Diagnosis and treatment planning are the most important parts of the entire implant therapy, determining whether the treatment will be a success or a failure. Skipping any of the recommended steps of the treatment-planning phase compromises the outcome of the final treatment.

**DIAGNOSTIC WORKUP FOR IMPLANT OVERDENTURE**

1. Perform a radiographic evaluation by utilizing a panoramic x-ray. Determine the magnification error of that image, and then determine the height of available bone.
2. Evaluate the existing conventional upper and lower denture to determine if satisfactory aesthetic, phonetic, and function have been achieved.
3. If the existing denture is satisfactory, it can be duplicated with clear acrylic and used for diagnostic mounting and fabrication of the surgical guide.
4. Take a bite registration record in centric relation for a diagnostic mounting.
5. Mount the duplicated upper and lower denture on an articulator.
6. Choose the proper length and diameter for the designated implant system.
7. Choose the number and location of the implants based on the desired attachment assembly.

**BENEFITS OF DIAGNOSTIC MOUNTING**

- Creates a surgical template
- Visualizes the relationship of the denture teeth with anticipated implant positions
- Gives the clinician and lab technician a good idea of the position and final design of the bar
- Creates an index for the position of the final overdenture teeth

In patients with a high smile line, a removable overdenture will more likely fulfill the patient’s functional and aesthetic demands better than an implant-supported fixed bridge. If the patient’s upper lip support needs to be enhanced,
an implant-supported overdenture with a labial flange is the preferred choice of treatment.

If the relationship between the maxilla and mandible is unfavorable, such as class II or class III, or if excessive inter-ridge space is present, implant-supported overdentures are preferred over fixed bridges supported by implants.

**RADIOGRAPHIC EVALUATION**

**Panoramic Radiograph**

The panoramic radiograph is the most common image used to evaluate implant overdenture cases. This radiograph produces a single image of the maxilla and mandible with all of the anatomical landmarks in a frontal plane. It is very cost effective and practical, because it can be generated in most dental offices. The clinician can easily identify the gross anatomy of the jaws and opposing landmarks, as well as form an initial assessment of the vertical height of the bone. Any pathology within the maxillary and/or mandibular bone can be detected. The patient is exposed to a relatively low radiation dose compared to a CT scan or conventional tomogram.

However, the panoramic radiograph has several disadvantages such as overlapping images, distortion of the special relationship among anatomical landmarks, and magnification errors. Also, fine anatomical details cannot be seen as they appear on a CT scan. This radiograph usually increases the horizontal dimension by about 30–70 percent and increases the vertical dimension by about 20–30 percent.

The use of a diagnostic template while taking the panoramic x-ray can effectively eliminate the magnification error. The diagnostic template is an acrylic base, which has been fabricated over the study cast.

One or more ball bearings (BBs) should be incorporated into the template using self-cured acrylic. Place the BBs as close as possible to the desired implant sites (Figure 2.3).

**FIGURE 2.1.**

**DETERMINING MAGNIFICATION ERROR OF PANORAMIC X-RAYS**

1. Measure the diameter of the ball bearings before incorporating them into the templates (Figure 2.2).

2. Incorporate the ball bearings into the acrylic template utilizing self-cured acrylic (Figure 2.3).

3. Insert the acrylic template in the patient’s mouth (Figure 2.1).
4. Take the x-ray image (Figure 2.4).
5. Measure the diameter of the ball bearings as they appear in the x-ray image.
6. Use the following formula to calculate the actual height of the alveolar process:
   
   \[ d = \text{Actual diameter of the ball bearing} \]
   \[ D = \text{Diameter of ball bearing in the panoramic x-ray} \]
   \[ H = \text{Height of the bone in the panoramic x-ray} \]
   \[ h = \text{Actual height of the bone} \]
   \[ \text{Magnification Error: } ME = \frac{d}{D} \]
   \[ h = ME \times H \]

**PANORAMIC LANDMARKS**

- Crest of the ridge
- Opposing landmarks

   Note the opposing landmarks in the mandible (Figure 2.5):
   - Anterior: Inferior border of the symphysis
   - Canine/Premolar Region: Mental foramina
   - Posterior: Mandibular nerve canal

**Occlusal Radiograph**

An occlusal radiographic image is very helpful in assessing the width of the bone in the mandibular symphysis area. Employ proper techniques such as symmetrical positioning of the central ray and the film.
Make an acrylic base on the lower cast and glue a 5mm diameter ball bearing to the side of the acrylic base in the symphysis area. The patient should wear this acrylic base when the image is taken. Changes in the diameter of the ball bearing in the radiograph will help the clinician determine the magnification error of the radiograph.

**Computed Tomography (CT Scan)**

Since plain films fail to provide data on bone width and bone density, clinicians started utilizing CT scan technology to enhance their diagnostic and treatment planning abilities (Figure 2.7).

The CT scan creates three-dimensional images of the edentulous arches at 1.00mm intervals from left to right around the entire dental arch in both the mandible and maxilla. The images (cross sections) are sequentially numbered. The clinician has at his or her disposal cross-sectional, panoramic, and occlusal views of the actual osseous topography. This radiographic technology results in no magnification error, and all of the images have the exact same dimensions as the patient’s anatomical structure being examined. Therefore, this scan permits precise measurement of the bony structure that is relevant to the desirable implant locations in all three planes.

The techniques for producing clinically useful CT image vary, depending upon the equipment employed. However, regardless of the type of equipment, the thickness of each cut must be 1mm or less.

Placing a radioopaque material such as special barium sulfate teeth as a marker in the diagnostic guide identifies the desired site for an implant placement (Figure 2.8). This allows the clinician to see the markers on the CT images and evaluate the underlying bony structure.

**FIGURE 2.7.**

CT analysis of the jaws is normally very expensive; the technique is therefore generally used only if additional diagnostic information is necessary due to anatomical complexity or other diagnostic difficulties. The need to assess accurately the position of the inferior alveolar canal, the mental foramen, the contour of the lingual surface of the mandible, and the floor of the sinuses are primary indications for using a CT scan during the treatment planning phase for implant overdenture cases. The advantages of CT scanning when planning for the placement of dental implants must be balanced against the cost and the amount of the radiation exposure incurred with CT scans.

**FIGURE 2.8.**
JOINT TREATMENT PLANNING

The next phase in the treatment planning process involves an effective conference among the entire implant team, which consists of the restorative dentist, surgeon, and laboratory technician, along with any number of supporting members such as the hygienist and the representative of the implant company.

The crucial factor in building an effective conference is to create a team of people, each of whom knows his or her job and can perform it well. Each member of the team must be committed to listening as well as sharing his or her ideas and observations. Ideally, the treatment planning conference should be done in person. However, it can be conducted via telephone or web conferencing.

The leader of this team will be the restorative dentist. He or she begins the communication with the patient regarding the patient’s chief complaint and continues that communication throughout the treatment process and beyond. The secondary leaders in this process are the surgeon and the laboratory technician.

ANATOMICAL CONSIDERATIONS DURING DIAGNOSIS AND TREATMENT PLANNING PROCESS

Available Bone Quantity

Bone quantity is one of the most important factors that dictate the treatment plan. The height, width, length, and shape of the available bone should be assessed.

HEIGHT OF BONE The distance between the crest of the alveolar ridge and opposing anatomical landmarks (e.g., maxilla: floor of the sinuses and the nasal cavity; mandible: the mandibular nerve canal, mental foramina, and inferior border of the symphysis) determines the height of the bone. It is advisable to leave 2mm between the bottom of the implant and border of the opposing landmark. The height of the bone can easily be determined through a panoramic x-ray.

WIDTH OF BONE The distance between the buccal and lingual walls of the alveolar process determines the width of the bone. It is recommended that at least 1mm thickness of the bone should remain on the buccal and lingual aspects of the implants. Very thin buccal and lingual bone plates around the implant will have a compromised blood supply and increase the risk of bone loss. The width of the bone cannot be determined by a panoramic x-ray. However, the occlusal x-ray or the CT scan will provide suitable images for measuring the width of the bone.

SHAPE OF BONE The shape of the alveolar ridge influences the clinician’s selection of the shape of the implant body (e.g. choosing a tapered implant vs. parallel sided screw). The shape of the bone influences the trajectory of the implant, which is not always inline with the path of insertion of the overdenture. This problem can cause application of destructive forces to the supporting implants. The shape of the bone can be modified by bone grafting techniques or alveoloplasty.

LENGTH OF BONE The distance from one point of the alveolar ridge to another point in the mesio-distal direction determines the length of the bone. The mesio-distal distance between the supporting implants will be determined based on the design of the attachment assembly.

Misch and Judy described an easy and practical classification for fully edentulous jaws based on the available bone.

Classification of Fully Edentulous Ridges Based on Bone Quantity

GROUP A There is minimum bone loss, which translates to less inter-ridge space. On average, the height of the bone in the anterior mandible is more than 20mm, and the width of
the bone is more than 5mm (Figure 2.9). The height of the bone in the anterior maxilla is usually more than 15mm, and most of the time the width of the bone is more than 5mm. Because of small inter-ridge space, patients in this group are not good candidates for a bar attachment assembly. Insufficient room is available to fabricate a cleansable bar and an overdenture with adequate denture base thickness. Patients in this category are good candidates for hybrid prosthesis as well as overdenture supported by stud attachments.

**GROUP B**  The height and width of the bone is less than group A, which means more inter-ridge space is available. On average, the height of the bone in the anterior mandible is between 15–20mm, and the width is more than 5mm (Figure 2.10). The height of the bone in the anterior maxilla is approximately 12–15mm, and the width is more than 5mm. Patients in this group can qualify for any kind of implant overdenture. The bone quantity and inter-ridge space allow the clinician to utilize any type of attachment assembly.

**GROUP C**  Patients in this group demonstrate severe resorption of the alveolar process. The height of the bone in the anterior mandible is approximately 10–15mm, and the width of the bone in this region is almost 5mm (Figure 2.11). The height of the bone in the anterior maxilla is less than 10mm, and the width of the bone is less than 5mm. This means that patients have expansive inter-ridge space. These patients generally are not good candidates for a stud attachment assembly since the expansive inter-ridge space translates into longer teeth and denture base. This space will increase the chance of lateral dislodgement of the prosthesis if the overdenture is supported by small and short stud attachments. Bar attachments are strongly recommended for this group of patients. However, exceptional situations mandate use of stud attachments for these types of patients. (Refer to Chapter 5, “Stud Attachments.”) In some cases, alveolar ridge augmentation, ridge expansion, or sinus lift may be necessary.

**GROUP D**  Patients in this group demonstrate complete resorption of the alveolar process, as well as part of the basal bone. Generally, the height of the bone in the anterior mandible is...
less than 10mm, and the width of the bone is less than 5mm (Figure 2.12). The height and width of the bone in the anterior maxilla is severely deficient. Any overdenture treatment for patients in this group requires advanced bone grafting procedures to accommodate implants longer than 10mm length and 4mm in diameter.

The other approach to accommodate patients in this group is to utilize shorter implants with expansive surface area instead of subjecting the patient to the bone grafting procedure. The endopore implant has been designed with a porous titanium surface and a tapered body and can be used in most of the group D patients with compromised bone quantity. (Refer to Chapter 12.)

**Classification of Edentulous Ridges Based on Bone Quality**

A direct correlation exists between the primary stability of the implants and the bone quality. This is a very important factor if the patient has been treatment planned for immediately-loaded overdenture.

Since most of the implant overdenture patients are over 50 years of age, the issue of bone quality plays a roll in the prognosis of the treatment. Most people in this age group, especially women, experience some level of osteoporosis. Generally, in osteoporotic patients, a physiological reduction of the trabecular bone can be observed. The most accurate way to determine the bone quality is by assessing the bone during the surgical steps or when the clinician starts drilling the osteotomy.

Misch described a simple classification for different bone quality osteotomy (Figure 2.13):

- **D1**: Thick, compact bone
- **D2**: Thick, porous, compact bone with a highly trabecular core
- **D3**: Thin, porous, compact bone surrounding a loosely structured cancellous bone
- **D4**: Loose, thin, cancellous bone

![FIGURE 2.13. (Photo courtesy of Dr. Eliane dos Santos Porto Barboza)](image)

**D1: THICK, COMPACT BONE** This type of bone usually can be found in the symphysis part of the mandible (Figure 2.14).

**Advantages**

- Provides good primary stability for the implants
- Expansive implant bone interface
- Use of short implants is possible
- Overdenture can be loaded immediately

![FIGURE 2.14. (Photo courtesy of Dr. Eliane dos Santos Porto Barboza)](image)
Disadvantages
- Reduced blood supply
- Difficult implant bed preparation, which can cause overheating
- Extra step of tapping the bone is required to eliminate the possibility of the pressure necrosis

**D2: THICK, POROUS, COMPACT BONE WITH A HIGHLY TRABECULAR CORE**
This type of bone can be found in the anterior and posterior portions of the mandible as well as the palatal aspect of the anterior maxilla (Figure 2.15).

![D2 Bone](image)

**Advantages**
- Provides good primary stability
- Easy implant bed preparation
- Overdenture can be loaded immediately
- Good blood supply, which means shorter healing time and faster osseointegration

**Disadvantages**
- None

**D3: THIN, POROUS, COMPACT BONE SURROUNDS A LOOSELY STRUCTURED RED CANCELLOUS BONE**
This type of bone can be found in the facial aspect of the anterior maxilla, posterior maxilla, posterior portion of the mandible, and the remaining bone after the osteoplasty of the D2 bone (Figure 2.16).

![D3 Bone](image)

**Advantages**
- Good blood supply

**Disadvantages**
- Possibility of unwanted widening of the osteotomy, which can lead to poor primary stability
- Reduced implant bone interface

**D4: LOOSE, THIN CANCELLOUS BONE**
This type of bone can be found in the posterior maxilla as well as the remaining bone after osteoplasty of the D3 bone (Figure 2.17).

![D4 Bone](image)
Advantages
- None

Disadvantages
- Poor primary stability
- Reduced implant bone interface

REFERENCES AND ADDITIONAL READING


Mericske-Stern, R. (1990). Clinical evaluation of overdenture restorations supported by


