confined to anterior teeth and are often eliminated on posterior teeth, unless there is proper rationale for group function on a particular case. Green is defined as “Mediotrusion” but is perhaps better understood as a “Non-Working” or “Balancing” movement or interference. These are by far the most destructive and should always be eliminated. While the focus of this article is the proper set-up of the VA and not the specifics of occlusion adjustment, the ultimate goal is, of course, proper adjustment of designed restorations to hopefully avoid excessive adjusting at the bench.

One of the most important things to understand in the digital design world is that what you see, or better yet, what you think you see on the screen, is not necessarily accurate! How many times have you designed a smile case only to produce it and find the centrals are too short, too long, or the midline is canted? Very frustrating, right?
Mastering the 3Shape Virtual Articulator: A few things you’ll need to know

It is VERY important to understand that the 3D you think you see on the screen is not real. It is a construct that utilizes a combination of virtual shadow and light in conjunction with algorithms that distort the object as it is manipulated in this fake virtual “3D” space. I call this the “2D-3D Isometric Dilemma.” It is your brain that is the true miraculous “computer” that takes this information and translates it into a 3D representation of 2D images. This is also why once you stop moving an object on screen you can very quickly lose perspective and not know exactly what you are looking at.

In order to see the teeth as they really are, you MUST view them exactly straight on from both a left-to-right and an up-and-down perspective. Any deviation from this straight on view will begin to distort what you see.

Four things need to be done to correct the viewing perspective:
1. Invoke the Virtual Articulator as the FIRST step when beginning your design.
2. Center the arch on the blue alignment circle (Fig. 18).
3. Position the maxilla properly into the Virtual Articulator (Fig. 19).
4. Utilize the Grid function to accurately determine length and width of the teeth and midline direction. You can trust what you see ONLY when viewing properly (Fig. 20).

It is IMPOSSIBLE to maintain the proper viewing perspective while modeling the teeth. You MUST refer back to the “Set-Up” function in the VA to re-establish the proper perspective before judging any lengths and/or midline directions (Fig. 21).
Notice in Figure 22 how the arrangement of the teeth varies due to perspective. The center image is correct. The top images are viewed slightly from the left and the right. Note the distortion of the midline direction. The bottom two are viewed from slightly below and above. Note the distortion to the perceived length.

Figure 23 shows the very common issue with incorrect length (short in this case) even though it appeared correct during modeling (Fig. 24). This “Perspective Distortion” is the culprit in all those frustration situations where the anterior teeth are either too short or too long.

About the Author

Al Fillastre, BS, CDT has been working in the field of dental technology since 1975. After graduating from Stetson University in 1974, he moved to Atlanta, Georgia where he got his first job in a dental laboratory. In 1979 he opened his own laboratory inside his father’s dental practice, gaining valuable firsthand clinical experience working directly with patients in a high-end dental practice. He initially became involved in education at the Pankey Institute in Miami, Florida and continued in this endeavor through relationships with a number of dental companies. His lab became fully digital with 3Shape in 2012 and since that time has become recognized as a leader in the digital dentistry with a particular focus on form, function, smile design, occlusion, diagnostics, and implant design. He currently works closely with the Whip Mix Company and through this relationship continues to present lectures, hands-on clinics, and webinars in all of these areas. Al now owns and operates Ceram-O-Arts, Inc. dental lab in Lakeland, Fla.