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Analysis of Marginal Bone Loss and Residual Ridge Resorption in Conventionally Loaded Single and Two Implant Supported Overdentures

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Original Article

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ABSTRACT

Purpose: The aim of this study was to analyze the marginal bone loss and residual ridge resorption in patients wearing single and two implant-supported overdentures.

Materials and methods: This study was conducted on 20 edentulous patients between 50-75 years of age who have been completely edentulous for a period of at least one year or more. Patients were divided into two groups: Group-A in which two implants of size 3.75x13mm were placed in B and D position and ball abutments were attached to make an overdenture; in Group-B patients, a single implant at position C was placed and overdenture was made with ball abutments. Crestal bone loss was recorded around the margins in both the groups and residual ridge resorption was calculated in the mandibular posterior region using Wical And Swoope method. The data collected were compared for analysis using the Man-Whitney U test.

Results: For 2-IOD overall mean crestal bone loss for one year was 0.15± 0.03cmand for S-IOD it was 0.14 ± 0.03cm. The significance value was calculated to be 0.518 and U=41.5 which was found to be non-significant. Difference in residual ridge resorption was also found to be non-significant in both the groups with the significance value of 0.284 and U=36.

Conclusion: The scope of the single implant-retained overdentures can be a promising alternative for patients with an atrophic mandible, systemically compromised patients with financial difficulties.

Keywords: Implants, Ball-abutments, Metal Housings, Crestal Bone Loss, Residual Ridge Resorption.

Introduction

For over a century, the accepted treatment for edentulous patients has been to provide maxillary and mandibular dentures that rest on the soft tissues of the alveolar ridges and are not directly connected to them. Adequate retention and stability of complete maxillary and mandibular dentures are fundamental determinants for a successful treatment outcome of an edentulous patient.[1] An implant-supported overdenture is one such treatment option that not only increases the retention of a mandibular denture but also improves the stability of a complete denture. A consensus adopted by a panel of experts at a symposium at **McGill University (Canada) in 2002** effectively established that the two-implant-supported overdenture should become the first choice of treatment for the edentulous mandible.[2] In 2009, a further consensus statement (**The York Consensus Statement**) was released as a support and follow-up to the McGill consensus statement; the consensus conclusion supports the proposal of a two implant-supported mandibular overdenture as the minimum offered to edentulous patients.[3] The success of this treatment modality, while excellent, is unfortunately outside the financial scope of many edentulous patients. A cost comparison study between an unsplinted two-implant retained mandibular overdenture and a conventional complete mandibular denture showed the direct cost of the overdenture to be 2.4 times the cost of the conventional complete denture.[4] There is a new concept emerging, which uses a single central mandibular implant to retain the mandibular denture. Success of implant-retained overdenture depends upon osseointegration and stability of implants.[5] So, the present study was conducted to analyze marginal bone loss and residual ridge resorption in single and two implant-supported overdentures.

Materials and Methods

This study was conducted on 20 edentulous patients between 50-75 years of age who have been completely edentulous for a period of at least one year or more. Approval for the study was granted by the Ethical Committee of Himachal Pradesh University.

A total number of 20 patients who were completely edentulous and aged between 50-75 years including both males and females visiting the **Department of Prosthodontics, Crown, and Bridge in Himachal Dental College at Sundernagar, Distt. Mandi Himachal Pradesh, India** was selected. After detailed examination for the inclusion criteria, they were divided into two groups, one group (Group A) was given two implant-supported overdenture and the other group (Group B) was given single implant supported overdenture. Later on, marginal bone loss and residual ridge resorption were evaluated at an interval of 3, 6, and 12 months after the placement of implants. The criteria for the selection of patients for the study were as follows:

Inclusion Criteria

I. Edentulous for at least one year or wearing complete dentures
II. No teeth remnants or infection at the surgical site
III. Suitable patients were below 75 years of age who were able to give informed consent
IV. Bone height of at least 10 mm and bone width of 4.5 to 5mm in the anterior mandible
V. Patient should be fit for surgery
VI. Non diabetic, non-hypertensive and non- smoker

Exclusion Criteria

I. Severe maxilla-mandible skeletal discrepancies
II. Severe clenching habits or bruxism
III. Drugs or alcohol abuse and heavy smokers
IV. Patients undergoing anticancer therapy
V. Patients suffering from bleeding disorders

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VI. Immuno-compromised patients
VII. Lack of interest and cooperation

This study was conducted in two steps: (1) surgical phase (2) prosthetic phase

Surgical Phase

Patient Selection: In this phase patients who fulfilled the inclusion and exclusion criteria were assessed clinically and radiographically. The shape and contour of the alveolar ridge were examined. Patients who were having U- shaped or square form of alveolar ridge was kept for treatment. Crestal bone width of the ridge was assessed with the help of bone gauge and with the help of K- file at the occlusal, buccal, and lingual aspect of the ridge in the cuspid/bicuspid region. OPG X-ray of the patient was taken and the interforaminal region was assessed for implant placement.

Denture Fabrication

Primary impression of both maxillary and mandibular arch of the patient was made with impression compound. Beading and boxing were done and a cast was poured in plaster of Paris. Border moulding was done with green stick compound using sectional technique and a second impression was made with Zinc Oxide Eugenol impression paste. Master cast was poured in dental stone after beading and boxing base plate was adapted and occlusion rim was made from modelling wax of appropriate dimensions. Maxillary plane was established and centric jaw relation was recorded. Maxillary and mandibular casts were articulated according to recorded jaw relation. Inter–arch distance was measured with the help of a Vernier Calliper and patients having more than12 mm of inter-occlusal distance were selected for the implant placement.[6,7,8] Teeth arrangement was done and occlusion of the patient was adjusted for maximum intercuspation of posterior teeth and no occlusion was given in the anterior region.

Wax-up of denture was done; flasking with plaster of Paris was done and the flask was kept in boiling water for dewaxing. After removal of wax, packing with high strength acrylic was done after applying a thin layer of cold mould seal and the denture was kept for curing in the acrylizer following recommended procedure i.e. heating at 740C for 2hrs then raising the temperature to 1000C for 1hour.[7] The denture was removed from the flask, trimmed, finished, and polished. The same prosthetic procedure was followed for a single implant and two implant-supported overdentures. Patients were randomly selected for two implant or single implant-supported overdentures as per the requirements and socio-economic limitations of the patients.

Surgical Protocol for Patient

After try-in procedure, two points corresponding to position B and position D in Misch classification were marked on the secondary cast of the patient. A surgical splint was fabricated with a transparent sheet with the help of a vacuum press machine and both the positions mentioned above were duplicated on the splint

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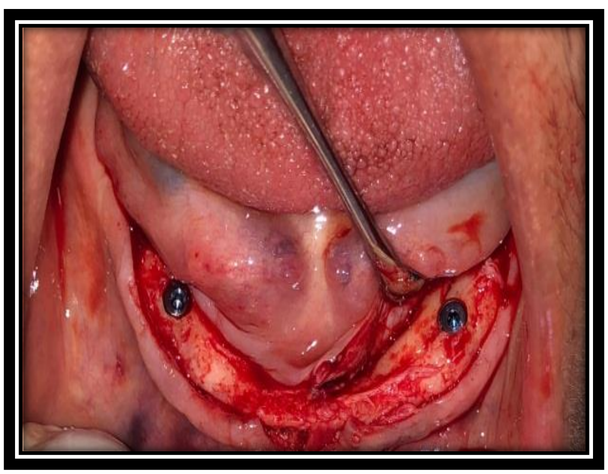
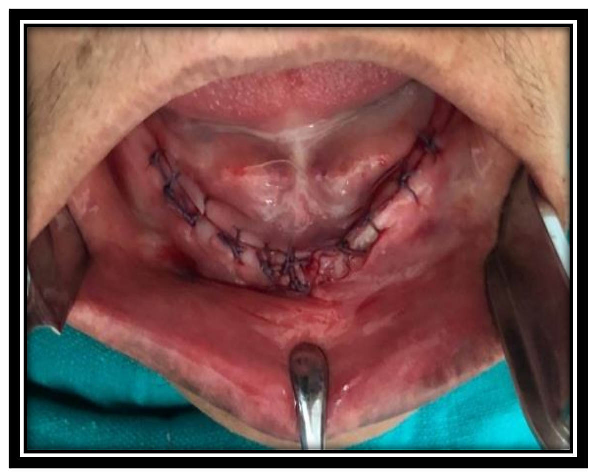
and the splint was sterilized in a solution of 1% Sodium Hypochlorite before surgery. The patient was scheduled for surgery after routine blood investigations; Hb, BT, CT, FBS, HBSAg, HIV, and written consent was taken before the procedure. Chlorhexidine 2% mouth rinses were done and Local Anaesthesia, Lignocaine 2% with Adrenaline 1:80000 dilution was given through infiltration at the proposed implant site. The surgical splint was placed in the patient's mouth and the implant position was marked with a pilot drill on the bony crest of the alveolar ridge through the surgical splint. A vertical crestal incision was made from the left premolar to the right premolar region with releasing incisions at both ends. A full-thickness flap was elevated and an alveolar ridge was exposed on both buccal and lingual sides. Osteotomy was started at position B with 2mm pilot drill engaged on the 20:1 reduction handpiece of **Physiodispensor**. Osteotomy site was further widened step by step increasing the width of the drill from 2.5mm < 2.8mm < 3.2mm < 3.65mm. The average length of the implant was kept at 13mm for this study. After completing the osteotomy at position B, the second site of implant placement i.e. position D was prepared following the same surgical procedure. The implant was inserted deep till the collar of the implant was 1mm below the cortex of bone and the torque handle showed a torque breakage of 35-40 N-cm. The buccal and lingual flap was closely approximated and sutured with interrupted sutures using 4-0 proline sutures.

Patient was sent after taking OPG X-Ray and RVG and necessary instructions were given after prescribing the required medicines. Patient was recalled for suture removal after one week.





Patients willing for implant-supported prosthesis and fulfilling the inclusion criteria with financial constraints were kept for single implant overdentures. The position of implant for single implant overdenture was selected to be midline in the symphysis area or position C according to Misch classification.[9,10,11] Osteotomy was done and the site was prepared with sequential drilling as described earlier for Group-A patients. After the osteotomy was done implant of 3.75 x 13mm size was placed with the help of an implant driver and torque wrench. Sutures were placed and the patient was sent with the same instructions as earlier in Group-A patients.

Prosthetic Procedure

Patients of both the groups were recalled after one week and the same procedure was followed for them post-surgically. The sutures were removed and the denture was inserted in the patient's mouth after the careful inspection for tissue fitting surfaces, borders, and peripheral extensions. A lower complete denture was taken out and trimmed 1mm from the intaglio/tissue surface and a layer of GC soft liner was applied to prevent masticatory forces on the implant. Intra-oral periapical radiographs and OPG X-rays were taken and the patient was called after three months for a pick-up impression of denture over implants.

For attachment of dentures with implants as their support position of implants was located and cover screws were exposed with a small incision and ball abutments were placed over the implants and torque wrenched up to 25-30 N-cm.

A thin rubber sheet was kept in between and the metal housing was placed over the ball abutments. Position and diameter of metal housing were recorded on the mandibular denture and grooves were made with an acrylic bur. Metal housing was picked within the denture with self-cure acrylic taking into consideration the centric relation and vertical dimension of the denture. Occlusal adjustments were made to maximize the first molar loading and relief anterior loading. Excess of acrylic was trimmed and the denture was finished and polished. The same prosthetic procedure was followed for a single implant-supported overdenture.

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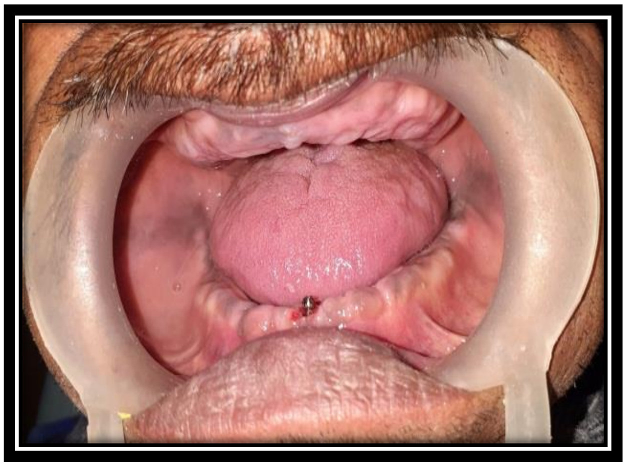

Data Collection

1) Crestal bone loss was recorded with the help of radiographs at 3 months, 6 months, and 12 months intervals. IOPA X-rays were taken with parallel tube technique and the images were uploaded in the software **Image Meter version 3.5.1 License: Free evaluation**; crestal bone loss was measured from the flat coronal end of the implant to the most apical end of the bone to implant contact or bone-implant interface. the dimensions; height and width of the IOPA X-Ray film was taken as a fixed reference plane and the length of the implant i.e. 13mm was taken as another reference scale crestal bone loss was measured accordingly. The distance travelled was evaluated after three months, six months, and twelve months.

2) OPG (orthopantomograms) X-Ray taken at various intervals were traced on a trace paper and the mental foramen was recorded carefully. The distance between the lower border of mandible and the lower border of mental foramen is considered to be non-changing with time. The distance between the lower border of mandible and the lower border of mental foramen was used to calculate the amount of residual ridge resorption.[12,13]

$$R = [3x - L] \times 1/f$$

- R: amount of Ridge resorption

- L: perpendicular height of upper cortex of mandible from lower border of mandible at the mental foramen level
- x: perpendicular height of lower border of mental foramen from lower border of mandible
- f: magnification factor

Calculation of magnification factor:
Magnification factor was calculated for OPG with the help of ball abutment used as an attachment for a prosthesis. Diameter of the ball abutment was measured with the help of **a Screw Gauge or Micrometre.**

D (diameter) = MSR + (CSR x L.C.)

- **D:** diameter of ball attachment
- MSR : main scale reading
- CSR: circular scale reading
- L.C.: least count
- D (actual diameter) x Magnification Factor = D'(diameter observed)

Statistical readings were recorded at every three months, six months, and twelve months intervals radiographically. The data thus obtained was subjected to statistical analysis.

Results: The study focuses on two parameters; the marginal bone loss and the residual ridge resorption in a single and two- implant-supported overdenture at different time intervals. The results of the study are listed through **Table I** and **Table IV**.

Time Intervals	**Group**	**N***	**Mean ± SD (Range)**	**Mean Rank**	**Sum of Ranks**	**U**	**Sig**
Three months	Group A	10	0.10 ± 0.02 (0.05- 0.10)	10	100	45	0.542
	Group B	10	0.09 ± 0.02 (0.05- 0.10)	11	110		
Six months	Group A	10	0.15 ± 0.04	10.4	104	49	0.938

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			(0.10- 0.20)				
	Group B	10	0.15 ± 0.04 (0.10- 0.20)	10.6	106		
Twelve months	Group A	10	0.20 ± 0.05 (0.10- 0.30)	9.1	91	36	0.254
	Group B	10	0.18 ± 0.03 (0.10 -0.20)	11.9	119		
Overall	Group A	10	0.15 ± 0.03 (0.08- 0.20)	9.65	96.5	41.5	0.518
	Group B	10	0.14 ± 0.03 (0.10- 0.17)	11.35	113.5		

***N** is the number of patients in Group A and Group B; N=10

Table I Comparison of marginal bone loss between single and two-implant supported overdenture.

Sides	**Time intervals**			
	3 months	**6 months**	**12 months**	**Combined**
Left side	0.04 ± 0.04 (0.00– 0.10)	0.09 ± 0.04 (0.03 – 0.15)	0.12 ± 0.04 (0.07 – 0.20)	0.08 ± 0.04 (0.02 – 0.15)
Right side	0.04 ± 0.04 (0.00– 0.10)	0.08 ± 0.04 (0.03 – 0.15)	0.12 ± 0.05 (0.03 – 0.20)	0.08 ± 0.04 (0.02 – 0.15)
Both sides combined	0.04 ± 0.03 (0.00– 0.10)	0.08 ± 0.03 (0.03 – 0.15)	0.12 ± 0.04 (0.05 – 0.20)	0.08 ± 0.03 (0.03 – 0.15)

Table II, Descriptive statistics of residual ridge resorption in two implant supported overdenture. Values are mean ± SD (range).

Sides	**Time intervals**			
	3 months	**6 months**	**12 months**	**Combined**
Left side	0.05 ± 0.04 (0.00–0.10)	0.09 ± 0.03 (0.05 – 0.15)	0.13 ± 0.03 (0.10 – 0.20)	0.09 ± 0.03 (0.05 – 0.15)
Right side	0.04 ± 0.02 (0.00– 0.07)	0.08 ± 0.02 (0.05 – 0.12)	0.12 ± 0.02 (0.10 – 0.15)	0.08 ± 0.02 (0.05 – 0.11)

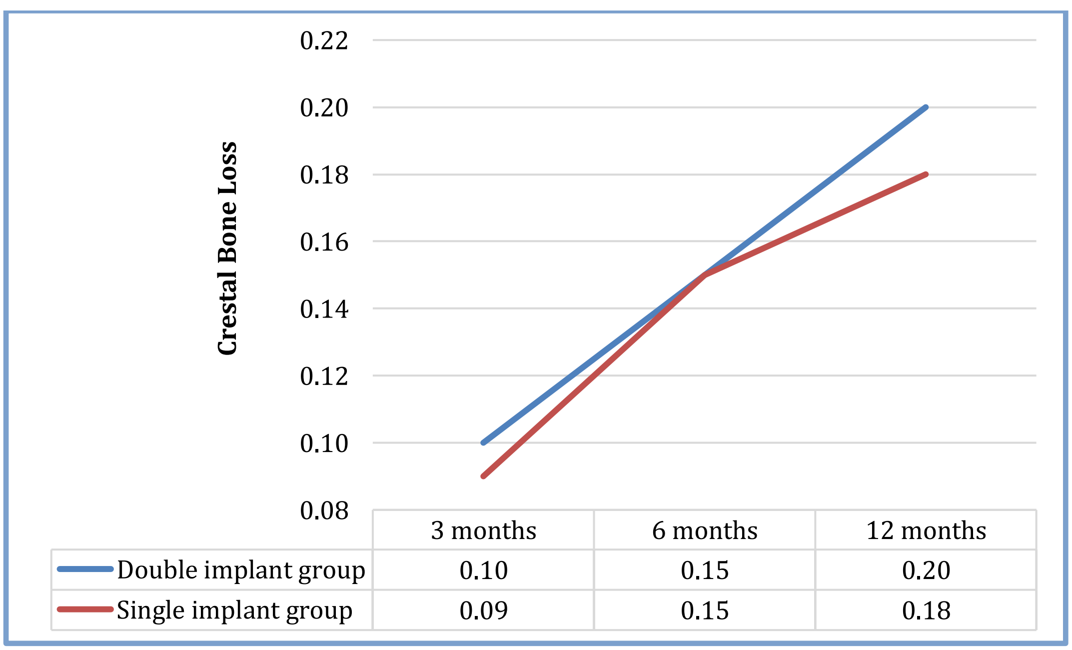
Both sides combined	0.05 ± 0.02 (0.01– 0.08)	0.09 ± 0.02 (0.06 – 0.11)	0.12 ± 0.02 (0.10 – 0.15)	0.09 ± 0.02 (0.06 – 0.11)

Table III Descriptive statistical analysis of residual ridge resorption in posterior mandibular region in overdenture supported by single implant. Values are mean ± SD (range).

Time Intervals	Groups	N*	Mean	SD	Min	Max	Mean Rank	Sum of Ranks	U	Sig
Three months	Group A	10	0.044	0.026	0.00	0.10	9.15	91.5	36.5	0.298
	Group B	10					11.85	118.5		
Six months	Group A	10	0.0865	0.025	0.03	0.15	9.55	95.5	40.5	0.461
	Group B	10					11.45	114.5		
Twelve months	Group A	10	0.1215	0.033	0.05	0.20	8.9	89	34	0.216
	Group B	10					12.1	121		
Overall	Group A	10	0.0835	0.026	0.03	0.15	9.1	91	36	0.284
	Group B	10					11.9	119		

***N is the number of patients for Group A and Group B; N=10**

Table IV: Comparison of residual ridge resorption in posterior mandibular region in single and two implant supported overdenture.



Graph I: Mean Crestal Bone Loss for double and single implant group.

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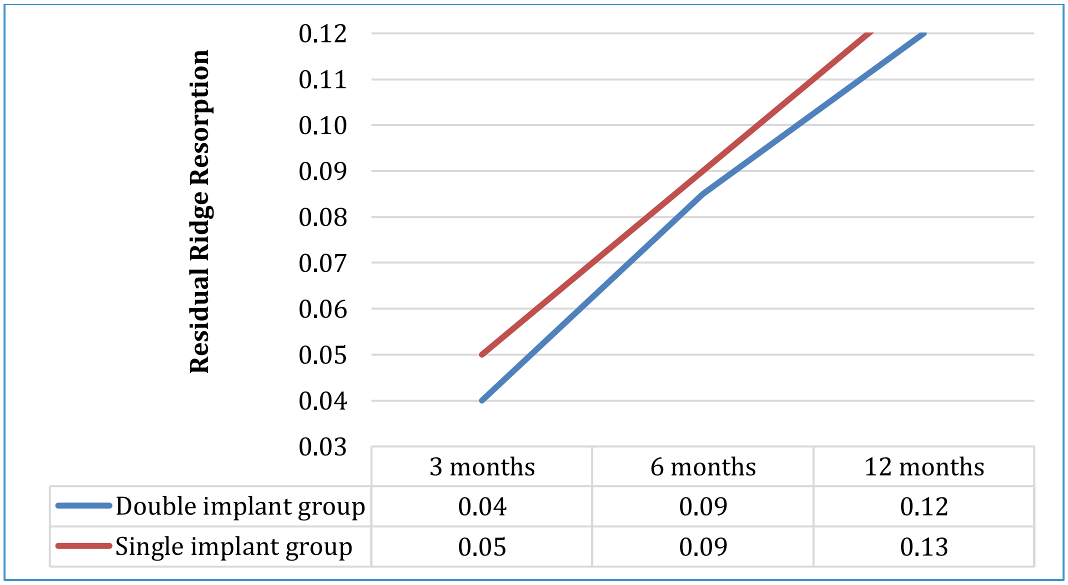
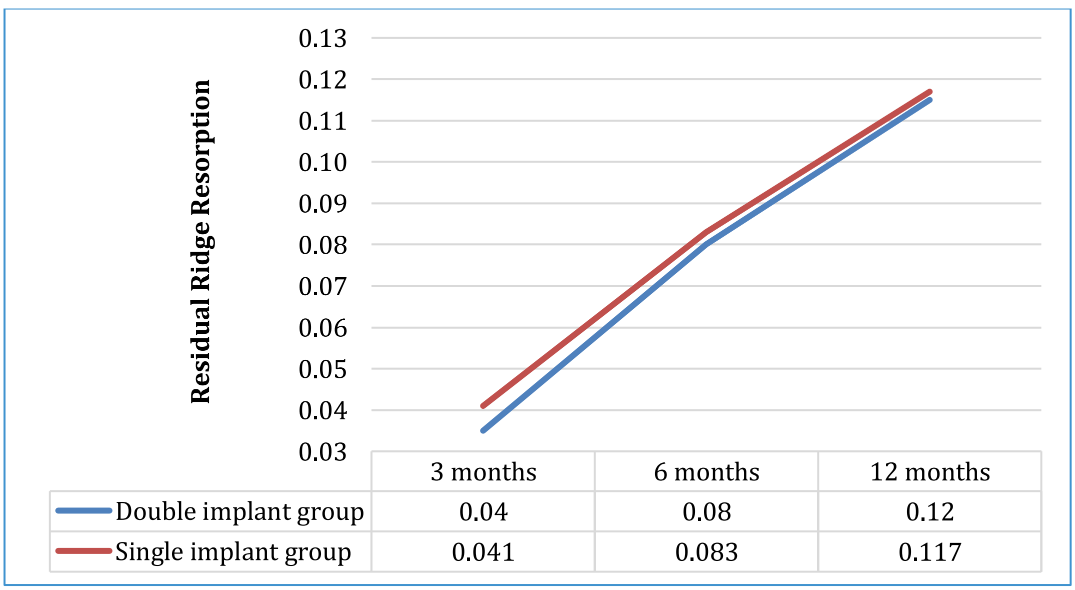


	3 months	6 months	12 months
Double implant group	0.04	0.09	0.12
Single implant group	0.05	0.09	0.13

Graph II: Left side residual bone resorption for Single and Double implant group at different time intervals.



	3 months	6 months	12 months
Double implant group	0.04	0.08	0.12
Single implant group	0.041	0.083	0.117

Graph III: Right side residual bone resorption for Single and Double implant group at different time intervals.

The data thus obtained was analysed statistically by **SBSS-16. Man- Whitney U Test or Wilcoxon's Test** was applied to calculate the mean bone loss and significance value (0.05). Mean crestal bone loss for **2-IOD** is shown in **Table-I**, overall mean crestal bone loss for one year was 0.15± 0.03cm which was well within the implant success criteria laid by **Albrektsson, Zarb, Worthington, and Eriksson in 1986**.14 The crestal bone loss was quite comparable in **S-IOD**, the average bone loss for one year was 0.14 ± 0.03cm. These values were very close to the earlier values which were recorded in patients wearing **2-IOD**. The significance value was calculated to be 0.518 and U=41.5 (**Table-I**), for crestal bone loss showing the difference between the crestal bone loss in **2-IOD** and **S-IOD** wearers to be non-significant. The mean residual ridge resorption for 2-IOD was found to be 0.08 ± 0.03 cm after six months while it was 0.12 ± 0.04 after twelve months (**Table-II**). For S-IOD it was found to be 0.05± 0.02 after three months, 0.09±0.02 after six months, and 0.12± 0.02 after twelve months period (**Table-III**). The significance value was calculated to 0.284 and U=36 for comparison between the two (**Table-IV**) after observation of one year, which shows the difference between the posterior mandibular ridge resorption in **2-IOD** and **S-IOD** was not significant and after a period of one year, both groups showed almost equal ridge resorption in spite of the difference in a number of implants used for retention of overdenture.

Discussion: Rehabilitation with complete dentures becomes more challenging when the patient has compromised mandibular alveolar bone. This often results in instability, denture soreness, poor retention leading to social embarrassment and psychological as well as clinical loss of health.[15] Implant-retained overdentures can be a treatment option for such patients to increase retention of the prosthesis, enhance the masticatory function and reduce the absorption of alveolar bone.[16] There is now overwhelming evidence that a 2-implant overdenture should become the first choice of treatment for the edentulous mandible.[15] They concluded that a two-implant-supported mandibular overdenture should be the minimum offered to edentulous patients as a first choice of treatment.[17] However, economic constraints especially among the emerging elderly population in developing countries like India make this treatment strategy financially challenging. A cost comparison study showed the direct cost of the overdenture to be 2.4 times the cost of the conventional complete denture.[4]

Cordioli et al 1997, Krennmair & Ulm 2001 supported the use of Single Implant Overdenture (**S-IOD**) over Two Implant overdentures (**2-IOD**) as a successful alternative treatment for completely edentulous patients.9,18 In **2014 Byrant et al** concluded that there was no statistical difference after 5 y in overall satisfaction or survival of implants with mandibular overdentures retained by 1 or 2 implants. It was further concluded that the full mucosal support develops a more favourable stress distribution in the horizontal dimension.10 **Passia et al in2014** observed in their study 100% success of implants, which was conducted on 11 patients over a period of 75.9 months and they recorded a mean Periotest Value of -3.4 establishing single implant overdenture therapy as a successful alternative to a conventional complete denture.11

Another aspect that should be considered is the influence of the overdenture movement and its biomechanical behaviour. The most widely used technique to calculate Residual Ridge Resorption is the Orthopantomograph method which was initially described by **Wical and Swoope**. The single implant–retained overdenture may allow complex denture movements under clinical situations, as a single implant cannot limit the direction of movement.[19] This causes rotation around the implant upon anterior and canine loading. To prevent this movement an implant overdenture should not be given definitive occlusal contacts in the anterior area.[19,20] S-IODs may be associated with excessive lateral movements especially when the occlusion presents with premature contacts and this aspect was taken care of in our study, as maximum intercuspation was given in posterior teeth and no occlusion was given in the anterior region of the denture.[21] The additional degree of freedom may also influence denture stability and consequently the chewing efficiency and to avoid this it is mandatory to fabricate a denture which is very closely adapted to the alveolar ridge so as to decrease the rotatory movements and increase the denture surface area resulting in a **Tissue –Implant-Supported Overdenture.**[21,22]

It is clear from the above discussion that the successful survival of implant-retained overdenture prosthesis is hardly dependent on the number of implants used. With regard to the failures reported, the most common was the replacement of attachment system components and fractures of the acrylic base, probably due to structural overload. The prosthetic complications such as attachment loosening fracture/wear of attachment fracture of abutment retaining screw, fracture of the bar, fracture of the acrylic denture base and cracks seen in the denture base.[24,25] But none of these complications were encountered in our study of patients and follow–up of one year. However, occlusion in complete dentures is dynamic and changes during the wearing period, regular remounting of the dentures is recommended.[23] None of the implant failure was recorded during the observation period and the success rate was yielded which was comparable in both **2-IOD and S-IOD**. The scope of the single implant-retained overdentures can be a promising alternative for patients with an atrophic mandible, systemically compromised patients with financial difficulties.

Conclusion: It can be concluded that the single implant-supported overdentures is a good treatment alternative for severely resorbed, financially compromised completely edentulous patients of developing countries like India. Further studies are required to confirm long-term success and recommending single implant-supported overdentures as basic and definitive treatment for completely edentulous patients. However, regular maintenance for patients with **S-IOD**, including relining and occlusal adjustments may be required periodically.

References

1. British Dental Journal VOLUME 207 NO. 4 AUG 22 2009.
2. Feine JS, Carlsson GE, Awad MA, Chehade A, Duncan WJ, Gizani S, Head T, Lund JP, MacEntee M, Mericske-Stern R, Mojon P, Morais J, Naert I, Payne AG,Penrod J, Stoker GT, Tawse-Smith A, Taylor TD, Thomason JM, Thomson WM, Wismeijer D. The McGill consensus on Overdentures J Pros. Dent. 2002
3. Thomason JM, Feine J, Exley C, Moynihan P, Müller F, Naert I, Ellis JS, Barclay C, Butterworth C, Scott B, Lynch C, Stewardson D, Smith P, Welfare R, Hyde P, McAndrew R, Fenlon M, Barclay S, Barker D. Mandibular two implant-supported overdentures as the first choice standard of care for edentulous patients--the York Consensus Statement. Br Dent J. 2009 Aug 22; 207(4):185-6. https://doi.org/10.1038/sj.bdj.2009.728
4. Heydecke, G., Penrod, J. R., Takanashi, Y., Lund, J. P., Feine, J. S., & Thomason, J. M. (2005). Cost-effectiveness of Mandibular Two-implant Overdentures and Conventional Dentures in the Edentulous Elderly. Journal of Dental Research, 84(9), 794–799; https://doi.org/10.1177/154405910508400903
5. Mahoorkar S, Bhat S, Kant R. Single implant supported mandibular overdenture: A literature review. J Indian Prosthodont Soc 2016; 16:75-82. https://doi.org/10.4103/0972-4052.164881
6. Dental Implant ***Prosthetics*** by ***Carl E. Misch*** DDS MDS PhD(HC)
7. Shanahan TEJ: Physiologic vertical dimension and centric relation. 1956; The journal of prosthetic dentistry, 2004; 91(3): 206-209. Doi: https://doi.org/10.1016/j.prosdent.2003.09.002
8. Zarb G. A., Bolender C. L., Carlsson G.E.: Boucher s Prosthodontic Treatment for Edentulous Patients. Baltimore, 9th ed C.V. Mosby Co, st. Louis Baltimore, Philadelphia, Toranto, 1990; pp 279.280.294.295.
9. Cordioli G, Majzoub Z, Castagna S, Mandibular overdentures anchored to single implants: A five year prospective study. J. Prosthet. Dent. 1997; 78:159-65. https://doi.org/10.1016/s0022-3913(97)70120-3
10. Bryant S R, Walton J N, and MacEntee M I, A 5-year Randomized Trial to Compare 1 or 2 Implants for Implant Overdentures. J Dent Res, 2014 1-8. https://doi.org/10.1177/0022034514554224

11. Passia N, Wolfart S, Kern M. Six-year clinical outcome of single implant-retained mandibular overdentures – a pilot study. Clin. Oral Impl. Res. 00, 2014, 1–4 doi: https://doi.org/10.1111/clr.12427
12. Jayaram B, Shenoy K K, Analysis of Mandibular Ridge Resorption in Completely Edentulous Patients Using Digital Panoramic Radiography. IOSR Journal of Dental and Medical Sciences (IOSR-JDMS) Volume 16, Issue 8 Ver. I (Aug. 2017), PP 66-73; http://www.iosrjournals.org/iosr-jdms/papers/Vol16-issue8/Version-1/O1608016673.pdf
13. Wical K E and Swoope C C, Studies of residual ridge resorption. I. Use of panoramic radiographs for evaluation and classification of mandibular resorption. J. Prosthet. Dent. July 1974. https://doi.org/10.1016/0022-3913(74)90093-6
14. Albrektsson T, Zarb G, Worthington P and Eriksson AR, The long-term efficacy of currently used dental implants: A review and proposed criteria of success. Int J Oral Maxillofac Implants 1986; 1:11-25. https://pubmed.ncbi.nlm.nih.gov/3527955/
15. The McGill Consensus Statement on Overdentures: Mandibular two-implant overdentures as first choice standard of care for edentulous patients. (2002). *Gerodontology, 19(1), 3–4.* doi: https://doi.org/10.1111/j.1741-2358.2002.00003.x
16. Srinivasan M, Makarov NA, Herrmann FR, Müller F. Implant survival in 1- versus 2-implant mandibular overdentures: a systematic review and meta-analysis. Clin Oral Implants Res. 2016 Jan; 27(1):63-72. https://doi.org/10.1111/clr.12513
17. Thomason, J. M., Kelly, S. A. M., Bendkowski, A., & Ellis, J. S. Two implant retained overdentures––A review of the literature supporting the McGill and York consensus statements. Journal of Dentistry, 40(1), 22–34. doi: https://doi.org/10.1016/j.jdent.2011.08.017
18. Krennmair G, Ulm C. The symphyseal single-tooth implant for anchorage of a mandibular complete denture in geriatric patients: a clinical report. Int J Oral Maxillofac Implants. 2001 Jan-Feb; 16(1):98-104. https://pubmed.ncbi.nlm.nih.gov/11280368/
19. Oda K, Kanazawa M, Takeshita S, Minakuchi S. Influence of implant number on the movement of mandibular implant overdentures. J Prosthet Dent. 2017 Mar; 117(3):380-385. doi: https://doi.org/10.1016/j.prosdent.2016.08.005
20. de VE, et al. Clinical viability of single implant-retained mandibular overdentures: a systematic review and meta-analysis, Int J Oral Maxillofac Surg (2018) doi: https://doi.org/10.1016/j.ijom.2018.01.021
21. Srinivasan M, Makarov NA, Herrmann FR, Müller F. Implant survival in 1- versus 2-implant mandibular overdentures: a systematic review and meta-analysis. Clin Oral Implants Res. 2016 Jan; 27(1):63-72. https://doi.org/10.1111/clr.12513
22. Padmanabhan, H., Kumar, S. M., & Kumar, V. A. (2019). Single Implant Retained Overdenture Treatment Protocol – A Systematic Review & Meta-Analysis. Journal of Prosthodontics. https://doi.org/10.1111/jopr.13133
23. UTZ, K.-H. Studies of changes in occlusion after the insertion of complete dentures* (Part II). Journal of Oral Rehabilitation, 24(5), 376–384. https://doi.org/10.1046/j.1365-2842.1997.00489.x
24. Amaral, C. F. do, Pinheiro, M. A., & Rodrigues Garcia, R. C. M. (2017). Reinforcement of Single Implant-Retained Mandibular Overdenture with a Cobalt-Chromium Framework before Implant Surgery. Journal of Prosthodontics.2017, 1-5. https://doi.org/10.1111/jopr.12732
25. Gonda T, Maeda Y, Walton JN, MacEntee MI. Fracture incidence in mandibular overdentures retained by one or two implants. J Prosthet Dent 2010;103:178–181 doi: https://doi.org/10.1016/s0022-3913(10)60026-1

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