The Prevalence and Significance of Anatomic Variance in the Mandibular Symphysis: A Retrospective Study

Dov M. Almog, DMD; Shirl Lanni; Lynn W. Solomon, DDS, MS

As computerized tomography (CT) becomes more widespread in implant treatment planning, dentists are bound to encounter more uncharacteristic anatomical conditions in the jaws. This retrospective study examined the prevalence of one such anatomic variance on 78 CT scans of human mandibles. Irregular heterogeneous circular radiopacities with internal radiolucencies were present in a majority (97.4%) of the CT scans examined; however, the phenomenon only appeared pronounced in 28.9% of this group. Bone radiodensity was higher in the regions with the phenomenon as compared with adjacent bone without the phenomenon, which suggested no adverse indications for implant placement.

Key Words: mandibular symphysis, cone beam CT, dental implants

Introduction

In recent literature reviews on dental implants in the new millennium,[1–6] it has become clear that one of the fastest growing segments and most important developments in modern dentistry has been permanent tooth replacement with dental implants. In the industrial world, over 240 million people lack at least one tooth. It is estimated that 40% of the Western population is missing one or more teeth. In the United States alone, about 10% of the population is edentulous, and every year approximately two million Americans lose teeth due to sporting accidents. Furthermore, edentulism is a public health concern that affects millions of people. According to Douglass et al,[7] the 10% decline in edentulism experienced in recent decades will be offset by an increase in the elderly population, and dentists will find that a considerable number of the patients will continue to need complete denture services.

As imaging technologies for dental implant treatment become increasingly sophisticated, clinicians are likely to encounter a greater diversity of anatomical conditions that fall outside the norm. In many instances, the presurgical analysis of implant sites is enhanced by the use of new imaging technologies, such as cone beam computerized tomography (CT) and surgical/prosthetic guidance technologies. Cone beam CT produces image data that is manipulated by software for analysis in sagital, axial, and coronal planes. Associated software is also utilized to produce 3-dimensional reformatted views that have never before been available outside of medical CT imaging. Images produced by cone beam CT reveal anatomic conditions that are often undetectable on conventional dental radiographs and that may require interpretation.

For years, edentulism has been treated with implant-supported overdentures,[8] although recently there has been considerable interest in full-arch screw-retained prostheses with distal extensions (hybrid

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prostheses).[9–10] These screw-retained prostheses represent a viable treatment option for mandibular and/or maxillary edentulism. The hybrid prostheses consist of a screw-retained metal framework supporting the denture teeth and base. In the case of lower hybrid prosthesis, the implants are predominantly placed between the mental foramen, including the midline region of the mandible (Figures 1 and 2).

Historically, the overall success rate of dental implants has been relatively high.[11–16] While some clinicians limit their presurgical dental implant treatment planning to the evaluation of study casts, probing the depth of the mucosa over the bone, and the use of panoramic and/or other plain radiographs, the number of implant surgeons using cone beam CT imaging for presurgical implant site assessment is on the rise. According to numerous studies,[17–23] the primary reason for this trend is that cone beam CT provides 3-dimensional visual capabilities with precise anatomic measurements and low dose radiation. While the clinical significance of CT-based imaging and surgical/prosthetic guidance software programs is currently being investigated, several publications suggested that optimal, and at times critical, implant size selection, orientation and placement is significantly aided by these 3-dimensional radiographic and guidance software programs.[24–27]

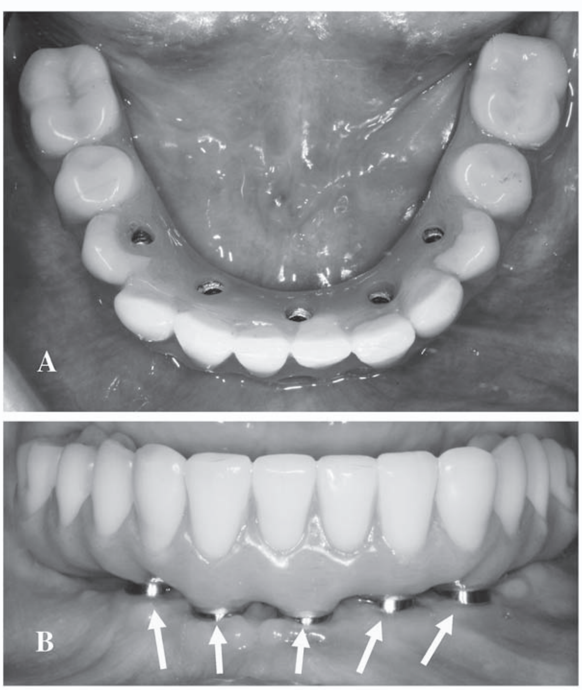

FIGURE 1. A mandibular full-arch screw-retained prosthesis with distal extensions (hybrid prosthesis seen from an occlusal view (A) and facial view (B). The hybrid prosthesis is supported by 5 implants (arrows).

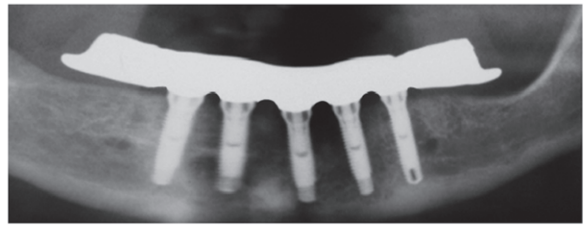

FIGURE 2. The screw-retained prosthesis consists of a metal framework supporting the denture teeth and base. In the case of lower screw-retained prosthesis, the implants are predominantly placed between the mental foramen, including the mandibular symphysis region under review.

Prior to commencing this study, the authors have incidentally observed that presurgical CT diagnostic imaging performed in preparation for implant placement in the anterior region of the mandible often revealed an anatomic variance in the midline of the mandibular symphysis region. It has the appearance of irregular heterogeneous circular radiopacities with radiolucencies within them. At times, it is also associated with lingual exostoses in the symphysis region. This anatomic variance has been observed in both edentulous and dentate cases (Figures 3 and 4).

The objective of this retrospective study was to determine the prevalence and bone density in Hounsfield units (HU)[28–29] of this anatomic variance, with the goal of better understanding its clinical significance relative to implant fixation.

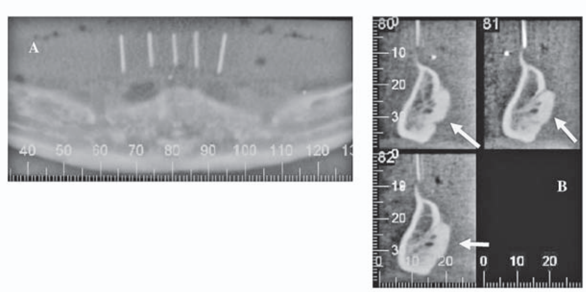

FIGURE 3. Cone beam CT study performed while the patient was wearing an imaging guide with radiopaque restorative markers seen in the panoramic view (A) and cross sections (B). Each cross-section's number (80, 81, and 83) corresponds with the same number on the panoramic ruler. The markers seen on the panoramic and cross-sectional images represent optimal prosthetically driven trajectories for implants in the anterior region of the mandible, between the right and left mental foramina. Arrows show the anatomic variance.

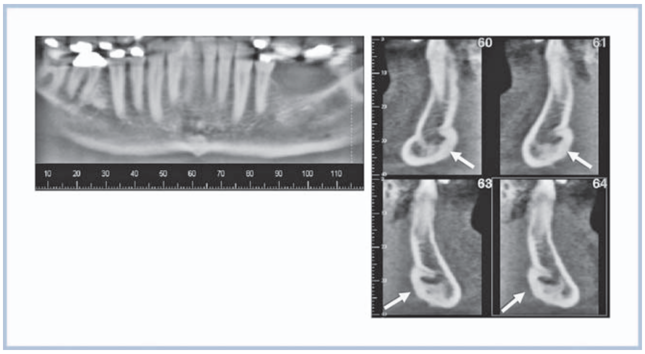

FIGURE 4. Incidental anatomic condition of fibrocartilaginous joint seen in the midline of a dentate mandibular symphysis region (arrows). Each number on the cross sections (60, 61, 63, and 64) corresponds with the same number on the panoramic ruler.

Materials and Methods

Between April 2005 and October 2006, 390 CT scans of the mandible were performed on patients referred to the Craniofacial Digital Imaging Center in Rochester, New York, for various diagnostic and treatment planning purposes. While some CT scans were ordered for orthodontic and complex exodontia purposes, the majority of the referrals were for diagnostic scans in preparation for dental implant treatment. CT scans were performed using the cone beam CT imaging technology (i-CAT, Imaging Sciences International, Hatfield, PA). To avoid any potential for bias, a random sample of 78 scans representing every fifth case was selected for this review from the total 390 cone beam CT scans of the mandible.

Before commencing the study, examiner 1 (SL) and examiner 2 (DMA) underwent inter-examiner calibration by reviewing several scans together and concurring on the appearance of such irregular heterogeneous circular radiopacities with radiolucencies within them observed in the mandibular symphysis region. Both the cone beam CT panoramic and relevant cross-section views in the mandibular symphysis region were reviewed for the presence of such anatomic variances.

Bone density in HU, a quantitative measure of the bone radiodensity, was gauged in the regions of interest, both within the anatomic variances and in otherwise normal sites distal to those locations. Mean bone density values were calculated by using the cone beam CT imaging technology software (i-CAT).

Results

Of the 78 CT scans selected for this investigation, 27 were in male patients (34.6%) and 51 were in female patients (65.4%). Mean age was 57 (range = 14 to 87) years. Irregular heterogeneous circular radiopacities with radiolucencies within them were found in the mandibular symphysis region in 76 of the 78 CT scans selected for review (97.4%). Within this group exhibiting the phenomenon, 22 (28.9%) showed a large anatomic variance with pronounced lingual exostoses in the symphysis region and 54 (71.1%) appeared mild. Two scans displayed no such anatomic variance.

The mean bone density in Hounsfield units within the anatomic variance was 821.6 HU, ranging in density from 22.7 HU to 1544 HU. The mean bone density observed within trabecular sites distal to the anatomic variance was 319.74 HU, ranging in density from −282.4 HU to 1056.4 HU.

All medical histories of these patients, which were recorded at their initial visit, were reviewed again. It was determined that there were no common denominators among the medical histories of those subjects who exhibited the anatomic variance in the anterior region of the mandibular symphysis.

Discussion

As the use of implants continues to revolutionize the dental profession, cone beam CT has emerged in recent years as a useful diagnostic procedure for preoperative assessment and planning of dental implant placement. Cone beam CT provides 3-dimensional cross-sectional views of the jaws at an average distortion rate of 0.2mm.[17] This feature alone would allow for more accurate and predictable treatment planning at it pertains to locating the mandibular nerve and other critical anatomical landmarks, in comparison to conventional radiography.

The present study reviewed cone beam CT images of the mandibular symphysis region to determine the prevalence of heterogeneous circular radiopacities with radiolucencies within them and gauge the associated bone radiodensity in a random population of patients, many of whom were scheduled to undergo implant surgery in the anterior region of the mandible.

While no biopsies were performed to obtain histological data on these anatomic variances, it is assumed that they are most likely developmental rarefactions (regions of decreased particle density) and radiopacities (regions of increased particle density). The mere fact that the associated mean bone radiodensity within the anatomic variance measured above the mean bone radiodensity observed in adjacent sites suggests that there are no limitations from a bone quality and implant fixation perspective in these regions.

Conclusions

While irregular heterogeneous circular radiopacities with internal radiolucencies appeared pronounced in approximately 28% of all CT scans reviewed, bone radiodensity was also higher in these regions compared to adjacent bone without the phenomenon, which suggested no adverse indications for implant placement.

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