# IMPLICATION OF IMAGES FOR DENTAL IMPLANT TREATMENT PLANNING: A SYSTEMATIC REVIEW AND META-ANALYSIS

***Siavash Samadi Khasraghi***
*Resident of Dental Medicine, Faculty of Dentistry, University of Baguio. Philippines*
***Faeghe Fazeli***
*Post Graduate Student, Dental Implants Research Center, Department of Periodontology, School of Dentistry, Isfahan University of Medical Science, Isfahan, Iran.*
***Sobhan Pourarz***
*Post Graduate student, Department of Oral and Maxillofacial Surgery, School of Dentistry, Isfahan University of Medical Science, Isfahan, Iran*
***Negin Hosseini***
*Post Graduate student, Department of periodontology, School of dentistry, Isfahan University Of Medical Science, Isfahan, Iran*
***Kaveh Tutunchian***
*Department of Prosthodontics, Faculty of Dentistry, Babol University of Medical Science, Babol, Iran.* [1]*Doctor of Dental Medicine, Faculty of Dentistry, University of Baguio. Philippines*
***Zahra Shirazi***
****Corresponding Author:** Siavash Samadi Khasraghi, s.samadi@e.ubaguio.edu*

**Abstract. Background and aim:** Meanwhile, cone beam computed tomography (CBCT) has developed rapidly and is now being routinely used for preoperative planning by some implant surgeons. The aim of this systematic review and meta-analysis, evaluate the Implications for dental implant treatment planning. **Method:** The search took place between 2010 and 2019. In this study, we first reviewed the abstract of the articles and selected the studies that had the most coordination with our goals, and then we examined the entire text and finally, 4 studies were selected. In addition to reviewing the literature, the results are extracted and enter the meta-analyzer stata14, which summarizes the final results. **Result:** CBCT observer-based planning gives more homogeneity of treatment plans as compared to the surgical gold standard. Further, complications were predicted better when the planning was based on CBCT images. **Conclusion:** Hat either PAN or CBCT can be reliably utilized to determine the preoperative implant width.

**Key words:** dental implant, treatment planning, systematic review.

## 1.Introduction

There are many factors that an implant specialist should be aware of and consult with their patient in this regard and consider them in the planning and treatment of the tooth(1). There is a lot of evidence that the risk of implant failure in people who smoke and history of radiation and bone problems is more than other patients. People who have a history of tooth loss due to gum disease are at risk of per implant disease(2). Patients with an autoimmune disorder should inform their physician that the physician will take the necessary measures(3). Comprehensive treatment planning is essential for each patient, but when it comes to oral dental treatment or an implanted tooth, this becomes even more important. Three important steps should be taken into consideration: 1) Full assessment of patient's history of treatment, 2) Appropriate diagnosis, 3) Appropriate therapeutic planning(4). The correct diagnosis of knowledge and experience is sufficient, although the dentist has sufficient knowledge and activity in the field of his specialization, it leads to a great deal of understanding and expertise in the field of specialized surgery as well as being restored. They include: radiography, study models, clinical trials, as well as assessing bone quality, bone size, and enough for joint implantation(5). Appropriate treatment logic is obtained after obtaining sufficient information from the history and essential information necessary for diagnosis. After the patient becomes aware of all the therapeutic options and implications for the implant's implantation, a specific treatment plan must be given to the patient, in which the patient's expectations are also considered, the patient's expectations for dental implants may also be It will increase the process of implant surgery(6). Surgical experts believe that the correct planning and proper treatment plan can multiply the success of implant implantation(7, 8). Meanwhile, cone beam computed tomography (CBCT) has developed rapidly and is now being routinely used for preoperative planning by some implant surgeons(9). The aim of this systematic review and meta-analysis, evaluate the Implications for dental implant treatment planning.

## 2. Method

The PRISMA (Preferred Reporting Items for Systematic reviews and Meta-Analyses) reporting guidelines are followed in the systematic review. Systematic evaluation of four selected studies was performed in order to prepare the study protocol. Data extraction forms were constructed after the initial results of the search.

### 2.1.Search strategy

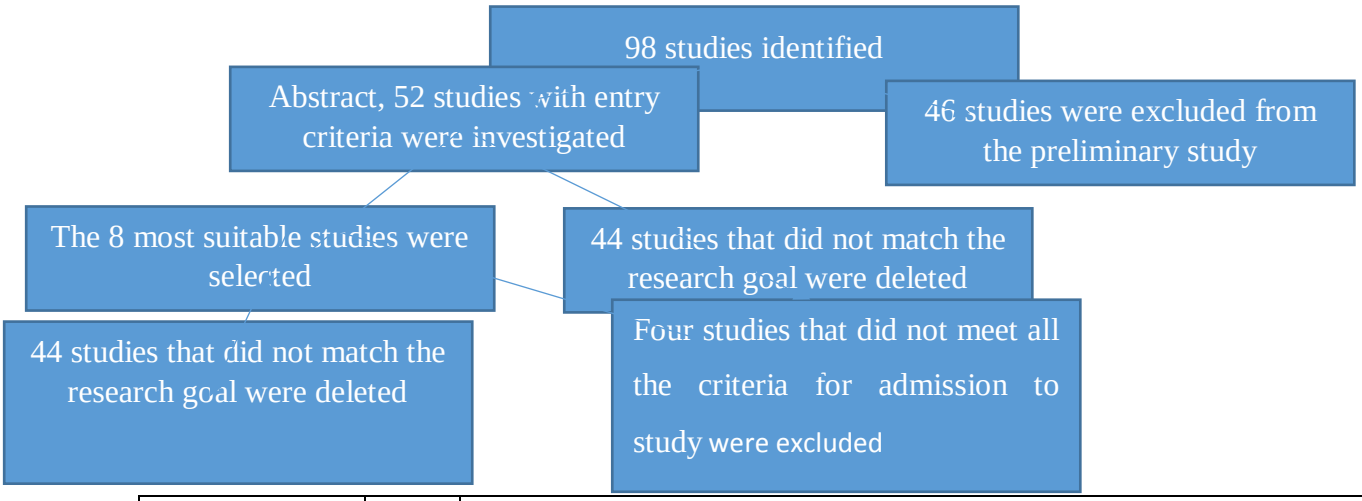
The search took place between 2010 and 2019. In this study, we first reviewed the abstract of the articles and selected the studies that had the most coordination with our goals, and then we examined the entire text and finally, 4

studies were selected. In addition to reviewing the literature, the results are extracted and enter the meta-analyzer stata14, which summarizes the final results (Chart 1, table 1).

**2.2.Eligibility criteria**

The following inclusion criteria were applied:

1. Partially dentate
2. Referred for one or more implants
3. Images with high technical standards
4. All languages




| study | year | Title |
|---|---|---|
| Guerrero et al(10) | 2014 | Comparison of preoperative implant planning using panoramic versus cone-beam CT images |
| Lee et al(11) | 2013 | An assessment of template-guided implant surgery in terms of accuracy and related factors |
| Guerrero et al(12) | 2014 | Preoperative implant planning considering alveolar bone grafting needs and complication prediction using panoramic versus CBCT images |
| Jensen et al (13) | 2016 | Comparing Two Diagnostic Procedures in Planning Dental Implants to Support a Mandibular Free- Ending Removable Partial Denture |

Table 2. Treatment planning, Significance (p)

**3.Result**

Proper implant treatment planning remains the first priority for implant success. Dental imaging is an important tool to accomplish this task. Traditional radiographs provide adequate information about proposed implant sites; however, limited film size, image distortion, magnification, and a 2-D view restrict their use in some cases. The aim of this systematic review and meta-analysis, evaluate the Implications for dental implant treatment planning. CBCT machines are available for private dental office use, and in many ways, resemble a panoramic X-ray machine, including both size and simplicity of use. Resources are available to support or train dentists who have not worked with this technology(14). Coupled with converting software programs, CT/CBCT images may assist in selecting implant dimensions and predicting treatment outcomes. Understanding the up-to-date development of imaging aids could potentiate our ability in planning implant therapy(8). The benefits of CBCT are to produce a 3D data set capable of producing all 2D images (such as Orthopantomogram, lateral cephalogram), and allows vertical scanning of the patient in the sitting position. CBCT shows high resolution images of anatomical structures, bone trabeculae, periodontal pelvis (PDL) and formation of root formation. Other benefits include a fast scan method, low radiation dose, distortion of metal structures, low cost, easy access, easy manipulation, and compatibility. The criterion can be the low contrast range, the limited field of view (FOV), the reduced scanned volume due to the size of the detector, the quantitative information about the inner soft tissue, and the increase in the sound of diffuse irradiation and artifacts(15, 16).

Table 3. Variation on presurgical planning with panoramic radiography (PAN) and cone beam computed tomography (CBCT), Anterior

| STUDY | p- value | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Length of implants | | | | Diameter of implants | | | |
| | Observer1 | Observer2 | Observer3 | Observer4 | Observer1 | Observer2 | Observer3 | Observer4 |
| Guerrero et al(10) | 0.576 | 0.454 | 0.855 | 0.312 | 0.469 | 0.698 | 0.543 | 0.321 |
| Guerrero et al(12) | 0.47 | 0.47 | 0.47 | 0.47 | 0.10 | 0.08 | 0.08 | 0.08 |
| Jensen et al (13) | 0.08 | 0.16 | 0.61 | 0.69 | 0.08 | 0.16 | 0.61 | 0.69 |

| study | Male | female | mean age | Imaging | treatment planning | Significance (p) |
|---|---|---|---|---|---|---|
| Guerrero et al(10) | 77 | 28 | 46 | PAN, CBCT | Two dimensional (2D) image datasets and at least one month later on the three dimensional (3D) image dataset | 0.000 |
| Lee et al(11) | 22 | 26 | 52 | CT | Pre- and post-operative CTs | 0.001 |
| Guerrero et al(12) | 63 | 45 | 55 | PAN, CBCT | using PAN image datasets, and at least one month later, using CBCT image datasets | 0.000 |
| Jensen et al (13) | 32 | 32 | 48 | panoramic radiograph and CBCT | The feasibility of implant placement in the premolar and molar region was judged by three observers on basis of casts either with a panoramic radiograph or a CBCT | 0.000 |

Table 4. Variation on presurgical planning with panoramic radiography (PAN) and cone beam computed tomography (CBCT), Posterior

| | STUDY | p- value | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | Length of implants | | | | Diameter of implants | | |
| | Observer1 | Observer2 | Observer3 | Observer4 | Observer1 | Observer2 | Observer3 | Observer4 |
| Guerrero et al(10) | 0.089 | 0.000* | 0.002* | 0.779 | 0.100 | 0.230 | 0.830 | 0.615 |
| Guerrero et al(12) | 0.47 | 0.47 | 0.47 | 0.47 | 0.00 | 0.00 | 0.00 | 0.00 |
| Jensen et al (13) | 0.001 | 0.001 | 0.001 | 0.001 | 0.001 | 0.001 | 0.001 | 0.001 |

Table5. Heterogeneity chi-squared = 2.00 (d.f. = 2) p = 0.368
I-squared (variation in ES attributable to heterogeneity) = 0.0%
Test of ES=0: z= 3.20 p = 0.001

| STUDY | ES | [95% Conf. Interval] | | % Weight |
|---|---|---|---|---|
| | | Lower | Upper | |
| Guerrero et al(10) | 92.100 | -81.357 | 265.557 | 2.42 |
| Guerrero et al(12) | 28.000 | -7.279 | 63.279 | 58.45 |
| Jensen et al (13) | 65.000 | 21.881 | 108.119 | 39.13 |

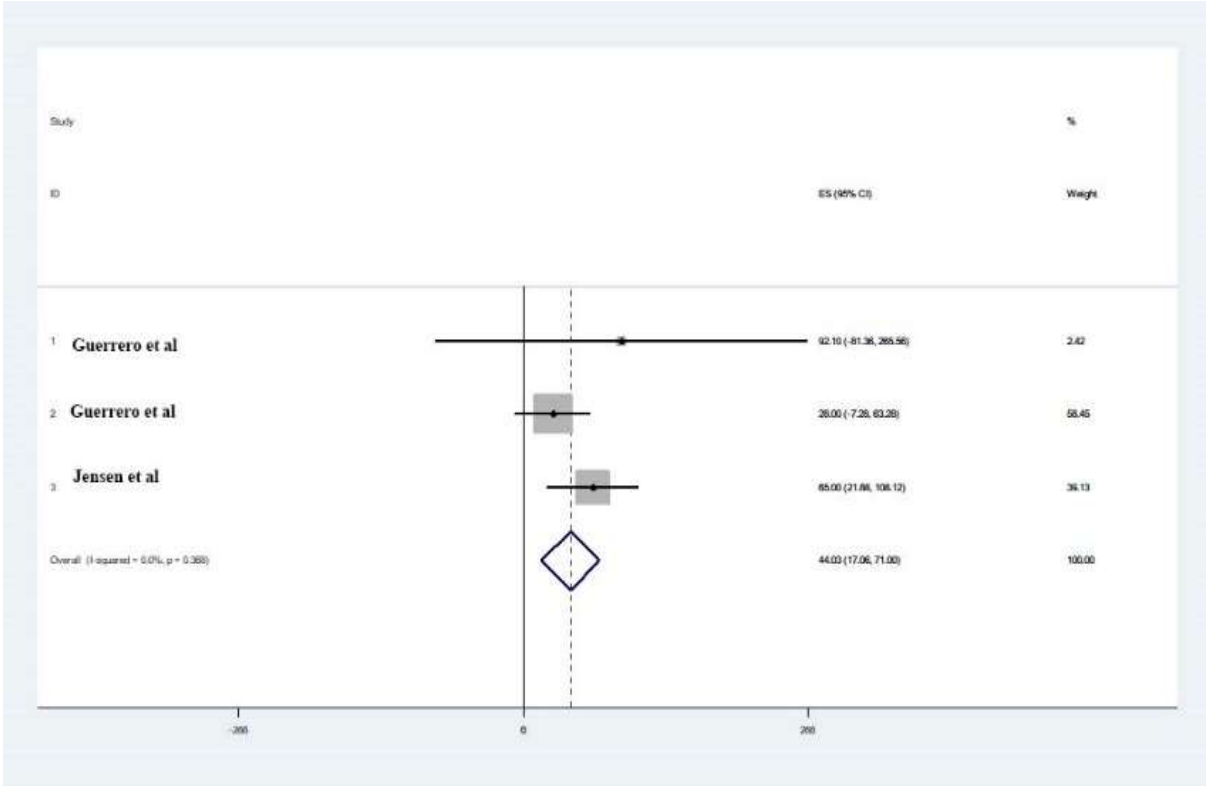



**Figure1: Heterogeneity chi-squared chart**

**Discussion & Conclusion**

Finally, 325 patients were enrolled (194 males, 131 females) with 50 mean age. Presurgical planning variations with PAN and CBCT showed the implant length and width romaine unchanged in 92.1% and 88.5% of the cases, respectively. According to Table 2, no differences were found between both imaging modalities for the length and the diameter on implants with an anterior location. However, only significant

differences were found for the length of implants with a posterior, Guerrero et al(10). Planning implant location, both PAN and CBCT planning agreed. Another study showed that both 2D and 2D+3D planning on multislice computed tomography (MSCT) images had a good predictability for the number and site of the implants location(17). in comparing CBCT and PAN, the implant lengths were different for the two observers in Guerrero et al(10) study, with a trend towards the selection of longer implants using PAN ,Other studies also confirm this finding(18-20). The stereo lithographic template-guided implant surgery in the Lee et al(11) study had errors of 1.09 mm at the coronal center, 1.56 mm at the apical center, and 3.80° in axis deviation. Controlling the accuracy in horizontal deviation at the coronal center and ensuring template stabilization in the case of anterior edentulous areas should be considered for safe implant surgery and prospective prosthodontic treatment. The 3D data from CBCT scans can be extremely revealing, CBCT allowed the visualization of an interosseous artery and help localizing this structure during surgery(21). CBCT observer-based planning gives more homogeneity of treatment plans as compared to the surgical gold standard. Further, complications were predicted better when the planning was based on CBCT images, Guerrero et al(12). Tables 2, 3 and 4 illustrate the data collected from the selected studies. Table 5 showed the percentage of planning changes with PAN and CBCT represents the length and width of the implant.

Hat either PAN or CBCT can be reliably utilized to determine the preoperative implant width. CBCT can allow observers to plan implant surgery with an improved subjective image quality and higher surgical confidence.

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