

# EFFICACY OF FLAPLESS DENTAL IMPLANTS- A SYSTEMATIC REVIEW

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**Abstract:** *Dental implant placement using flapless surgery is minimally invasive technique which improves blood supply compared with flapped surgery. Objectives: The aim of this systematic review was to evaluate the clinical parameters following implant surgery in healed sites, using 2 procedures: flapped vs flapless surgery. A detailed electronic search was carried out in the PubMed/Medline, Scholar Library databases. The focused question was, what is the efficacy of flapless surgery compared to the flapped approach?" All the studies included with a prospective controlled design were considered separately, depending on whether they are being conducted on animals or humans. The following data were recorded in all studies: number of implants, failures, location (maxilla, mandible), type of rehabilitation (partial or single), follow up and flap design. The variables selected for comparison in animal studies were : flap design, gingival index, mucosal height, recession and probing pocket depth. In humans studies the variables were as follows: flap design, plaque index, gingival index, recession, probing pocket depth, papilla index and keratinized gingiva. Results: Ten studies were included, of which 2 are excluded because of irrelevance, out of which 6 were human studies and 2 were animal studies. Results obtained showed that human studies proved that the flapless implant approach proved to be efficient over flapped approach whereas the animal studies showed no significant differences between the two.*

**Keywords:** *Flapless implant surgery, Marginal bone loss, Papillary fills, Postoperative pain, Esthetics.*

## 1. INTRODUCTION:

Replacing missing teeth with dental implants is highly predictable. Immediate implant placement and immediate restoration aim at the preservation of the peri-implant bone and soft tissues to achieve long-term osseointegration in combination with the re-establishment of a natural, and thus, esthetic peri-implant mucosa. Immediate functional implant restoration has been established almost 20 years ago<sup>9</sup>. The contemporary patient's demands are not only a "functionally stable implant", but moreover an esthetic and functional rehabilitation in short treatment time<sup>10</sup>. Implant placement is a traumatic procedure, resulting in postoperative inflammation and bone resorption. However, achieving implant esthetics also remains a challenge with respect to recreating a natural-appearing gingival margin and papilla. The technique of flap elevation for implant placement requires suturing and potentially involves more post-operative bleeding, discomfort and swelling, and may result in a compromised esthetic result due to the potential bone loss and recession associated with raising a flap. One technique to overcome this concern is flapless implant. The well-documented correlation between flap elevation and bone loss resulted in the introduction of minimally invasive or flapless techniques, an approach that is gaining popularity in implant dentistry<sup>17,18,19,20</sup>. Flapless implant placement could be performed by minimum incision, immediate perforation with the drill through the soft tissues, computer guidance, or soft tissue removal using a tissue punch. The advantages of this type of procedure include less surgical trauma, shorten operative time, rapid post-surgical healing, fewer post-surgical complications, and decreased patient discomfort. Another advantage of flapless surgery was that when implants were placed without flap reflection, the length of the junctional epithelium extended more coronal than in flap surgery, which may provide an environment that is less prone to peri-implantitis. The advantages of this type of procedure include less surgical trauma, shorten operative time, rapid post-surgical healing, fewer post-surgical complications, and decreased patient discomfort<sup>11,12,13</sup>.

## 2. PRIMARY OBJECTIVE QUESTION:

To review current literature, to analyze the efficacy of implant placement by the minimally invasive flapless approach.

### 2.1. CRITERIA FOR SELECTION OF STUDIES:

The **inclusion criteria** for this study were:

- 1) articles published from 2010-2019,
- 2) original studies published in English language,
- 3) animal and human studies,
- 4) cell culture studies.
- 5) interventional studies

The **exclusion criteria** for the study were

- 1) historic reviews,
- 2) letter to the editor,
- 3) case series and reports,
- 4) non-clinical trials.

**2.2. SEARCH METHODOLOGY:**

An electronic database was carried out using the keywords ‘flapless dental implants’ via the Pubmed/Medline and Cochrane databases for relevant articles published from 2009 to 2019.

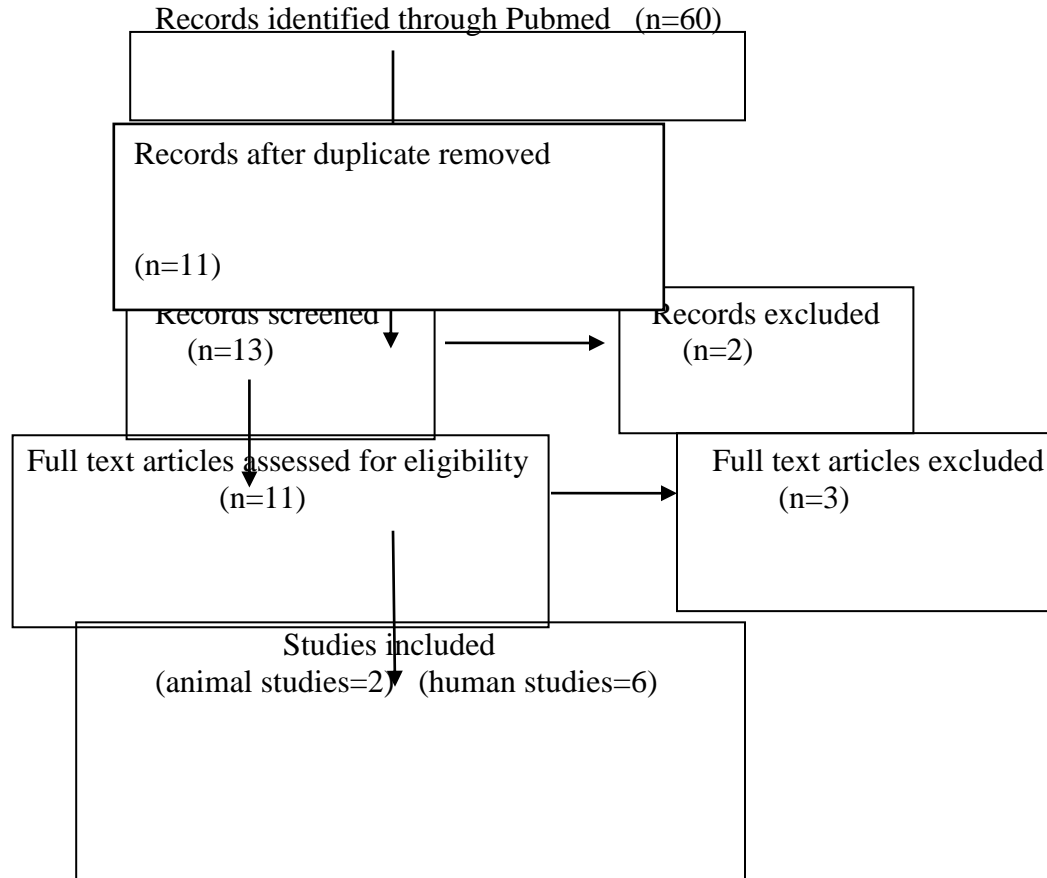


Table 1 : Characteristic features of animal studies

Study (Auth ors And Year)	Study Design	Methods	Control	Test	No. Of Group	Follow Up	Outcome

Marco Caneva (2010)	VIVO	GROUND SECTION AND HISTOMORPHOMETRIC STUDY	6	6	6	4MONTHS	“Flapless” implant placement into extraction sockets did not result in the prevention of alveolar bone resorption and did not affect the dimensional changes of the alveolar process following tooth extraction when compared with the usual placement of implants raising mucoperiosteal flaps.
Juan Blanco (2009)	VIVO	HISTOLOGICAL ANALYSIS	10	10	5	3MONTHS	The clinical evaluation of immediate implant placement after 3 months of healing indicated that buccal soft tissue retraction was lower in the flapless group than in the flap group, without significant differences.

Table 2. General characteristic features of human studies

STUDY	Study Design	No Of Patients	No.O f Females	No. Of Males	Mean Age	Interventions		Follow Up	Outcome
						TEST (FLAPLESS TECHNIQUE)	CONTROL (TRADITIONAL FLAP)		
Marina Tsoukaki (2012)	RCT	20	11	9	46-55	10	10	3 Months	Flapless implant proved to be efficient in clinical ,radiographic, microbiological and immunological findings.
Jill D Bashutski (2013)	RCT	24	14	10	18	12	12	3 Months	Flapless implants provided better esthetic results
Raja V sunitha (2013)	RCT	40	15	25	25-62	20	20	2 YEARS	Flapless implant surgery results in less crestal bone loss during healing period as well as after loading.
Feng Wang (2016)	RCT	40	14	26	39±12	20	20	2YEARS	Compared with FS, single implants placed applying the flapless technique showed advantages in improving patient comfort and decreasing post-implant placement soft tissue reaction.

Janet Stoupel (2016)	RCT	39	25	14	30-70	18	21	1YEAR	flapless and flap-involving immediate single implant placement and provisionalization resulted in largely comparable recession, interproximal bone-loss and buccal ridge reduction at 6 and 12 month
Enric Jané-Salas (2017)	RCT	35	12	18	36-68	48	24	1YEAR	Participants operated for implant placement using the flapless technique undergo a better postoperative period, measured using objective and subjective parameters.

**Table 3: Mean changes and clinical parameters reported by animal studies:**

STUDY	GROUPS	SURFACE	M-C (mm)	M-B (mm)	PM-aBE	aBE-BC	PM-BC	S-PM
Marco Caneva (2010)	Control	BUCCAL	1.7 (1)	2.1(0.9)	N/A	N/A	N/A	N/A
		LINGUAL	0.9 (0.9)	1.4 (0.6)	N/A	N/A	N/A	N/A

	Test	BUCCAL	1.5 (1)	2.2(0.9)	N/A	N/A	N/A	N/A
		LINGUAL	0.9 (0.9)	1.7 (0.6)	N/A	N/A	N/A	N/A
Juan Blanco (2009)	Control	BUCCAL	N/A	N/A	2.54	0.68	2.11	0.6
		LINGUAL	N/A	N/A	2.11	0.54	2.75	0.42
	Test	BUCCAL	N/A	N/A	2.59	1.09	2.07	0.67
		LINGUAL	N/A	N/A	2.07	0.91	2.99	0.13

M–B, distance from rough–smooth implant limit (M) to the coronal end of osseointegration (B); M–C, vertical distance from rough–smooth implant limit (M) to alveolar bone crest (C). PM, peri-implant mucosal margin; aBE, apical barrier epithelium; BC, first contact point of the bone with the implant; S, shoulder of the implant.

Table 4: Mean changes and clinical parameters reported by selected studies:

STUDY	GROU PS	DURATI ON	VA S	mPI	PD	MBL	PPI	GI	KM
Marina Tsoukaki (2012)	Contro l	6 weeks 12 weeks	day 1- .59 day 7- .26	43.85±4 .88 15.52±4 .88	2.59±. 06 1.88±. 06	NA 0.29±. 06	N/A N/A	44.51± 5.9 39.51± 5.9	N/A N/A
	Test	6 weeks 12 weeks	day 1- 1.0 8 day 7-	25.94±4 .84 12.60±4 .84	2.43±. 06 1.93±. 06	NA 0	N/A N/A	21.04± 5.8 14.38± 5.8	N/A N/A

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Jill D Bashutski (2013)	Contro l	Baseline 15 months	N/ A N/ A	0.40 ± 0.49 0.54 ± 0.61	N/A N/A	N/A N/A	2.38±0 .51 2.52±0 .52	0.38±0 .49 0.56±0 .59	4.71±1 .94 4.02±1 .35
	Test	Baseline 15 months	N/ A N/ A	0.50 ± 0.10 0.64 ± 1.02	N/A N/A	N/A N/A	2.31±0 .48 2.64±0 .54	0.51±0 .50 0.71±0 .60	3.85±1 .26 3.58±0 .96
Raja V sunitha (2013)	Contro l	0-6 months 6months- 1yr 1-2 yrs	N/ A N/ A N/ A	1.95±.0 6 1.90±.0 5 1.95±.4 0	N/A N/A N/A	.20±.0 6 .35±.2 5 .47±.4 0	N/A N/A N/A	N/A N/A N/A	N/A N/A N/A
	Test	0-6 months 6months- 1yr 1-2 yrs	N/ A N/ A N/ A	2.75±.0 5 2.80±.0 4 2.80±.0 2	N/A N/A N/A	.03±.0 5 .07±.0 1 .09±.0 2	N/A N/A N/A	N/A N/A N/A	N/A N/A N/A
Feng Wang (2016)	Contro l	4 weeks 24 months	N/ A N/ A	0.71± 0.24 N/A	2.7±1. 2 0.2±.0 7	N/A 0.4±.0 3	N/A N/A	N/A N/A	4.5±1. 3 0.1±.0 5
	Test	4 weeks 24 months	N/ A N/ A	0.68±0. 23 N/A	2.3±1. 0 0.1±.0 4	N/A 0.5±.0 2	N/A N/A	N/A N/A	4.2 ± 1.6 0.1±.0 7
Janet Stoupel (2016)	Contro l	6 months 1 year	N/ A N/ A	N/A N/A	Baseli ne- 2..7±0 .4	0.37± 0.9 0.73± 1.1	N/A N/A	N/A N/A	N/A N/A
	Test	6 months 1 year	N/ A N/ A	N/A N/A	Baseli ne- 2..7±0 .3s	0.31± 0.4 0.47± 0.9	N/A N/A	N/A N/A	N/A N/A
Enric Jané- Salas (2017)	Contro l	24 hrs 7days 15 days	3.0 0 2.8 0	N/A N/A N/A	N/A N/A N/A	N/A N/A N/A	N/A N/A N/A	N/A N/A N/A	N/A N/A N/A



			1.0 7						
	Test	24 hrs	1.8	N/A	N/A	N/A	N/A	N/A	N/A
		7days	0	N/A	N/A	N/A	N/A	N/A	N/A
		15 days	0.6	N/A	N/A	N/A	N/A	N/A	N/A
			0						
			0.2						
			7						

VAS-visual analog scale, m PI- modified plaque index, PD-probing depth, MBL- mean bone loss, PPI- papillary index, GI- gingival index , - Width of keratinized gingival

### 3. RESULTS

#### 3.1. SEARCH RESULTS

Following the removal of the duplicate search results, the primary search resulted in 10 articles in total.. After exclusion of another two irrelevant studies , eight studies were included in this review.

Two studies were animal studies (Marco Caneva 2010, Juan Blanco 2009)and remaining six studies were human trials (Marina Tsoukaki (2012), Jill D Bashutski (2013), Raja V sunitha (2013), Feng Wang (2016), Janet Stoupel (2016), Enric Jané- Salas (2017) as listed in [Table 1, 2 and 3](#).

#### 3.2RESULTS:

All two animal studies were in vivo prospective studies , The number of animals used as test subjects ranged from 8 to 20 .In the study<sup>1</sup>12 Implants were placed 6 through flapless approach and 6 with traditional flap approach. In the study<sup>2</sup> 20 Implants were placed 10 in flapless group and 10 in traditional flap group.

#### HUMAN STUDIES:

All human studies were randomized control trials (RCTs)trials (Marina Tsoukaki (2012), Jill D Bashutski (2013), Raja V sunitha (2013), Feng Wang (2016), Janet Stoupel (2016), Enric Jané- Salas (2017) Number of patients included the studies ranged from 12to 40 in which the number of female subjects ranged from 11to25, the number of male subjects ranged from 9 to26. The age of the patients ranged from 18 to 70years.In 2012, Marina Tsoukaki took a total of 20 patients who received 30 dental implants, where the patients were randomly assigned into two study groups: control group with 15 flapped implants and test group with 15 flapless implants<sup>3</sup>. In 2013 by Jill D Bashutski 24 adult patients missing a single tooth in the esthetic zone (maxillary anterior or premolar region)were scheduled into two groups; 12 in the control group (implant placement using a traditional flap ) and 12 in the treatment group<sup>4</sup> (flapless implant placement ). In 2013 Raja V sunitha took 40 Patients who were assigned into 2 groups 20patients

in flap group and 20 in the flapless group<sup>5</sup>. In 2016 by Feng Wang Forty subjects 20 in MI (minimally invasive flapless group and 20 in Flap group) were included<sup>6</sup>. In 2016 Thirty-nine patients were randomized following extraction of a non-restorable tooth to a FLS (21 patients) or F (18 patients) group by Janet Stoupe<sup>7</sup>. In 2017 implants were placed in 30 participants (15 participants in flapless and 15 in the flap group) by Enric Jané-Salas<sup>8</sup>.

### 3.3. ASSESSMENT OF PARAMETERS

**ANIMAL STUDIES:** In the study<sup>1</sup> by Marco Caneva 2010, the following measurements were performed: (i) vertical distance between IS and the top of the adjacent bone crest (C); (ii) distance between IS and (B) the most coronal point of contact between bone and implant; (iii) remaining gap (GAP) between the implant surface and the socket bony wall; (iv) area (AREA) of the remaining gap between the implant surface and the inner surface of the bony crest; and (v) amount of bone-to-implant contact (BIC%). In the study<sup>2</sup> by Juan Blanco in 2009 the following parameters were assessed PM-S: distance from the peri-implant mucosal margin to the implant shoulder PM-aBE: length of the junctional epithelium in mm. aBE-BC: length in millimeters of the connective tissue of the peri-implant mucosa.

#### HUMAN STUDIES:

The clinical parameters necessary to evaluate a dental implant was given by (Mombelli 1994)<sup>14</sup>. In the study<sup>3</sup> The modified plaque index (mPLI) (Mombelli et al. 1987), the modified gingival index (mGI) (Mombelli et al. 1987), and PD were recorded, sulcular fluid sampling, microbiological analysis, and digital subtraction radiography were also utilized. In the study<sup>4</sup> Clinical parameters evaluated were Plaque Index (PII), Gingival Index (GI), papillary index (PPI) marginal tissue levels, biotype, width of keratinized tissue and soft tissue thickness. In the study<sup>5</sup> the amount of crestal bone and the papillary presence index were evaluated. In the study<sup>6</sup>, Items of evaluation were the following: implant installation position, soft tissue healing, post-surgical pain, soft tissue outcome, marginal bone loss (MBL), and implant survival rate. In the study<sup>7</sup> changes in the peri-implant mucosal margin, the interproximal bone and buccal horizontal ridge at 3, 6 and 12 months were evaluated. In the study<sup>8</sup> oral hygiene, mouth opening, inflammation (facial perimeter), surgical time and analgesic consumption, as well as subjective parameters of pain and degree of satisfaction with the procedure, were evaluated.

### 3.4 OUTCOME OF STUDIES:

**ANIMAL STUDIES:** In the study<sup>1</sup> Both at the test and at the control sites, bone resorption occurred with similar outcomes. In the study<sup>2</sup> Both flap and flapless groups showed minimal recession, with no significant differences between groups.

#### HUMAN STUDIES:

In the study<sup>3</sup> Flapless implant placement yielded improved clinical, radiographic, and immunological outcomes compared with flapped implantation. In the study<sup>4</sup> Crestal bone levels in the flap group were more apical in relation to the implant platform compared to the flapless group for the entire duration of the study. No differences between groups were noted for all other measurements. In the study<sup>5</sup> flapless implant approach provided better papillary fill and less crestal bone loss during healing as well as after loading. In the study<sup>6</sup> Compared with FS, single implants placed applying the MI technique in selected subjects showed advantages in improving patient comfort and decreasing post-implant placement soft tissue reaction. Meanwhile, implants with MI approach have the same level of MBL and high success rates as FS procedure at 2-year

follow-up. In the study<sup>7</sup> flapless and flap-involving immediate single implant placement and provisionalization resulted in largely comparable recession, interproximal bone-loss and buccal ridge reduction at 6 and 12 month. In the study<sup>8</sup> Participants operated for implant placement with flapless surgical technique go through less postoperative discomfort.

#### **4.DISCUSSION:**

All the eight studies were reviewed

##### ANIMAL STUDIES:

In 2010 Marco Caneva conducted the study where implants were installed immediately into the distal alveoli of the second mandibular premolars of six Labrador dogs. In one side of the mandible, a full thickness mucoperiosteal flap was elevated (control site), while contra-laterally, the mucosa was gently dislocated, but not elevated (test site) to disclose the alveolar crest. After 4 months of healing, the animals were sacrificed, ground sections were obtained and a histomorphometric analysis was performed. “Flapless” implant placement into extraction sockets did not result in the prevention of alveolar bone resorption and did not affect the dimensional changes of the alveolar process following tooth extraction when compared with the usual placement of implants raising mucoperiosteal flap<sup>1</sup>.

In 2009 Juan Blanco carried out the study on five Beagle dogs. Where Four implants were placed in the lower jaw in each dog immediately after tooth extraction. Flap surgery was performed before the extraction on one side (control) and flapless on the other (test). After 3 months of healing, the dogs were sacrificed and prepared for histological analysis. Both groups showed minimal recession, with no significant differences between groups (flapless group – 0.6 mm buccal and 0.42mm lingual; flap group – 0.67 and 0.13mm),The clinical evaluation of immediate implant placement after 3 months of healing indicated that buccal soft tissue retraction was lower in the flapless group than in the flap group, without significant differences. The mean values of the biological width longitudinal dimension at the buccal aspect were higher in the flap group than in the flapless group, probably because of a thinner biotype in this region<sup>2</sup>.

##### HUMAN STUDIES:

Peri-implant bone loss is a crucial parameter affecting implant success<sup>15</sup>, significantly higher mean pain scores the first day after implantation probably because of the local postsurgical inflammatory reaction<sup>16</sup>.In 2012 Marina Tsoukaki conducted the study where a total of 20 patients received 30 dental implants, where The patients were randomly assigned into two study groups: control group with 15 flapped implants and test group with 15 flapless implants. The results indicated that implants placed with a flapless approach had decreased peri-implant sulcus depth values, a milder postsurgical inflammatory reaction, and no peri-implant crestal bone resorption, compared with implants placed with the conventional flap surgery. The elevated numbers of specific periodontal pathogens detected around flapless implants possibly indicated an earlier formation and maturation of the peri-implant sulcus in this group. Finally, flapless implantation caused less postoperative pain and was more easily tolerated by patients<sup>3</sup>.

In 2013 Jill D Bashutski took 24 adult patients missing a single tooth in the esthetic zone (maxillary anterior or premolar region)11 were scheduled into two groups; 12 in the control group (implant placement using a traditional flap ) and 12 in the treatment group (flapless implant placement ).The results indicated that both flapless and flap implant placement protocols result in high success rates, although a flapless protocol may provide a better short term esthetic result<sup>4</sup>.

In 2013 Raja V sunitha assigned 40 Patients into 2 groups 20 patients in flap group and 20 in the flapless group .The results indicated that the flapless surgical approach showed less crestal bone loss compared with when flaps are elevated, this flapless approach produced less crestal bone loss during healing as well as after loading of implants. Flapless surgery also gives a better papillary fill because of reduced interproximal bone loss compared with flap technique. Flapless surgery also provide less post operative pain, discomfort and swelling<sup>5</sup>.

In 2016 by Feng Wang Forty subjects 20 in MI(minimally invasive flapless group) and 20 in Flap group were included . Minimally invasive implant surgery offers advantages over the traditional flap access approach in that The subjects in the MI group experienced significantly less pain than the patients allocated in the FS group, no mucoperiosteal flap evaluation occurs in the MI flapless approach, there might be less soft tissue response and faster soft tissue healing. In the present study, PD was 2.7 mm in average in FS group compared to 2.3 mm in MI group 4 weeks after surgery, which might be attributed to less swelling after surgery with MI approach. For MBL, no statistically significant difference was found between the two treatment modalities. That is to say, in the study, less soft tissue reaction and inflammation did not seem have positive influence on preservation marginal bone around implant with MI procedure compared to conventional open flap approach in early healing period<sup>6</sup>.

Janet Stoupel in 2016 randomized Thirty-nine patients following extraction of a non-restorable tooth to a FLS(21 patients) or F (18 patients)group. At three months post-extraction, a 0.5 mm recession of the interproximal GM compared to the pre-surgical position was observed in the F arm, while largely unchanged GM levels were observed in implants placed using a FLS approach. However, the difference between the two treatment arms was no longer discernible at 6 or 12 months, mostly due to a coronal shift of the interproximal tissue in the F arm. Although the apex of the buccal mucosa exhibited a trend for greater recession in the F arm during the first three months, it remained virtually stable in both treatment arms between 3 and 12 month. With respect to interproximal bone-crest level change, one of the secondary outcomes investigated, a trend for greater bone loss was noted in the F group, though the difference was not statistically significant. flapless and flap-involving immediate single implant placement and provisionalization resulted in largely comparable recession, interproximal bone-loss and buccal ridge reduction at 6 and 12 months<sup>7</sup>.

In the study by Enric Jané- Salas in 2017 48 implants were placed in 30 participants (15 participants in flapless and 15 in the flap group). The results suggest that postoperative morbidity is lower in participants treated without a flap. The oral hygiene index has been shown to be better in the flapless surgery group. Participants reported less postoperative pain in flapless group(at 24 h, 7 and 15 days)consequently there was less consumption of analgesics.

## **5.CONCLUSION:**

The conclusion derived from this review is that the placement of implants by flapless approach provided best postoperative results. The flapless protocol is found to provide less post operative pain and better esthetic results and lesser amount of bone loss and bone resorption. Further studies is needed with larger number of samples, different criteria, so that the efficacy of the flapless implant approach can be proven in a wide array of phenomenon.

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