Concept of Neutral Zone

The objectives of any prosthodontic service are to restore the patient to normal function, esthetics, and health. The design of prostheses to replace lost teeth and resorbed ridges is largely determined by the position and amount of morphological changes in the denture bearing area of the jaw. These changes affect artificial teeth position in complete denture patients. The arrangement of teeth must be physiologically and esthetically acceptable.

The eruption of the teeth in the oral cavity is influenced by the forces exerted by the tongue, cheeks, and lips. These muscular forces collectively determine the final dental arch form and position of the tooth in the oral cavity. This muscular environment continues throughout life, even after teeth have been lost, and greatly influences this potential space.

After the loss of natural teeth, it is difficult to ascertain the exact position due to varying patterns of alveolar bone resorption in different segments.
The concept of **"teeth over the residual ridge"** is based on the mechanical principle of ensuring stability by directing the forces at a right angle to supporting tissues. Mandibular posterior teeth are placed with their central fissures coinciding with a line joining the cuspid tip and the middle of the retromolar pad. Bucco-lingually narrow teeth when placed closer to the ridge offer additional lever balance. Crests of the residual ridge may be used as a biometric guide.

Unfortunately, the crests do not remain in the same antero-posterior and medio-lateral positions. Viewing from the occlusal aspect, the crest of the residual alveolar ridge shifts lingually in the maxilla and buccally in the mandible. Both arches are resorbed in vertical and horizontal directions.
The alveolar ridge crest change its location in a bucco-lingual direction after resorption. The probable cause of this resorption pattern may be due to the eruptive pathway of teeth, the development pattern of alveolar processes, or muscular or myodynamic forces. So the arrangement of artificial teeth over the crest of the residual ridge may lead to facial deformity, aggravate phonetic problems, and affect deglutition.

Generally, loss of bone occurs from the lingual plate of the mandibular arch and buccal aspects of the maxillary arch. This allows more space for tongue movement and hence tongue enlarges over the years. This results in the exertion of force more towards the buccal and labial sides. Cheeks and lips may not respond in the same fashion due to loss

of tonicity of muscles with advancing age. Therefore neutral zone may not lie at the place where it was when teeth were present.

Complete dentures are primarily mechanical devices, but since they function in the oral cavity, they must be formed so that they are in harmony with normal neuromuscular function.

Neutral zone may be defined as the space where during function the forces of the lips and cheeks pressing inwards neutralize the forces of the tongue pressing outwards. The neutral zone concept involves acquired muscle control, especially by the tongue, lips, and cheeks towards denture stability. Believers in the neutral zone agree that a lack of favorable leverage is observed when teeth are positioned directly over the ridge. As in this case teeth are not positioned in harmony with the surrounding musculature. By employing the neutral zone concept, the dislodging muscle energy can easily become a retentive and stabilizing force.

After the loss of natural teeth, space or void exists within the oral cavity called the **potential denture space**. It is bounded by the maxilla and soft palate above, by the mandible and floor of the mouth below, by the tongue medially or internally, and by muscles and tissue of lips and cheeks laterally or externally. Within the denture space, neutral zone lies. Denture teeth should be arranged in the neutral zone, where during function the forces of the tongue pressing outward are neutralized by the forces of cheek and lips pressing inward.

The concept of the neutral zone approach in complete dentures is to locate that area in the edentulous mouth where the teeth should be positioned so that the forces exerted by the muscles will tend to stabilize the denture rather than unseat it.

When the residual alveolar ridges have resorbed significantly, denture stability and retention are more dependent on the correct position of teeth and contour of the external surfaces of dentures.

Failure to recognize the importance of tooth position, flange form, and contour often results in dentures that are unstable and unsatisfactory. This potential space is known as the neutral zone, which is bounded by the tongue medially, and the lips and cheeks laterally.

In the highly atrophic mandible, muscular control over the denture is the main retentive and stabilizing factor during function. A denture shaped by the neutral zone (NZ) technique will ensure that the muscular forces are working more effectively and in harmony.

Historically, **different terminologies** have been associated with this concept, including:

1. Dead zone.
2. Stable zone.
3. Zone of minimal conflict.
4. Zone of equilibrium.
5. Zone of least interference.
6. Biometric denture space.
7. Denture space.
8. Reciprocal space.
9. Potential space.
10. Reciprocal zone.
11. Zone of neutralmuscular forces.

Objectives of neutral zone technique:

1. **Enhance Stability**: Prevent denture displacement by muscle forces.
2. **Improve Retention**: Utilize muscle activity to keep the denture in place.
3. **Optimize Functionality**: Ensure better speech and chewing efficiency.
4. **Increase Comfort**: Reduce soreness and irritation from unstable dentures.
5. **Reduce Food Impaction**: Minimize food trapping for better oral hygiene.

This technique is particularly useful for patients with severe ridge resorption, where conventional denture techniques may fail to provide stability and comfort.

Indications of the Neutral Zone Technique:

1. **Severe Ridge Resorption**: Lack of adequate bone support for conventional dentures.
2. **Flabby or Mobile Ridges**: Prevents denture instability and discomfort.
3. **Unstable Dentures**: Frequent dislodgment due to muscle forces.
4. **Strong Muscle Activity**: Hyperactive tongue, cheeks, or lips affecting denture retention.
5. **Neuromuscular Disorders**: Conditions like Parkinson's or stroke affecting oral muscle control.
6. **Post-Surgical or Trauma Cases**: Patients with altered oral anatomy due to surgery or injury.
7. **Gag Reflex Issues**: Helps in positioning dentures to minimize gagging.
8. **Previous Denture Failures**: For patients struggling with conventional denture stability.

Advantages of the Neutral Zone Technique:

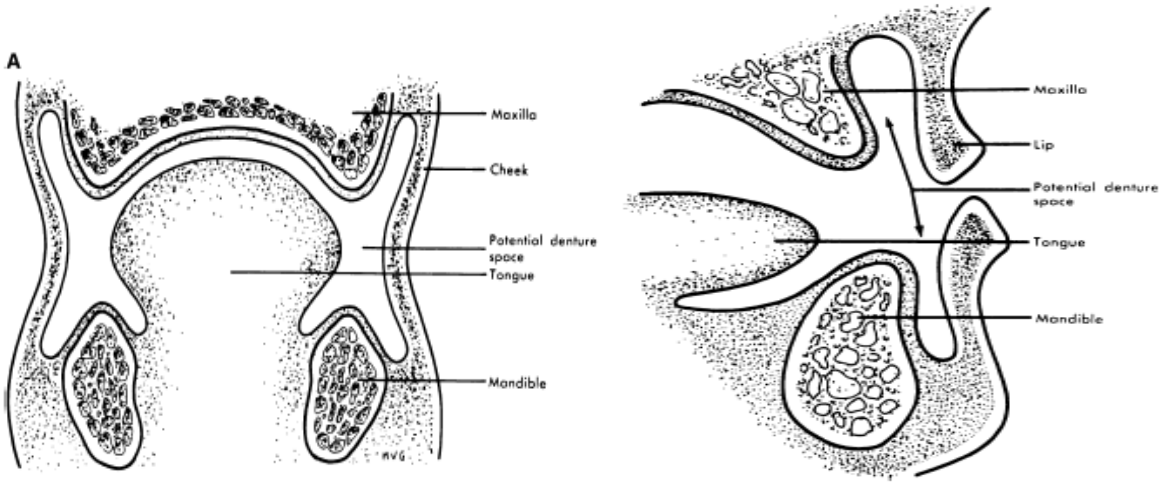
1. **Enhanced Stability & Comfort.**
2. **Improved Functionality.**
3. **Better Adaptation to Oral Structures.**

Disadvantages of the Neutral Zone Technique:

1. **Time & Cost Intensive:** Requires multiple appointments and is more expensive than conventional methods.
2. **Skilled Expertise Needed:** Demands a highly trained clinician for accurate results.
3. **Limited Patient Suitability:** Not ideal for patients with severe neuromuscular issues or poor muscle function.
4. **Potential Discomfort & Errors:** Risk of initial discomfort and instability due to inaccurate muscle positioning.

Boundaries of denture space

It is bounded by the upper ridge, hard, and soft palate from above, the lower ridge from below, the tongue medially, and cheek and lip externally or laterally.



Anatomy of soft tissue boundaries:-

1. Maxillary and mandible buccal region: In this region, the ***buccinator*** is considered the main boundary of the denture space. It originates from pterygomandibular raphe and area opposite to the maxillary and mandible molar and fibers go anteriorly to converge with other muscles at the modiolus. The role of buccinators is to position the food between teeth in coordination with the tongue.

Because of the direction of muscle fibers (which is parallel to the border of the denture and not at a right angle to it), the contraction of the muscle has a slight displacing action to the denture and we may have a possibility of overextension with the limit of function and health.

Masseter and Temporalis (Masticatory Muscles) these muscles are involved in chewing. While they are not directly in the neutral zone, their force and action impact the position of the lower denture, especially during mastication. It exerts a strong force when the teeth come into contact during chewing, which impacts the position and stability of the lower denture, particularly at the distobuccal (back and outside) region.

2. Anterior margin of the buccal region: In this region, the ***modiolus*** is a strong knot that alters the position of the mouth angle. It is composed of the intersection of ***buccinators, orbicularis oris, zygomaticus major, levator and depressor anguliorис***.

The modiolus determines the position of the premolar and the shape of the polished surface in that region. This produces narrowing of the denture so that the polished surface doesn't interfere with the modiolus movement during function.

3. Labial region: It extends from one modiolus to the other. Its boundaries in the maxilla are formed by ***levator labisuperioris*** and in the mandible by ***depressor labiinferioris*** and ***mentalis***. The origin of these muscles determines the length of the labial flange but the degree of ridge resorption and the tonicity of the muscle determine the thickness of the flange. The anterior portion of the labial region is bounded by ***orbicularis oris***.

The movement of the lip and tongue determines the position of lower anterior teeth, if the teeth are positioned too far labially, the contraction of lip will displace the denture posteriorly.

4. Palatal region: It is bounded by the upper residual ridge, hard palate, and anterior part of the soft palate. It is very important during phonation of words.

5. Mandibular lingual region: It is the most important region. It is formed mainly by the tongue which is a powerful group of muscles and it is in contact with denture during rest and function. The polished surface and position of teeth are critical in this region.

Tongue Muscles:

- **Intrinsic Muscles**: Responsible for shaping the tongue within the mouth.
- **Extrinsic Muscles**: These muscles move the tongue in different directions and are important for controlling the position of the denture. they include:
    - **Genioglossus**: Moves the tongue forward and downward.
    - **Hyoglossus**: Depresses the tongue.
    - **Styloglossus**: Draws the tongue upward and backward.
    - **Palatoglossus**: Elevates the back of the tongue.

If the anterior or posterior teeth are set too lingual, the tongue will displace the denture during function. Also, the occlusal plane should not be high to allow the tongue to lie on the occlusal surface during rest.

6. Floor of mouth: The composition of this region is mainly the ***mylohyoid*** muscle arising from the mylohyoid line. The direction of the muscle fibers is different in various regions.

In the anterior part of the floor of the mouth, the fibers extend almost horizontally while posteriorly, it extends obliquely to the hyoid bone. So anteriorly the ***mylohyoid*** muscle is considered as the limit of the denture while posteriorly the denture flange is extended sometimes below the mylohyoid line depending on the direction of the muscle fibers.

Methods of assessing the neutral zone:

1. Conventional method

It is based upon the arrangement of artificial teeth following certain anatomical guides and then waxing and carving of the trial denture in a conventional way.

The incisive papilla is thought to be a fixed anatomical landmark and it is not affected by bone resorption. It is a good guide for anteroposterior positioning of the anterior teeth. The labial surfaces of the central incisors are usually 8-10 mm in front of the papillae. Also, the line bisecting the midline at the center of the incisive papilla should pass through the tips of the upper canines.

For the arrangement of lower posterior teeth, we have the retromolar pad which is also a fixed anatomical landmark and not affected by bone resorption. Arrangement of teeth is done according to a line passing from the center of the retromolar pad to the tip of the lower canine. This line is passing through the central grooves of the lower posterior teeth.

After the arrangement of teeth, we do corrections inside the patient's mouth according to esthetic, phonetic, and functional needs.

Then waxing and carving are performed in a conventional way (the labial and buccal flanges are given concavity and sometimes convexity at the anterior segment to receive muscle action).

2. Functional method

Many methods are used but all of them try to register the neutral zone through molding of soft material by the action of the tongue, lips, cheeks, and floor of the mouth by specific oral functions. Materials of impression used are impression compound, soft wax, silicon, or tissue conditioning material.

Modeling plastic impression compound, being a thermoplastic material, is easy to manage and has the advantages of low cost and ease of availability, compared to wax which is temporarily stable. A tissue-conditioning material was preferred by many

authors because of the ease of mixing, elective initial viscosity, and slow-setting properties that enabled the capture of the movable tissue morphology in the functional state. Moreover, this material also allows for an incremental molding procedure, which is important in patients with focal neurological deficits and slow or false reactions to various commands. A disadvantage of this material is its relatively high cost

This method may register the neutral zone at rest or function (swallowing, phonation, sucking, whistling).

The impression material will capture in greater details the action of the lips, cheeks, and tongue and determine the thickness, contours, and shape of the polished surface of the denture to be functionally compatible with muscle action.

Neutral zone Functional technique procedures:

1. Maxillary and mandibular primary impressions are made in stock trays using an impression compound. Custom trays are fabricated in autopolymerizing resin and a final impression is taken in zinc oxide eugenol impression paste after border molding. Jaw relation records are then recorded using conventional occlusal rims made of modeling wax and occlusal blocks are mounted on a semi-adjustable articulator.

2. An additional autopolymerizing resin mandibular denture base is fabricated and is attached with retentive loops made of thin orthodontic wire in the center. Two vertical pillars made of low fusing compound (Tracing Sticks) are placed in the first molar region at an established vertical dimension. This autopolymerizing resin base is placed in the mouth, checked for stability, and ensured that loops and vertical pillars do not interfere with muscle movements during function. The maxillary occlusal rim is placed back in the mouth.

3. A high viscous mix of a tissue conditioner (exp. Viscogel, Dentsply, Weybridge, UK), is advocated for the impression. The volume of the material should be controlled and kept to a minimum so that the sulci are not distorted. The material is mixed so that it can be manipulated by hand and positioned as an approximate rim on the lower base plate. Before making the impression the patient should be in a comfortable, upright position with the head supported. The material is inserted in the mouth and the patients are asked to perform a series of muscle actions designed to simulate physiological functioning. Such as counting, talking loud, pronouncing exaggerated ‘EEE’ and ‘OOO’ sounds, swallowing, slightly protruding the tongue, and lick the lips. These actions will need to be rehearsed so that they are performed naturally and effectively. These actions are repeated for 10 minutes until the material has been set.

4. The impression of denture space is placed over the mandibular master cast. Indexing is made on the side and center of the cast. The lingual matrix of this denture space is made using silicone putty. Putty is adapted into the tongue space of the neutral zone record so that it is at the level of the occlusal plane of the record and extends over the posterior area of the cast.
Likewise, the facial matrix is developed along the facial contours of the neutral zone record. Once polymerized, putty matrices are sectioned and removed from the cast. Then tissue-conditioning material is removed from the base and replaced with wax using putty matrices.

5- **Arrangement of Teeth**
All of the lower teeth are set first. This is done by removing just enough wax to set one tooth at a time, and constantly checking its position with the index matrices. When all of the lower teeth have been set, the upper teeth are arranged. They must be positioned within the neutral zone and to the proper height of the occlusal plane as established on the tissue conditioner occlusion rim with the putty matrices in position. However, the position of maxillary anterior teeth can be modified based on the esthetic and phonetic requirements of the patient.

6. Flasking, processing, finishing, and polishing of the denture is then done using the conventional method.

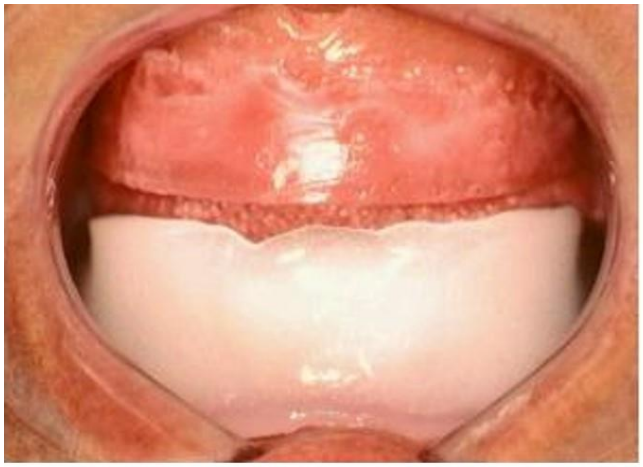
Comparison between conventional mandibular denture and mandibular denture made by neutral zone technique:

- **Stability and Retention**: The neutral zone technique enhances retention and stability, especially for patients with resorbed ridges, as it accounts for the muscle forces acting on the denture.
- **Function and Comfort**: The neutral zone technique offers better functional outcomes for speaking and chewing, improving overall comfort.
- **Complexity and Cost**: While the neutral zone technique is more complex and expensive, it is particularly beneficial for patients with challenging oral conditions that affect the stability and comfort of conventional dentures.

In summary, **conventional dentures** may work well for patients with stable jaw anatomy, but the **neutral zone technique** is particularly advantageous for patients with severely resorbed ridges or challenging muscle dynamics, providing better long-term stability, comfort, and function.

Limitations for the Success of the Neutral Zone Technique:

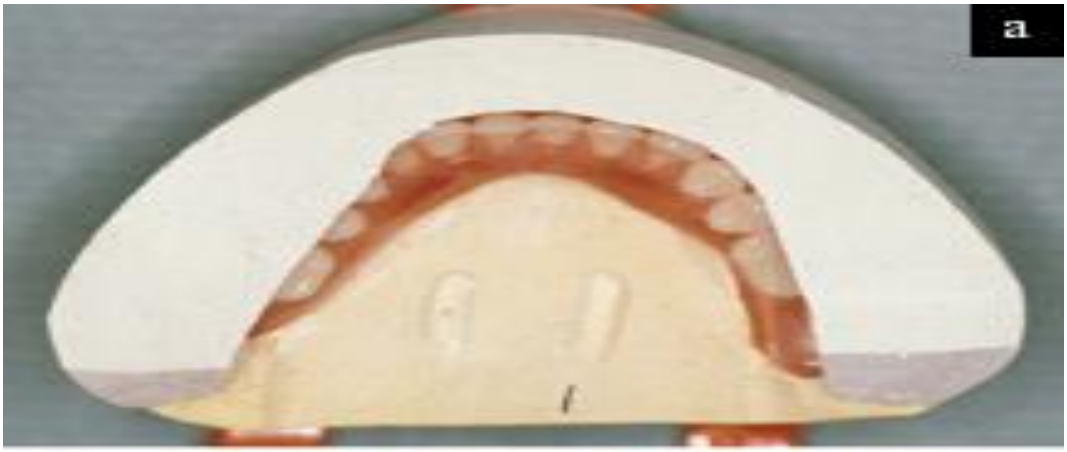
1. **Requires skilled practitioner** with experience.
2. **Patient cooperation** is essential, which may be challenging for some.
3. **Anatomical limitations** like severe ridge resorption can affect results.
4. **Muscle imbalances** may hinder proper function, especially in patients with neuromuscular disorders.
5. **Longer treatment time and adaptation period** with multiple visits needed.
6. **Higher cost** compared to traditional denture methods.
7. **Technical challenges** due to specialized materials and lab work.
8. **Not ideal for all patients**, particularly those with minimal muscle or ridge issues.



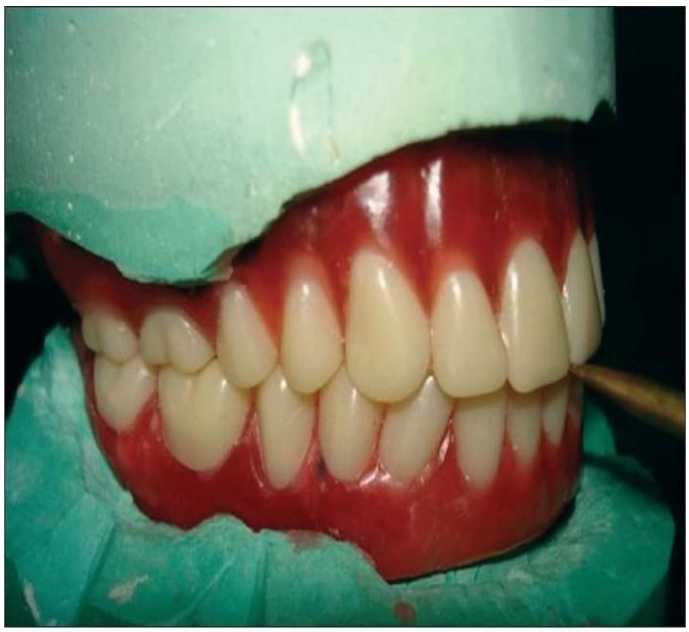

a


b


BUCCAL
BUCCAL
LINGUAL
LOWER
Mandibular Neutral Zone Record


a


b




A
B
C