The intent of this assessment is to illustrate a protocol for improving the effectiveness of the implant planning phase for guided surgery cases, as to mitigate potential surgical complications associated with limited interarch space.

**BACKGROUND**

The prevalence of guided surgery is growing with the "digitalization" of implant dentistry. The technologies supporting this trend (e.g., CT scanners, 3-D planning software, and surgical guide fabrication) continue to improve, and the cost per case is decreasing due to improved efficiencies and marketplace competition. These technologies still exist, however, with guided surgery, one of which is the ability to adequately plan for limited interarch space, particularly in the posterior.

The implant planning phase, during which the implant sizes and locations are determined by the clinician, is conducted with a 3-D virtual anatomic model of the patient in (or near) occlusion. Once the surgical planning is completed, a surgical guide is designed and fabricated to facilitate the case plan. The surgical guide design process is typically carried out by a technician working in a different software environment than what the clinician utilized. This creates a dilemma in that neither person is aware of the spatial access requirements for each surgical site; nor do they know the respective interarch values at maximum interarch opening (MIO).

There is an apparent conflict between the clinician's and technician's objectives. The clinician plans a case for superior results, but with a full understanding of the clinician's plan, but without a full understanding of the clinician's spatial requirements (i.e., spatial limitations). The clinician can then iterate the case plan if necessary to overcome any potential access limitations. Beyond improving the effectiveness of the implant planning phase, this protocol can mitigate surgical complications, reduce unanticipated surgical time, increase patient satisfaction, and advance the acceptance of guided surgery.

**MATERIALS AND METHODS**

The proposed protocol is intended to counteract the "misalignment" between the clinician planning the case and the technician designing the surgical guide by enabling the clinician to gain a real-time understanding of the interaction between the surgical plan, the surgical guide, and the spatial limitations. Following is an overview of an example workflow:

1. Acquire a CT scan of the patient in occlusion with the scan appliance (see fig. 1a).

2. Acquire a second scan of the patient in the MIO position (see fig. 1b), either using CT, an intra-oral scanner (IOS), or a 3D camera. If the latter options are selected there must be visual landmarks from the image data which are common to both datasets (1.2 & 2), but only a small section of data from both arches is necessary to "register" the articulation. Import the DICOM data from the initial CT scan into the surgical planning software and specify the location of each implant (see fig. 2).

3. Virtually articulate the case into the MIO position, and visualize the interference associated with each site to determine if interference exists with the opposing arch (see fig. 3). If no interference exists and/or no adjustment is desired the case can then be submitted for surgical guide fabrication.

4. Assuming interference is detected, one or more of four actions can be taken to try to overcome this. Figure 4 illustrates a combination of the first three options below:
   a. Reduce the length of the implant and/or
   b. Reduce the depth of the implant seating surface and/or
   c. Angle the implant mesially and/or
   d. Change the location of the implant

**RESULTS & CONCLUSIONS**

The methods outlined above enable the clinician to visualize the resultant instrument requirements (maximum size and location) for a planned implant site, and to verify that sufficient interarch space exists. The clinician can then iterate the case plan if necessary to overcome any potential access limitations. Beyond improving the effectiveness of the implant planning phase, this protocol can mitigate surgical complications, reduce unanticipated surgical time, increase patient satisfaction, and advance the acceptance of guided surgery.