The All on 4 Shelf: Mandible

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The use of full arch alveolar reduction as an aide to doing All on 4 implant restoration in the mandible is presented. The osteoplasty is described as a flat “shelf” on which to place the restoration. The shelf approach is used to establish optimal implant position and angulation as well as to define anatomy to maximize implant fixation for immediate load prosthetics.

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All on 4 treatment of the mandible requires preprosthetic surgery planning in order for nerve injury to be avoided even as maximum anterior-posterior spread of implant placement is obtained.1,2

Although inferior alveolar nerve mapping via computer manipulation of computed tomographic scan derived images is of great value in surgical planning for dental implant placement and nerve avoidance,3,4 there is nothing like direct visualization of the nerve at the time of implant placement to achieve a margin of safety.5 For delivery of All on 4 treatment, this is largely obtained by vertical bone reduction and creation of what is termed the All on 4 shelf.

There are a number of reasons bone modification for the placement of implants in the All on 4 configuration is required. However, this must first be understood by the surgeon as not only a prosthetic, but a surgical imperative, even though this is counterintuitive to the surgical dictum to preserve as much bone as possible for osseointegration.6-8

The surgeon, therefore, finds him- or herself in a perplexing quandary, asking the following: should bone be preserved for axial implant placement or removed as part of an angled implant placement strategy? Excess bone removal has been considered anathema—even iatrogenic—to long-term osseointegration, provoking countless bone regeneration schemes to recover the original alveolar plane and establish orthoalveolar form.9-15 However, in edentulous or soon to be edentulous settings the loss of alveolar bone is easily compensated for by prosthetic replacement given the common finding of sufficient basal bone stock for osseointegration.16-18

For the mandible, a reasonable approach to implant reconstruction, because biomechanical subtraction of required implant supporting elements have gone from 6 to 5 to 4,19-22 is the “All on 4” strategy. This approach requires site-specific placement to maximize the biomechanical advantage of the All on 4 distribution.19 This is best facilitated by bone reduction, not augmentation, by creation of the All on 4 shelf, which serves multiple functions for both surgeon and prosthodontist, as follows:

1. Establishes prosthetic restorative space
2. Establishes a level alveolar plane and uniform implant levels
3. Establishes alveolar width for implant diameter selection
4. Bone reduction makes basal bone accessible for implant fixation
5. Helps to establish arch form, implant distribution, and anterior posterior spread
6. Identifies optimal implant sites
7. Identifies secondary implant sites
8. Exposes lingual plate width and lingual concavities
9. Facilitates posterior implant placement with respect to the nerve
10. Provides bone stock for secondary bone grafting

**Prosthetic Restorative Space**

Inadequate interarch space, especially in combined maxilla-mandibular All on 4 treatment, leads to pros-
thetic failure (Fig 1). There needs to be a minimum of 20 mm of interarch space between the arches to have room for abutment, titanium bar, and the prosthetic restoration. In the mandible, this typically translates to about 5 mm of vertical bone reduction but more if there is segmental hypereruption. Therefore, the most important function of the All on 4 shelf is adequate bone reduction for prosthetic rehabilitation.

**Alveolar Plane**

In the mandible there is frequent segmental incongruity anterior-posterior (A-P). One common finding is marked atrophy posteriorly combined with anterior supereruption of residual anterior teeth and alveolar process such that when teeth are removed, the alveolar plane is not level. This usually is corrected anteriorly by alveolar reduction. Like the maxilla, the alveolar plane must be parallel to the interpupillary line. When upper and lower All on 4 are done simultaneously, the 2 All on 4 shelves should be parallel to each other to ensure optimal laboratory and prosthetic procedures.

**Alveolar Width**

As bone reduction is done, the alveolar width can actually diminish due to hour-glass alveolar constriction (Fig 2). The surgeon must then decide on using a narrower diameter implant or sometimes reduce bone further to where the alveolar base widens enough for placement of standard diameter implants. Also, in severe periodontal bone loss cases with significant periapical bone defects, adjustment of the shelf can improve or eliminate defects from being an obstacle to optimal implant placement.

**Basal Bone Access**

In the mandible the bone is usually dense, so-called type I bone. However, certain osteoporotic patients have nearly “hollow” mandibles such that once the alveolar process is reduced there is not a possibility for implant fixation. Often by reducing additional vertical height the inferior border bone becomes accessible for fixation using long implants, something not possible without creation of the All on 4 shelf. This is important as adequate torque and implant stability quotient (ISQ) values for immediate loading cannot be obtained without cortical bone. However, bone height should not be reduced to the point that the mentalis muscle is detached, leading to chin ptosis (Fig 3).

**Identification of Optimal and Secondary Implant Sites**

After the All on 4 shelf is made, even in dental extraction cases or where lesion ablation has occurred, optimal implant sites can be specifically identified. The 4 implant sites are mapped out from the available bone as well as secondary sites to fall back on if the primary sites do not provide adequate insertion torque for immediate function. Implant placement proceeds back to front placing the posterior sites initially, which then by spacing criteria establishes anterior placement sites.

**Lingual Plate**

The usual finding with bone reduction for the All on 4 shelf is a thin or absent buccal plate, a poorly
mineralized marrow trabecular space, and a thick lingual plate (Fig 4). The lingual plate is often the key to primary stability of implants. As the All on 4 shelf is established, the clinician can usually identify lingual concavities more readily. When there is significant osteoporosis and the inferior border cannot be reached even with long implants, the lingual plate becomes paramount to implant fixation. In general, the thicker the lingual plate, the more likely primary stability and osseointegration will occur.

**POSTERIOR IMPLANT PLACEMENT AND THE MENTAL FORAMEN**

By reducing bone and establishing an alveolar plane in closer proximity to the mental foramen, the inferior alveolar nerve can often more clearly be avoided as the posterior implant is angled forward at 30° to avoid the nerve (Fig 5). The surgeon has a better conceptualization of the course of the nerve the closer the alveolar plane is to the mental foramen.

As a guide for implant placement, the most anterior wall of the foramen, where the nerve will loop forward of the exit from the mandible 2 to 4 mm, is designated the N-point (nerve point). The angled implant must pass anterior to the N-point, but is still placed posterior to the foramen when placed at a 30° angle. Figure 6A,B shows a schematic in which a 10-mm vertical height from N-point to the All on 4 shelf allows a 10-mm distalization on the shelf for 30° implant placement, in this case, placing the implant posterior to the N-point 10 mm, on a 1-to-1 ratio.

This simple rule allows for increased A-P spread of several millimeters, usually 1 bicuspid tooth.

A second rule to apply to the shelf and N-point has to do with shelf width and the course of the nerve. When it is critical to gain A-P spread, the nerve can often be avoided even with implant placement more posterior to the foramen than outlined above, by angling transalveolarly buccal toward lingual (Fig 7A,B). This provides an added measure of safety for avoiding the nerve, which usually is midalveolar to lateral as it approaches its exit at the foramen.

In highly atrophic settings, nerve manipulation at the foramen can be done to facilitate implant placement but this is rarely required for satisfactory All on 4 anterior-posterior distribution and is only suggested if the foramen is located anatomically anterior (Fig 8A,B).

**Bone Graft Stock**

The All on 4 shelf creates a quantity of bone that can be used for grafting isolated defects or exposed screw threads, especially useful in combined maxillary and mandibular All on 4 treatment where graft

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**FIGURE 3.** Bone reduction in a patient with severe periodontal disease should maintain mentalis muscle attachment if possible to prevent chin ptosis. *Jensen et al. The All on 4 Shelf: Mandible. J Oral Maxillofac Surg 2011.*

**FIGURE 4.** In planning implant placement, it is not uncommon when dental extractions are required to have little or no buccal plate as well as limited bone mineral in the marrow space. The lingual plate then becomes most important for implant fixation which is best observed from a bone reduction shelf. *Jensen et al. The All on 4 Shelf: Mandible. J Oral Maxillofac Surg 2011.*

**FIGURE 5.** Thirty degree angled implants are placed just anterior to the mental foramen. By directly visualizing the exit of the nerve laterally, the operator can take appropriate measures to avoid nerve injury. *Jensen et al. The All on 4 Shelf: Mandible. J Oral Maxillofac Surg 2011.*
material is often required despite the misnomer of describing the All on 4 procedure as “graftless” treatment.

**Discussion**

The creation of the All on 4 shelf in the mandible is a necessary precursor to implant placement for All on 4 delivery and provides a number of advantages for implant placement (Fig 9A,B). Placement schemes without bone reduction may need to rely on axial placement, guided bone regeneration, nerve laterализation, and possibly increased number of implants.35-38

It appears that immediate function is well-founded in the mandible.39-46 It is now a matter of determining

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**FIGURE 6.** A, The most anterior deflection of the intraosseous nerve is termed N-Point. B, A 10 mm vertical height measured from N-Point to the All on 4 shelf allows for a 10 mm distalization on the shelf when an implant is placed at 30°. This usually allows for an increased anterior posterior spread of implants of 1 full bicuspid tooth.


**FIGURE 7.** A, Occasionally, when the mental foreman is well forward in the arch and there is adequate height of bone over the nerve, implants can be placed trans-alveolarly, buccal to lingual. B, This technique allows implant placement without nerve manipulation. C, The implant is placed at a 30° angle from the axis of the alveolus at a 30° flared angle engaging the lingual plate when viewed occlusally.

the optimal treatment plan, of which the All on 4 approach is one of many candidates. Although minimal long-term data are available as of yet for All on 4 mandibular restoration, early data with regard to marginal bone loss and implant stability have been favorable. The shelf does not appear to accelerate bone loss around implants or lead to a greater incidence of implant loss (Fig 10) nor does the procedure lead to a higher complication rate than is found with standard alveoplasty procedures. The need for bone graft or guided bone regeneration (GBR) procedures is very much reduced when the All on 4 shelf is used.

The major utility for the use of the All on 4 shelf in the mandible is to gain A-P spread without causing nerve injury, something much more difficult to do with other approaches.

In the future, navigation or computer-based guidance techniques may be developed to improve on the geometric conceptualization described here using the All on 4 shelf.

In summary, All on 4 bone reduction is advocated for mandibular All on 4 implant placement to establish optimal implant positioning for immediate function. The shelf approach helps the surgeon avoid nerve injury, select implant sites, and establish the biomechanical advantage of increased A-P spread for immediate function.
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