Introduction
Block grafting is a technique that has used for many years for the treatment of atrophic partially or fully edentulous patients. While many graft materials are available autogenous bone grafts offers many benefits, including their osteogenic, osteoinductive, and osteoconductive properties. Currently, 3D printing allows the fabrication of surgical guides for many applications. Multiple articles have reported that mandibular autogenous bone blocks offer predictable outcomes for horizontal bony defects. Cordaro et al. concluded that the limitation when harvesting bone blocks is proximity to anatomical structure or insufficient bone volume at the harvest site. A technique is proposed that allows clinicians to digitally plan and 3D print a guide to outline a harvest site that avoids anatomical structures while ensuring adequate size and volume of the block is harvested.

Materials & Methods
Pre-operative CBCT analysis showed inadequate bone for implant placement in the area of #29 & 30 as shown in figure 1-4. A 3D bone model was rendered from the CBCT using Invivo 5 (Anatomage Inc.) and the STL file superimposed with the CBCT data using Blue Sky Plan software. Using Blue Sky Plan (LLC.) software the location of adequate cortical bone and desired block dimensions were located with the CBCT cross-section. (fig. 5) A bone supported surgical guide was designed to cover the buccal shelf and edentulous ridge crest. (fig. 6)

Using Blue Sky Plan a window was cut in the surgical guide to outline the planned bone block. The surgical guide was then exported as an STL file and trimmed using Meshmixer (fig. 7) The designed bone block guide was imported into PreForm (FormLab Inc.) printing software and 3D printed using the Form 2 Printer in the Dental SG Resin. The bone block guide was then light cured (fig. 8) and autoclaved according to manufacturer guidelines prior to surgery.

Using Geomagic Control 2014 (3D Systems Inc.) software the bone model and guide were used to digitally isolate and extract the bone block. (fig. 9) Then the bone block was digitally positioned on the recipient site to determine the best adaptation of the block. In this example the best adaptation was found by rotating the block 180 degrees. (fig. 10)
Materials & Methods Cont.

Midcrestal, sulcular and vertical releasing incisions were made. A full thickness mucoperiosteal flap was reflected exposing the buccal shelf and ascending ramus. The bone block guide was placed intraorally. (fig. 11) Using a surgical pencil, an outline of the desired bone block was marked (fig. 12), and cut using a piezoelectric instrument. (fig. 13) Utilizing a chisel and mallet, separation of the bone achieved (fig. 14), and corticotomies created at the recipient site using a small carbide round bur. (fig. 15) The bone block was then rotated 180 degrees and stabilized with two stabilization screws (truSCREW, ACE Surgical Inc.). (fig. 16) The sharp areas of the block were removed and a mixture of 70% xenograft (Bio-Oss, Geistlich) and 30% autogenous bone (harvested via bone scraping) was placed around the block and the recipient site (fig. 17). A collagen membrane (Bio-Gide, Geistlich) was placed over the grafted site and secured with 4 tacks (truTack, ACE Surgical Inc.). (fig. 18) The flap was re-approximated and sutured with passive primary closure (fig. 19). Superimposing the digitally planned position of the bone block with a clinical picture of the actual block position validated the benefits of pre-surgical digital planning. (fig. 20)
Discussion/Clinical Relevance

In clinical situations, bone block harvesting has limitations including insufficient volume at the donor site in relation to the amount of required bone, risk of neurologic and/or dental root damage, and patient postoperative discomfort. During surgery, the surgeon has few reference points to which he can relate the anatomical information obtained from the analysis of the CBCT scan. Using a surgical guide to assist in proper size and positioning of the ramus bone block could lead to decreased bone block complications. Additionally, specific anatomical structures such as nerves and vessels can be avoided. The method described takes advantage of a computer-guided procedure to control the angulation and depth of the osteotomies to maximize the harvested bone volume needed for the reconstruction of single or multiple defects.

References