

# A Case Series of Neutral Zone Recording in Prosthetic Rehabilitation of Mandibular Residual Ridge Height Defect

**Bolanle Oyeyemi AKINBOBOYE\***, **Somtochukwu Pascal OZOEMENA\*\***, **Ifemasokaolise Victoria OJOGBO \*\*\***, **Toluwanimi OLA-ADISA\***, **Abdul-kabir Adegoke YAHYA-IMAM\*\***.

*\*Department of Restorative Dentistry Department, Lagos University Teaching Hospital; \*\*Department of Oral and Maxillofacial Surgery, Lagos University Teaching Hospital; \*\*\*Department of Child Dental Health, Lagos University Teaching Hospital]*

## Correspondence

**Dr BO Akinboboye**

*Department of Restorative Dentistry, Lagos University Teaching Hospital, Lagos state*

*Email: [bakinboboye@unilag.edu.ng](mailto:bakinboboye@unilag.edu.ng)*

## ABSTRACT

**Background:** The neutral zone recording is commonly utilized in severely resorbed ridges that pose challenges to prosthetic retention and stability due to a lack of alveolar ridge height and width. Prosthetic rehabilitation of mandibular defects that lack residual ridge height is equally challenging and requires careful planning and fabrication of prosthesis that will be stable, retentive, and functional.

**Objective:** To utilize neutral zone recordings impression in construction of prosthesis for the rehabilitation cases with mandibular residual ridge defects and evaluate outcomes

**Case Series:** This case series involved four female patients aged 52, 28, 26 and 26 years respectively, who complained of poor appearance, inability to masticate and speak effectively, and requested prosthetic rehabilitation following a surgical treatment for ameloblastoma. All the cases were reconstructed after the surgical intervention without any form of prosthesis. Case 1 had a segmental mandibular resection; case 2 had partial mandibulectomy; case 3 had a subtotal mandibulectomy and alveolar bone grafting while case 4 had subtotal mandibulectomy.

**Conclusion:** The use of neutral zone recording impressions in plate reconstructed mandibular defects, improved prosthesis retention and stability and gave a satisfactory outcome

**Keywords:** Neutral zone, Prosthetic, Rehabilitation, Defect

**Bolanle O. Akinboboye**

<https://orcid.org/0000-0001-5779-4567>

**Somtochukwu P. Ozoemena**

<https://orcid.org/0000-0001-5005-7150>

**Ifemasokaolise V Ojogbo**

<https://orcid.org/0009-0001-0185-8979>

**Toluwanimi Ola-Adisa**

<https://orcid.org/0009-0009-5654-1379>

**Abdul-kabir A. Yahya-Imam**

<https://orcid.org/0009-0004-9546-6555>

*Received: 4-March, 2024*

*Revision: 18 June, 2024*

*Accepted: 21 June, 2024*

**Citation:** Akinboboye BO, Ozoemena SP, Ojogbo I, Ola-Adisa T, Imam AY. A case series of neutral zone recording in prosthetic rehabilitation of mandibular residual ridge height defect. *Nig J Dent Res* 2024; 9(2):71-79.

<https://dx.doi.org/10.4314/njdr.v9i2.4>

## INTRODUCTION

Prosthetic rehabilitation is one of the treatment options in facial reconstruction after surgical resection of head and neck tumors.<sup>1</sup> Surgical resections create defects that pose prosthetic retentive challenges. These defects may require surgical reconstruction. They may also require a combination of surgical and prosthetic reconstruction. These treatments help to create symmetry and harmony with surrounding natural tissue.<sup>2,3,4</sup> The goals of prosthetic rehabilitation include restoration of mastication, speech, facial contour, aesthetics and the maintenance of the integrity of surrounding natural tissue.<sup>5</sup> To be able to achieve these prosthetic goals, usually there is a need for adequate residual ridge height and width to ensure stability. This is especially true in the mandibular arch which has less denture bearing area compared with the maxillary arch.<sup>6</sup> The lack of residual ridge height or width may require the placement of prostheses with artificial teeth in the neutral zone. This will aid in maintaining the stability of the prosthesis. The neutral zone is the area of minimal conflict between forces acting from buccal and lingual directions that may destabilize the denture. The prosthesis is in harmony with neuromuscular function within the neutral zone. This harmony enables the production of retentive and stabilizing forces on the prosthesis by the tissues.<sup>6</sup> Placing prostheses in the neutral zone is an option where implant retention is unavailable. Implant-retained prostheses that employ the use of the bars, balls and Locator R-Tx fixtures are very effective,<sup>7</sup> but their use may be contraindicated by a lack of residual alveolar bone or financial considerations.<sup>6</sup> There are different classifications<sup>8-11</sup> of mandibular defects after ablative surgery but none is universally accepted.<sup>11</sup> Boyd's classification considers function, aesthetics; and, difficulty in restoration of form and

function. This classification was used in reporting the managed cases.<sup>12</sup> The classification is based on three upper-case and three lower-case characters: H, C, L and o, m, s. H defects are lateral defects of any length, including the condyle but not significantly crossing the midline; L defects are the same only without the condyle; C defects consist of the entire central segment containing the four incisors and the two canines. Combinations of these letters are possible (an angle-to-angle defect, for example, is represented as LCL). Thus, H and L defects may reach or even extend slightly beyond the midline but are not referred to as LC or HC unless they contain the entire central segment. The letters o (neither a skin nor a mucosal component), s (skin), m (mucosa), and s m (skin plus mucosa) are added to denote the epithelial requirement.

This report demonstrates the challenge of rehabilitating mandibular defects with absent residual ridges reconstructed with surgical plates. The placement of prostheses in the neutral zones in these individuals is reported. The outcomes of these treatments are also elucidated.

## CASE SERIES

### Case 1

A healthy looking but slightly withdrawn 52-year-old female trader, presented to the Prosthodontic Unit of the Lagos University Teaching Hospital for prosthetic replacement of her missing mandibular teeth. Her complaint was the inability to masticate and speak effectively, as well as her poor appearance. She also exhibited low self-esteem and an overall reduction in quality of life. She had a history of segmental mandibular resection involving the bilateral body and the anterior segment extending from the right to the left mandibular angle with total loss of all the mandibular teeth. The defect of about 4 years was reconstructed

only with a 2.4 adaption titanium plate (without any bone graft). The patient had never used any dental prosthesis since surgical intervention. There was obvious facial asymmetry with a mild deviation of the lower face to the right, reduced lower facial height, wrinkled mento-labial fold with sunken cheeks and absence of mental protuberance. There were no significant temporomandibular joint abnormalities. Intraorally, oral soft tissue appeared clinically healthy with complete loss of alveolar ridge. The floor of the mouth, labial and buccal sulcus appeared clinically healthy with the tongue freely mobile. There was no ridge height or width at the anterior mandibular area. However, there was about 3mm sulcus depth posteriorly at the area of the second molar to the retromolar pad region bilaterally. A diagnosis of LCL mandibular defect<sup>12</sup> was made. A lower complete denture fabrication was planned for the patient.



Pre-op extra oral view



Pre-op intraoral view



Radiographic view

### Prosthetic Treatment

Primary impressions of the upper and lower jaws were made with alginate impression material. These impressions were poured into gypsum. Close-fitting special trays were fabricated on the mandibular casts with a peripheral clearance of 2mm. The special tray was border moulded utilizing greenstick impression compound and zinc-oxide-eugenol paste. A secondary impression was then obtained with the tray.

The neutral zone impression was obtained with the use of orthodontic wire pillars attached to the polished surface of the special tray. These wire pillars also acted as stops to prevent alterations to the estimated vertical dimension. A softened impression compound was placed around these pillars and tempered. The tray was then placed in the patient's mouth and the patient was instructed to carry out functional movements including the pronunciation of "ah" and "oh".

The laboratory fabricated bite-blocks around the neutral zone impression. Jaw relations records were obtained using the bite-blocks. The rest vertical dimension was 62mm and the occlusal vertical dimension was set at 60mm with a freeway space of 2mm. The lingual flange of the record block was extended to the floor of the mouth to allow the tongue to rest on the extension, enhancing retention and stability. The midline, canine line, and smile line were marked on the record block. Occlusal registration was done using a wax wafer and the lower record block apposed with the upper cast. The assembly was transferred to the laboratory with a request to fabricate a trial complete denture with non-anatomic teeth and the development of neurocentric occlusion. The try-in was done satisfactorily in conjunction with the patient. The lower complete denture was fabricated and fitted and post-operative instructions were given.

At one-week post-insertion review, the patient complained of speech affectation, which was subsequently reported to be gradually improving. There was a complaint of hypersalivation for the first 5 days. She, however, noted her ability to masticate on soft food and an improved overall quality of life.

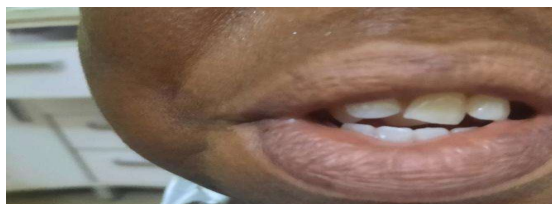
On examination, denture retention was satisfactory, there was no area of ulceration or trauma around the denture-bearing area. The patient was referred to the orthodontics department for review and management of the severe crowding in the maxillary arch with a plan to adjust the complete denture to accommodate new occlusion post orthodontic treatment.



Bite Registration with record block



Patient wearing a lower prosthesis



Front view with prosthesis

### Case 2 (PH)

A 28-year-old female customer care personnel presented in the prosthodontic unit with a 1-year history of partial mandibulectomy as a treatment of ameloblastoma. She complained

of an inability to chew well, disturbance of speech and poor appearance. On examination, there was presence of facial asymmetry with a flattened appearance of the left cheek. Intraoral examination revealed a left mandibular defect extending from the distal surface of the lower left canine (33) to the mesial surface of the lower left third molar (38). The oral soft tissue, the floor of the mouth, as well as the labial and buccal sulcus, appeared clinically healthy except at the left mandibular defect where there was no ridge height or width. There was slight TMJ pain on opening the mouth. The patient was referred to oral and maxillofacial surgery on this account. Symptoms were relieved over a month. The orthopantomogram revealed reconstruction with only a 2.4mm titanium reconstruction plate.



Radiographic view

A treatment plan was made to fabricate a removable mandibular prosthesis to replace the missing teeth 34,35,36,37 in an L Mandibular defect<sup>12</sup>. A "C" Clasp was planned to engage the lower left canine (33) and Adam's clasp around the lower left 8 (38) during the design. Impression was made, as well as a secondary impression, neutral zone impression, bite registration, try-in, and fitting of prostheses. The patient came for a recall visit 1 week, 6 weeks, 1 month and 6 months.

On the first recall visit, she complained of pressure on abutment teeth and pain when chewing. Adjustment was done by adjusting Adams clasp and checking occlusion, there was

slight premature contact that was removed. Post-operative instructions were re-emphasized. The patient was satisfied with chewing and appearance.



Pre-operative Intraoral Picture



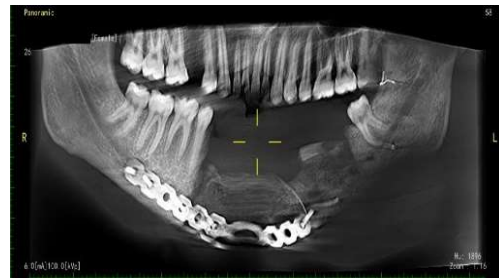
The patient wearing a lower prosthesis

### Case 3 (I.V)

A 26-year-old female student presented to the prosthodontic unit requesting rehabilitation of a mandibular defect of 6-month duration. The defect was said to have followed surgical excision of ameloblastoma. She complained of an inability to chew and a poor appearance. The patient had a subtotal mandibulectomy and alveolar bone grafting but on examination and review with an orthopantomogram, it was observed that the mandibular defect extended from the body of the mandible at the area of 46 extending to 37. There was the presence of a 2.4 adaption titanium reconstruction plate within the mandibular defect extending from the distal root of 47 to the distal root of 38 with the absence of alveolar bone.

There was obvious facial asymmetry with mild deviation of the lower jaw to the left side, reduced lower facial height, wrinkled mento-labial fold with collapsed cheeks and absence of mental protuberance. There were no temporomandibular joint abnormalities. Intraorally, there was adequate mouth opening and oral soft tissue appeared clinically healthy

with partial loss of alveolar ridge in the region of the mandibular defect. The lower labial frenum was continuous with the floor of the mouth. There was no ridge height or width at the area extending from the lower right second premolar to the lower left third molar. A diagnosis of LC<sup>12</sup> mandibular defect secondary to surgical excision of ameloblastoma was made. The treatment plan was to fabricate a removable partial mandibular prosthesis to rehabilitate the defect.



Radiographic view



Intraoral view



Secondary impression



Neutral zone impression



Record block for occlusal registration



Trial mandibular prosthesis



Patient wearing mandibular prosthesis

#### Case 4 (G.F)

A 26-year-old female skin therapist presented at the prosthodontic unit of the teaching hospital requesting for prosthodontic rehabilitation following surgical removal of Ameloblastoma of 8 months duration. She complained of an inability to chew well and poor aesthetics. She had previously visited the dental clinic for splinting and root canal therapy of avulsed central incisors. She is a known Peptic ulcer disease patient.

There was the presence of facial asymmetry with a deviation of the lower jaw to the right, reduced lower facial height, wrinkled mento-labial fold with collapsed cheeks and absence of mental protuberance. There was an absence of any TMJ pathology with adequate mouth opening. Intra-oral soft tissue appeared clinically healthy with partial loss of alveolar

ridge extending from the lower right third molar to the lower left second premolar. The floor of the mouth, labial and buccal sulci appeared clinically healthy. The tongue was freely mobile. However, there was no residual ridge height or width from the distal border of 48 to the distal border of 36.

The Orthopantomogram showed reconstruction with a 2.4 adaption titanium plate in the lower jaw bone extending from a distal border of 48 to a distal border root of 36 with an absence of alveolar bone.

A diagnosis of LC mandibular defect<sup>12</sup> secondary to surgical excision of ameloblastoma (missing 47,46,45,43,42,41,31,32,33) and with absence of alveolar ridge was made with a plan to rehabilitate with mandibular prosthesis. Rehabilitation was accomplished with identical methods to the first two reported cases.



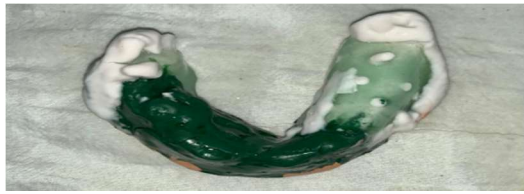
Pre-operative Intra oral view



Radiographic view



Secondary impression



Neutral zone impression



Patient wearing prosthesis

## DISCUSSION

The different cases highlighted in this report are those of different classes of mandibular defects. However, the different cases share similar characteristics of reconstruction with RECON PLATE® with the absence of residual alveolar bone.

The denture-bearing area influences denture retention and stability.<sup>13</sup> Denture retention and stability are indicators of masticatory efficiency and quality of life, especially in the mandibular arch.<sup>14</sup> There are other challenges associated with mandibular defects depending on the size and location. The prosthodontic rehabilitation of anterior mandibular defects is more difficult than posterior defects. This is a result of muscle attachment of the genioglossus and geniohyoid muscles resulting in hindrance of tongue control, limitation of tongue mobility, compromise of speech, swallowing, mastication and the ability to control a removable prosthesis.<sup>15</sup> There is also a challenge of residual alveolar ridge height and width loss resulting in reduced stability and support of prostheses.<sup>15,16</sup> In the cases highlighted, especially Case 1, there was the presence of mandibular defect involving the anterior segment except in Case 2 which only involved the mandibular premolar and molar region. There was a challenge of

hindrance in tongue control, limitation of tongue mobility, and compromise of speech, swallowing, and mastication in most of the patients (especially in case 1). This challenge was encountered as a result of the mandibular defect extending to the anterior region. The prosthodontic challenge of retention, poor support and lack of stability in these cases required the use of neutral zone impressions to capture the zones of least conflict.<sup>6</sup>

All these cases will need the development of an occlusal scheme that also improves stability and retention, especially in an edentulous arch as reported in previous reports.<sup>17</sup> Mandibular defects using local and pedicle flaps were not used in all reported cases as these had disadvantages of poor prosthetic bearing surface, impinging space needed for dentition and these would have displaced prostheses as the flaps would have been sutured to movable tissues.<sup>18</sup>

There has been different techniques for rehabilitating mandibular defect<sup>3</sup> and those with resorbed ridge.<sup>5,19</sup> This report highlights the use of neutral zone impression technique and careful development of occlusion in managing mandibular defects without residual ridge.

The neutral zone impression technique was used in the dental prostheses fabrication of different cases of mandibular defect with total loss of alveolar ridge.<sup>20</sup> There are various reported methods of recording the neutral zone such as using impression compound as an occlusal rim,<sup>21</sup> using maxillary wax rim at the selected vertical dimension,<sup>22</sup> refining polished surface of trial wax denture with impression material or relining the polished surface of the fitted denture by making a functional impression.<sup>23</sup> In this case series, the method of using impression compound as an occlusal rim to determine the neutral zone was used. It was a practical, easier method and the outcome resulted in improved retention and stability as reported in earlier study.<sup>24</sup> This impression technique improved retention and stability of all

dental prostheses fabricated in these reported cases, especially the anterior mandibular defect, thereby making the prostheses functional and ensuring prosthetic success coupled with careful development of occlusion. Non-anatomic posterior teeth were used to reduce horizontal forces and stress. The occlusion was also developed to minimize occlusal load directed at the basal seat of the dentures to improve retention, stability and function for patients.<sup>25</sup>

### CONCLUSION

The use of neutral zone recording impressions in plate reconstructed mandibular defects, improved prosthesis retention and stability and gave a satisfactory outcome. Employment of the neutral zone impression technique resulted in patients receiving functional prostheses that may have been very difficult to otherwise provide. This impression technique may be considered as a treatment option where supported prostheses are either unavailable or impracticable in post-mandibulectomy patients.

### Sources of support

Nil

### Conflict of interest

None declared

### REFERENCES

1. Lemon JC, Kiat -Amnuay S, Gettleman L, et al. Facial prosthetic rehabilitation: preprosthetic surgical techniques and biomaterials. *Curr Opin Otolaryngol. Head Neck Surg.* 2005; 13:255-62.
2. Roumanas ED, Freymiller EG, Chang TL, Aghaloo T, Beumer J 3rd. Implant-retained prostheses for facial defects: an up to 14-year follow-up report on the survival rates of implants at UCLA. *Int J Prosthodont.* 2002; 15(4):325-32. PMID: 12170845
3. Guttal SS, Patil NP, Shetye AD. Prosthetic rehabilitation of a midfacial defect resulting from lethal midline granuloma- a clinical report. *J Oral Rehabil.* 2006; 33(11):863-7. doi:

- 10.1111/j.1365-2842.2006.01616.x. PMID: 17002746.
4. Huband M. Prosthetic rehabilitation. *Dermatol Clin.* 2011; 29:325-30, x. doi: 10.1016/j.det.2011.01.006. PMID: 21421156.
5. Gupta KL, Agarwal S. Salvation of a severely resorbed mandibular ridge with a neutral zone technique. *Indian J Dent Res.* 2011; 22:883. doi: 10.4103/0970-9290.94699. PMID: 22484902.
6. Cagna DR, Massad JJ, Schiesser FJ. The neutral zone revisited: from historical concepts to modern application. *J Prosthet Dent.* 2009; 101:405-12. doi: 10.1016/S0022-3913(09)60087-1. PMID: 19463668.
7. Uludag B. Fabrication of a fractured mandibular bar-retained implant overdenture without implant-level impression making: a clinical report. *J Prosthodont.* 2012; 21(8):622-5.
8. Davis D J, Tan E, Katsaros J, Sheen R. Mandibular reconstruction with vascularized iliac crest: a 10-year experience. *Plast Reconstr Surg.* 1988;82:792-803
9. Hashikawa K, Yokoo S, Tahara S. Novel Classification system for oncological mandibular defect: CAT Classification. *Jpn J Head Neck Cancer.* 2008;34: 412-18
10. Iizuka T, Häffliger J, Seto I, Rahel A, Mericske-Stern R, Smolka K. Oral rehabilitation after mandibular reconstruction using an osteocutaneous fibula free flap with endosseous implants. Factors affecting the functional outcome in patients with oral cancer. *Clin Oral Implants Res.* 2005;16: 69-79
11. Brown JS, Barry C, Ho M, Shaw R. A new classification for mandibular defects after oncological resection. *Lancet Oncol.* 2016;17:e23-30. doi: 10.1016/S1470-2045(15)00310-1. Epub 2015 Dec 23. PMID: 26758757.
12. Boyd JB, Gullane PJ, Rotstein LE, Brown DH, Irish JC. Classification of mandibular defects. *Plast Reconstr Surg.* 1993; 92:1266-75. PMID: 8248401.
13. Xia Y, Ma C, Chen J, Witter DJ, Zhang Q, Creugers NHJ. Mandibular residual ridge morphology in relation to complete dentures and implant overdentures-Part I: Predictors for perceived conventional denture stability. *Clin*



Implant Dent Relat Res. 2021; 23:131-139. doi: 10.1111/cid.12976. Epub 2021 Feb 16. PMID: 33592676.

14. Limpuangthip N, Somkotra T, Arksornnukit M. Modified retention and stability criteria for complete denture wearers: A risk assessment tool for impaired masticatory ability and oral health-related quality of life. *J Prosthet Dent.* 2018; 120(1):43-49. doi: 10.1016/j.prosdent.2017.09.010. Epub 2017 Nov 29. PMID: 29195820.

15. Taylor DT. Diagnostic considerations for prosthodontics rehabilitation of the mandibulectomy patient. In: Taylor TD, editor. *Clinical Maxillofacial Prosthetics*. Illinois: Quintessence Publishing Co Inc; 2000. pp. 155–70.

16. Oelgiesser D, Levin L, Barak S, Schwartz-Arad D. Rehabilitation of an irradiated mandible after mandibular resection using implant/tooth-supported fixed prosthesis: A clinical report. *J Prosthet Dent.* 2004; 91:310–4.

17. Goldstein G, Kapadia Y, Campbell S. Complete Denture Occlusion: Best Evidence Consensus Statement. *J Prosthodont.* 2021; 30:72-77. doi: 10.1111/jopr.13309. PMID: 33336857.

18. Jacob RF. Prosthodontic rehabilitation of mandibulectomy patient. In: Taylor TD, editor. *Clinical Maxillofacial Prosthetics*. Illinois: Quintessence Publishing Co. Inc; 2000. pp. 171–88

19. Mahule A, Shaikh A, Deshpande P. Rehabilitation of mandibular defects using

unconventional approaches: a case series. *J Dent Panacea.* 2022; 3:176–80.

20. Yi-Lin Yeha, Yu-Hwa Pana,b, Ya-Yi Chen. Neutral zone approach to denture fabrication for a severe mandibular ridge resorption patient: Systematic review and modern technique. *J Dent Sci.* 2013; 8: 432e438.

21. Agrawal KK, Singh SV, Vero N, Alvi HA, Chand P, Singh K, Goel P. Novel registration technique to register neutral zone. *J Oral Biol Craniofac Res.* 2012;2:198-202. doi: 10.1016/j.jobcr.2012.10.003. Epub 2012. PMID: 25737865; PMCID: PMC3941689.

22. Lott F, Levin B. Flange technique: an anatomic and physiologic approach to increased retention, function, comfort and appearance of dentures. *J Prosthet Dent.* 1966; 16:394–413. doi: 10.1016/0022-3913(66)90044-8.

23. Agarwal S, Gangadhar P, Ahmad N, Bhardwaj A. A simplified approach for recording neutral zone. *J Indian Prosthodont Soc.* 2010 ;10(2):102-4. doi: 10.1007/s13191-010-0019-8. Epub 2010 Dec 9. PMID: 21629452; PMCID: PMC3081261.

24. Masumi SI, Makihara E, Yamamori T, Ohkawa S. Effectiveness of denture space recording method in the prosthetic treatment of edentulous patients. *J Prosthodont Res.* 2022; 66:221-225. doi: 10.2186/jpr.JPR\_D\_21\_00035.

25. Sabir, Regragui A, Merzouk N. Maintaining occlusal stability by selecting the most appropriate occlusal scheme in complete removable prosthesis. *Jpn Dent Sci Rev.*2019; 55:145-150.