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### RESEARCH ARTICLE

#### MINI-IMPLANT- VERSUS CONVENTIONAL IMPLANT-RETAINED MANDIBULAR OVERDENTURE IN COMPLETELY EDENTULOUS PATIENTS: A SYSTEMATIC REVIEW AND META-ANALYSIS.

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##### Key words:-

Mini Implant, Conventional Implant, Implant Mandibular Overdenture, Patient Satisfaction, Survival Rate, Marginal Bone Loss.

#### Abstract

**Purpose:** The aim of this study was to evaluate the impact of mini implant versus conventional implant mandibular overdenture on patients' satisfaction and survival and success rates.

**Material and methods:** A comprehensive electronic searching in PubMed and Cochrane databases up to March 2017 with language restriction to English only. We include randomized controlled trials compare between mini implant versus conventional implant regarding patient's satisfaction, survival rate, marginal bone loss and complications. In addition, a manual searching was performed for related journals from January 2013 to March 2017. A meta-analysis was performed on all included studies by using a random effect model [mean, 95% confidence intervals (CI)] to pool the effect size as a heterogeneity between studies was high ( $P < 0.0001$  and  $I^2 = 88\%$ ).

**Result:** Primary screening and manual searching result in 124 articles from which only 5 articles compatible with our inclusion criteria. No statistically significance was found between mini implant versus conventional implant mandibular overdenture regarding patient satisfaction, survival rate, marginal bone loss and fracture incidence (confidence interval CI=95 and  $p=0.39$ ).

**Conclusion:** There is no strong evidence to reveal that mini implant could be used in the same degree as conventional dental implant however mini dental implant could be used as an alternating choice to conventional dental implant.

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#### Introduction:-

Compromised retention, stability and support of conventional complete denture especially lower denture directly affect the patient confidence, function, comfort and bring a major challenge for prosthodontics. (Fitzpatrick BT 2006, Burns 2000)

(Burns 2000) concluded that bone reduction that occur in the alveolar ridge will result in diminished tissue mucosal support which adversely affecting functional properties of the denture ending in poorly fitted denture.

(Burns 2000) stated that utilizing dental implants to retain over-denture will provide excellent benefits than conventional denture essentially due to bone preservation around implant and inhibition of further bone loss. (Doundoulakis et al 2003) Stated that implant supported over denture have a higher success rate furthermore it promote patient satisfaction, denture retention and stability and they concluded that implant supported over-denture should be the first choice when treating completely edentulous patients.

(The McGill consensus) instituted that mandibular over dentures retained by two implants in the inter foramina area should be the first choice standard of care for the edentulous patient.(Feine et al 2002)

Overdentures supported by conventional implants display good long-term results however; some limitations are present such as: cost (Ribeiro et al 2015) difficulty with the implant insertion in reduced buccolingual dimensions of bone without the need for bone-grafting procedures (Aparecido et al 2016) and the occurrence of chronic systemic diseases that can preclude most progressive surgeries as bone grafts and lateralization of the inferior alveolar nerve (Aparecido et al 2016),(Preoteasa et al 2010).

Mini implants may be reflected as a treatment option for the rehabilitation of patients who have revealed dissatisfaction with conventional dentures and have limitations in the placement of standard implants (Aparecido et al 2016),(Bidra & Almas 2013),(de Souza et al 2015). Mini implants enable the use of less-complex surgical techniques since the reduced diameter of the implant permits its placement in areas with low bone thickness

On the other hand, there is no consensus supporting the use of mini implants to retain overdentures in the literature; some studies on this subject have verified great survival rates for overdentures retained by mini implants (Aparecido et al 2016),(Preoteasa et al 2014), and other studies have testified low survival rates compared with conventional implants (de Souza et al 2015).

Therefore, the goal of this systematic review was to verify the feasibility of using mini implants to retain overdentures. The assumptions of this study were: (1) There is no difference regarding the survival rates between mini implants retaining overdenture prosthesis compared with standard implants; (2) Mini implants do not affect marginal bone loss, satisfaction, or quality of life.

## **Materials and Methods:-**

This systematic review accomplished according to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA).(Moher et al 2009)

### **Research Question:-**

For mandibular implant retained over denture patients will the use of mini implants retained over denture result in different satisfaction, quality of life, implant loss and prosthetic maintenance when compared with standard implant retained over denture?

### **PICO Format:-**

**P** - Mandibular retained over dentures

**I** – mini implants

**C**- Standard implants

**O**- Patient satisfaction, quality of life, Implant survival rate, and prosthetic maintenance.

A prior protocol for This systematic review was created and registered in at PROSPERO International prospective register of systematic reviews (PROSPERO: CRD42017068623).

### **Search Strategy:-**

The Pub Med and Cochrane databases will be searched for published articles until March 15-2017. Regarding language we plan to restrict research to English language only. In addition, a manual search was performed from references and from the journals: Clinical implant dentistry and related research, Clinical Oral Implants Research, Journal of prosthodontics and Journal of prosthetic dentistry

**The following search terms were performed:-**

mandibular overdentures OR mandibular overdenture OR mandibular over-dentures OR mandibular over-denture OR mandibular overlay dentures OR mandibular overlay denture OR mandibular overlay prosthesis OR mandibular overlay prostheses OR lower overdentures OR lower overdenture OR lower overdentures OR lower overlay dentures OR lower overlay prosthesis OR lower over-denture OR lower over\_denture OR lower over\_dentures OR lower over-dentures OR mandibular stabilized overdenture OR mandibular anchored overdenture OR mandibular assisted overdenture OR mandibular retained overdentures AND (((((((mini dental implant) OR mini dental implants) OR mini implants) OR mini implant) OR single piece dental implant) OR single piece dental implants) OR one piece dental implant) OR narrow dental implants) OR little dental implants) OR small dental implant) OR minute dental implant) OR tiny dental implant AND (((((((conventional dental implant) OR conventional dental implants) OR standard dental implant) OR standard dental implants) OR regular dental implant) OR normal dental implant) OR normal dental implants) OR typical dental implant) OR average dental implant) OR usual dental implants) OR conventional implant) OR standard implant

**Eligibility criteria:-****Inclusion criteria:-**

1. Studies of management of completely edentulous patients with conventional implant or mini implant
2. Articles published in English
3. Randomized control trial
4. Humans trial

**Exclusion criteria:-**

1. Animal study
2. Vitro study
3. Articles published other than English
4. Studies other than RCT
5. Systematic review study

**Outcome Measures:-**

The survival rates of implant supported mandibular overdenture were determined by percentage. While the prosthetics maintenances and complications were considered as dichotomous outcomes (no of events in each attachment designs).

Disagreement between reviewers (MH, AA,) was resolved by the observer (AK). The kappa agreement was calculated.

**Quality and Risk of Bias Assessment:-**

The Quality assessment of included studies was performed using the Cochrane Collaboration tool for assessing the risk of bias(Higgins et al.,2011 ,which covers: sequence generation, allocation concealment, blinding, incomplete outcome data (e.g. dropouts and withdrawals) and selective outcome reporting. For each domain in the tool, we will describe the procedures undertaken for each study, including verbatim quotes. A judgment as to the possible risk of bias on each of the six domains will be made from the extracted information, rated as 'high risk' or 'low risk'.

**Data Extraction and Analysis:-**

All reviewers were extracted data independently from each eligible study. Data abstracted were including and all reported patient-important outcomes. Therefore, it was decided to tabulate the data where appropriate and report the findings in a description manner. The following information was required: demographic information (study ID, number of patients) methodology (immediate loading, conventional loading), intervention details, (type of implants, type of attachments, period of follow up,) and outcomes on patients' satisfaction, quality of life, survival rate and prosthetic maintenances. Reviewers were resolve disagreements by discussion.

Meta-analyses were performed from studies on survival rates (odds ratio with random effects model). The reviewers (MH, AA,) extracted relevant information from the selected articles and entered it into a Microsoft Excel worksheet independently from each other. Due to the heterogeneity of outcome variables, and reporting, no meta-analysis was performed.

**Identification of Studies:-**

Searches of the databases resulted in 124 articles (Fig. 1) of these, 75 articles were excluded, as it was clear from the title and abstract that they did not fulfill the selection criteria. For the remaining 49 articles, 6 articles were duplicated, the remaining 43 full articles were obtained and following analysis of these, five potentially relevant studies were identified. 38 publications were excluded for the following reasons: case reports, non RCT, retrospective, cohort, studies not comparing mini implant with conventional implant. Therefore, 5 studies were included in the present study (Table 1).

**Quality of the Included Studies:-**

The quality of randomized controlled studies had high risk of bias (Omran et al 2013 and Jawad et al 2017) in random sequence generation and allocation concealment, while studies had low risk of bias blinding of outcome assessment, incomplete outcome data, and selective reporting. Fig 2&3

**Study Characteristics and Patient Populations:-**

Five papers compared between mini implant and conventional implant regarding patients satisfaction (Aunmeungtong, Kumchai, Strietzel, Reichart, & Khongkhunthian, 2016) (de Souza et al 2015), quality of life (de Souza et al., 2015) (Jawad, Barclay, Whittaker, Tickle, & Walsh, 2017), fracture incidence (Aunmeungtong et al 2016) (de Souza et al 2015), implant loss (Aunmeungtong et al., 2016) (de Souza et al 2015) (Jawad et al 2017) (Ribeiro et al 2015) (Omran et al 2013) and marginal bone loss (Aunmeungtong et al 2016) (Omran et al 2013). Table (1)

**Implant survival rate:-**

In total, 360 patients were included, 229 patients received 664 mini implants and 131 patients received 262 conventional implants. Follow-up periods up to one year reveal that for the mini implant groups 32 implants lost while in the conventional implant groups 1 implant lost. Mean implant survival rates to 1 year were 95.2% in the mini implants groups and 99.2% in the conventional implants groups. Table (2), Fig (4&5)

**Patient satisfaction:-**

From the five eligible studies only two studies (Aunmeungtong et al 2016) (de Souza et al 2015) evaluated the patient satisfaction. They revealed that the patients was not statistical significant between the two treatments modalities. Fig.(6&7)

**Marginal bone loss:-**

Only two articles (Aunmeungtong et al 2016) (Omran et al 2013) evaluated marginal bone loss and showed that no statistical significant difference between the treatment modalities however marginal bone loss was slightly higher in conventional group than mini implant group. Fig.(8)

**Fracture incidence:-**

From all studies only two (Aunmeungtong et al 2016) (de Souza et al 2015) evaluated fracture incidence and revealed that the fracture incidence is not statistically significant although it take place more in conventional group. Fig.(9&10)

**Discussion:-**

This systematic review was done to decide if there is an actual variance between mini dental implant and conventional dental implant over-dentures in the tem of patient satisfaction and implant loss in addition to the peri implantitis complication that expressed as marginal bone loss. Patient's satisfaction is considered the most important patient related outcomes in the evidence based dentistry however there is no standard format to evaluate this outcomes. Visual analogue scale (VAS) is considered the most reliable scale to assess the patient satisfaction. Implant loss was reported by the number of implant lost during the follow up period. Peri-implantitis is an advanced damage of peri-implant tissue and can be assessed by gingival index, plaque index, pocket depth in addition to clinical attachment loss and marginal bone loss (MBL). But, in this review we choice the marginal bone loss as a parameter for peri-implantitis since it is the most essential indicator and most of trial basically evaluate peri-implantitis via MBL measurement.

Comparing earlier systematic reviews in the similar subject which contain RCTs, prospective and retrospective studies, we attempt in this systematic review to focus on the mandibular implant retained over-denture to reach

strong evidence by including only a randomized clinical trials because this type of studies is considered as a high quality studies in evidence based dentistry. Moreover, the preceding systematic reviews didn't include RCT comparing frankly both treatment modalities but instead they collected studies of mini dental implant, conventional dental implant separately and thereafter compared between them indirectly (Aparecido et al 2016).

Patient satisfaction with the overdenture studied by authenticated questionnaires established on a visual analogue scale (VAS) (Naert et al 2004) which considered the most important and most reliable scale.

One of the most reliable criteria to assess the success of the implant is loss of the osseointegration around the implant which lead to total loss of implant and consequently failure of prosthesis so implant loss was reported in this review by counting number of implant lost during the follow up period.

Regarding the assessment of peri implant condition which represented by the marginal bone loss, A minimum of 1-year of follow-up was needed as major inclusion standard to diminish bias, according to the results reported by (Adell et al 1981) (Adell, Lekholm, Rockler, & Brånemark, 1981) which reveal that the marginal bone loss around osseointegrated implants occurs mainly during the first year of function and tends to stabilize later (Ghelfan & Chaushu, 2011).

Assessment of included studies for possible risk of bias was accomplished independently by the two reviewers (M.H and A.A) using Cochrane tool for risk of bias assessment which is considered as one of the most popular tools used by many researchers in the scientific field (Higgins & Altman 2011).

The result of the meta-analysis revealed that mini dental implant resulted in more patient satisfaction compared with conventional dental implant but this difference was statistically insignificant, perhaps this result attained due to minimal surgical procedure and simple technique related to mini dental implant than conventional dental implant.

Regarding the implant loss the result of the meta-analysis revealed that the mini dental implant showed more implant loss when compared with conventional dental implant this difference was statistically significant.

Although the result of the meta-analysis revealed that mini dental implant resulted in less marginal bone loss when compared with conventional dental implant but this difference was statistically insignificant, perhaps this result attributed to the minimal surgical procedure and small diameter of the mini implant.

The limitations of this systematic review including; the total sample size of included studies was relatively small to reveal the actual influence of both treatment modalities and the include articles published only in English language could convey a source of bias.

Finally, analysis of this systematic review results must be accomplished with attentions as the included studies were very limited.

### **Conclusion:-**

There is no strong evidence to reveal that mini implant could be used in the same degree as conventional dental implant however mini dental implant could be used as an alternative to conventional dental implant since it presents tolerable marginal bone loss, and enhancements in variables related to satisfaction of patients.

**Conflict of interest:** - There is no conflict of interest.

**Funding:** - Self-funding.

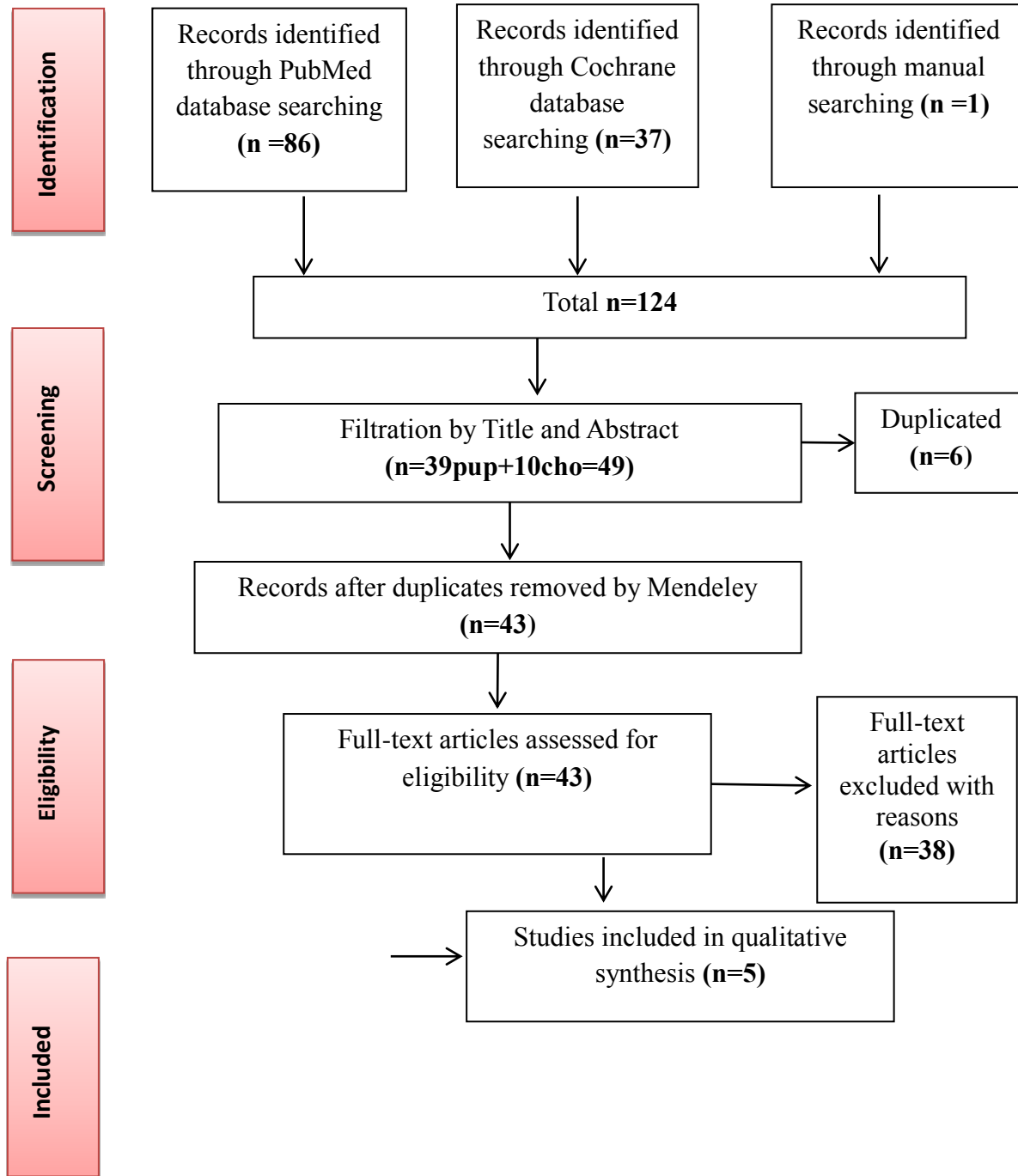
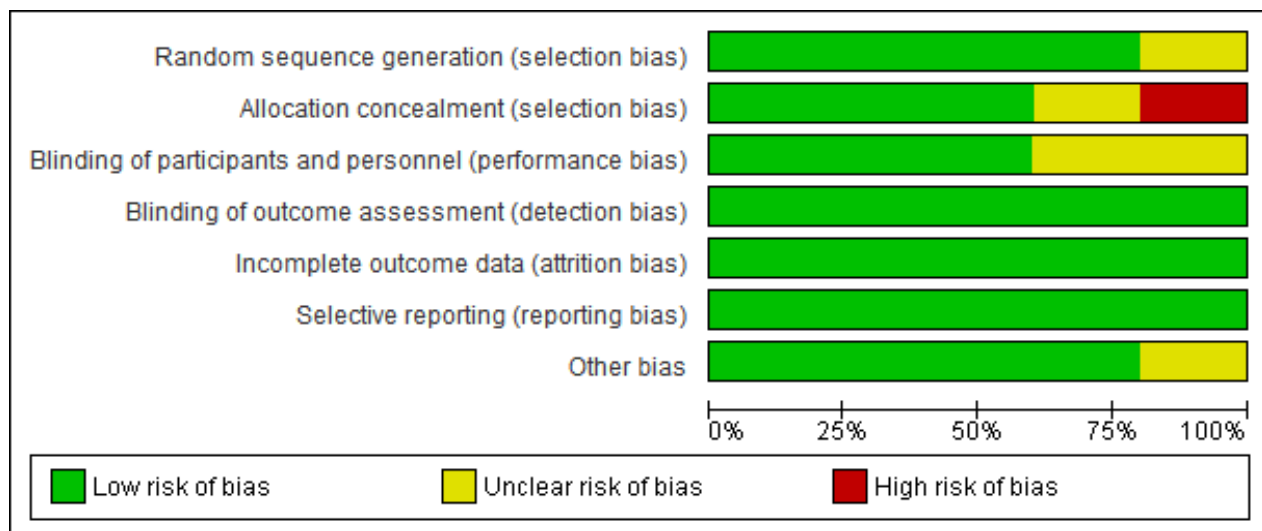


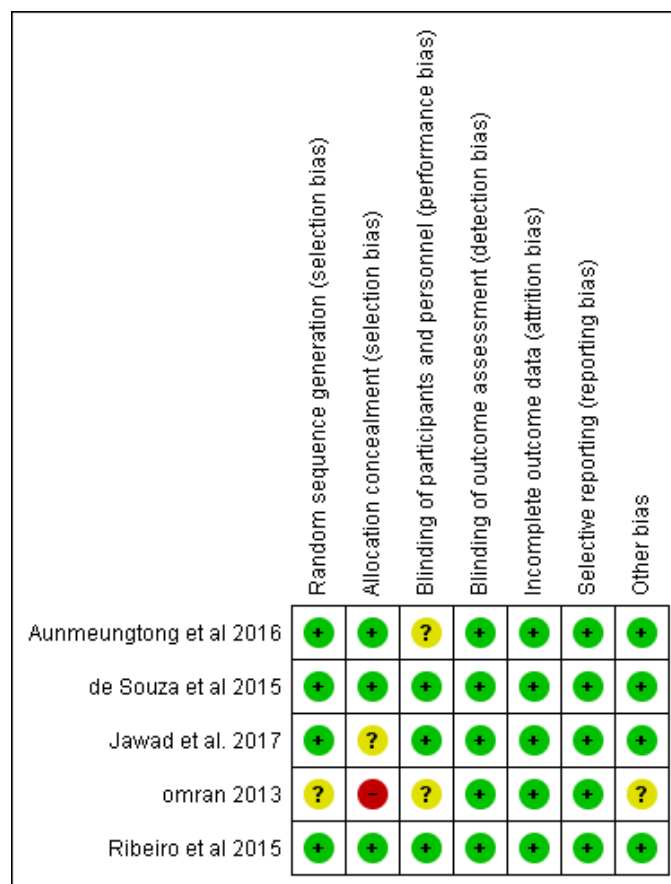
Figure 1:- prisma 2009 flow diagram:

Study ID	follow-up month	Age Mean (Gende)	Loading time (days)	Implant system	Type of attachments	No. of subjects	Subjects per	Implant per subject	Implant	Subject analyzed	MBL <sup>1</sup> Mean $\pm$ SD**	Number of
Aunmeungtong et al 2016	12 m	G1 69.2 $\pm$ 11.2 y	immediate	(PW plus) Nakhon Pathom, Thailand)	Equator	60	20	2 mini	40	20	0.53 $\pm$ 0.41	0
		G2 66.65 $\pm$ 6.28 y	immediate		Equator		20	4 mini	80	20	0.60 $\pm$ 0.45	
		G3 73.8 $\pm$ 10.4 y	Delayed		Ball		20	2 stand	40	20	1.33 $\pm$ 0.67	0
De Souza et al 2015	12m	59.5 $\pm$ 8.5 y	Delayed	Boca Raton, FL, USA)	Ball	120	38	4 mini	152	35	NR	????
					Ball		42	2 mini	84	36	NR	0
					Ball		40	2 stand	80	35	NR	0
RIBEIRO et al 2015	7d	59.5 $\pm$ 8.5 y	Delayed	Morse-Lock Straight	Ball	120	38	4 mini	152	38	NR	0
					Ball		42	2 mini	84	42	NR	
					Ball		40	2 stand	80	40	NR	0
jawad et al 2017	6m	????	Early	ASTRA TECH®	Ball	46	22	2mini	44	20	NR	
					Ball		24	2 stand	48	22	NR	0
Omran et al 2013	12m	55 y	Mini implant immediate	(Sendax MDI MAX; IMTEC, Corp., Ardmore, USA	Ball	14	7	4 mini	28	28	1.023 $\pm$ 0.122 mm	0
			Standard Implant Delayed	Biohorizons Co., USA	Ball		7	2 standard	14	14	0.936 $\pm$ 0.099 mm	0

Table 1:- Characteristics of the included studies



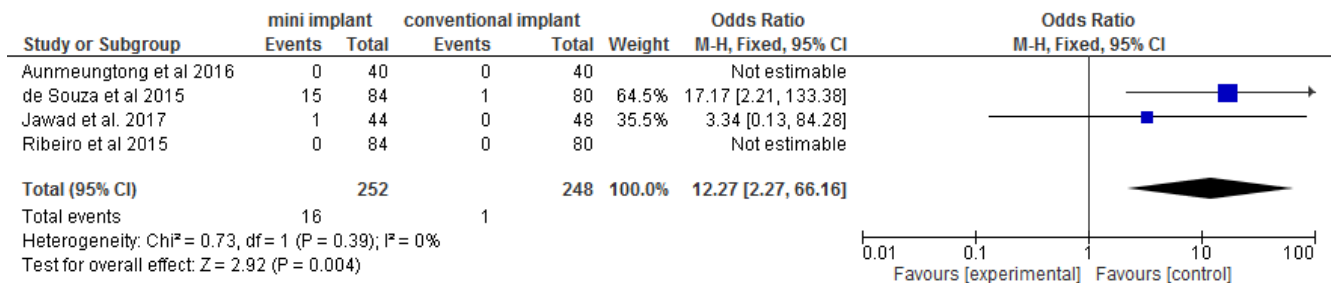
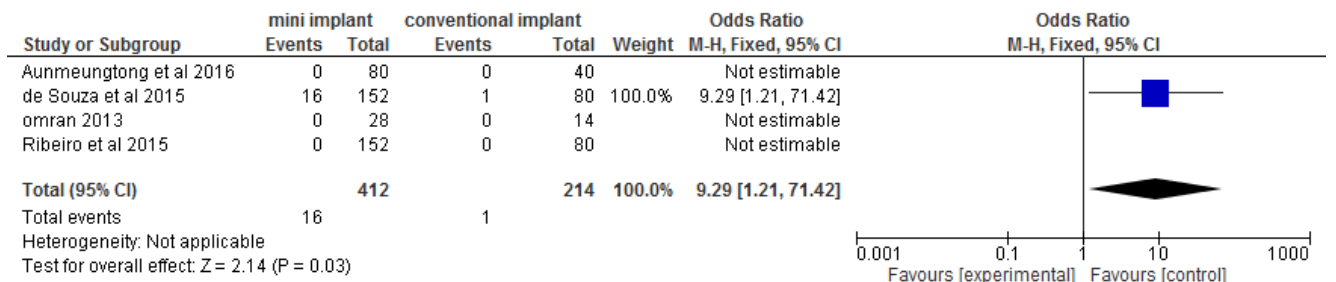
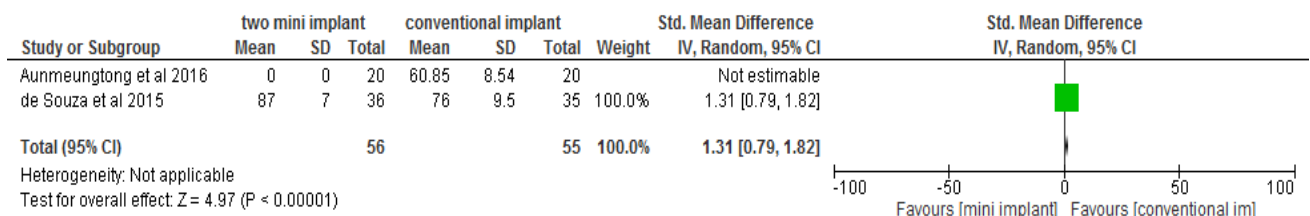
**Figure (2):-** Risk of bias graph:

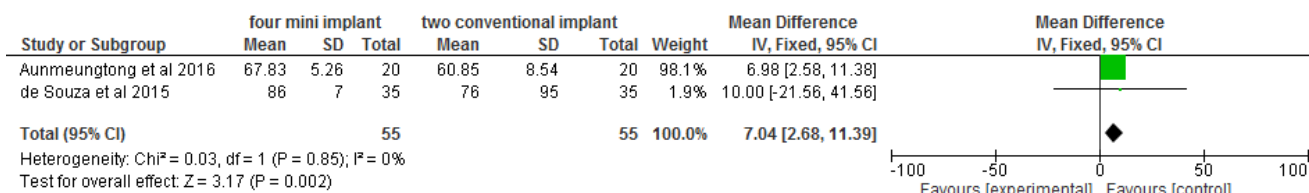


**Figure 3:-** Risk of bias summary

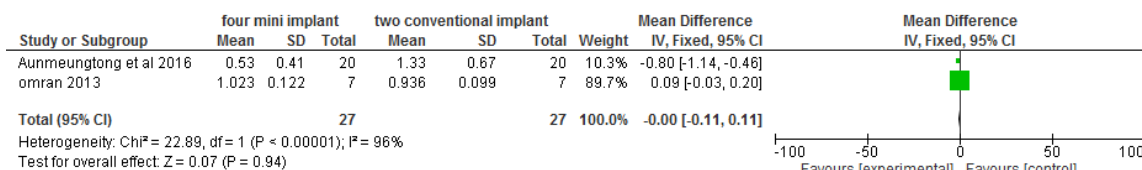


Study ID	Implant survival rate Mini implants	Implant survival rate Conventional implants
Aunmeungtong et al 2016	100%	100%
de Souza et al 2015	86.8%	98.8%
omran 2013	100%	100%
Ribeiro et al 2015	100%	100%
Jawad et al. 2017	97.7%	100%

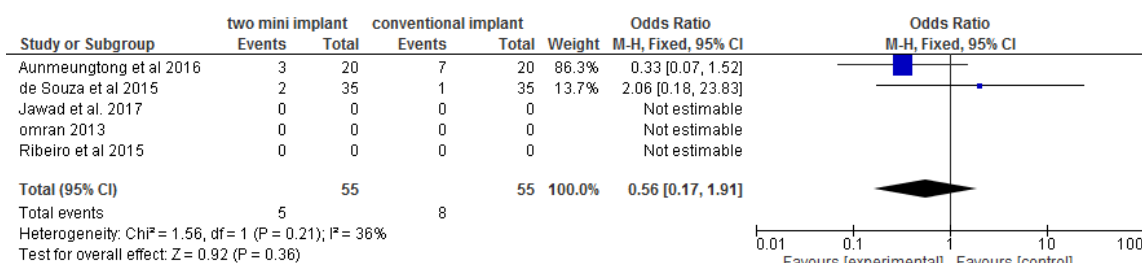
**Table 2:-** Implant survival rate**Figure 4:-** Forest plot of Implant Survival two mini implants versus two conventional**Figure 5:-** Forest plot of Implant Survival four mini implants versus two conventional**Figure 6:-** Forest plot of Patient satisfaction two mini implants versus two conventional



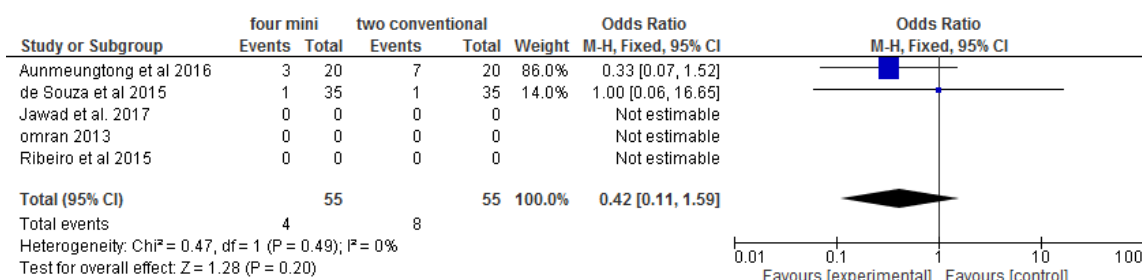
**Figure 7:-** Forest plot of Patient satisfaction four mini implants versus two conventional



**Figure 8:-** Forest plot of Marginal bone loss four mini implants versus two conventional implant



**Figure 9:-** Forest plot of Fracture incidence two mini implants versus two conventional



**Figure 10:-** Forest plot of Fracture incidence four mini implants versus two conventional

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