



Republic of Iraq Ministry of Higher
Education and Scientific Research University
of Baghdad College of Dentistry



Management Of Resorbed Mandibular Ridge

A Project Submitted to The College of Dentistry ,
University of Baghdad , Department of Prosthodontics
in Partial Fulfillment of the requirement for B.D.S
degree

By

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2023

Declaration

I certify that this project entitled “**Management of resorbed mandibular ridge** ” was prepared by the fifth - year student **Aliaa Kadhim Hussien** under my supervision at the College of Dentistry / University of Baghdad in partial fulfilment of the graduation requirements for the Bachelor Degree in Dentistry

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Dedication

To his fragrant biography, and enlightened thought; He was the first credit for my attainment of higher education (My beloved father), may God prolong his life.

To the one who put me on the path of life, and made me calm, She nursed me until I was big (My dear mother), may God bless her soul.

To the person who supported me for the past five years

To my sisters; Those who had a great impact on many obstacles and hardships.

Acknowledgment

In the Name of Allah , the Most Merciful , the Most Compassionate all praise is to Allah , the Lord of the worlds ; and prayers and peace be upon Mohamed His servant and messenger . First and foremost , I must acknowledge my limitless thanks to Allah , the Ever - Magnificent ; the Ever - Thankful , for His help and bless . I owe a deep debt of gratitude to our university for giving us an opportunity to complete this work .

I would like to thank Professor Dr. Raghad Al Hashimi , the dean of the College of the Dentistry , University of Baghdad for providing me the opportunity to complete my work .

I would like to thank Prof. Dr. Abdulbasit Ahmed , the chairman of the prosthodontic department for his support .

My sincere appreciation is to my supervisor Assist . Lec . Dr.Ghsak H. Jani , for her thoughtful guidance , suggestion , invaluable help and advice planning and conducting this research .

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List of Abbreviations

R.R.R.	Residual ridge resorption
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INTRODUCTION

Residual ridge is the portion of the alveolar ridge and its soft tissue covering that remains, following the removal of or loss of teeth. A term Residual Ridge Resorption is used for the decreasing amount and form of residual ridge after teeth are removed. The event of inflammatory reaction is instantly started after tooth extraction, and the extraction socket is temporarily closed by the blood clot. The disorganized tissue due to the changes occurring due to resorption can be initiated in the first week as the epithelial tissue initiates its multiplication. Residual alveolar ridge bone undergoes a lifelong catabolic remodeling even after healing of wounds. This is the distinctive feature of healing of extraction wound. The residual ridge resorption is at the highest rate in the initial 3 to 6 months, and then gradually reduces further. However, the rate of residual ridge resorption continues throughout the lifetime depending on various factors resulting in 3-4 times bone loss in mandible as compared to maxilla. The rate of residual ridge resorption varies from patients to patients. The episodes of residual ridge resorption are easily seen clinically after tooth extraction, but the sequence of biologic events is not understood (Sweta Pisulkar et al., 2019).

RRR It is a chronic, progressive and irreversible condition (Kumar et al., 2016). It can cause physical, psychological and economic problems for individuals (Singh et al., 2016). Differences in the amount and rate of alveolar bone loss exist between individuals. The differences have been attributed to several factors, including age, gender, facial anatomy, metabolism, oral hygiene, parafunctions, general health, nutritional status, systematic illnesses, osteoporosis, medications and the amount of time the patient has been edentulous.

Residual ridge resorption is considered a multifactorial disease that occurs as a result of anatomic, metabolic, prosthetic and functional factors (Atwood, 1962, Gupta et al., 2010). Anatomic factors are related to the amount and quality of bone (Gupta et al., 2010). Metabolic factors includes nutritional, hormonal other metabolic factors that influence the osteoblasts and osteoclasts activity. Among the hormonal factors, thyroid hormone affects the activity of osteoblasts and osteoclasts whereas the parathyroid (hormone affects osteoclasts (Gupta et al., 2010). Therefore, hormonal factors contribute strongly to bone resorption.

Age is another important factor that influences the extent of bone resorption. Edentulism and osteoporosis are commonly observed in the elderly (**Gupta et al., 2010**). As age increases, there is an increase in the amount of resorption [**Al-Jabrah and Al-Shumailan, 2014, Jagadeesh and Patil, 2013, Jayaram and Shenoy, 2017**]. In older age groups (over 60 years of age), the progression of mandibular resorption in relation to duration of edentulism was faster than in a younger age group (40 to 60 years) (**Jayaram and Shenoy, 2017**).

Furthermore, gender plays an important role in RRR, where a greater bone resorption was reported in women than men (**Al-Jabrah and Al-Shumailan, 2014, Liang et al., 2014**).

A difference between the rate of mandibular alveolar resorption and resorption of the maxillary alveolar process has been reported. The degree of mandibular alveolar resorption is three or four times higher than alveolar resorption in the maxilla (**Atwood, 1974**)

In prosthetic rehabilitation, the success of treatment may be dependent on the size of remaining edentulous tissues both with regard to the denture bearing surface area as well as bone quantity for dental implant placement and it is important to understand the contour, ridge height, ridge morphology, proximity to crestal bone height of soft tissue and muscle attachments in order to predict the prognosis of a removable dental prosthesis with respect to retention, stability and support (**Singh et al., 2016**)

AIMS OF REVIEW :

1-Identify residual ridge resorption

2- what are the factors that affecting residual ridge resorption

3-know different types of management of its.

CHAPTER ONE
REVIEW OF LITERATURE

1.1 Residual ridge resorption

Residual ridge resorption (RRR) is a continuous process of alveolar bone loss , which is greater during the first few months after the tooth extraction than later . The rate of resorption is twice more pronounced in the mandible than in the maxilla (**Al - Jabrah & Al - Shumailan , 2013**) Residual ridge consists of denture - bearing mucosa , submucosa , periosteum , and underlying alveolar bone . Residual bone is that part of alveolar ridge which remains after the teeth have been lost (**Devaki et al . , 2012**)

1.2 The structural elements of bone

A basic concept of bone structure and its functional elements must be clear before bone resorption can be understood . The structural elements of bone are :

a . Osteocytes : These are cells responsible for metabolic activity of bone .

b . Calcified cementing substance : The calcified cementing substance consists mainly of polymerized glycoprotein . Mineral salts namely calcium carbonate and phosphates are bound to these protein substances .

c . Osteoblasts : by their function of forming and calcifying the intercellular substance , are the active bone forming cells . The osteoblasts surround the bone in a continuous layer . In the course of bone formation , some osteoblasts get engulfed in the intercellular substance and become osteocytes .

d . Osteoclasts : Osteoclasts are the cellular components of bone that are responsible for bone resorption . Bone resorption always requires the simultaneous elimination of the organic and inorganic components of the intercellular substance (**Sarandha et al . , 2007**)

1.3 Classifications

a) **Atwood classified residual ridge resorption into**

Order 1: Pre-extraction

Order 2: Post-extraction

Order 3: High, well-rounded

Order 4: Knife-edged

Order 5: Low, well rounded

Order 6: Depressed (**Atwood. ,1963**)

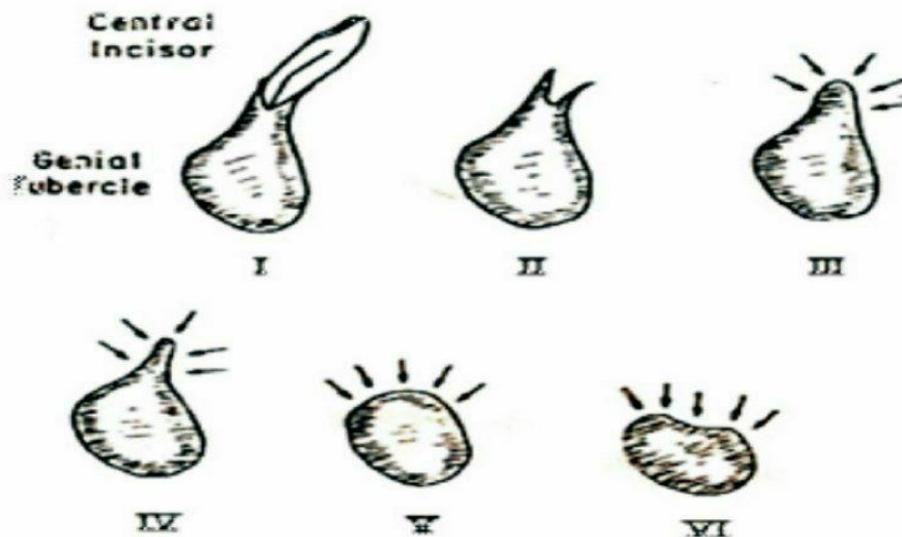


figure 1.1 Atwood classified (**Kaur. ,2017**)

b) **Neil classified residual ridge resorption in relation with floor of the mouth and mylohyoid ridge(Burugupalli et al.,2020)**

Class 1: 0.5 inch space exists between mylohyoid ridge and the floor of the mouth.

Class 2 : Less than 0.5 inch space exists between mylohyoid ridge and the floor of the mouth.

Class 3 : The mylohyoid muscle is at the same level as the mylohyoid ridge.

c) Branemark Classification

Bone quality:

Class 1:-Almost the entire jaw is composed of homogenous compact bone.

Class 2:-A thick layer of compact bone surrounds a core of dense trabecular bone.

Class 3 :-A thin layer of compact bone surrounds a core of dense trabecular bone.

Class 4:-A thin layer of compact bone surrounds a core of low-density trabecular bone. **(Burugupalli et al.,2020)**

d) American college of Prosthodontics classification based on bone height (mandible only)

Class 1 : Residual bone height of 21 mm or greater measured at the least vertical height.

Class 2 : Residual bone height of 16 – 20 mm.

Class 3 : Residual alveolar height of 11 – 15 mm.

Class 4 : Residual alveolar height of 10 mm or less**(Tupac,2005)**

E)Cawood and Howell's descriptive classification of the changes of the shape of the alveolar processes

Class I Dentate

Class II Immediately post extraction

Class III Well rounded ridge form, adequate in height and width

Class IV Knife-edged ridge form, adequate in height and inadequate in width

Class V Flat ridge form, inadequate in height and width

Class VI Depressed ridge form, with some basilar loss evident**(Cawood and Howell's,1988)**

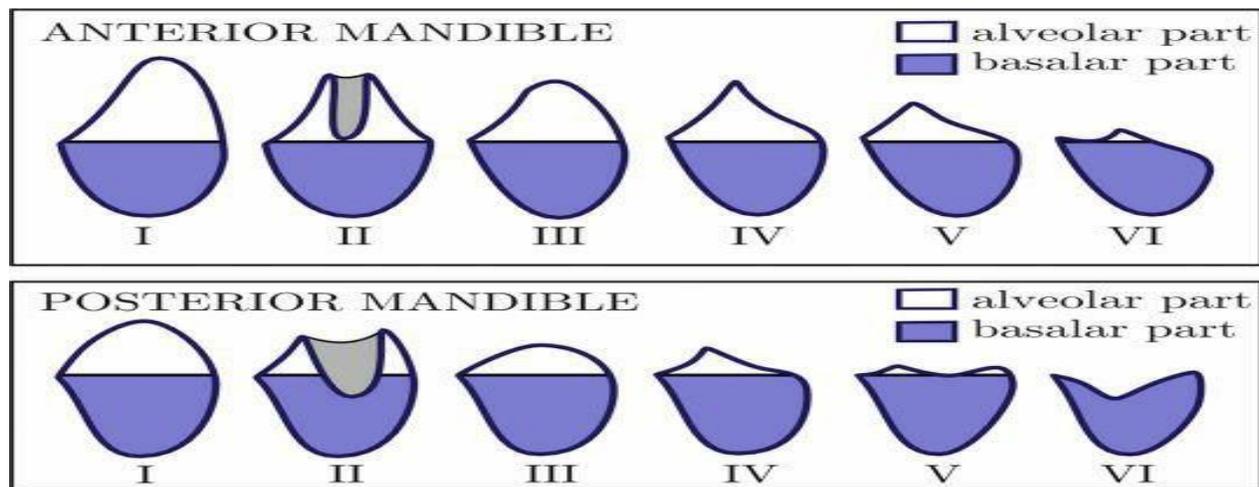


figure 1.2:cawood classification(Ulrike Gerken et al.,2020)

1.4 PATHOPHYSIOLOGY

Normally bone undergoes constant remodelling throughout life via bone resorption and bone formation. The amount of bone loss may be greater than the original thickness of the cortical bone. This mean that, in such patients, new bone is laid down internally while resorption occurs externally. The bone remodelling process does not always work with equal success is shown in the many patients in whom residual ridge crest has no cortical layer. This process of external resorption and endosteal deposition is not unique .As long bones grow longer, they are constantly reshaped in three dimensions. (Takeru et al , 2023)

This narrowing of a portion of a bone is achieved by external rcsorption. Such external resorption does not occur without endosteal deposition. If no new bone were laid downendosteally, the cortex would become progressively thinner until it completely disappears. The structural product of this inward growth is called “endosteal bone” and is characterized either by a convoluted whorled appearance (when growth occurs into a trabecular area) or by a zone of even, regular, uninterrupted circumferential lamellae (when bone is laid down in layers on the endosteal side of smooth cortical bone). In each instance, the configuration of the new bone is dependent upon the configuration of the bony surfaces on which the deposition occurs. (Chandra shekar.,2018)

1.5 Pathogenesis of R.R.R.:

RRR is chronic, progressive, cumulative and irreversible. Immediately following the extraction, any sharp edges remaining are rounded off by external osteoclastic resorption, leaving a high well rounded residual ridge.

As resorption continues from the labial and lingual aspects, the crest of the ridge becomes increasingly narrow ultimately becoming knife-edged. As the process continues, the knife-edge becomes shorter and even eventually disappears, leaving a low well rounded or flat ridge. Eventually, this too resorbs, leaving a depressed ridge. The resorption phase lasts about 8–10 days, presumably the life span of the osteoclast after completion of one resorption lacuna, the osteoclast can move along the bone surface and restart resorption or undergo apoptosis. The rate of reduction in size of the residual ridge is the maximum in the first three months and then gradually tapers off. The rate of residual ridge resorption differs from person to person and even at different times and sites in the same person and also affects the function of removable prostheses, which relies greatly on the quantity and the structure of jaw bones. The lower ridges showed a continuing RRR at a steady rate (0.4 mm. per year) over 15 year period. The vertical bone loss of the anterior part of the

ridge in 19 years is 14.5 mm. in the mandible. (Mohamed A El Maroush et al.,2019)

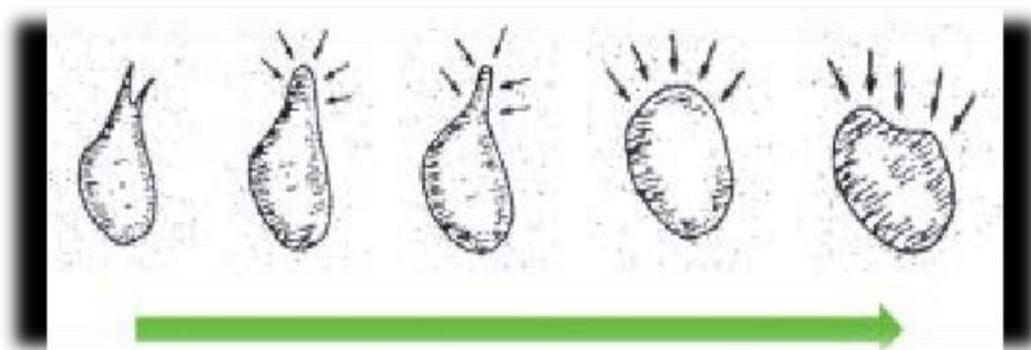


figure 1.3:stage of mandibular R.R.R. (Baiba Springe et al.,2014)

1.6 Direction of resorption in Mandible:

The anterior mandible teeth generally incline up-ward and forward to the occlusal plane where as posterior teeth are either vertical or incline slightly lingually. The mandible ridge resorbs primarily from occlusal plane because the mandible is wider at inferior border than residual alveolar ridge in the posterior part of mouth. Resorption effect moves left and right ridges progressively farther apart. The mandible arch appears to be wider while the maxillary arch becomes narrower. Thus RRR is centripetal in Maxilla and centrifugal in man. **(Poojitha Burugupalli et al.,2019)**

1.7 Etiology

RRR is a multi-factorial biomechanical disease that results from a combination of Anatomic, Mechanical and Metabolic determinants.

1.7.1 Anatomic factors

It includes size and shape of the ridge, type of bone, type of mucoperiosteum, bone quality and form before extraction. It is postulated that RRR is directly proportional to anatomic factors.

1) R.R.R. varies with quality and quantity of the bone of residual ridge. If there is more bone there will be more resorption. We should also try to evaluate the present status of the residual ridge to determine what has gone before. If a ridge has existed as high and well rounded for several years it will continue to do like so Large well rounded ridges and broad palates seem to be favourable anatomic factors

2) Another anatomic factor is density. However, for the density at given moment does not signify the current metabolic activity of the bone and bone can be resorbed by the osteoclastic activity regardless of its calcification **1(Ramandeep Kaur et al,2017)**

1.7.2 Metabolic factors

They include such things as age, sex, hormonal imbalance, osteoporosis. In older individuals bone resorption is more as compared to bone formation. All values used to study ridge resorption are higher for male groups as compared to female. Generally females have high predilection of resorption because of hormonal imbalance. Certain local bone resorbing factors are also important. They include:

- a) Endotoxins – from dental plaque (plaque can occur in edentulous mouth, in patients who do not clean their dentures)
- b) Osteoclast activating factor
- c) Prostaglandins
- d) Human gingival bone resorption stimulating factor
- e) Heparin – cofactor in bone resorption secreted by the mast cells
- f) Others include trauma under ill-fitting denture, which leads to increased or decreased vascularity and changes in oxygen tension Systemic factors – include circulating oestrogen, thyroxine, growth

hormone, androgens, calcium, phosphorus, vitamin D, proteins and fluorides.
(**Ramandeep Kaur et al.,2017**)

1.7.3 Mechanical factors:

this comprises of the

a. Functional factors

When considering the force, consider the amount of force, frequency, duration, direction, area over which force is distributed, and the damping effect of the underlying tissue. Woelfel in his study on a patient made maxillary denture of area 4.2 square / inch and 2.3 square / inch on mandible (ratio 1.8 : 1). If patient bites with a pressure of 50 pounds, so pressure under maxillary denture is 12 pounds / square inch and under mandibular denture is 21 pounds / square inch. So it can be said that there is more of mandibular ridge resorption than in the maxilla (**Burugupalli & Nair, 2018**)

Wolff's law postulates that all changes in the function of bone are attended by definite alterations in its internal structure. Forces within physiologic limits of bone are beneficial in their massaging effect. On the other hand, increased or sustained pressure, through its disturbance to the circulatory system, produces bone resorption.

The amount and frequency of stress and its distribution and direction are important factors in treatment planning. Although the total amount of the necessary masticatory stress cannot be diminished, increasing tissue coverage and decreasing the length and width of the occlusal table may lessen the load/unit area.

The frequency of stress application modifies the reaction of alveolar bone to external forces. Constant pressure on bone causes resorption, while intermittent forces favor bone formation. Since recurrent forces over short intervals of time have essentially the same resorbing effect as constant pressure, a rest period between meals is beneficial. For this reason, the patient should be warned that gum chewing has a destructive effect on the bone. **(Mohamed A El Maroush et al.,2019)**

Bruxism is an expression of nervous tension, which manifests itself as gnashing, grinding or clenching of the teeth while the patient is asleep or awake. Since most denture patients do grind their teeth in sleep, the dentures should not be worn during this period. Thus the supporting structures are afforded the rest period essential to the maintenance of the alveolar bone. While grinding of the teeth when the patient is awake may be a habit of tension, it may also be caused due to lack of interocclusal distance.

The principal concern should be in the pattern and position of the posterior teeth. There are two mandibular movements associated with mastication: a closing/cutting movement and a lateral or grinding movement. A sharp cusp will penetrate a bolus of food with less force than a flat occlusal form. However, a law of physics explains that forces applied to an inclined plane produce a resultant force or vector perpendicular or right angles to the plane. Applying this principle to occlusal form, the resultant force of the steep incline of high cusps would produce a lateral force, which might cause alveolar resorption.

Stress distribution favorable to healthy alveolar bone maintenance is dependent principally upon bilateral balanced occlusion. Balanced occlusion is that arrangement of the teeth, which will permit the necessary mandibular movements without tending to dislodge the denture or traumatize the supporting structure. **(Mohamed A El Maroush et al.,2019)**

b. Prosthetic factors

- 1• Type and fit of final denture prosthesis
- 2 • Time interval while the prosthodontic treatment occurs for the patient
- 3• Maximum amount of time the is patient wearing prosthesis everyday
- 4• Faulty impression procedures , employing compressive forces
- 5•Lack of freeway space due to increased vertical dimension of occlusion
- 6• Incorrect centric relation record .
7. Faults in selection and placement of posterior teeth .
- 8• Lack of balance in posterior occlusion .
- 9• Non - correction of occlusal errors caused due to processing technique and factor of tissue resiliency .
- 10• Use of non - rigid material with high flexure for denture base
- 11• Non - observance of biological principles of stress reduction
- 12• Occlusal imbalance or premature contacts
- 13• Disuse atrophy(**Sreeprada Dash et al ,2019**)

1.8 Consequences of RRR:

- a. There is apparent loss of sulcus width and depth.
- b. Muscle attachments are displaced closer to the crest of the residual ridge. Due to loss of VDO lower face height is reduced and mandible is rotated anteriorly.
- c. Patient may develop habitual prognathic appearance.
- d. Inter-alveolar ridge relationship is altered.
- e. Morphological changes in residual ridge may appear such as sharp, spiny, uneven residual ridges.
- f. Resorption of the mandibular canal wall and exposure of the mandibular nerve.
- g. Location of the mental foramina close to the top of the mandibular residual ridge.

This provides serious problems to the clinician on how to provide adequate support, stability and retention of the denture. (**Chandra shekars,2010**)

1.9 Treatment

1.9.1 Diet (Abbad et al.,2016)

Dietary guidelines for patients at risk of losing bone

- Maintain high quality Ca intake
- Consume about 6 ounces of protein
- Use small amounts of processed foods high in sodium
- Obtain 4000IU of vit - D daily
- Less intake of caffeine .

☆Ca , phosphorous and albumin , copper are essential minerals for bone Matrix .

1.9.2 prosthetic mangment

1.9.2.1 The modified functional impression technique (Nair K. Chandrasekharan et al.,2011)

seems to be a logical option for the management of compromised mandibular.

technique:-

1. The mandibular primary impression is made with irreversible hydrocolloid 2. The primary cast is poured in Type III dental stone and a tray devoid of spacer or relief wax is fabricated over the primary cast using autopolymerizing resin
3. After evaluation in the mouth, the custom tray is adjusted to be 2 mm short of the functional depth of the labial and lingual sulci.
4. The crest of the ridge is marked using an indelible pencil and is transferred to the tray
5. A window is cut in the tray using a straight bur . outlining the marked area,corresponding to the crest of the ridge

6. The tray is then seated onto the cast, and softened modeling is placed into the window, thereby replacing the eliminated acrylic resin, and shaped to form a handle
7. Putty consistency elastomer and tray adhesive on the borders and intaglio surface of the custom tray are placed on the tray. The tray is seated onto the ridge, and the labial and lingual borders are molded.
- 8-Areas of overextension indicated by exposure of the tray borders are corrected by removing the putty in the corresponding area and trimming the tray
9. A second application of putty is made over the first, and the borders are molded again .
10. The borders are re-examined for any over- or under-extensions and are corrected accordingly.
- 11-trimmed by 0.5 mm using a sintered diamond bur
12. The wax handle is removed and the putty material over the window is cut out using a sharp Bard-Parker knife.
13. Light-body elastomeric impression material is loaded into the tray, which is then seated on the ridge. Additional light-body material is then expressed into the window. Lingual and facial borders are molded, ensuring the tray remains steady until the impression material sets
- 14-Once set, the impression is removed, disinfected, and inspected . Beading and boxing is performed, and the impression is poured using Type III dental stone

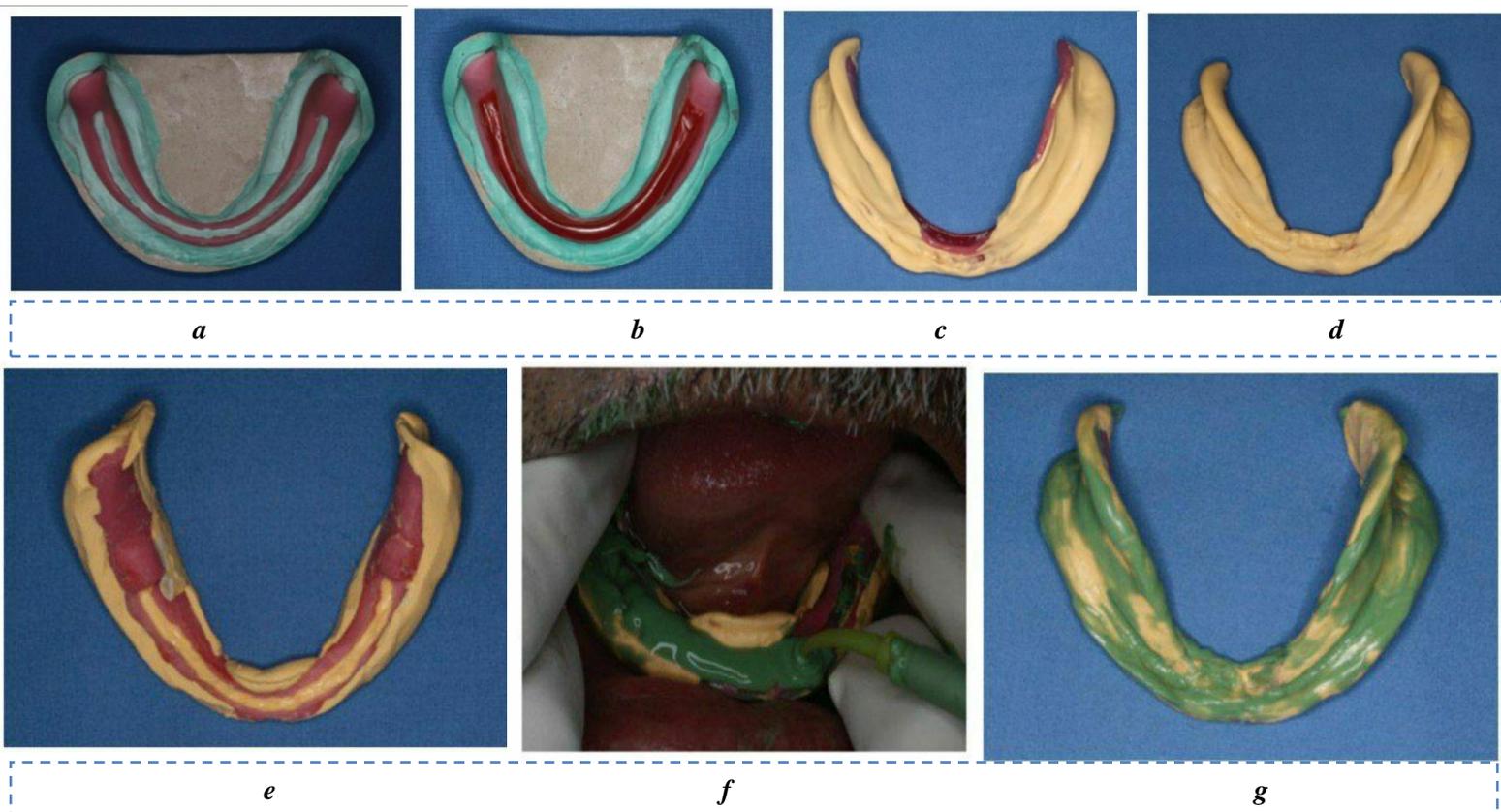


figure 1.4:Technique of modified functional impression a)

Window corresponding to crest of ridge.b)Handle made with modeling wax.c)Areas of over- and under-extension.d)Completed border molding.e)Removal of wax handle.f)Light body expressed into window intraorally.g)Completed mandibular impression.(Nair K. Chandrasekharan et al.,2011)

1.9.2.2 Physiologic Impression Technique(Manisha Herekar et al.,2013)

The objective is to develop a physiologic impression with maximum support of both hard and soft tissues. Tissues could be displaced during impression making and result in subsequent pathology, or they could be placed i.e. compression within the physiologic limits in order to maximize the support from the edentulous ridge. Close adaptation to the basal seat contributes to stability.

Technique :

1. Make a preliminary impression of the edentulous arch using McCord's technique. [3 parts impression compound +7 parts greenstick compound] in a metal stock tray.
2. Refine the impression using irreversible hydrocolloid over the existing primary impression
3. Remove, disinfect and pour the impression with dental plaster within 12 minutes. Retrieve the casts and adapt spacer wax extending from left canine to right canine region.
4. Fabricate a custom impression tray on the preliminary cast using self cure acrylic resin. Adjust the border extension of the tray to be at least 2 mm short of the vestibules. Evaluate and adjust the extension of the tray in mouth, if necessary. Remove the wax spacer.
5. Soften modeling plastic impression compound (green stick) by heating over the flame and load it over the anterior third of the intaglio surface of the special tray. Temper and seat the tray over the denture bearing area, mold the labial and buccal borders and ask the patient to perform various tongue movements to mold the lingual flange.
6. Repeat this procedure for middle third, followed by posterior third of the impression tray on either side simultaneously .Trim away any excess green stick material on the periphery with a Bard-Parker blade No. 20.

7. Trim away the material from the crest of the ridge providing the required relief. Roughen the impression surface by making grooves. This will enable mechanical retention of light body polyvinyl siloxane
8. Apply adhesive on the impression and tray borders and allow it to dry
9. Mix base and catalyst pastes of light body Poly Vinyl Siloxane impression material, spread it over the intaglio surface of the impression and obtain the final wash impression by performing lip, cheek movements and tongue movements. Allow the impression material to polymerize according to the manufacturer's recommendations.
10. Remove, disinfect the impression and pour with dental stone.

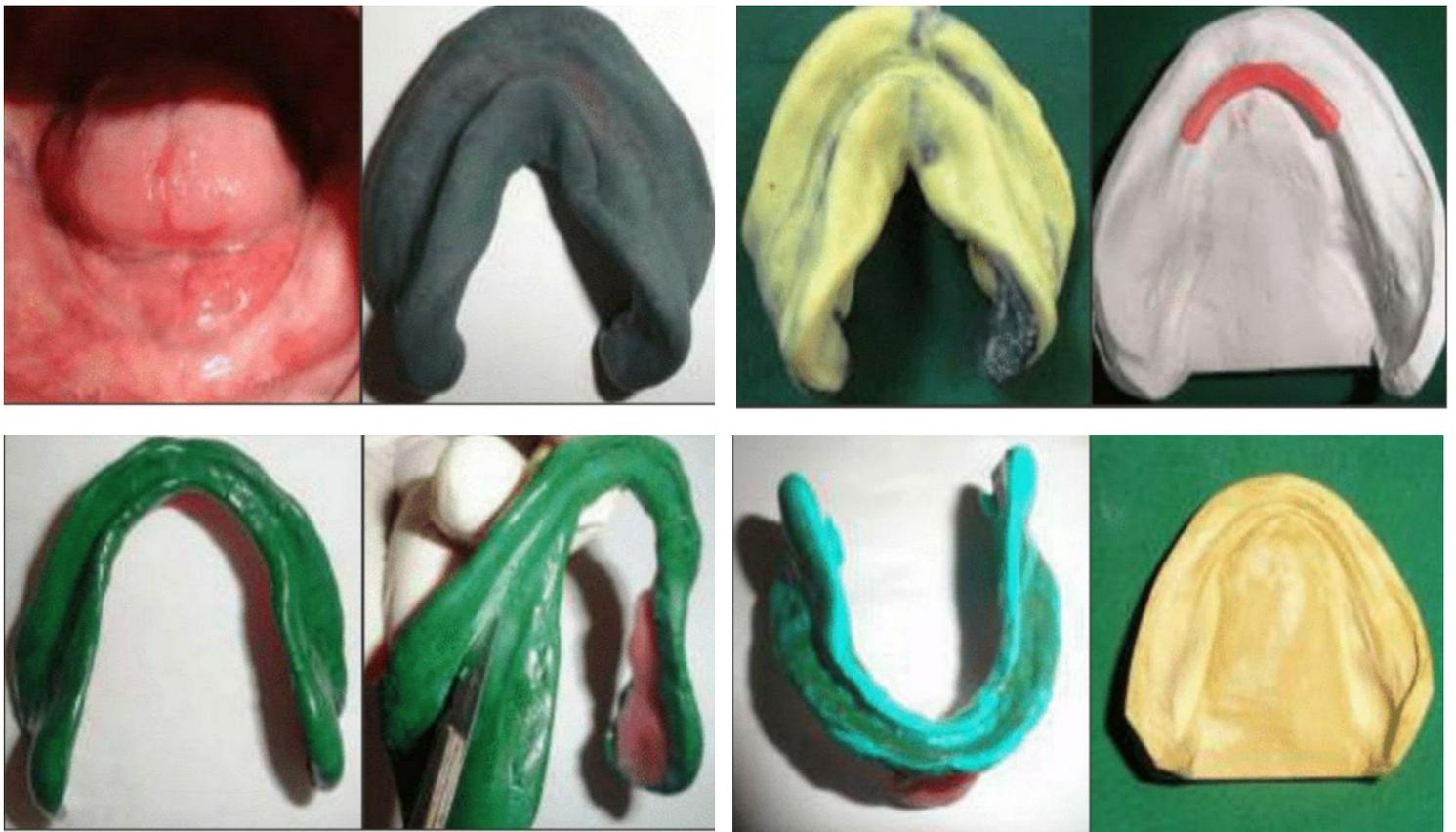


figure 1.5 :Physiologic Impression Technique(Manisha Herekar et al.,2013)

1.9.2.3 Wire impression technique (Humaira Tanvir et al. ,2017)

an impression technique of highly resorbed mandibular ridge using an orthodontic wire and elastomeric impression materials, to gain maximum retention

Technique

A primary mandibular impression was made using patient's previous denture with irreversible hydrocolloid impression material. A primary mandibular cast was made using dental plaster A 19 gauge wire (S.S smith) was adapted on the mandibular ridge on the primary cast in the form of special tray.

An orthodontic wire was used to make a loop with the help of universal plier, which extended from one retromolar pad to other covering the crest of the ridge. A handle was fabricated with the same wire. The special tray was checked in the patient's mouth.

The primary impression was made with putty consistency of Polyvinyl siloxane by mixing equal proportion of base and catalyst. The mixed impression material was loaded on wire and primary impression was made. Any deficiencies were rectified by addition of putty in deficient areas.

After completion of border moulding, a flame shaped carbide bur was used to trim the putty to make space for the final impression material.

Final impression was made using addition silicone elastomeric impression material of light body consistency Master cast was poured using die stone After this denture was fabricated using conventional denture fabrication procedures and denture was delivered.

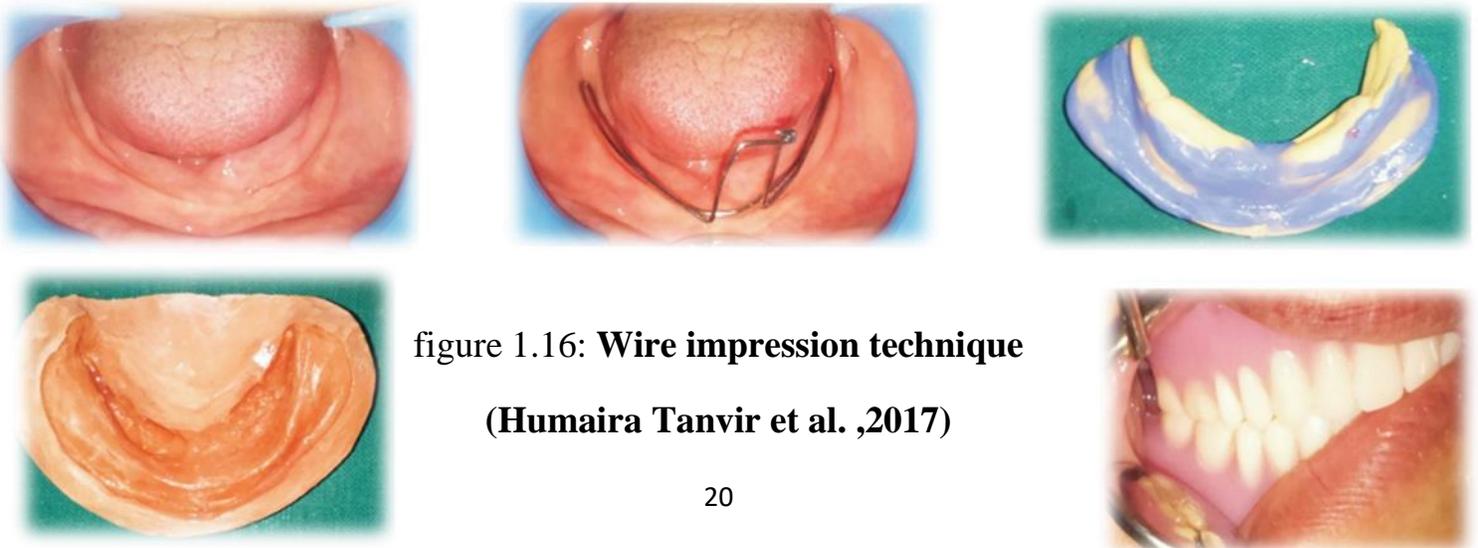


figure 1.16: Wire impression technique

(Humaira Tanvir et al. ,2017)

1.9.2.4 Cocktail impression technique(Arka Swarnakar et al.,2017)

Efforts have been made to improve stability of mandibular denture by combining various techniques to obtain an accurate impression Preliminary and definitive impressions were made following the cocktail impression .An over was made with the objective to record the entire support area for the denture base.

Preliminary impression was impression compound by open mouth technique. Customized tray according to Dynamic Impression Technique . The tray had a 1 mm wax spacer and cylindrical mandibular rests in the posterior region that wmade at increased vertical height



figure 1.7: Custom tray stabilized using impression compound for closed mouth impression(Arka Swarnakar et al.,2017)

High-fusing impression compound is softened, placed on top of the mandibular rests and inserted in the patient's mouth. Patient is advised to close her mouth so that the mandibular rests fit against the maxillary alveolar ridge.



figure 1.8: Intra Oral view while making Cocktail Impression(Arka Swarnakar et al.,2017)

This helps to stabilize the tray in position by preventing anteroposterior and mediolateral displacement of the tray during definitive impression. Space was made for the tongue by making the lingual surfaces of mandibular rests concave.



figure 1.9 :Functional movements during closed mouth(Arka Swarnakar et al.,2017)

Impression compound and green tracing stick in the ratio of 3:7 parts by weight is placed in water at 60°C and kneaded to a homogenous mass that provides a working time of about 90 seconds. Wax spacer is removed, this homogenous mass is loaded and patient is guided to close his mouth on the mandibular rests.

The patient was instructed to run her tongue along her lips, suck in her cheeks, pull in her lips and swallow water by keeping her mouth closed, for recording the functional state of oral structures till the impression material hardens.



figure 1.10: Functional movements during closed mouth impression(Arka Swarnakar et al.,2017)

On removal from the mouth, impression is chilled and reinserted to check the denture bearing area for pressure sensibility by applying heavy finger pressure on the impression and the thumbs on the underside of the patients' mandible to simulate functional loads. If the mucosa has been properly loaded, the only discomfort that the patient should report is where the thumbs press on the lower border of the mandible.(**Elio Minetti et al , 2022**)

Reheating the impression in whole or part, or adding more material to deficient areas is contraindicate to prevent the flow of material which in turn will result in differential loading of the tissues.

The retrieved impression is visually inspected for surface irregularities, disinfected and poured. After this a conventional complete denture was fabricated



figure 1.11: Final impression (McCord and Tyson)(**Arka Swarnakar et al.,2017**)

1.9.2.5 Neutral zone technique

Complete dentures are primarily mechanical devices but since they function in the oral cavity, they must be fashioned so that they are in harmony with the normal neuromuscular function. All oral functions, such as speech mastication, swallowing, smiling, and laughing, involve the synergistic actions of the tongue, lips, cheeks, and floor of the mouth which are very complex and highly individual. Failure to recognize the cardinal importance of tooth position and flange form and contour often results in dentures which are unstable and unsatisfactory, even though they were skillfully designed and expertly constructed. The coordination of complete dentures with the neuromuscular function is the foundation of successful, stable dentures. When all of the natural teeth have been lost, there exists within the oral cavity a void which is the potential denture space. (Chandra shekars.,2010)

"The neutral zone "is the potential space between the lips and cheeks on one side and the tongue on the other, that area or position where the forces between the tongue and cheeks or lips are equal. (Chandra shekars.,2010)

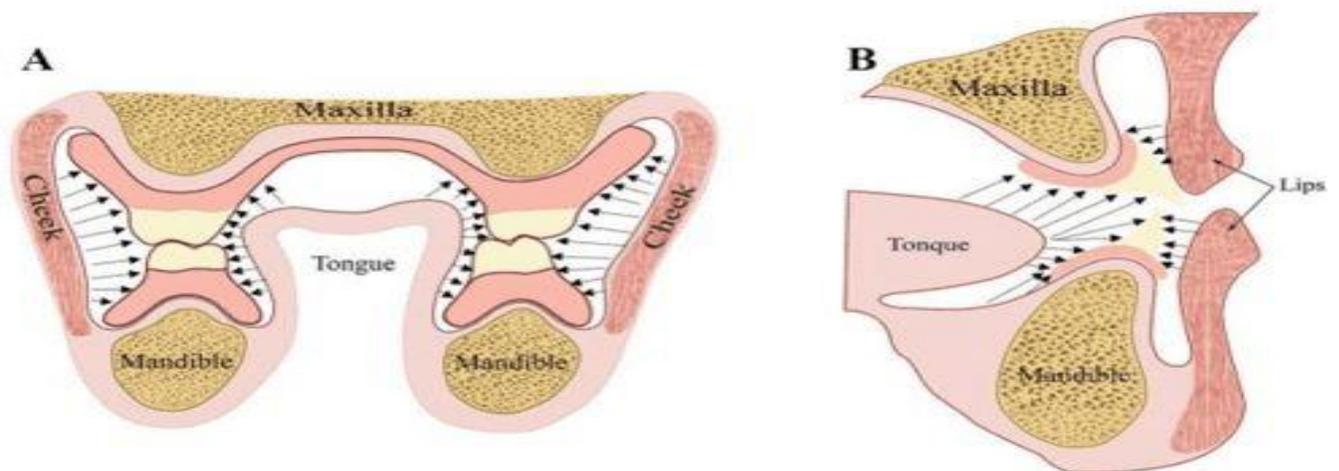


figure 1.12 : Neutral zone(Chandra shekars.,2010)

1.9.2.5.1 Important of neutral zone

As the patient grows, the position of teeth, size and relationship of jaws are controlled by muscles, both in repose and in function. Similarly when the natural teeth are lost, the shape and function of their artificial replacements must be determined by the muscles, if they are to be successful. Prosthodontic treatment is influenced by this concept. The lower denture commonly presents the most difficulties with pain and looseness being the most common complaint. This is because mandible atrophies at a greater rate than maxilla and has less residual support for retention and support. With the increase in resorption rate, the influence of impression surface on denture retention and stability decreases. Stability and retention becomes more dependent on correct position of teeth and the contour of external or polished surface of the dentures. Therefore these surfaces should be so contoured that horizontally directed forces applied by perioral muscles should act to seat the denture in the well balanced muscular zone. Neutral zone technique is most effective way for patients who have unstable and unretentive dentures (Sharad Vaidya et al., 2015)

1.9.2.5.2 Indications (Sharad Vaidya et al., 2015)

In general, neutral zone technique is indicated when stability and patient's acceptance of lower complete denture are in question. This technique is found to be used in the following clinical situations:

1-Severely atrophic mandibular ridge

2-Patients with prominent and highly attached mentalis muscle, lateral spreading of tongue as a result of poor transition from dentate to edentulous state and severe resorption.

3-Patients with diminished neuromuscular control such as those with a history of stroke, Parkinson's disease or patients with impaired motor innervation to oral and facial muscle

4-Patients with atypical shape or consistency of oral and perioral structures. Patients with scleroderma or patients who have undergone marginal or segmental mandibulectomy are also candidates for this technique.

5-This technique can be used to locate optimal position for implants in cases of implant-supported or retained over dentures, which enhances the overall outcome of treatment.

1.9.2.5.3 Neutral zone and denture stability

The dentist generally is only concerned with transmitting the vertical forces through the occlusal surfaces of the teeth and which is later neutralized by the ridges. Horizontal forces exerted on the external surfaces of the dentures are usually ignored. Fish has described that denture has three surfaces, with each surface playing an independent and important role in stability and comfort of the denture. The two surfaces are the impression and the occlusal surfaces of the denture. The third surface "the polished surface" which is the rest of the denture that is not part of the other two surfaces. The polished surface of the denture is in contact with the cheeks, lips, and tongue. **(Gibi Babu Philip et al.,2013)**

When there is excess bone resorption, the denture base area is smaller and so is the impression surface due to which the stability and retention of the denture base is compromised. As the area of the impression surface decreases and the polished surface area increases, the position of the teeth becomes more critical. In other words, we can say

that when more of the alveolar ridge is lost, denture stability and retention are more dependent on correct position of the teeth and contour of the external surfaces of the dentures. The forces exerted on the external surfaces of the teeth and the polished surfaces are usually horizontal. When the occlusal surfaces of the teeth are not in occlusion, the stability of the denture is due to the fit of the impression surface and amount of forces transmitted through the polished surfaces. In order to construct a dentures which function properly in chewing, swallowing, speaking etc, we must develop proper tooth position and also the fit and contour of the polished surfaces .

(Gibi Babu Philip et al.,2013)

The palatal surface of the upper denture looks inward and downward while the lingual surface of the lower denture looks inward and upward. The flanges of lower dentures should extend under the fold of the buccinator muscle and under the tongue to act as ' handles ' to hold the denture in place . The lower denture must be narrow in the bicuspid region (the region of modulus function to avoid being lifted up) by the corners of the mouth , and the posterior teeth must not encroach on the tongue posteriorly. so that all of the forces exerted are neutralized and the denture maintains a state of equilibrium Antagonistic activity of muscles can be used to advantage in

stabilizing dentures ; e.g. , if the right side of the tongue and the right buccinator muscle are pressed against the denture at the same time , the opposite directed forces will hold the denture in place . A similar action of antagonistic muscle groups between the functioning genioglossus and orbicularis oris muscles will fix a lower denture by opposing forces on its anterior section. **(srivatsava V,2012)**

1.9.2.5.4 The advantages of neutral zone technique :

- (1) Improved stability and retention .
- (2) Posterior teeth will be correctly positioned allowing sufficient tongue space .
- (3) Reduced food trapping adjacent to the molar teeth .
- (4) Good esthetics due to facial support . **(shaista Z,2005)**

1.9.2.5.5 The Disadvantages of Neutral Zone Technique :

- 1- This may be mainly attributed to a lack of knowledge and experience of clinicians to this technique.
- 2- The complex procedures not only increase chair time and laboratory cost but also prohibit their clinical use**(shaista Z,2005)**

Technique

- The primary impressions of maxillary and mandibular denture bearing area were made with reversible hydrocolloid impression material maxillary and mandibular impressions were poured in plaster of paris and primary casts were obtained.
- The custom trays were fabricated with self-cure resin over the primary casts keeping borders 2mm short of the sulcus after applying the separating media.
- The muscle trimming was achieved with green stick impression compound and the secondary impressions were made with zinc oxide eugenol impression material and master casts were poured in dental stone . **(Garima et al. ,2020)**

▪Maxillary wax rim and a mandibular base plate were constructed on the master cast. A base plate of acrylic without handle, with spurs or fins made with 26 gauge wire attached in anterior and in molar region protruding upwards towards the upper arch was made in mandible .cast. These spurs help in the retention of the low fusing compound. The lower base plate with the softened impression compound in a 650 C water bath was placed in the patient's mouth; this plate was very carefully adjusted in the mouth to ensure that it was not overextended and remained stable during opening, swallowing, and speaking. The patient was then asked to talk, swallow, drink some water, etc. The intrinsic and extrinsic muscle groups were brought into play, moving them along their respective paths of action. In doing so, reciprocating pressures have been exerted upon the compound, which had gradually molded impression compound into a state of neutral balance and become centrally inert in relation to all of the complex forces acting upon it. **(Garima et al. ,2020)**

▪The neutral zone impression so obtained was placed on master cast, master cast was covered with separating medium on buccal and lingual side & plaster index around the impression on both the labial and lingual sides were made. The index contained three notches: one in the anterior regions and two in the posterior regions for easy index removal . **(Garima et al. ,2020)**

The compound occlusal rim was then removed from the base plate and melted modelling wax was poured into that index space .Final vertical jaw relation recorded. The maxillary and the mandibular rims were fused at the centric relation. The occlusal rims were articulated in a mean value articulator.Teeth were arranged exactly following the POP index. **(Garima et al. ,2020)**

▪The position of the teeth was checked by placing the index together around the wax try-in.Once the waxed up dentures were ready, they were checked in the patient's mouth for esthetics, phonetics and occlusion.After try in was carried out satisfactorily, the dentures were fabricated, finished and inserted in patient's mouth . **(Garima et al. ,2020)**

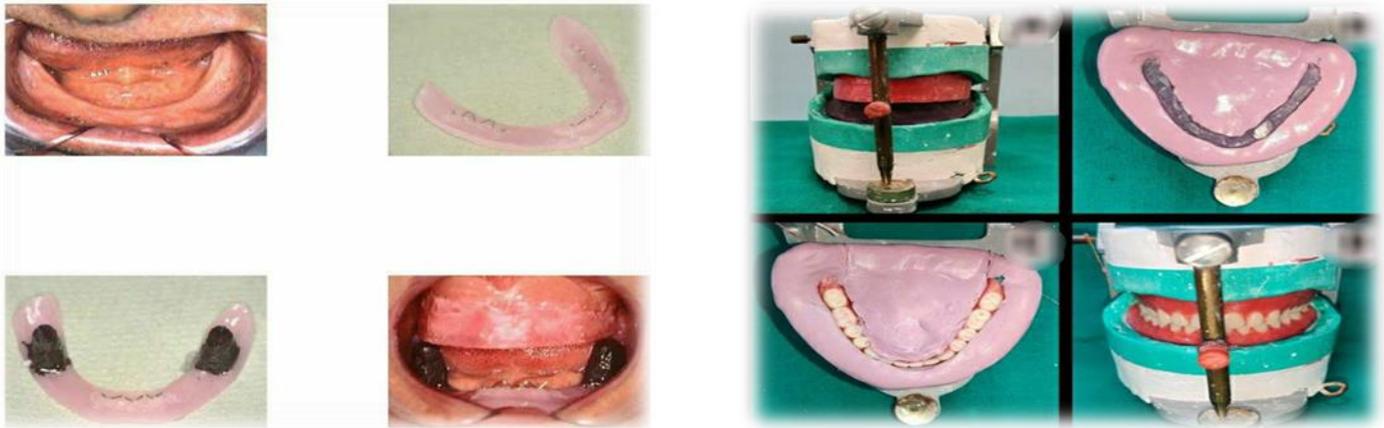


Figure 13 Neutral zone impression technique . (Garima et al. ,2020)

1.9.3 Surgery

1.9.3.1 Reduction of genial tubercle

Genial tubercles are the bony projections located on the lingual aspect of the mandible, two on either side of the midline, which gives attachment to the genial muscles. The two genial tubercles located superiorly are more prominent than the inferior ones due to the gross resorption of the mandibular ridge. This may elevate the ridge lingually, giving a shelf-like appearance and making the anterior lingual seal impossible. Genial tubercles are exposed by blunt dissection. Using bur, chisel, or rongeurs, the tubercle is removed, and the rough bony margins are smoothed using file. (Sahil Choudhari et al.,2018)



figure 1.14:surgical procedure of reduction genial tubercle(Andrew M. Henry et al.,2019)

1.9.3.2 Mylohyoid Ridge Reduction

In cases of extensive resorption , the ridge becomes prominent and creates hurdle for the smooth placement of denture hence , the need for ridge reduction occurs . The denture flanges impinge on the sharp mylohyoid ridge and patient experiences pain and discomfort . **(Sruti et al , 2022)**

Procedure:- After successful nerve block , the incision is carried out along the crest of the ridge in the posterior mandible area followed by subperiosteal dissection and exposure of the mylohyoid ridge and the attached muscle . The muscle is detached and relieved . The residual ridge is smoothed with file , flap returned , and closed with sutures. **(Bobby John,2021)**

1.9.3.3 Vestibuloplasty (Sahil Choudhari et al.,2018)

Vestibuloplasty should be performed in case of the shallow vestibule to widen denture-bearing area. There are different techniques of vestibuloplasty. Most of them provide access from the buccal aspect of the mandible

A) Kazanjian Vestibuloplasty

A mucosal flap pedicled from the alveolar ridge is elevated from the underlying tissue and sutured to the depth of the vestibule. The inner portion of the lip is allowed to heal by secondary epithelialization.

B) Clark Vestibuloplasty

Clark's vestibuloplasty technique uses mucosa pedicled from the lip. Horizontal incision is performed from canine to canine between immobile gingiva and mobile gingiva. After suprapariosteal dissection the mucosa is sutured at the depth of the vestibule. The denuded periosteum heals by secondary epithelialization. It is possible to use tissue graft on exposed periosteum. The healing process is more rapid in this situation.

C) Corn Vestibuloplasty

This vestibuloplasty is similar to Clark's vestibuloplasty. Difference: Horizontal incision is through soft tissue/mucosa and periosteum/to the mucoperiosteal flap is dissected, and the bone is exposed.

Disadvantages: More painful procedure; The healing process is longer.

D) Obwegeser Vestibuloplasty

Vestibuloplasty described by Obwegeser is the method in which labial extension procedure and Trauner's procedure provide a maximal vestibular extension to both the buccal and lingual aspects of the mandible

1.9.3.4 Alveoloplasty

is one of the most common preprosthodontic surgical procedures done in dental practice. The aim of the prosthetic surgery is to improve the quality and condition of the hard and soft tissues of the oral supporting structures. So, that they have better retention, stability and support to the dental prosthesis .The bony prominences are removed by means of alveolo-plasty and alveolectomy. "Alveoloplasty" is the term used to de-cribe the trimming and removal of the labial buccal alveolar along with some internal and interradicular bone and is carried out at the time of extraction and after the extraction of the teeth. When surgery is planned on edentulous ridge, incision should be made on the crest of the alveolar ridge; usually the envelope flap would surface, but releasing incision can be made on the labial side to provide a broad base to the flap(**Amanthi Ganapathi et al.,2021**)

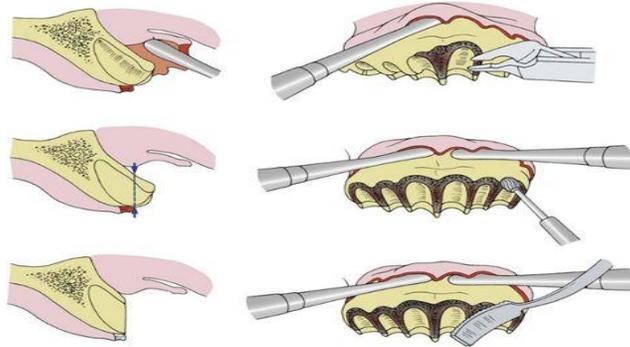


Figure 1.15:surgical procdure of Alveoloplasty (**Michael S. Block DMD ,2015**)

1.9.3.5 Ridge Augmentation

A) Inferior Border Augmentation

The resorption of the mandible has been so extensive that it results in the severely atrophic condition and liable for a pathological fracture. In such a case, augmentation has to be achieved in the inferior border. Access to the lower border is gained by different ways by different authors. **(P.R Verma et al.,2014)**

-Some literature supports the use of incision used in the neck dissection, viz. a supraclavicular incision. It extends from the anterior border of sternocleidomastoid to the opposite counterpart.

-According to Sanders a continuous submandibular incision from angle to angle is sufficient.

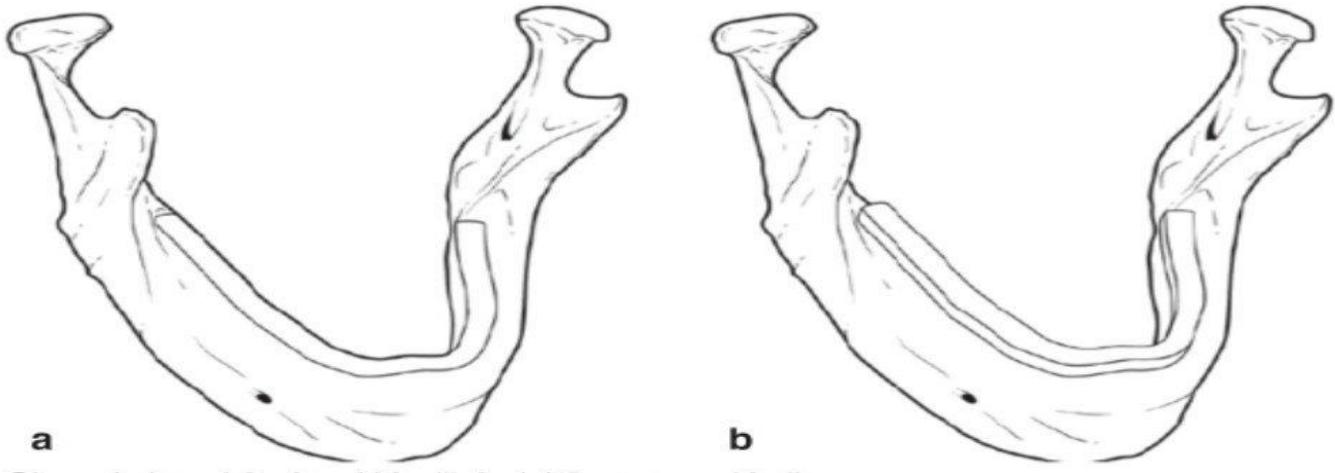
-Ridley and Mason proposed the use of three small submandibular incisions connected by subperiosteal tunnels.

Dissection is carried out to expose the inferior border of mandible. Two ribs of 15 to 20cm long are harvested and bent to adapt the shape. Three or four transosseous holes are drilled in the lower border of mandible and wires are passed through these holes. One rib is placed against the lingual aspect and the other abutted against the buccal aspect. The space between the ribs is packed with available cortical chips. Ribs are secured in place by interosseous wires in circumferential pattern. Closure is achieved in layers and pressure dressing is applied. **(P.R Verma et al.,2014)**

B) Superior Border Augmentation

The superior border enhancement is needed in cases where the resorption is so severe that the height of the mandible is insufficient to accommodate the prosthesis or in cases where the patient suffers from pain during mastication, secondary to the pressure on the mental neurovascular bundle. **(P.R Verma et al.,2014)**

_Recipient site is prepared and the mucosa is infiltrated with local anaesthetic solution. Crestal incision from the retromolar area to the opposite retromolar area is made and mucoperiosteal flap is raised. Care to be taken to avoid the mental nerve if it is near the superior border. The existing superior border is exposed and prepared to receive the graft(ridge augmentation, which uses two rib grafts of 15cm) **(. Goudarzi et al , 2023)**



1.16 Superior Border Augmentation **(P.R Verma et al.,2014)**

1.9.4 Overdenture

is a complete or removable partial denture that covers and rests on one or more remaining natural teeth, the root of natural teeth, or dental implants. Overdentures offer many advantages over conventional complete dentures. The most important benefits are preservation of the remaining alveolar supporting bone along with increased stability and retention of the prosthesis (**P.R Verma et al.,2014**)

Overdentures can be classified into:

- Tooth supported over denture
- 2- Implant supported overdenture

A)Tooth supported over denture: a complete or PRD supported by retained roots that is intended to provide improved support, stability, &tactile &proprioceptive sensation &to reduce ridge resorption (**P.R Verma et al.,2014**)

B)Implant supported overdenture

Edentulous patients often experience problems with their mandibular complete dentures. Patients with the resorbed mandibular ridge often complain of lack of stability and retention of the mandibular denture, together with a decreased chewing ability. Insertion of implants creates more favorable environment for the restoration in such patients. Implant-supported prostheses options for an edentulous arch include -implant-supported fixed prosthesis -implant-supported removable prosthesis. (**Kuntal S Kadam et al.,2017**)

While implant-supported fixed prosthesis offers many advantages like being esthetically pleasing and feels being actually like natural dentition, they are very expensive and not indicated in many conditions. Implant- supported removable prosthesis offers certain advantages over implant-supported fixed restoration. Many patients are satisfied with a stable implant-supported overdenture that requires limited clinical time and financial expense (**Kuntal S Kadam et al.,2017**)

The treatment was divided into three phases:

- (1) diagnostic denture fabrication,
- (2) implant placement
- (3) final prosthesis fabrication

Diagnostic denture

was fabricated using conventional steps for denture fabrication. It was used to analyze the space available for overdenture attachment and fabrication of radiographic stent, which was later to be used as a surgical stent (**Kuntal S Kadam et al.,2017**)



figure 1.17: Surgical stent placed intraorally
(Kuntal S Kadam et al.,2017)

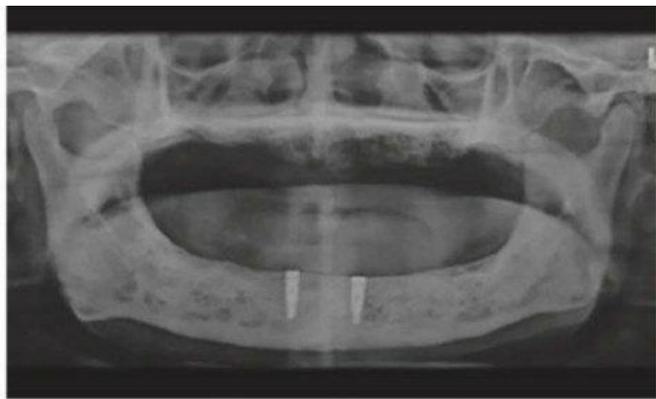


figure 1.18: OPG after healing
(Kuntal S Kadam et al.,2017)

Implant placement

After CBCT analysis was done. Two implants of 4.2×10 mm were placed. Stage II surgery was carried out after 3 months with radiographic and clinical evidence of healing .Healing abutments were placed. After soft tissue healing prefabricated single ball abutments were attached . **(Kuntal S Kadam et al.,2017)**



figure 1.19:Solitary ball attachment incorporated **(Kuntal S Kadam et al.,2017)**

Final prosthesis fabrication

Two weeks after placement of healing abutments, primary impression was made using irreversible hydrocolloid impression material. Maxillary final impression was made using conventional technique. For mandibular final impression, custom tray was fabricated and window was created for splinted open tray pickup/direct impression of implants. Border molding was completed. Then, open try impression copings were placed over implants. Low-viscosity polyvinyl siloxane was loaded in the tray. Impression copings were splinted using self-cure acrylic resin. After complete polymerization, the copings were loosened and tray was removed . Definitive casts were made. Autopolymerizing acrylic resin was used to fabricate denture bases over the definitive cast. Using face bow record, upper cast was mounted and then centric relation was recorded. Bilateral balanced occlusion scheme was used for teeth arrangement. Try-in was done. Retentive metal housings were incorporated by an indirect method. **(Kuntal S Kadam et al.,2017)**

For this, after dewaxing, ball abutment analogs were attached to the cast. Metal housing with retentive rings were placed over analogs and denture was processed. Denture finishing and polishing were done in a conventional manner. The prosthesis was delivered and patient was instructed about the aftercare and recall schedule **(Kuntal S Kadam et al.,2017)**



Figure 1.20 final impression **(Kuntal S Kadam et al.,2017)**



figure 1.21: Intaglio surface of processed denture showing incorporated stainless steel housings with white retentive clasp**(Kuntal S Kadam et al.,2017)**

CHAPTER TWO

Conclusion

Conclusion

1-Residual ridge resorption is a chronic, progressive, irreversible, and disabling disease , of multifactorial origin. Much is known about its pathology and pathophysiology, but a lot remains to know about its pathogenesis, epidemiology and etiology . Residual ridge resorption (RRR) is a continuous, often lifelong, alveolar bone resorption occurring after tooth loss. Losing teeth in adult is the result of injury or disease, such as dental avulsion, tooth decay, and periodontal disease.

2-The factors affecting ridge resorption play a very vital role in the treatment planning of the patients with long standing edentulism.

3-Mandible is more affected with RRR as compared to maxilla.

4-RRR requires a multiple approach for diagnosis and treatment planning. The cause must be detected, by the aid of a physician, and then eliminated or stabilized before dentures are constructed. Construction of a stable functioning denture and a regular follow up treatment can help in the restoration of function, and thus, the restoration of the physical and mental vitality of the patient.

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