

Evidence Summary

Single implant supported mandibular overdenture: A literature review

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Abstract

Purpose: Rehabilitation of the edentulous mandible by implant-supported prosthesis is a successful and satisfying treatment as suggested by many clinical trials. However, the minimum number of implants required for this restoration is debatable. Single implant retained overdenture (SIROD) has gained popularity as a simple protocol. The purpose of this review is to systematically analyze the literature on SIROD.

Materials and Methods: An electronic search was done in the PubMed and Medline databases using the key words "central single implant overdenture," "implant overdenture retained by one implant," "implant overdenture retained by single implant," "mandibular single implant overdenture," "mandibular SIRODs." Articles from 1993 to November 2012 were included in the review. Out of 208 articles, only 18 had relevant data pertaining to mandibular single implant overdenture. Two more were hand-picked from journals that are non-PubMed indexed but from reputed publishing houses.

Results: Majority of studies supported the concept of SIROD. Success outcome was addressed in relation to surgical, prosthetic, functional parameters, and patient satisfaction. 65% studies evaluated the primary stabilities of the placed implants, 50% of studies assessed the marginal bone loss quarterly across a 1-year period. Prosthesis outcome was a criterion for evaluation of success rate in 45% of studies.

Conclusion: The SIROD is proved to be successful and an economic treatment protocol. However, the clinical parameters such as masticatory efficiency bite force, retention, and stability needs to be investigated.

Key Words: Central implant, dental implants, mandibular overdenture, one implant overdenture, single implant overdenture, symphyseal implant

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Received: 18th March, 2015, Accepted: 18th July, 2015

INTRODUCTION

Edentulism is a chronic condition for which the palliative therapy is a set of removable complete dentures. Given the global increase in the life expectancy, and the increase in the

elderly population, the seekers for this treatment among the elderly edentulous population will be increased.^[1] Though it is an economical option for the elderly, the conventional denture has certain shortcomings. The patient still has difficulty in

Access this article online	
Quick Response Code:	Website: www.j-ips.org
	DOI: 10.4103/0972-4052.164881

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How to cite this article: Mahoorkar S, Bhat S, Kant R. Single implant supported mandibular overdenture: A literature review. J Indian Prosthodont Soc 2016;16:75-82.

chewing the hard foods, there is accelerated bone resorption and the clinical morbidity with the denture continues.^[2]

Rehabilitation of the completely edentulous mandible using implants to either retain or support restorations is a predictable long-term treatment modality.^[3] There are several long-term studies, which prove beyond doubt, that implant retained prosthesis improved the quality of life of an elderly individual.

Evidence of biomechanical success and psychosocial satisfaction has led to an emerging consensus that a two implant overdenture should be recommended treatment in the management of an edentulous mandible.^[4] The McGill and York consensus statement have come out strongly in favor of the two-implant supported overdenture (TISOD).^[5-7] The minimum number of implants needed for the implant restoration is still debatable.

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.^[8]

There is a new concept emerging, which uses a single central mandibular implant to retain the mandibular denture. Implant success and prosthetic outcome and patient satisfaction are comparable whether one or two-implants are used for support of mandibular overdentures.^[9] In addition to possible cost savings with a single implant overdenture, there are potential surgical advantages as well.

A finite element method (FEM) study by Jingyin Liu *et al.*^[10] on the number of implants required to retain an overdenture suggested that single implants were able to bear the load and dissipate it to the bone well. The TISOD was thought to move around a fulcrum line. A third implant in the symphyseal region was suggested in this scenario to stabilize the denture.

Traditionally, the anterior mandible has been considered a safe, preferred site for implant placement for overdentures even with severe residual ridge resorption and the anticipation of a relatively less challenging surgical procedure.

Though the concept is proved successful, only a few handful studies are published in the literature. The concept still needs adequate scientific back up and this review tries to compile/analyze all the available data on single implant retained overdenture (SIROD) [Table I compiles the advantages of the single implant overdenture over two implant overdenture as advocated by the various studies published in literature].

MATERIALS AND METHODS

An electronic search was carried out in PubMed and Medline from 1993 to November 2012 using the search terms “central single implant overdenture,” “implant overdenture retained by one implant,” “implant overdenture retained by single implant,” “mandibular single implant overdenture,” “mandibular SIRODs.” Articles were also manually searched by the reviewers based on the content related to the mandibular single or one implant overdenture [Figure 1].

The inclusion criteria were as follows: Articles published in the English language only were considered for inclusion. The articles from 1993 to November 2012 were considered. The articles should have discussed or included mandibular single overdenture in any aspect. Both *in-vivo* and *in-vitro* studies were considered. The studies with a follow-up period of at least 12 months were considered. Case reports were not considered.

All articles were PubMed indexed except two other articles^[11,12] which were manually searched and included into the review based on their relevant content to the topic of interest. The articles were not PubMed indexed but from reputed publishing houses.

The conventional denture is no longer recommended as the first choice because of the obvious disadvantages of reduced

Table 1: Comparison of single implant retained and two implant retained mandibular overdenture

Parameter	Two implant	Single
Cost	2.4 times of conventional	1.31 times conventional
Expertise	Skilled implantologist	Relatively less expertise
Surgery	Should be parallel placed implants	Relatively less challenging and takes less time
Postsurgical complications	High risk of paresthesia and complete anesthesia if the mental nerves are damaged	Potentially less complicated than the two implant supported
Maintenance	High maintenance cost Postinsertion recalls higher	Relatively very less Very few adjustment recalls needed
Retention	Adequate	Optimum

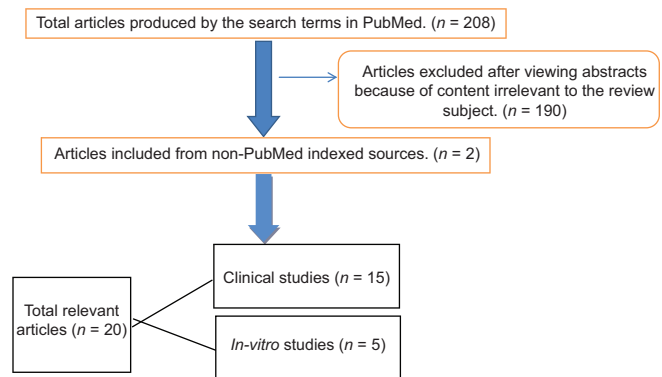


Figure 1: Methodology

retention and stability, difficulty in speech and chewing, accelerated residual ridge resorption, and overall psychological effect on the elderly individual wearing them. The TISOD is suggested as the standard of treatment for the edentulous mandible.

But, the TISOD is beyond the financial limits of economically weaker elderly patients.

The first evidence in the literature about the use of a single implant to retain the mandibular overdenture was published in 1993 by Cordioli *et al.*^[13] in Italy. The same authors published a report with a follow-up of 5 years in 1997.^[14]

Recent studies have documented that the use of a single implant to retain the denture as satisfactory in blinded clinical studies. The literature available about the concept is very limited. The surgical technique for placement is relatively less challenging and has the least probability of endangering any vital structure because of its distance from the mental foramen.

Of the 20 studies which were reviewed, all the clinical trials had a follow-up period of a minimum 12 months. The clinical studies conducted, and the results obtained by the researchers are listed in Table 2a and 2b. In all the included studies, the implants were placed with an elevation of mucoperiosteal flap except for one patient in one study^[23] where owing to lack of keratinized mucosa, a flapless technique was used. Ball attachments were the standard attachments used in most of the publications studied except for two studies,^[11,24] where the locator attachments and magnet attachments were evaluated. A strange irony, however, was that the SIROD, which is an economically viable option is still not yet practiced in the developing countries.

The literature available on the SIROD is analyzed in the following criteria:

- Type of study design
- Sample size
- Surgical protocol
- Implant characteristics
- Loading protocol
- Period of Follow-up
- Success rate of the implant/prosthesis
- Attachment design
- Mechanical factors: Retention and stability
- Chewing ability
- Prosthesis maintenance
- Patient satisfaction
- Complications
- Cost comparison.

Type of study design

Most of the studies included were clinical trials. Of these 11 studies (55%) had a prospective study design and followed the subjects after the intervention. Two studies (10%) were randomized clinical trials. One study (5%) was a retrospective study.

Five studies (25%) were *in-vitro* studies carried out with the help of simulated models. All the studies were unicentric in nature in their location. The study design has to be multi-centric and in tune with the international standard to validate a new treatment concept/modality.

Sample size

The sample sizes in these studies were a varied one. The largest sample size for a SIROD was of 42 in a study by Walton and Glick.^[9] The smallest sample size of 2 in a clinical report by Wolfart *et al.*^[21] The mean sample size for the study groups was 27.41. The mean age of these samples ranged from 53.2 to 82.2 years. The mean age of all the study groups used in this review was 68.28 years. The need was felt for studies with larger sample sizes to authenticate the treatment protocol.

Surgical protocol (flap technique and single stage/two stage)

In all the studies reviewed all the implants were placed with flap elevation technique, only 1 implant in one study was placed with flapless technique.^[23] Eight studies (40%) followed a single stage, nonsubmerged procedure. Two studies (10%) had a second stage surgery after a healing period of 3 months. There seems to be a widespread preference for single stage protocol with a flap elevation technique. A need for a study was felt to validate a simple surgical technique of flapless, single stage surgery for implant placement.

Implant characteristics

All the implants used in the studies were conformity Europe and Food and Drug Administration certified. In a majority of cases (40%) implant of 3.2–4.2 mm (regular diameter) were used. However, Nabeel and associates^[15,26] have used a wide diameter (>5 mm) implant in the symphyseal region in their studies and have come up with the success of the restoration anchored with these implants. The implants were surface treated in most cases (50%) but a few machined surface implants (10%) were also placed. It is conclusive to note that the machined surface implants eventually failed in a few studies and increased the failure rate of these particular studies. These had to be replaced or eliminated from the study.

Loading protocol

Four of the clinical studies (20%) had a conventional delayed loading protocol for the SIROD. Implant was loaded after a healing period of 3–4 months. Most of the studies followed either with an early loading or immediate loading protocol.

Table 2a: Clinical studies included in the review

Authors/journal	Country of origin	Type of study	Sample size	Loading protocol*	Implant make	Attachments^	Objective of the study	Conclusion
Alsabeeha <i>et al.</i> ^[15] COIR 2011	New Zealand	RCT	36	E	Southern wide, Southern regular, Neoss	B L	Marginal bone loss, stability, implant, and prosthesis success rate	Mandibular single implant therapy is a successful, treatment protocol for elderly
Walton <i>et al.</i> ^[9] IJP 2009	Canada	RCT	42	E	SLA Straumann	B	VAS score of the patient satisfaction b/n single and two implant supported	Reduced treatment costs, time for surgery and prosthesis
Alsabeeha <i>et al.</i> ^[16] COIR 2010	New Zealand	Prospective	36	I	Southern wide, Southern regular Neoss	B L	ISQ values for primary stability	significant satisfaction Host site variables do not influence the primary stability of the implant
Liddelw and Henry ^[17] IJP 2010	Australia	Prospective	35	E	MK III-oxidized MK III-machined	B	Clinical assessment	Single implant overdenture is a beneficial treatment with minimal financial outlay
Harder <i>et al.</i> ^[18] J dent 2011	Germany	Prospective	11	E	Camlog	B	Clinical outcome, subjective chewing ability (VAS)	Successful treatment option
Krennmair and Ulm IJOMI ^[19] 2001	Austria	Prospective	9	C	IMZ or Frialit	B	Patient response Bone loss	Economic treatment for octogenarian geriatric patients
El-Sheikh <i>et al.</i> ^[20] IJD 2012	Egypt	Prospective	20	E	SLActive	B	Marginal bone loss, VAS satisfaction scores	Safe, reliable cost effective treatment
Wolfart <i>et al.</i> ^[21] QI 2008	Germany	Prospective	2	C	Camlog	B	Periotest values	Early results were promising
Kronstrom <i>et al.</i> ^[22] IJOMI 2009	Canada	Prospective	36	I	Nobel TiUnite	B	Success rate	Immediate loading with caution as there is a high risk of failure
Cordioli <i>et al.</i> ^[14] JPD 1997	Italy	Prospective	21	C	3i	B	Implant success rate, periodontal parameters	Low treatment cost and low prevalence of postsurgical complications
Liddelw and Henry ^[23] JPD 2007	Australia	Prospective	28	I	Branemark MK III	B	Subjective VAS, marginal bone loss stability measurements	Safe, reliable cost effective treatment
Cheng <i>et al.</i> ^[11] J Dent Sci 2012	China	Prospective	13	E	Nobel TiUnite Straumann	L M	Chewing efficiency in conventional and SIROD	Both magnets and locator are equally efficient
Cheng <i>et al.</i> ^[24] J Dent 2012	China	Prospective	15	E	Straumann	L M	Chewing efficiency	Both magnets and locators are equally efficient
Gonda <i>et al.</i> ^[25] JPD 2010	Japan	Retrospective	42	C	Straumann	B	Fracture Incidence in the overdentures	SIROD and two implant overdentures had similar fracture incidences
Alsabeeha <i>et al.</i> ^[26] COIR 2009	New Zealand	Review	6 studies	Variable	Variable	Variable	Review literature Bring forth a novel concept of using wide diameter implant	SIROD is a successful treatment outcome needs validation

*Loading protocol E: Early, I: Immediate, C: Conventional, ^ Attachments B: Ball, L: Locator, M: Magnet. RCT: Randomized clinical trial, VAS: Visual analog scale, SIROD: Single implant retained overdenture, ISQ: Implant stability quotient

Seven studies (35%) proceeded with an early loading protocol for the SIROD. In three studies (15%) immediate loading protocol was followed. Prospective clinical studies by Liddelw and Henry^[17,23] Kronstrom *et al.*^[22] Ali M Sheikh *et al.*^[20] Nabeel Alsabeeha *et al.*^[16] with a follow-up period of 1-year support the evidence that the immediate and early loading with the SIROD is a successful procedure. However, Kronstrom *et al.*^[22] concluded that the immediate loading of a single

complete denture should be proceeded with caution as there is a higher expectation of failure. These authors, however, have not compared the success rates of immediate loading with that of success rates of TISOD. The studies are limited to a period of 1-year which is inadequate to report the longevity of the implant/prosthesis. Further, long-term studies are required to validate the fact that immediate loading can be a safe option for the SIROD.

Table 2b: *In vitro* studies and case reports included in the review

Authors Journal	Country of origin	Type of study	Sample size	Loading protocol	Implant make	Attachments	Parameter assessed	Conclusion
Alsabeeha et al. ^[27] IJP 2011	New Zealand	<i>In vitro</i>	36	-	Analogs	B L	Wear of attachment	Large ball attachment favorable for the single implant denture
Maeda et al. ^[28] COIR 2008	Japan	<i>In vitro</i>			Analogs	B M	Biomechanical rationale with SIROD using different attachments	Dome shaped magnet or ball attachment similar to two implant overdenture
Alsabeeha et al. ^[29] IJP 2010	New Zealand	<i>In vitro</i>	30	-	Analogs	B L	Retentive force	Large ball attachments are more retentive than standard and locator attachments
Żmudzki et al. ^[12] Archives of material sciences 2011	Poland	3D-FEM study	1 FEM model with standard and silicone attachment	-	Mini implant	B	Lateral force dissipation	Silicone attachments dissipate lateral forces better
Liu et al. ^[10] J Dent 2012 (in press)	China	3D-FEM study	4 FEM models with respective number of implants	-	Straumann	L	Biomechanical behavior of denture	SIROD do not show damaging strains, cost effective treatment

FEM: Finite element model, SIROD: Single implant retained overdenture, B: Ball, L: Locator, M: Magnet

Period of follow-up

Studies reviewed had a least follow-up period of 1-year and a maximum follow-up period of 5 years. Six studies (30%) followed up their subjects for the least period of 1-year. One study (5%) followed up the subjects and reported the observations for 18 months. Only 3 (15%) had a follow-up of more than 2 years out of which two studies (10%) followed up for 3 years and 1 (5%) with a follow-up period of 5 years. In all the studies, the follow-up interval was quarterly. Three studies (15%) had no provision for follow-up in their study design. On the other hand, the TISOD has been proved to be a relatively successful implant treatment option by both retrospective and prospective studies and their success rates over the years of follow-up which exceed 10 years.^[30,31] However, there is no study regarding SIROD to provide evidence of success as comparable to TISOD with a follow-up period of equal to or more than 10 years.

Success rates

An implant overdenture success rate depends on the both the success of the implant and the success of the prosthesis. The implant should meet the success criteria as suggested by Albrektsson et al.^[32] in 1986. Of the 20 studies included in the review 12 (60%) were of *in-vivo* nature. Of this eight studies (66.66%) reported 100% success rate and four studies (33.33%) had failures of varying degrees. Out of the 346 implants placed to retain denture the implants which survived were 336. Therefore, the implant success rate, on the whole, was 97.68%. Yet the evidence of the long-term success of the implants used to retain the SIROD is limited. Four studies (20%) reported implant failures. A maximum failure of three implants was reported by Liddlelow and Henry^[17] who used machine turned implant. A similar failure was reported by Kronstrom et al.^[22] as well. However, the implants declared as successful do not meet the widely accepted Albrektsson's^[32]

long-term success criteria to be declared as clinically successful in the present scenario. Table 3 gives the various implant and peri-implant parameters assessed by the clinical studies. The implants seem to be successful in the time frame of the respective study, but the long-term success of these restorations were inconclusive. Further longitudinal studies including all the parameters of the success of an implant need to be carried out.

Attachment design

17 out of 20 studies (85%) have reported the use of the standard ball attachment or the Dalbo attachments for the SIROD. Only two studies^[11,24] (10%) have reported the use of attachments other than ball attachments in their study. One study^[10] (5%) reports the use of locator attachments. An *in-vitro* comparison of the ball and locator attachments for the retention was reported by Nabeel and associates.^[29] Tao Cheng^[11] and associates evaluated the objective and subjective chewing ability with the SIROD in 13 subjects in a cross over the trial to measure the efficacy of the locator and the magnet retained overdenture. The authors reported that both the attachment designs were equally efficient both objectively and subjectively over the conventional dentures.

A three-dimensional FEM study by Żmudzki^[12] recommended the use of a silicone attachment to reduce the "funnel shaped bone loss" which was reported with the SIROD in the same study by the authors. The authors noted that a silicone attachment could dissipate the lateral oblique masticatory forces as well and minimal amount of stresses to the transferred a very crestal bone. The ball attachment was proved to be a successful attachment to be used as the preferred one.

Retention and stability

The use of an attachment enhances the retention of the prosthesis. The value of retention varies from the type of

Table 3: Parameters assessed in clinical studies

Authors/study	Marginal bone loss	Implant stability Osstell (O)/periostest (P)	Soft tissue conditions	Implant success rates	Prosthesis success rates	Maintenance or complications reported
Cordioli <i>et al.</i> ^[14] JPD 1997	✓	✓ (P)	✓			
Kronstrom <i>et al.</i> ^[22] IJOMI 2010	✓	✓		✓		
Krennmair and Ulm ^[19] IJOMI 2001	✓	✓ (P)	✓			
Wolfart <i>et al.</i> ^[21] QI 2008		✓ (P) (O)				
Liddelw and Henry ^[23] JPD 2007	✓			✓	✓	✓
Harder <i>et al.</i> ^[18] J DENT 2011		✓ (P)		✓	✓	✓
El-Sheikh <i>et al.</i> ^[20] Int J Dent 2012	✓	✓	✓			✓
Alsabeeha <i>et al.</i> ^[15] COIR 2011	✓	✓		✓	✓	✓
MacEntee <i>et al.</i> ^[19] IJP 2009					✓	✓
Liddelw and Henry ^[17] IJP 2010	✓	✓				✓
Alsabeeha ^[16] COIR 2010		✓				
Gonda <i>et al.</i> ^[25] JPD 2010						✓
Cheng <i>et al.</i> ^[24] J Dent 2012					✓	✓
Cheng <i>et al.</i> ^[11] J Dent Sci 2012					✓	
Total percentage of studies using the above said parameters	50	64.28	21.42	28.57	42.85	45.85

retention system used. Nabeel Alsabeeha *et al.*^[29] in their *in-vitro* study of various attachments, compared the retention values and force required to completely dislodge the denture. They compared the retention force between the large ball attachment (diameter 5.9 mm, 7.9 mm) and the standard ball (2.25) and stud attachments available. The retention forces required to dislodge a denture with a 7.9 mm large ball attachment were 36.97 ± 2.23 N, and for 5.9 mm ball was 32.06 ± 2.59 N, and the values for regularly used standard abutment ball 17.32 ± 3.68 N and locator attachments with white O-ring 12.39 ± 0.55 N, pink O-ring 9.40 ± 0.74 N, blue O-ring 3.83 ± 0.64 N, respectively. However, the use of a large ball attachment for single implant in the mandibular anterior region is questionable. There is no *in-vivo* study available in the literature. Further *in-vivo* and *in-vitro* studies are required to know the prosthodontic outcomes of these attachments.

Chewing ability/quality of life

The chewing ability of the patient, by the incorporation of the single implant in the mandibular overdenture, had increased manifold as is evident by three studies.^[11,21,24] Wolfart *et al.*^[21] in their case report and Tao Cheng *et al.*^[11,24] in their two studies reported the objective chewing efficiency by a graded sieve test. The results of the studies state that the chewing ability of the

elderly individual improved significantly with the use of SIROD when compared to conventional dentures.

The studies by Wolfart^[21] and Sonke Harder^[18] highlight the fact that a SIROD is better in improving the quality of life of an edentulous individual than a conventional complete denture. Authors found that the patient ratings for pain and discomfort and social disability, favored the SIROD indicating the sense of well-being presented by the patients after wearing these dentures supported by implants. One clinical report of nine geriatric patients by Krennmair *et al.*^[19] treated with SIROD states that a single implant was enough to rehabilitate the geriatric patient. On recall examinations, the peri-implant soft-tissue conditions and bone conditions stabilized after 6 months. The patient acceptance and the quality of life were improved to a greater extent. The authors concluded that the SIROD could be an economic alternative for an octogenarian patient. However, there is no comparative study to evaluate the performance of SIROD with that of TISOD, which is considered international standard for edentulous mandible restoration.^[5-7]

Prosthesis maintenance

An important aspect of any prosthesis is the long-term success of the restoration and the least possible maintenance complications. It is a well-known notion that the 1st year of

service is the most critical for the maintenance of the implant overdenture.^[33,34] 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.

There is a high risk of overdenture fracture if there is insufficient space to accommodate the attachment height.^[34] Fracture incidence of overdentures retained by one and two implants was studied by Gonda *et al.*,^[25] who concluded that there was no difference in the incidence rate of fractures in both the given situations.

Wear of the attachments is a common finding in the prolonged use of an overdenture. The wear of the O-ring and the replacing of the nylon caps were a frequent phenomenon in the maintenance of the overdenture. Nabeel Alsabeeha *et al.*^[27] in their *in-vitro* study, on the wear properties of attachment under SIROD after a 1-year clinical usage, compared three attachments and found that large ball attachment had minimal replacements when compared to ball attachment with Dalla Bona-type gold alloy matrices. The authors further found that a titanium nitride coating would reduce the wear of the attachment and enhance the prosthesis longevity.

Maeda *et al.*^[28] in their *in-vitro* study to evaluate the biomechanical rationale for SIROD concluded that that SIROD with dome-type magnet or ball attachments had biomechanical effects similar to TISOD in terms of lateral forces to the abutment and denture base movements under molar functional loads.

Patient satisfaction.

Although logically less retentive when compared to the TISOD, the SIROD reported equally acceptable satisfaction. Seven clinical studies (35%) assessed the patient satisfaction with SIROD and conventional dentures with a visual analog scale test (VAS). Walton and Macentee^[9] compared the treatment costs and the prosthetic outcome of the TISOD and SIROD. The same authors in the same study, also compared the satisfaction levels of the patients in the two groups with a VAS score and concluded that the SIROD costed half as much as the two implant supported and the patient satisfaction was statistically significant.

Complications

Failures of implants were considered the most important complication surgically, and denture fracture was considered a most important complication prosthetically.

Out of the 346 implants placed in all the studies, a total of 8 implants failed (2.31%). Surgical failures were reported in

four clinical studies (20%) in varying degrees. Three implants failed in two studies each after implant placement with immediate loading, and other studies reported the failure of one implant postimplant placement prior to loading. Prosthetic failure was reported by two clinical studies (10%). Nine studies (45%) reported success rates of nearly 100% without any complications or failures. This shows that SIROD is a successful treatment option with very few reported failures surgically or prosthodontically.

Cost comparison

The two implant overdenture is a successful outcome, but the initial expenditure and the maintenance costs after delivery of the prosthesis makes it unaffordable for many financially challenged elderly individuals. A study by Takanashi *et al.*^[8] reported that the fabrication cost of TISOD was 2.4 times that of the conventional denture. A SIROD, however, could be of use to give a better treatment to the economically challenged edentulous patient. A study by Walton and Macentee^[9] compared the treatment costs of overdentures supported by one or two implants. The study also estimated the chair side time involved in the fabrication of each. The two implant overdenture costed 1.75 times more than SIROD. The authors concluded that the SIROD was an economical and satisfactory treatment outcome. The SIROD can be an economically viable option considering the cost of the two implant overdenture.

CONCLUSION

An overwhelming majority of the studies have reported surgical as well as the prosthetic success of the SIROD. Patient satisfaction and chewing ability were also reported to be greater than the conventional dentures. Implant survival rate seemed to be high with the SIROD, and no association was found between the implant failures and the type of surgery, implant type, and dimensions of implants. Some studies reported SIROD to be at par with the TISOD in terms of patient satisfaction and prosthodontics complications. Further, all the studies were short-term studies, and none of these studies followed the existing protocol for evaluation to be declared as an acceptable, successful treatment outcome. However, a need was felt for a multi-centric long-term prospective study to validate the treatment protocol to report a definitive improvement in parameters such as masticatory efficiency, bite force generated, retentive force, and stability factors.

Financial support and sponsorship

Nil.

Conflicts of interest

There are no conflicts of interest.

REFERENCES

1. Petersen PE, Kandelman D, Arpin S, Ogawa H. Global oral health of older people – Call for public health action. *Community Dent Health* 2010;27 4 Suppl 2:257-67.
2. Carlsson GE. Clinical morbidity and sequelae of treatment with complete dentures. *J Prosthet Dent* 1998;79:17-23.
3. van Waas MA. The influence of clinical variables on patients' satisfaction with complete dentures. *J Prosthet Dent* 1990;63:307-10.
4. Melescanu Imre M, Marin M, Preoteasa E, Tancu AM, Preoteasa CT. Two implant overdenture – The first alternative treatment for patients with complete edentulous mandible. *J Med Life* 2011;4:207-9.
5. Feine JS, Carlsson GE, Awad MA, Chehade A, Duncan WJ, Gizani S, *et al.* The McGill consensus statement on overdentures. Mandibular two-implant overdentures as first choice standard of care for edentulous patients. Montreal, Quebec, May 24-25, 2002. *Int J Oral Maxillofac Implants* 2002;17:601-2.
6. Feine JS, Carlsson GE, Awad MA. The McGill consensus statement on overdentures. *Quintessence Int* 2003;34:78-9.
7. Thomason JM, Feine J, Exley C, Moynihan P, Müller F, Naert I, *et al.* Mandibular two implant-supported overdentures as the first choice standard of care for edentulous patients – The York Consensus Statement. *Br Dent J* 2009;207:185-6.
8. Takanashi Y, Penrod JR, Lund JP, Feine JS. A cost comparison of mandibular two-implant overdenture and conventional denture treatment. *Int J Prosthodont* 2004;17:181-6.
9. Walton JN, Glick N, Macentee MI. A randomized clinical trial comparing patient satisfaction and prosthetic outcomes with mandibular overdentures retained by one or two implants. *Int J Prosthodont* 2009;22:331-9.
10. Liu J, Pan S, Dong J, Mo Z, Fan Y, Feng H. Influence of implant number on the biomechanical behaviour of mandibular implant-retained/supported overdentures: A three-dimensional finite element analysis. *J Dent* 2013;41:241-9.
11. Cheng T, Ma L, Ling XL. Use of a single implant to retain mandibular overdenture: A preliminary clinical trial of 13 cases. *J Dent Sci* 2012;7:261-6.
12. Żmudzki J, Chladek G, Kasperski J. Silicone attachment for avoidance of bone tissue overloading in single implant-retained denture. *Arch Mater Sci Eng* 2011;2:107-15.
13. Cordioli GP. Mandibular overdentures supported by a single implant. *Minerva Stomatol* 1993;42:469-73.
14. Cordioli G, Majzoub Z, Castagna S. Mandibular overdentures anchored to single implants: A five-year prospective study. *J Prosthet Dent* 1997;78:159-65.
15. Alsabeeha NH, Payne AG, De Silva RK, Thomson WM. Mandibular single-implant overdentures: Preliminary results of a randomised-control trial on early loading with different implant diameters and attachment systems. *Clin Oral Implants Res* 2011;22:330-7.
16. Alsabeeha NH, De Silva RK, Thomson WM, Payne AG. Primary stability measurements of single implants in the midline of the edentulous mandible for overdentures. *Clin Oral Implants Res* 2010;21:563-6.
17. Liddelov G, Henry P. The immediately loaded single implant-retained mandibular overdenture: A 36-month prospective study. *Int J Prosthodont* 2010;23:13-21.
18. Harder S, Wolfart S, Egert C, Kern M. Three-year clinical outcome of single implant-retained mandibular overdentures – Results of preliminary prospective study. *J Dent* 2011;39:656-61.
19. 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;16:98-104.
20. El-Sheikh AM, Shihabuddin OF, Ghoraba SM. A prospective study of early loaded single implant-retained mandibular overdentures: Preliminary one-year results. *Int J Dent* 2012;2012:236409.
21. Wolfart S, Braasch K, Brunzel S, Kern M. The central single implant in the edentulous mandible: Improvement of function and quality of life. A report of 2 cases. *Quintessence Int* 2008;39:541-8.
22. Kronstrom M, Davis B, Loney R, Gerrow J, Hollender L. A prospective randomized study on the immediate loading of mandibular overdentures supported by one or two implants: A 12-month follow-up report. *Int J Oral Maxillofac Implants* 2010;25:181-8.
23. Liddelov GJ, Henry PJ. A prospective study of immediately loaded single implant-retained mandibular overdentures: Preliminary one-year results. *J Prosthet Dent* 2007;97 6 Suppl:S126-37.
24. Cheng T, Sun G, Huo J, He X, Wang Y, Ren YF. Patient satisfaction and masticatory efficiency of single implant-retained mandibular overdentures using the stud and magnetic attachments. *J Dent* 2012;40:1018-23.
25. Gonda T, Maeda Y, Walton JN, MacEntee MI. Fracture incidence in mandibular overdentures retained by one or two implants. *J Prosthet Dent* 2010;103:178-81.
26. Alsabeeha N, Payne AG, De Silva RK, Swain MV. Mandibular single-implant overdentures: A review with surgical and prosthodontic perspectives of a novel approach. *Clin Oral Implants Res* 2009;20:356-65.
27. Alsabeeha NH, Swain MV, Payne AG. Clinical performance and material properties of single-implant overdenture attachment systems. *Int J Prosthodont* 2011;24:247-54.
28. Maeda Y, Horisaka M, Yagi K. Biomechanical rationale for a single implant-retained mandibular overdenture: An *in vitro* study. *Clin Oral Implants Res* 2008;19:271-5.
29. Alsabeeha N, Atieh M, Swain MV, Payne AG. Attachment systems for mandibular single-implant overdentures: An *in vitro* retention force investigation on different designs. *Int J Prosthodont* 2010;23:160-6.
30. Verduyck M, Marcelis K, Coucke W, Naert I, Quirynen M. Long-term, retrospective evaluation (implant and patient-centred outcome) of the two-implants-supported overdenture in the mandible. Part 1: Survival rate. *Clin Oral Implants Res* 2010;21:357-65.
31. Visser A, Meijer HJ, Raghoebar GM, Vissink A. Implant-retained mandibular overdentures versus conventional dentures: 10 years of care and aftercare. *Int J Prosthodont* 2006;19:271-8.
32. Albrektsson T, Zarb G, Worthington P, 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.
33. Trakas T, Michalakis K, Kang K, Hirayama H. Attachment systems for implant retained overdentures: A literature review. *Implant Dent* 2006;15:24-34.
34. Karabuda C, Yaltirik M, Bayraktar M. A clinical comparison of prosthetic complications of implant-supported overdentures with different attachment systems. *Implant Dent* 2008;17:74-81.