Limitations of computer-guided surgery
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December 2013

Guided Surgery Solutions

Guided surgery using a CT-derived drill guide is the most accurate method for placing implants. However, preparing an osteotomy using a drill guide is not like using a drill press to create a hole in steel. Like other methods, guided surgery has limitations and nuances which must be appreciated. It is not a substitute for surgical judgment and experience.

One variable which must be considered is system error. Errors are inherent in CBCT scans, data merging, fit of guides on the teeth, fit of drills within drill stops or keys, and the fit of drill stops or keys within guide tubes. The specific characteristics of bone at a given osteotomy site and the shape and thread design of an implant present additional variables. Guided surgery works well in most cases because the cumulative effect of these errors is less than the precision needed to place an osteotomy in a given (the ideal) position.

Given these challenges, successful use of drill guides requires identification of cases where the cumulative error may exceed the tolerances needed, and crestal entry point and trajectory must be visually and/or radiographically verified before preparing an osteotomy. If these cautions are observed, guided surgery is a safe, accurate, and efficient method.

<u>Situations where visual/radiographic verification is indicated:</u>

1. CBCT scan in which crestal bone cannot be visualized due to scatter or poor image resolution. A guide can be used, but crestal entry point and depth must be verified visually
2. Thin ridge or tight space: guides are usually precise in defining the crestal entry point, but in a minority of cases (across all manufacturers), there is the possibility of a 0.3-1.0 mm error, which exceeds the tolerances needed for placement of an implant in a thin ridge or tight space. In these cases, it is imperative to visually verify the crestal entry point and trajectory before creating the osteotomy. Maxillary lateral incisor and lower incisor sites are often in this category
3. Knife edge or oblique ridge: when drilling into an oblique surface, the surface will tend to push the drill tip laterally and apically. A sharp drill, rotating at high speed, advanced slowly is a useful strategy. The ridge may need to be flattened before drilling. Visualization is necessary in this case
4. Edentulous guides: the accuracy of mucosal supported drill guides is a challenge and is compromised if there is insufficient surface area to allow the guide to be accurately indexed with the ridge. In these cases, the guide is useful for defining implant spacing and future tooth position; however, position of entry points and trajectory must be verified clinically

<u>Inadequate vertical clearance</u>

Tube guides require 6-10 mm more vertical clearance than freehand drilling. Using extended length "guided" drills with the tubes adds another 6 mm of vertical space.

1. If there is insufficient vertical clearance for freehand drilling, a drill guide cannot be used as intended
2. If an implant site can be accessed for freehand drilling, a drill guide can be fabricated and used. If the vertical clearance is minimal, it is possible that the tube guide will not be useable. In this case, the tubeless ThinLayer® Guide minimal clearance protocol will be required for preparation of the osteotomy

<u>Drill guides cannot be manufactured if:</u>

1. The CBCT scan has poor image quality
2. The data from the patient bone scan and the model scan cannot be merged due to radiographic scatter or poor CBCT image quality
3. Digital or physical impressions do not capture all relevant anatomy
4. Stone models are of poor quality, broken or have voids