Original Article

Comparison of masticatory efficiency, patient satisfaction for single, two, and three implants supported overdenture in the same patient: A pilot study

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Abstract

Statement of Problem: Over 30% of the world population suffers from edentulism. Implant supported overdenture have been a relatively successful treatment option for edentulism and have shown to slowed the rate of residual resorption and maintain the vertical height of the residual.

Purpose: The purpose of this study was to measure patient masticatary efficiency and satisfaction with the mandibular one-, two-, and three-implant-retained overdenture therapy when compared with conventional denture in a the same patients.

Materials and Methods: Ten complete edentulous patients, who were wearing conventional complete dentures, were involved in this study. Three single piece endosseous implant of 3.0 mm in diameter and 13 mm in length were surgically placed in the mandible in the region of B, C, and D. Mandibular denture was connected for single, two, and three implant supported overdenture periodically and checked for masticatory efficiency using a bite gauge and patient satisfaction using a questionnaire.

Results: Statistical analysis was done using Wilcoxon signed rank test. Four groups of bite forces when compared to each other. Group 1 was compared with Group 2, with the statistical value showing significance. Signed rank test showed no significance (0.268) when Group 2 was compared with Group 3. When Group 3 was compared with Group 4, and Group 1 compared with Group 4, rank test showed significant values. Four groups were compared with each other for patient satisfaction, Group 1 was compared with Group 2, with the statistical value showing no significance.

Conclusions: A single midline implant supported overdenture can be considered as a suitable and cost-effective treatment option over conventional denture. The study concludes that masticatory efficiency of this single midline implant supported overdenture is better than the conventional complete denture.

Key Words: Implant, masticatory efficiency, overdenture

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INTRODUCTION

Edentulism is considered as handicap for the elderly patients, and over 30% of the world population suffers from this condition.[1] India has a large geriatric population (60+ years) of 77 million, comprising 7.7% of its total population.[2] Edentulism affects the underlying nutritional deficiency, as the patient is not able to chew and digest his food properly. These patients may also suffer from a range of age-related diseases, which may be further worsened by the patient's edentulism and thus effecting the quality of life.[3] Tooth supported overdentures have been relatively successful treatment option for edentulism, and retaining the roots have shown to have slowed the rate of residual resorption due to proprioception.[4] A successful treatment option could be placing implants in the edentulous jaw and connecting it to the denture through an attachment similar to tooth supported overdenture.[4,5] This treatment option provides greater clinical benefits and patient satisfaction than a conventional denture and can significantly improve patient's quality of life.

The McGill consensus in 2002 and York consensus 2009 have been proved the necessity of implant supported overdenture to enhance masticatory efficiency.[6-8] The reports of these consensus meetings have concluded that conventional dentures should be no longer used as a standard option for the treatment of edentulism. Instead, a two implant supported mandibular overdenture should be the standard choice for treatment.[9] Literature mentions that masticatory efficiency is improved in the two implant-supported overdenture, when compared to the conventional dentures.[4] The single midline implant placed in the mandibular symphyseal region has also been proved to be efficient enough to the two implant supported overdenture.[10,11] The advantages of placing the single midline implant are reduction in the cost, time, and maintenance required when compared to the two implant overdenture.[11] The success rates of these implants also have been reported to be satisfactory.[11]

Comparative evaluation of the masticatory efficiency and patient satisfaction in patients with single implant support and two-implant supported is not documented. Hence, a clinical study was planned with a research hypothesis, to compare the masticatory efficiency and patient satisfaction of conventional complete denture, when compared with single, two, and three implant supported dentures, respectively, in the same patient over a period of time.

MATERIALS AND METHODS

Ten maxillary and mandibular edentulous patients, treated with a set of maxillary and mandibular conventional complete dentures, for more than 6 months, were considered for this study. These patients were explained with complete treatment protocol, and an informed consent form was signed from these patients. Masticatory load generated through the conventional dentures was recorded in all these patients using the specially designed bite gauge. Satisfaction with its function, esthetics was assessed based on a questionnaire supplied to the patients.

Three single piece endosseous implant of 3.0 mm in diameter and 13 mm in length (Snap, Eqvinox Pvt. Ltd., India) were surgically placed in the mandible in the region of B, C, and D, after reflecting the anesthetized mucosa [Figure 1]. Parellelism and equi-distance of the implants in between each other was maintained with a prefabricated surgical stent for the initial drill. The reflected mucosa was sutured back and analgesics were prescribed, and the patient was advised not to wear the denture for a week to allow soft tissue healing. After a week, the existing denture was relieved in the tissue surface area of the denture to accommodate the projections of the single pieces implants and rechecked intraorally with occlusal spray (Okklean, DFS, Landenstrabe, Reidenburg, Germany). Patient was asked to use the conventional denture limitedly for 3 months of healing face.

After 3 months of healing, the implants were loaded sequentially over a period of time. In stage 1, the single midline implant (C position) was the first to be loaded by engaging the dolla bona head of the single piece implant with that of the female component in the denture. The other two implants (B and D position) were not engaged. After a month time from the time of loading, the patient was evaluated for his masticatory efficiency using the bite gauge and patient satisfaction by the questionnaire.

In stage 2 of the study, the implants in B and D positions were engaged with a denture, after disengaging the implant in position C and making sure that there is no contact of the denture and implant of position C. Thus, in stage 2, it was two implant supported overdenture [Figure 2]. Again, after 1 month of

Figure 1: Three single piece implant placed in the mandible

implant loading in this situation, the masticatory recording and patient satisfaction was recorded as previously did for in stage 1. In stage 3 of the study, the implant in the position C was again connected and thus making it three implant supported overdenture. One month of loading the three implant supported overdenture, similar recording of the masticatory efficiency and patient satisfaction was recorded (Annexure I). The bite gauge used was based on the principles of the strain gauge to measure the bite force (ASEC Solutions, Bengaluru, India). It consists of a processing unit with an instrument panel and sensor. The force exerted was measured in Newton.

Bite force of the individual were measured as:
- Group 1: Bite force values of the individual with conventional dentures
- Group 2: Bite force values of the individual with conventional dentures supported by a single midline implant (C position)
- Group 3: Bite force values of the individual with conventional dentures supported by lateral two implants (B and D position)
- Group 4: Bite force values of the individual with conventional dentures supported by all the three implants (B, C, and D position).

RESULTS

The descriptive analysis was done to evaluate the mean value and standard deviation of the masticatory efficiency generated from a conventional denture, single, two, and three implant supported overdenture. Statistical analysis was done using Wilcoxon signed rank test. Four groups of bite forces when compared to each other. Group 1 was compared with Group 2, with the statistical value showing significance [Table 1]. Signed rank test showed no significance (0.268) when Group 2 was compared with Group 3 [Table 1]. When Group 3 was compared with Group 4, and Group 1 compared with Group 4, the rank test showed significant values [Table 1].

Similarly for patient satisfaction, statistical analysis was done using Wilcoxon signed rank test. Four groups were compared with each other for patient satisfaction, Group 1 was compared with Group 2, with the statistical value

showing no significance [Table 2]. Signed rank test showed significance (0.026) when Group 2 was compared with Group 3 [Table 2]. When Group 3 was compared with Group 4, and Group 1 compared with Group 4, the rank test showed significant values [Table 2].

DISCUSSION

Two implant supported mandibular overdenture has been accepted, as the most appropriate first choice treatment for the edentulous individuals.[4-9] Prospective long-term clinical studies have proved that not only does the placement of implants enhance the retention and stability of the denture, but also prevents/reduces the rate of residual ridge resorption.[12-14]

Masticatory efficiency of the edentulous individual has shown improvement when it is supported by implants.[15-17] Chen *et al.* evaluated the masticatory efficiency using electromyography of the masseter and internal pterygoid muscle and concluded that placement of implants in the edentulous mandible increased the muscle activity of the masticatory muscles and thus mastication.[4] Similarly, in our study, when conventional denture was compared with that of the two and three implant supported denture, it showed a significant difference in masticatory efficiency, as mentioned by Fueki *et al.*[18]

The patient satisfaction was very high when compared to the conventional dentures which were validated by many studies involving questionnaires and blinded studies.[19,20]

The improvement in the quality of life of the edentulous individual has been the mainstay for the recommendation of this implant-supported overdenture.[21-23] After rehabilitation with the implant-supported overdenture an improvement in the quality of life, food selection, and nutrition had been observed in the past.[24,25] The patients were highly satisfied with the implant-supported overdenture due to the comfort and the fit of the denture. The findings of this present study showed that the patients rated the implant-supported overdenture to be more comfortable than their previous conventional dentures.

Figure 2: Mandibular overdenture showing the implant attachments

Table 1: Means values of bite force recorded

	Group 1 (with denture)	Group 2 (I implant)	Group 3 (II implant)	Group 4 (III implant)
Mean	35.09	58.36	61.40	71.57
SD	8.43	13.31	12.98	13.54

SD: Standard deviation

Table 2: Mean values of patient satisfaction, based on the grade scale of 10

	With denture	I implant	II implant	III implant
Mean	2.43	3.86	4.86	5.71
SD	1.05	1.55	1.96	2.37

SD: Standard deviation

The statistical evaluation showed that there was no significant difference in patient satisfaction when conventional denture was compared with that single implant supported denture, even though the masticatory efficiency showed significance. The patients opinioned that their ability to chew food was improved after implant placement and that the three implant supported situation was the most comfortable. Though according to the literature, the least number of implants to be used in a mandibular overdenture is two. Recent studies challenge this fact that a minimum of two implants must be used, with the use of a single midline implant. In this study, it was observed that the masticatory efficiency of single implant when compared with two implants was significant, which indicates that patient did find much difference with one and two implant-supported overdenture. The single midline implant in the mandibular symphyseal region followed by a suitable attachment type incorporated in the mandibular denture have been compared to the two implant supported overdenture and have been reported to be as efficient and more cost effective. In the previous studies, the single and two implants were randomly placed in different patients, whereas in this study, all the implants were placed in the same individual so that he/she could differentiate between the situations. The results in the present study suggest that the single implant supported overdenture was as efficient as that of two implant supported overdenture in relation to bite force under the given conditions. The patients were satisfied with the implant-supported overdenture and rated the three implant-supported overdenture to be the most stable. The single implant supported overdenture, however, showed an increase in bite force and some patients were comfortable with the single implant-supported overdenture.

However, more prospective studies are required to validate the finding that a single implant retained overdenture can be used as a suitable cost-effective treatment alternative for the severely debilitated edentulous individual. This finding can be used to modify the McGill consensus and state that a single mandibular midline supported implant will suffice the treatment of an edentulous mandible. This finding would especially benefit the economically weakened section of the population in the developing nations and other third world countries.

CONCLUSION

Within the limitations of this study, it was concluded that a single midline implant supported overdenture can be considered as a suitable and cost-effective treatment option over conventional denture. The study concludes that masticatory efficiency of this single midline implant supported overdenture is better than the conventional complete denture. The three implant supported overdenture was the best among the three situations compared in this study. The two implant

supported overdenture can be further made efficient by placing a single midline implant and making it three implant supported.

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Conflicts of interest
There are no conflicts of interest.

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ANNEXURE 1

Patient satisfaction questionnaire (grade this question with maximum score of 10)

- Are you satisfied with the appearance of your dentures?
- Are you satisfied with how well you can speak?
- Are you satisfied with the way your lower denture stays in place?
- Are you satisfied with how well you can chew with your dentures?
- Are you satisfied with the comfort of your lower denture?
- Have you experienced any pain with your lower denture?
- How easy is it for you to place and remove your lower denture?
- Has your self-confidence increased since receiving the denture?