Implant Supported Overdenture - A Review

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Abstract: Background: Traditional complete dentures were the most common treatment option for patients with edentulous arches. However, the initiation of implant-supported overdentures has substituted orthodox dentures as an improved standard for restoration. Careful case selection is important criteria for improving success rate of implant supported over denture. Lower arch implant-supported overdentures have a better success percentage than upper arch implant-supported overdentures. Upper arch implant-supported overdentures are simulating a form of "salvage treatment," rather than being the primary modality of treatment for patients with completely edentulous upper arch. [Shah J Natl J Integr Res Med, 2022; 13(1): 115-122, Published on 26/01/2022]

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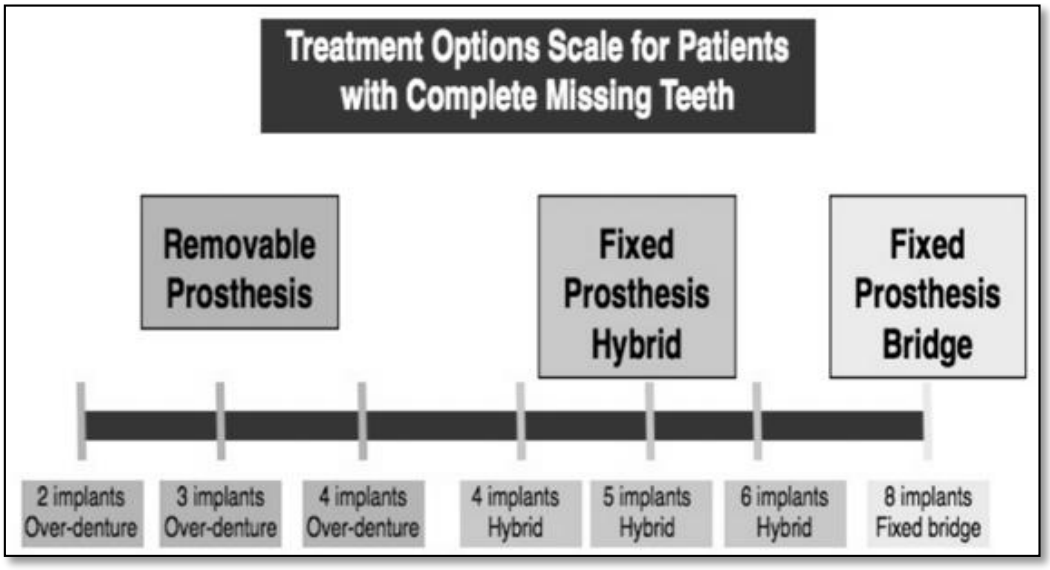
Introduction: Edentulism is measured as a unfortunate health consequence and may compromise quality of life. The prosthetic management of the patient with no teeth in either arch has been a foremost challenge for dentistry[1]. The conventional treatment for such patients is the orthodox complete removable dentures of both arches (Table-1)[2]. However, this treatment has several drawbacks, especially that of the mandibular denture. The factors that adversely affect prognosis of mandibular complete denture include: mobility of the floor of the mouth, thin mucosa lining the alveolar ridge, reduced support area and the motion of the mandible[3]. This, in turn, may negatively affect functional ability such as speech, aesthetic and mastication[4]. Recently, the most basic prosthetic rehabilitation of edentulous mandible is an implant retained overdenture with two implants placed in the anterior mandible. These implants are placed in conjunction with attachments to enhance the retention and stability of the overdentures. Different types of attachment systems have been suggested for retaining implant-supported overdentures including stud (ball and socket, locator), bar, telescopic and magnetic attachments. The aim of this literature review is to appraise the numerous studies and systemic reviews conducted on implant-supported overdentures of both arches.

Table 1: Treatment Plans For Completely Edentulous Patients



Implant-Supported Overdenture: The effect of tooth loss is two-fold which may affect the patients psychologically and clinically[5]. Clinically, the effects of tooth loss are important. Alveolar bone resorption is a prosthodontic impasse for the restoration of edentulous mandible.

Tallegren reported that mean decrease in anterior mandibular ridge height was four times greater than that of the maxilla[6].

Treatment Modalities For The Restoration Of Edentulous Maxillary And Mandibular Arch:

- Conventional complete denture,
- Preprosthetic surgery with conventional complete dentures
- Implant supported overdenture
- Implant supported fixed bridge.

Various research studies have shown that implant supported mandibular over dentures can preserve height of bone in those sites where implants are placed[7]. Extension of prosthesis and soft-tissue coverage are reduced in implant supported overdentures and thus it can be a boon for new users of dentures as well as for patients with low threshold of gagging. They tend to cause less bone resorption and provide greater prosthesis stability, better esthetic, and improved maintenance.

Van Steerberghstudied the implant-supported overdentures of mandibular arch and was among the pioneers to propose the placement of two implants in alveolus of mandible for support of an overdenture. In less than 52 months, a 98% success rate was achieved. Implant supported overdenture requires everydaymaintenance, specifically during their initial one year[8].

Atterd et al determined that collective survival rate of over dentures was 100% at 15 years with long life of prosthesis being 10.39 ± 5.59 years. Albrektsson et al have contended that state of nearly 'restitution and integrum', can be accomplishedby using dental implants[9].

Selection Of An Adequate ISO Attachment: Clinicians often have selected diverse attachment systems based on factors such as sturdiness, demands of patient, cost efficacy, technical ease, and retention. Attachments are classified depending on its function as a) rigid, if denture dislodgements are not allowed, or b) resilient: translation, rotation, axial or hinge over posterior axes movements or a combination of them because of their flexibility, are allowed. In case of rigid attachments, the implant will receive 100% of mastication load, whereas, for resilient attachments, mastication load will be supported by implant, denture or fibro-mucous. Currently, the most used attachments are:

"O" Ring Or Ball Attachment: Simplest type of attachment for clinical application with implant or even tooth supported overdentures is the classical Ball attachment. Male abutment is screw-retained in the implant with a globular shape on its occlusal portion, and an anchored female prosthetic part that can be formed from metal or enclosed with nylon having a diverse retention range.

This attachment does not require anexcessive prosthetic space and allow hinge and rotation dislodgements. Though, the precise design of the ball attachment influences the amount of free movement thus limiting the resiliency. These attachments cannot be used with non-parallel implants[10].

Magnetic Attachment: Basically, they consist of two magnets, which are attached to denture as well as implant. They create a modest and comfortable system for the patient as magnetic attraction guides in denture insertion. They have a feebler lateral firmness and retention as well as susceptible to corrosion by saliva as compared to mechanical attachments such as ball or bar devices[11].

However, a novel generation of rare-earth magnetic parts could advance their properties and can be clinically more often used.Edentulous patient with Parkinson's disease patientshave weak muscle tone and this magnetic attachment is very useful because they need a reduced amount of force for insertion and removal of the denture[12].

Bar Attachments: For superior retention, and improved force balance by its splinting effect and its ability to correct severe unparalellisms, Bar is an outstanding anchorage system that provides all these qualities.

The interchangeable clips or retention elements can be reactivated. Bars are required to be parallel to the rotation axis, i.e. straight and are positioned 1-2 mm to the alveolar crest.

Different types of bar designs are Ackermann Bar (spherical shape), Hader Bar (keyhole shape) as well as Dolder Bar (ovoid or "U" shape). Implant-supported milled bars are bars with precision attachments and rigid anchorage, made through casting, electroierosion technique or through CAD-CAM.

The foremost drawbacks of bar attachments are the requirement for a large prosthetic space and the increased risk for mucositis due to anderisory oral hygiene under the bar. Due to implants being places far from each other, Bar design is not indicated in cases where implants are placed far from each other as there will be increase in bone stress around implants.

Locator Attachments: An implant screw (metallic abutment) is the Male part and a metallic cap lined with nylon of various colors corresponding to their retention capacity is the Female part, which is anchored to the denture.

Nylon is mainly of two types: 1) With both, internal and external, retention for well-positioned implants (from less to more retention: colour coded as blue, pink, transparent) and 2) with external retention for parallel implants (from less to more retention: red, orange, green)[13,14]. Also, for laboratory use, yellow colored nylon is used frequently.

These attachments do not require a huge prosthetic space and can correct un-parallelism of ≤40 degrees. The attachments permit for rotation disarticulation and their use is widely recognized in the current literature.

Telescopic Attachment: Double crown, crown, and sleeve coping are some of the other names of Telescopic crowns. They comprises of a primary inner telescopic coping, cemented forever to an abutment, and a corresponding separable secondary outer telescopic crown, inflexibly linked to a removable prosthesis[14,15].

Parallel sided crowns,crowns with additional attachments, andtapered (conical-shaped) crownsare the types of telescopic retainers according to the wall design[16].

These retainers provide exceptional retention subsequentto the frictional fit between the crown and the sleeve[34]. They also provide better force distribution due to the circumferential relation of the outer crown to the inner abutment, making the vertical transfer of occlusal load producemuch lesser rotational torque on the abutment.

The other advantage is ease of removability. This inspires the patient for repetitive cleaning and maintenance purposes. Furthermore, the overdentures' self-finding mechanism in telescopic creations enabled prosthesis insertion substantially. This structure appeared to be an actual treatment modality for geriatric patients with grave systemic diseases like Parkinson's diseases[18].

Peri-Implant Findings And Prosthetic Complications: It has been reported that healthy marginal mucosa around implants could be achieved in good oral hygiene conditions also in situations when no keratinized mucosa is present[19,20]. Biological and technical or mechanical complications are frequently seen with implant overdentures.

Mucosal hyperplasia has been observedmore with bars as compared to ball attachments. It has been supposed that an insufficient space beneath the bar–which prevents proper cleaning – may cause a soft-tissue inflammatory response under the bar attachment. Additional cause for mucosal hyperplasia with bars could be the less accurate settling of the denture base to the mucosa equated with ball overdentures[40].

Peri-implant mucositis is rather often seen around implants. The incidence (an average of 19 %) associated with implant overdentures is greater than with fixed implants[22]. It has been found that peri-implant tissue health is not related to the retention system used[23].

The most common mechanical difficulties with implant overdentures are relief of the absorbent mechanism, usually seen in one-third of total cases[24]. Furthermore, fracture of the retentive anchor, loosening of occlusal screw with bars, breakage of the acrylic base material or cracked teeth and splintered bars are common findings.

Robust attachments were detected to be more recurrently have broken, loose, or lost female parts and a requirement for repairs and relining of the denture base, whereas rigid bar attachments are more typical and need tightening of the bar retainers[25]. It has been

shown that attachments wear over time and lose their retention force.

Several research papers have been published about the necessity for rectifications and alterations of overdentures after delivery of the prostheses.

Prosthetic maintenance is needed with all attachments, but bar-supported overdentures have been observed to need it less[26]. A rigid milled bar attachment on four-implant overdentures has been shown to cause less prosthetic maintenance compared with resilient denture attachments with ovoid bars[27].

On the other hand, Gotfredsen and Holm (2000) presented that the frequency of technical complications was higher with bars than with ball attachments with two implants and an overdenture[28].

Recent studies conclude, however, that there is no correlation between attachments and prosthetic complications. Surveys vary in results about whether maxillary overdentures are more likely to have prosthetic complications as compared to mandibular overdentures.

Discussion: Implant-supported and -retained overdentures have become a widespread and predictable treatment option for edentulous mandibles. Reasonably low prices and modest treatment equated with fixed structures, easiness of hygiene and many times show better aesthetic results especially when lost hard and soft tissues need to be replaced are factors that account for the success.

The number of implants needed for a mandibular overdenture is smaller than for a fixed implant bridge–usually two to four implants–and this is advantageous when the amount of jawbone is reduced. Numerous studies confirm good treatment results with two mandibular implants in the long term.

It is generally stated that for an edentulous mandible, two-implant overdenture treatment should be the standard of care relative to conventional denture treatment[29].

During the past decades several different attachment systems have been presented and compared with each other in terms of retentive force, easiness to use and hygiene, tendency to breakage and economic factors. It has been noted that when the attachment system or the number of implants is varied, there is no clear differences in satisfaction among patients with mandibular overdentures[30].

Cordioli G et al in 1997, directed a five-year study which appraised a treatment choice by using a single implants over denture in the midline of the mandible of 21 elderly patients conferring to the rules of standard surgical technique in two stages.

Oral comfort was improved along with improvement in function and health of the peri-implant soft tissues. The marginal bone levels inter proximally were gauged for 5 years after overdenture delivery. Results showed a note worthy enhancement in comfort and function without any catastrophes of the implants placed[31].

Krennmair G et al in 2001 examined 9 patients having a mean age of 82.2 years experienced placement of a single symphyseal endosseous implant and anchorage of complete denture using ball type attachments.

Standardized recall examinations were carried out at intervals of 3-6months for a period of 18 month. Enhancement of both, patients' subjective satisfaction and reduction in reported discomforts were seen due to the anchorage with single implant[6].

Wolfart S et al in 2008 reported 2 clinical cases of a single implant in the centre of the mandible with ball attachment and with a screw activated matrix for the stability and retention of the implant prosthesis. That results improvement in the chewing ability and quality of life in geriatric patients[32].

Liu J et al. In 2013 performed a study on the influence of number of implants on the biomechanical behavior of mandibular implant supported over dentures and reported that, single implant supported over dentures showed no damaging strain concentration in the bone surrounding the implant[33].

Grageda E et al in 2014 suggested a report that single implant retained over denture when compared to that of the over dentures reinforced

by two implants, had an additional advantage which was less expensive and invasive[34].

Bryant SR et al. In 2015 compared single or two implants for implant over dentures in a five year randomized clinical trial. It showed no significant difference in the satisfaction or survival of edentulous subjects[35].

Alsabeeha N et al. In 2010 did an in vitro retention force investigation on different designs of attachment systems used for single-implant retained mandibular over dentures.

Here, two ball attachments of greater dimension and four commercially available attachments of normal dimension were compared. They found that attachment systems of larger dimensions provided higher retentive forces for mandibular single implant over dentures[36].

Cheng T et al in 2012 conducted a study on patient satisfaction and masticatory efficiency of mandibular over dentures supported with single implant using the attachments and found that there were no statistically significant differences in overall patient satisfaction, speech, and retention between the above mentioned attachments[37].

Kono K et al in 2014 did a study on in-vitro assessment of mandibular single/two implant over dentures with stress-breaking ball attachments and conventional ball attachment.

Measurment of strain surrounding the implant, pressure at 5 different soft tissue areas, and displacement of the denture base was done and the pressure at each part of the stress breaker ball attachment was less than that compared with the conventional ball and also provided optimal stress distribution[38].

Nascimento JF et al. In 2015 conducted a study on the photo elastic stress distribution produced by different retention systems for a singleimplant mandibular over denture in photo elastic model of a resilient edentulous ridge.

They concluded that the load transmitted to the implant was equally distributed over the implant with low stress concentration[39].

Maeda Y et al conducted an in-vitro study and came to the conclusion that over dentures using single implant with dome-type magnet or ball attachments and the two-implant over dentures had biomechanical effects similar to each other in terms of lateral forces transferred to the abutment and denture base movements of molar functional loads[40].

Liu J et al. conducted a three-dimensional finite element analysis on the influence of number of implant on the biomechanical behavior of peri-implant bone, implants, abutments and over dentures and were recorded.

They concluded that single implant retained mandibular over dentures do not show damaging strain concentration in the bone around the only implant and that it was a cost-effective treatment option for edentulous patients.

The placement of third implant between the previous two in patients rehabilitated by two-implant over dentures showed enhancement in the constant and obvious denture rotation around the fulcrum line showed[53].

<u>The Selection Criteria For The Attachment System Are The Following:</u>

- Minimum of two implants, either splinted by bar or non-splinted.
- Splinting the dental implants by choosing bar as attachment system provides a more uniform distribution of occlusal forces, but has the disadvantage of higher costs for addressing the complications – loss of one implant may be accompanied by the need of replacement of the entire bar system and also the prosthesis[3,5,8,13,41].
- The inclination of implants, ball attachments imposing a divergence of maximum 30 degree, and locator allowing up to 20 degree divergence on each implant, meaning a divergence of the long axis of implants of up to 40 degree[5,8].
- The vertical prosthetic space, resilience of the oral mucosa, occlusal loading, overdenture retention and stability requirements analyzed in conjunction with patient's anatomical and functional particularities[1,2,3,8,13].

In patients with decreased manual dexterity which is frequently encountered in theelderly, it

is more appropriate to choose a less retentive attachment system[42,13]. Financial and time resources of the patient. The cost of fabrication of the bar attachments will be much superior in contrast to stud abutments[43].

Conclusion: A greater success rate has been observed in Mandibular implant-supported overdentures than maxillary implant-supported Overdentures. Careful case selection should be incorporated for the success of both maxillary and mandibular implant-supported overdentures to develop patient quality of life.

There is need of further research to advance the success for maxillary implant-supported overdentures.

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