Evidences of Applicability of Implant Supported Overdentures during Present Decade; A Review

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ABSTRACT

Implant overdenture was believed to be introduced since 40 years ago and showed various clinical success rate for a long time. In 2002 and 2009, there was an alternative treatment option approved for the rehabilitation of edentulous mandible rather than complete denture. Then implant overdentures showed a lot of high success rate in almost all aspects by various reliable reports over time gradually. This review aimed to collect and evaluate the updated evidences which developed increasingly in present decade and to be a brief clinical introduction for treatment options of edentulous patients.

INTRODUCTION

Successful reports for implant supported overdenture [IOD] were published since four decades ago (Misch, 2015). According to "McGill consensus 2002" and "York consensus 2009", mandibular two implant supported overdenture became a standard of choice for edentulous mandible (Feine et al., 2002; Thomason et al., 2009). Along with the evidences, implant overdenture showed superior results than conventional denture in many aspects. IOD was approved for improved masticatory functions and ability by functional assessment methods (Bae et al. 2015; Neto et al. 2012; Hasan et al. 2016). It showed significant improvement on chewing ability and food habits (Awad et al. 2012). Also muscle electromyrography approved that there is improved muscle activity for IODs (Sônego et al. 2016; Uram-Tuculescu et al. 2015). Comparison of improvement of dietary intake between patients who worn IODs and who worn conventional denture [CD] showed that IOD has moderate dietary improvement than CD (Moynihan et al. 2012).

Although effectiveness of prosthodontic treatments were previously measured by the results of clinical outcomes in the past, patient based measurement became an effective tools simultaneously with patient centered care. Conceptual change was based on the reason that there is poor association between the clinical qualities of prosthesis assessed by clinician or clinician's opinion and patient's satisfaction (Feine and Carlsson 2003). Many Reports have shown that most patients prefer IOD than CD. G. Sivaramakrishnan and K. Sridharan (2016) made a meta-analysis and concluded that IODs performed better than CDs in improving of quality of life (Sivaramakrishnan & Sridharan 2016). Studies concerning IOD were reviewed and approved that it showed satisfactory result in retention, stability and satisfaction for mandibular edentulous jaws (Andreiotelli et al. 2010; Carlsson 2014). But maxillary IODs showed lower rate of implant survival and high prosthetic complications (Andreiotelli et al. 2010).

This literature review aimed to summarize the studies of implant overdenture which were published during this decade and to be a reliable reference for choice of treatment and clinical decision making.

Literature Review

(i) Maxillary implant supported overdenture

The first report for maxillary complete IODs was reported in 1980s (Sadowsky & Zitzmann 2016). Most of previous evidences for maxillary IODs were inconsistent. The survival rate of maxillary IODs was less than mandibular IODs relatively (Dudley 2013). But during present decade, many experiments and designs had been investigated to improve the success of maxillary IODs.

Although two or one implant is enough to retain the mandibular IODs, maxillary IOD need 4 or more implants for enough retention and stress distribution. Minimum 4 implants usually and 6 implants in case of severely resorbed ridge was recommended by Raghoebar et al. (2014). Slot et. al. (2013) proved that maxillary IOD supported by six implants was the best followed by maxillary IOD supported by four implants in analyzing survival rate for 5 years. And also they found that limited marginal bone loss and high patient satisfaction in both study groups. (Slot et al. 2013) And also Payne et al. (2004) found that the survival rate of implant in maxillary IOD supported by three implants 3 IODs was under 85% (Payne et al. 2004).

Regarding with designs of maxillary IODs, many studies supported the splinted design by using bar attachments. Raghoebar et. al. (2014) made a systematic review and concluded that high implant and prosthesis survival rate was found in the cases with bar attachments for both 4 implants and 6 implants supported IOD groups. Slot et. al. (2010) stated that maxillary IOD supported by 6 implants with splinted design had greatest success followed by 4 implant supported IODs with splinted design. (Slot et al. 2010) And Raghoebar et. al. (2014) approved that 4 or less implants with ball attachments (unsplinted design) are not satisfactory due to least successful result (Raghoebar et al. 2014). Although unsplinted design is good for economic concern, ease of hygiene and needed less space for prosthesis and attachment, splinted design with bar showed greater clinical success (Dudley 2013). Recently, Sadowsky & Zitzmann et. al. (2016) recommended a protocol for maxillary IODs including; four to six implant supported maxillary IOD is suggested for clinical success, unsplinted design can result higher failure rate than splinted design although the latter need higher maintenance and high rate of soft tissue inflammation around bar, palateless design is recommended and patient has to follow long term regular maintenance. And the design of maxillary IODs should be maintainable, retrievable, repairable, or replaceable (Sadowsky & Zitzmann 2016).

(ii) Numbers of supported implants for mandibular implant overdenture

Although two or four implants were usually used to support for mandibular IODs, two implants became a reliable quantity for sufficient support after McGill and York Consensus. In a systematic review of Lee et. al. (2012), they found the survival rate of implants is almost 100% for 2 and 4 implants and 81.8% to 96.1% for 1 and 2 implants in six reports (Lee et al. 2012). Numbers of implants for IOD seem to have effect on retention and stability of prosthesis. Based et. al. (2013) reported that increased resistance for dislodgement is attained by increased number of implants (Based et al. 2013). Oda et. al. (2016) found that two implants could result easier rotation of mandibular IOD during mastication by the lower incisors than one and three IODs. There was small horizontal movement of IOD than vertically (Oda et al. 2016).

Most of the studies concluded that the numbers of supported implants has no correlation with clinical outcomes such as implant survival rate, marginal bone loss, prosthetic complication (Lee et al. 2012; Byrne 2015) and patients' satisfaction and quality of life (Kuoppala & Näpänkangas 2013; Balaguer et al. 2011), But a study reported that 4 IODs showed higher score for Oral Health related Quality of Life [OHRQoL]

than 2 IODs (Karbach et al. 2015). Byrne (2015) concluded after reviewing the studies that there is no optimal number of implants for the mandibular IODs (Byrne 2015).

During this decade, single implant supported overdentures [SIOD] became a highly suggested treatment option for mandibular edentulous jaw because of its advantages relatively. Lee et. al. (2012) stated that SIODs could save time around 20% in clinical steps and also it is really cost-effective, non-invasive and acceptable prognostic option so far (Lee et al. 2012).

(iii) Mandibular single implant overdenture (SIOD or 1-IOD)

This treatment option has been accepted as an alternative to two IOD because of its advantages; low cost, minimal trauma and less post-surgical maintenance. And there is no significant difference for success and failure rate between 1 and 2 IODs (Alqutaibi 2016). Patients' satisfaction and OHRQoL is comparable with 2 IOD treatment (El-Sheikh et al. 2012; Harder et al. 2011; Liddelow & Henry 2010; Tavakolizadeh et al. 2015) In two clinical studies, mean marginal bone loss of SIODs after one year were 0.19 mm (Alsabeeha et al. 2011) and less than 1 mm (El-Sheikh et al. 2012). Adjustment of the attachment, denture relining and fracture of denture base are frequent complications for prosthodontic maintenance in SIODs. (Harder et al. 2011; Passia et al. 2014)

Although there are satisfactory results and reports, the limitation is still present such as the position of implant placement and surgical risk. Severely resorbed ridge has probability of insufficient bone volume for implant in some dimension and sometimes it is dangerous for perforation and injury of vessel in symphesial region (Lee et al. 2012; Alsabeeha et al. 2009; Woo et al. 2006). Though clinical studies supported SIOD so far, more evidences are still needed to claim it.

(iv) Implant loading protocols

Most of the clinicians prefer immediate loading than early and conventional loading for IOD. There were a lot of studies investigated for patients' reported outcomes and clinical outcomes by comparing the loading protocols especially immediate loading and early or conventional loading for mandibular IODs. Immediate loading showed comparable results with conventional loading protocol and successful option with improved clinical outcomes, patients' satisfaction and quality of life through many studies (Emami et al. 2016; Zygogianniset al. 2016; Turkyilmaz et al. 2002). Also comparison among immediate, early and conventional loading showed comparable successes up to 2 years (Alsabeeha et al. 2010).

Ter Gunne et. al. (2016) reported that mean marginal bone loss for immediate loading of mandibular 2 IOD was 0.25 ± 0.63 mm and for early loading was 0.31 ± 0.96 mm after 3 years of treatment (Ter Gunne et al. 2016). And also 97.1% of success rate, 1.46 mm mean bone loss and 2.22 mm mean probing depth were found in a study of immediate loading of 2IODs which had used for 48 months (Zancope et al. 2014). There was significant difference between the marginal bone loss at baseline and after 48 months. Although loading protocols showed comparable results, early and conventional loading seem to be better and safer than immediate loading to result less early implant failure. Immediate loading for SIOD is not recommended until further evidence is available (Schimmel et al. 2014). For maxillary IOD, immediate loading is still questionable (Goiato et al. 2014).

(v) Mini-Implant Overdenture

In the "Glossary of Oral and Maxillofacial Implants", min-implant was defined as "implant fabricated of the same biocompatible materials as other implants but of smaller dimensions. Implant can be made as one piece to include an abutment designed for support and/or retention

of a provisional or definitive prosthesis"(Bidra & Almas 2013). Most commonly used mini-implants were with diameter ranging from 1.8 mm to 2.9 mm.

Mini IODs became an alternative treatment option for the edentulous mandible because it is suitable for limited anatomical condition and economically reasonable. Many clinical reports showed the high success rate of mini IOD treatment. Implant survival rate around 90% to 100% was reported after 7 years uses (Catala'n et al. 2015; Schwindling & Schwindling 2015) in which one of studies Catala'n et al., (2015) used 2 mini IOD only. Mean Bone loss of 1.04 mm after 18 months use of 4 mini IODs (Zygogianniset al., 2016), 1.2 mm after 24 months use of 4-5 mini IODs (Temizel et al. 2016) were also respectively reported. These values are comparable with conventional IODs.

Higher patient satisfaction and OHRQoL was found through studies of (Zygogiannis, Wismeijer & Parsa 2016; Elsyad 2015). Prosthetic complications are like the conventional IODs; attachment wear, relining and denture fracture (Elsyad 2015; Schwindling & Schwindling 2015). Both mini-implants and conventional implants can be used for IOD patients regardless of bone volume and density but mostly, mini-implant is preferable for narrow and resorbed ridge. Many longitudinal studies stated that mini IOD has great effectiveness in mastication, speaking, esthetic and patient satisfaction and those are increasing with time (Temizel et al. 2016; Schwindling & Schwindling 2015). However, stability and retention in the case of maxillary IOD decreased with time (Temizel et al. 2016).

(vi) Attachments

Three main groups of attachment type; Bars, Studs and Magnet are well categorized for IOD attachments for a long time. Among them, Bars seem to be the strongest for retention (Savabi et al. 2011; Takeshita et al. 2011; Botega et al. 2004; Van Kampen et al. 2003; Williams et al. 2001). But in some studies, locator attachment showed higher retention than bar (Uludag et al. 2014; Evtimovska et al. 2009). However, in all attachments, retention is gradually lost after repeated insertion and removal and over time of use (Srinivasan et al. 2015; Kim et al. 2015; Tabatabaian et al. 2010; Silva et al. 2015; Bazar Amarsanaa, Hiroshi Mizutani, Hidekazu Takahashi 2009).

According to the setting of bars, it is unfavorable for cleansing action and will lead to peri-implantitist or perimucositist due to poor hygiene (Karabuda et al. 2008; Payne AG, Solomons 2000). Ball attachments can deform gradually with time of use and will lose sufficient retention (ELsyad et al. 2015; Fromentin et al. 2012; Karabuda et al. 2008). Cracker et. al.(2011) showed that locator has superior clinical result than ball and bar attachments with regard of prosthodontic maintenance and complications (Cakarer et al. 2011). And locators showed lower plaque accumulation and lower interlukin 1b concentration in peri-implant crevicular fluid than magnet attachments in a study (Elsyad et al. 2015). Trakas et al (2006) pointed out that the correct implant placement influences on the maintenance of attachment systems and planning before placement should be emphasized with care. Bars and stud attachments are difficult to clarify which one needs more maintenance. Magnet always show corrosion and loose retention easier (Trakas et al. 2006).

For patients concerned factor, most of the studies provided that patients' satisfaction is not dependent on the types of attachments (Al-Zubeidi et al. 2012; Balaguer et al. 2011; Ritva Kuoppala , Ritva Näpänkangas 2013). Martínez-Lage-Azorín et. al. (2013) recommended that bar attachment system will be suitable in maxillary IODs because there can be some conditions like implant divergent placement, worse bone quality and choice of implant system due to anatomical requirements (Martínez-Lage-Azorín et al. 2013).

(vii) Masticatory Function

Most studies showed that masticatory performance increased significantly after implant treatment. Toman et al. (2012) used single sieving method to compare between CD and 2-IOD in a randomized controlled trial, and reported that the masticatory performance in patients with IOD was significant higher than that with CD. Sun et al. (2014) showed similar results in a pre-post clinical trial with masticatory performance increased significantly with 15.17% from pre- to post-implant. (Yunus et al. 2014) and (Bae & Jeong 2015) assessed masticatory efficiency of 2-IOD and CD using mixing ability index, and the results showed that significantly better mixing ability with IOD was noted, with the highest value observed after 1 year. Elioneide et al. (2011) reported that there was no statistically significant difference in masticatory efficiency between IOD and fixed implant-supported complete denture. A similar result was also stated by Müller et al. (2012). Although 2-implant overdenture is the first choice standard of care for edentulous patients (J Mark Thomason et al. 2009), 1-implant treatment also showed significantly better masticatory performance than CD, which was concluded in the study of Cheng et al. (2012) and Grover et al. (2014).

On the other hand, few studies revealed that there was no significant improvement after implant treatment. In a study of Neto et al. (2012), there was no significant statistical difference for masticatory efficiency between 2-IOD and CD. The authors suggested that IOD only benefited for a limited population having persistent functional problems due to severely resorbed mandible. The same results were showed in studies of Müller et al. (2013) and Enkling et al. (2016). However, the authors declaimed that most of the patients might have acquired inefficient chewing behaviors due to old mobile dentures, which compromised the effect of implant loading. Another explanation was that the study was statistically under-powered for the specific parameter chewing efficiency; therefore it cannot be concluded from the study that implant treatment had no effect on chewing efficiency.

In the light of previous studies, masticatory performance of implant overdenture compared to conventional complete denture remains a controversial issue. Besides, 1-IOD appears to warrant consideration as an alternative to the standard 2-IOD. Well-designed long-term trials about 1-IOD should be encouraged.

(viii) Cognitive Function Improvement

Recently a study of correlation between IOD treatment and cognitive function was published. MMSE (Mini-Mental State Examination) was used to assess cognition in that study and the mean score for complete edentulous state was 17.40, complete denture state was 18.30 and IOD state showed 23.8 (Banu et al. 2016). Although it was the only and pilot study, the possibility of improvement of cognitive function in edentulous patient by IOD become enlightened.

Conclusion

According to the overview of above literatures, IOD showed promising result as alternative solution for edentulous problem. Even though maxillary IOD was not satisfactory option, current evidence showed the improved results in almost all aspects. Two IOD is still a standard of choice for edentulous mandible then, 1 IOD is also thought to be a replaceable alternative option in very near future. During this decade, these developing evidences improved the clarity of a clinically successful avenue for edentulous patients.

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